INFORMATION HANDOUT

WATER QUALITY

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

CIWQS Place No. 02-01-C0990 (BT)
401 Database Site No. 02-01-C0990

PERMITS

STATE OF CALIFORNIA DEPARTMENT OF FISH AND GAME
NOTIFICATION OF LAKE OR STREAMBED ALTERATION

NOTIFICATION NO. 1600-2010-0372-R3

UNITED STATES ARMY CORPS OF ENGINEERS
NON-REPORTING NATIONWIDE 404 PERMIT

FILE Number SPN-2008-00396 S

CalOSHA UNDERGROUND CLASSIFICATION

#'S: C046-001-11T Thru C052-001-11T

CALIFORNIA DEPARTMENT OF FISH AND GAME
INCIDENTAL TAKE PERMIT

No. 2081-2011-013-03

AGREEMENTS

UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE
(Biological Opinion)

DATED 2/1/2008

MATERIALS INFORMATION

SOIL AND GROUNDWATER INVESTIGATION REPORT

DATED 4/2008

GEOTECHNICAL DESIGN REPORT AND MATERIALS REPORT

DATED 1/14/2011

ARROYO MOCHO ACCESS BRIDGE FOUNDATION REPORT

DATED 10/19/2010

ARROYO MOCHO BRIDGE FOUNDATION REPORT

DATED 10/19/2010

FOUNDATION REPORT
RETAINING WALLS 246, 391, 400N, 400S, AND 403

DATED 10/19/2010

DRAINAGE/HYDRAULIC INFORMATION

BRIDGE DESIGN HYDRAULIC STUDY REPORT

DATED 05/2009

DRAINAGE REPORT FINAL PS&E SUBMITTAL

DATED 01/2011

HYDROMODIFICATION REPORT

DATED 01/2011

STORM WATER DATA REPORT

DATED 1/2011

STORM WATER INFORMATION HANDOUT

DATED 1/2011

COOPERATIVE AGREEMENTS

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND CITY OF LIVERMORE COOPERATIVE AGREEMENT

DATED 12/4/2003

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY COOPERATIVE AGREEMENT

DATED 5/26/2005

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND ALAMEDA COUNTY TRANSPORTATION COMISSION COOPERATIVE AGREEMENT

DATED 5/17/2011

ADDENDUM TO THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND CITY OF LIVERMORE COOPERATIVE AGREEMENT

DATED 3/18/2010

FOR CONTRACT NO. 297614

CONSTRUCTION AND MAINENANCE AGREEMENT

BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
AND THE UNION PACIFIC RAILROAD COMPANY

CPUC No. 004-45.65-B
DOT No. 440-494K
DATED 3/18/2010

FOR CONTRACT NO. 297614

WATER QUALITY

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

CIWQS Place No. 02-01-C0990 (BT)
401 Database Site No. 02-01-C0990

California Regional Water Quality Control Board
San Francisco Bay Region

Linda S. Adams
Acting Secretary for Environmental Protection

1515 Clay Street, Suite 1400, Oakland, California 94612
(510) 622-2300 • Fax (510) 622-2460
http://www.waterboards.ca.gov/sanfranciscobay

Edmund G. Brown, Jr.
Governor

Date: June 15, 2011
CIWQS Place No. 717494 (BT)
401 Database Site No. 02-01-C0990

Sent via electronic mail: No hard copy to follow

California Department of Transportation
Attn: Mr. Issa Bouri
Issa_Bouri@dot.ca.gov
111 Grand Ave.
Oakland, CA 94612-3717

Subject: Water Quality Certification for the State Route 84 Expressway Widening Project, City of Livermore, Alameda County

Department Project No.: EA 04-29762

Dear Mr. Bouri:

We have reviewed and hereby issue water quality certification to the California Department of Transportation (Department) for the State Route 84 Expressway Widening Project (Project). The Department has received Nationwide Permit Nos. 14, *Linear Transportation Projects*, and 33, *Temporary Construction, Access and Dewatering*, (File Number SPN·2008·000396 S), from the U.S. Army Corps of Engineers (Corps), pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344). As such, the Department has applied to the Water Board for a Clean Water Act Section 401 water quality certification that the Project will not violate State water quality standards.

Project: The Department is proposing to upgrade State Route 84 (SR 84) to expressway standards from just south of Ruby Hill Drive to Jack London Boulevard in the city of Livermore. SR 84 would be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and from two to six lanes between Stanley Boulevard and Jack London Boulevard. The new roadway would consist of 12-foot travel lanes and 10-foot shoulder widths separated by a concrete median barrier, and new retaining walls at the edge of the roadway shoulders. Widening of SR 84 would occur over Arroyo Mocho and Arroyo Las Positas.

The proposed Project also includes construction of an approximately 19-foot wide quarry maintenance and pedestrian bridge across Arroyo Del Valle and an approximately 19-foot wide maintenance access bridge across Arroyo Mocho.

Stormwater flows from SR 84 and the city of Livermore are currently combined in the existing drainage system. New drainage systems would be constructed to separate Livermore and SR 84 stormwater; a new outfall would be constructed at Arroyo Del Valle to accommodate drainage from the city of Livermore.

The Project will be implemented in two phases. The first phase of the project is scheduled to start in 2012 and the second phase is expected to be completed in 2015.

Jurisdictional Wetlands and Waters Impacts: Project implementation will result in permanent impact to approximately 0.32 acres (3,478 linear feet) of State waters (See Table 1, below). Approximately 0.042 acres (1,070 linear feet) of State waters will be temporarily impacted (See Table 2, below).

Table 1: Summary of Permanent Impacts

Activity	Jurisdictional Feature Impacted (Feature ID)	Area and/or Linear Footage of **Permanent** Impact
Fill due to construction of two support wall extensions on downstream side of SR 84 to accommodate overpass widening. Shading of creek channel	Arroyo Mocho	0.018 acres 125 linear feet
Fill due to construction of pier and footings on upstream side of SR 84 to accommodate widening of overpass. Shading of creek channel and loss of willow riparian habitat	Arroyo Del Valle	0.002 acres 111 linear feet
Fill due to placement of abutments associated with new bridge upstream of SR 84	Arroyo Del Valle	0.001 acres 18 linear feet
Construction of new outfall	Arroyo Del Valle	0.009 acres 87 linear feet
Shading of channel and loss of willow riparian habitat due to construction of pedestrian bridge	Arroyo Del Valle	0.07 acres 19 linear feet
Shading of channel due to construction of maintenance bridge	Arroyo Mocho	0.05 acres 19 linear feet
Modification of existing roadside runoff outfall channel	Ephemeral tributary to Arroyo Del Valle (OW-3)	0.008 acres 25 linear feet
Fill due to roadway widening	Seasonal wetland (WL-5)	0.115 acres
Culvert extension to accommodate roadway widening	Intermittent drainage (OW-4)	0.005 acres 74 linear feet
Fill due to roadway widening	Ephemeral roadside drainage (OW-5)	0.030 acres
Fill due to roadway widening	Ephemeral roadside drainage (OW-6)	0.008 acres

total:	0.32 acres 478 linear feet

Table 2: Summary of Temporary Impacts

Activity	Jurisdictional Feature Impacted	Area (acres) and/or Linear Footage of **Temporary** Impact
Construction access for support wall extensions on downstream side of overpass	Arroyo Mocho	0.084 acres 140 linear feet
Construction access for widening of SR 84 overpass on upstream side,	Arroyo Del Valle	0.035 acres 150 linear feet
Construction access for construction of new trail bridge	Arroyo Del Valle	0.03 acres 130 linear feet
Construction access and possible creek diversion for construction of new outfall	Arroyo Del Valle	0.009 acres 101 linear feet
Construction access for modification of existing roadside runoff outfall channel	Ephemeral Tributary to Arroyo Del Valle (OW-3)	0.001 acre 4.5 linear feet
Construction of roadside ditch	Roadside drainage (OW-5)	0.005 acres 225 linear feet
Construction access for new access bridge	Arroyo Mocho	0.05 acres 125 linear feet
Replacement of existing riprap underneath and downstream of SR 84 to accommodate widening of overpass	Arroyo Del Valle	0.090 acres 103 linear feet
Replacement of existing riprap associated with new trail bridge upstream of SR 84	Arroyo Del Valle	0.060 acres 47 linear feet
Replacement of existing riprap associated with new trail bridge downstream of SR 84	Arroyo Mocho	0.051 acres 46 linear feet
	total:	0.42 acres 1,070 linear feet

Roadway Pollutant Impacts: Project implementation would result in approximately 33.9 acres of added and reworked impervious area. Stormwater runoff from impervious areas may contain hydrocarbons, metals, volatile organic compounds, trash, and sediment at levels that may significantly impact jurisdictional waters if left untreated. The Department has proposed mitigation of roadway pollutants as detailed below, under *Roadway Pollutant Mitigation*.

Hydromodification Impacts: Added impervious areas may result in alterations to existing hydrologic regimes, resulting in erosion and/or changes of sediment transport in receiving waters (hydromodification). Project implementation would result in approximately 27.2 acres of added impervious area and therefore the Department is required to evaluate and mitigate potential hydromodification impacts. As detailed in a Hydromodification Report dated March 2010, the Department evaluated susceptibility for hydromodification impacts to all receiving waters within the Project limits. The Department has identified receiving waters susceptible to hydromodification impacts and has proposed mitigation as detailed below, under *Hydromodification Mitigation*.

Jurisdictional Wetlands and Waters Mitigation: To mitigate for the permanent impacts to approximately 0.32 acres (478 linear feet) of State waters, the Department shall restore 0.52 acres of seasonal wetland within approximately 800 linear feet of an intermittent drainage at the nearby Murray Ranch mitigation site in Livermore (see Table 3, below). Restoration involves removing invasive plant species, cattle exclusion, and planting of native vegetation that may provide habitat for the California tiger salamander and red-legged frog.

Table 3. Mitigation for Proposed Permanent Impacts

Activity	Jurisdictional Feature Impacted (Feature ID)	Area and/or Linear Footage of **Permanent** Impact	Mitigation for Permanent Impacts
Fill due to construction of two support wall extensions on downstream side of SR 84 to accommodate overpass widening. Shading of creek channel	Arroyo Mocho	0.018 acres 125 linear feet	0.036 acres Offsite Wetland Restoration at Murray Ranch
Fill due to construction of pier and footings on upstream side of SR 84 to accommodate widening of overpass. Shading of creek channel and loss of willow riparian habitat	Arroyo Del Valle	0.002 acres 111 linear feet	0.004 acres Offsite Wetland Restoration at Murray Ranch, preservation of willow roots where possible, and planting of willows
Fill due to placement of abutments associated with new bridge upstream of SR 84	Arroyo Del Valle	0.001 acres 18 linear feet	0.002 acres Offsite Wetland Restoration at Murray Ranch
Construction of new outfall	Arroyo Del Valle	0.009 acres 87 linear feet	0.018 acres Offsite Wetland Restoration at Murray Ranch
Shading of channel and loss of willow riparian habitat due to construction of pedestrian bridge	Arroyo Del Valle	0.07 acres 19 linear feet	0.07 acres Offsite Wetland Restoration at Murray Ranch
Shading of channel due to construction of maintenance bridge	Arroyo Mocho	0.05 acres 19 linear feet	0.05 acres Offsite Wetland Restoration at Murray Ranch

Activity	Jurisdictional Feature Impacted (Feature ID)	Area and/or Linear Footage of **Permanent** Impact	Mitigation for Permanent Impacts
Modification of existing roadside runoff outfall channel	Ephemeral tributary to Arroyo Del Valle (OW-3)	0.008 acres 25 linear feet	0.016 acres Offsite Wetland Restoration at Murray Ranch
Fill due to roadway widening	Seasonal wetland (WL-5)	0.115 acres	0.230 acres Offsite Wetland Restoration at Murray Ranch
Culvert extension to accommodate roadway widening	Intermittent drainage (OW-4)	0.005 acres 74 linear feet	0.010 acres Offsite Wetland Restoration at Murray Ranch
Fill due to roadway widening	Ephemeral roadside drainage (OW-5)	0.030 acres	0.06 acres Offsite Wetland Restoration at Murray Ranch
Fill due to roadway widening	Ephemeral roadside drainage (OW-6)	0.008 acres	0.016 acres Offsite Wetland Restoration at Murray Ranch
	totals:	0.32 acres 478 linear feet	0.51 acres 800 linear feet

To mitigate for temporary impacts to State waters, the Department shall return impacted areas to pre-project or enhanced conditions. Photo-documentation of temporarily impacted areas shall be provided.

Roadway Pollutant Mitigation: As mitigation for increased pollutant loads associated with impervious areas, the Department shall provide treatment of stormwater runoff from no less than 37.1 acres of impervious area using five compost-amended biofiltration strips, seven bioretention swales, and two bioretention vaults. The swales and strips shall be installed per the plans included in Attachment A, *Biofiltration Swale and Strip Design and Soil Plans and Specifications*.

The following biofiltration swales, strips, and bioretention vaults will mitigate water quality impacts resulting from Project implementation:

BMP	SR 84 eastbound/ westbound	From SR 84 Post Mile	To SR 84 Post Mile	BMP Length (feet)	Treated Impervious Area (acres)
Strip 1	eastbound	22.94	22.98	244	0.27
Strip 2	eastbound	23.02	23.18	879	2.09
Swale 6s*	eastbound	23.58	23.59	150	0.86
Strip 3*	eastbound	23.57	23.61	227	0.15
Strip 4 +	eastbound	23.62	23.69	590	0.59
Swale 4ad +	eastbound	23.64	23.70	400	2.95
Swale 20m	eastbound	24.17	24.25	375	2.53
Swale 25b	westbound	24.43	24.51	350	3.10
Strip 5	eastbound	24.18	24.69	2709	3.52

BMP	SR 84 eastbound/ westbound	From SR 84 Post Mile	To SR 84 Post Mile	BMP Length (feet)	Treated Impervious Area (acres)
Swale 22i	eastbound	24.38	24.42	200	1.12
Swale 26e	eastbound	24.48	24.51	150	0.52
Swale 29g	eastbound	24.59	24.62	150	0.61
Bioretention Vault 1	westbound	24.84	24.87	--	10.36
Bioretention Vault 2	eastbound	26.19	26.21	--	8.43
				total:	37.10

*Between State Route 84 mainline and eastbound 84 to Vallecitos Road connector
[+] Between State Route 84 and Vallecitos Road mainlines

Hydromodification Mitigation: To mitigate for catchments susceptible to hydromodification impacts, the Department will use biofiltration basins and strips, metered flows from an existing pump station, and an oversized pipe with water quality weir, as summarized below:

Mitigation Measures	Swale or Strip No(s).[1]	Receiving Water	Mitigated Impervious Area (ac)
One biofiltration strip, two biofiltration swales	Swales 4ad, 6s, Strip 2	Tributary to Arroyo Del Valle	1.5
Five biofiltration swales, one biofiltration strip	Swales 20m, 25b, 22i, 26e, 29g, Strip 5	Arroyo Del Valle	8.2
Pump station[2]	n/a	Arroyo Mocho	8.5
Oversized pipes with water quality weir at Stanley Blvd., eastbound side of SR 84	n/a	Pipe to Arroyo Las Positas	0.8
		total:	19.0

The Department has proposed hydromodification mitigation for only approximately 69% of added impervious areas. The Water Board has issued a Municipal Regional Stormwater National Pollutant and Discharge Elimination System permit (MRP) to control stormwater discharges from the jurisdiction of various San Francisco Bay area municipalities. The Department is required to incorporate hydromodification mitigation into its projects at a level comparable to what is required of the MRP permittees. The MRP includes a reasonable cost impracticability provision that allows provision of partial hydromodification mitigation if the permittee can demonstrate that the cost of implementing stormwater treatment and hydromodification controls exceed two percent of the project construction costs. The total estimated cost to the Department

[1] Refer to *Roadway Pollutant Mitigation*, above, for swale information.
[2] Pending future modeling that is required in certification condition no. 13, the Water Board has not yet accepted the Department's proposal to be granted hydromodification credit for discharges from the pump station. Without credit for the pump station discharges, the Department would receive 10.5 acres of hydromodification credit instead of the 19.0 acres reported above. However, the Department's total cost for stormwater treatment and hydromodification mitigation would still be approximately 5% of the total project cost, and therefore additional hydromodification mitigation would not be required should we find the pump station does not sufficiently mitigate for hydromodification impacts.

to implement stormwater treatment and hydromodification controls is approximately 4.15 million dollars, or 5.3% of the total project cost. Because 5.3% is significantly greater than the 2% reasonable cost threshold, and because the Department has provided hydromodification mitigation in the catchments most susceptible to erosion, and because the bioretention swale designs have been modified to enhance hydromodification mitigation capacities, no further hydromodification mitigation is required.

California Wetlands Portal: It has been determined through regional, state, and national studies that tracking of mitigation/restoration projects must be improved to better assess the performance of these projects, following monitoring periods that last several years. In addition, to effectively carry out the State's Wetlands Conservation Policy of no net loss to wetlands, the State needs to closely track both wetland losses and mitigation/restoration project success. Therefore, we require that the applicant use the California Wetlands Form to provide Project information related to impacts and mitigation/restoration measures (see Condition No. 11 of this Certification). An electronic copy of the form and instructions can be downloaded at: http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml. Project information concerning impacts and mitigation/restoration will be made available at the web link: http://www.californiawetlands.net.

CEQA Compliance: The Project was evaluated pursuant to the requirements of the California Environmental Quality Act (CEQA) in a Negative Declaration. The Department filed a Notice of Determination on September 4, 2008, that the Project would not have a significant effect on the environment.

Certification: I hereby issue an order certifying that any discharge from the referenced project will comply with the applicable provisions of sections 301 (Effluent Limitations), 302 (Water Quality Related Effluent Limitations), 303 (Water Quality Standards and Implementation Plans), 306 (National Standards of Performance), and 307 (Toxic and Pretreatment Effluent Standards) of the Clean Water Act, and with other applicable requirements of State law. This discharge is also regulated under State Water Resources Control Board Order No. 2003 - 0017 – DWQ, "General Waste Discharge Requirements for Dredge and Fill Discharges That Have Received State Water Quality Certification" which requires compliance with all conditions of this Water Quality Certification. The following conditions are associated with this certification:

1. The Department shall adhere to the Standard conditions imposed by Nationwide Permit Nos. 14 and 33, issued to the Department by the Corps, and to the Biological Opinion issued by the United States Fish and Wildlife Service (USFWS);

2. Grubbing of willows in Arroyo Del Valle shall be avoided to the maximum extent possible. In locations where willow roots are removed and light conditions may sustain willows, willows shall be re-planted. A willow planting plan shall be submitted and found

acceptable to Water Board staff before construction within Arroyo Del Valle may commence;

3. The Project shall be constructed in conformance with the Project Description described in this certification and certification application materials. Any change in the Project may require modification to the certification and shall be reported to the Water Board;

4. Except as expressly allowed in this certification, no equipment shall be operated in areas of flowing or standing water; no fueling, cleaning or maintenance of vehicles or equipment shall take place within jurisdictional waters or within any areas where an accidental discharge to waters of the State may occur;

5. The Department shall install five biofiltration strips, seven biofiltration swales, and two bioretention vaults to treat stormwater contaminants from no less than 37.1 acres of impervious area. Swale and strips shall be installed and consistent with the information summarized above in "Roadway Pollutant Mitigation." The Department shall submit plans and details for the two proposed bioretention vaults. Details shall include the bioretention soil specifications and planting palette. Plans and details must be found acceptable to Water Board staff prior to the commencement of Project construction;

6. The Department shall restore no less than 0.52 acres of seasonal wetlands at the Murray Ranch mitigation site in Livermore. A Final Habitat Mitigation and Monitoring Plan (HMMP) shall be submitted and found acceptable to Water Board staff no later than 30 days from issuance of this certification. The HMMP shall be consistent with the terms and intent of the Las Positas College BO and BO amendment issued to the Department by the USFWS. The HMMP shall include all of the following:

    a. A detailed plan for restoration of wetland habitat and functions within no less than 0.52 acres of seasonal wetland, including:
        i. Invasive species removal and management plan;
        ii. A grazing management plan; and
        iii. A native species planting and protection plan, including arroyo willow, coyote brush and gumplant.

    b. A monitoring plan. The monitoring plan shall include:
        - Performance standards and success criteria for the proposed plantings and invasive species removal;
        - A proposal to submit annual monitoring reports for no less than 5 years. The Department may limit submittal of annual monitoring reports to years 0, 1, 3, and 5; and
        - Site maps with photo-documentation points. Prior to implementing the mitigationProject, the Department shall photographically document the condition of the Project site. Following installation

of the mitigation, the immediate post-construction condition of the site shall be photo-documented and a report shall be submitted to the Water Board including the pre-construction photographs, the post-construction photographs, and the map with the locations of the photo-documentation points clearly marked (Year 0 report).

7. Off-site mitigation implementation shall be completed no later than November 1, 2012;

8. Any planting established as part of the Project off-site mitigation plan shall not be considered successfully established until supplemental irrigation systems have been terminated for two or more full growing seasons;

9. Construction of temporary work platforms within Arroyo Del Valle and Arroyo Mocho are prohibited unless a proposal has been submitted to and found acceptable by Water Board staff. Diversion of Arroyo Del Valle flows is prohibited unless a diversion plan has first been submitted to and found acceptable by Water Board staff. Any diversion plan shall include a plan to have the diversion system removed by October 1 and installed no sooner than June 1;

10. Off-site mitigation shall not be considered to satisfy the conditions of this certification until a final mitigation success report has been submitted to the Water Board and found acceptable by the Executive Officer;

11. The Department is required to use the standard California Wetlands Form to provide Project information describing impacts and restoration measures within 45 days from the date of this certification. An electronic copy of the form can be downloaded at: http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml. The completed form shall be submitted electronically habitatdata@waterboards.ca.gov or shall be submitted as a hard copy to both (1) the address on the letterhead (or to the Water Board), to the attention of California Wetlands Portal and (2) to the San Francisco Estuary Institute, 7770 Pardee Lane, 2nd Floor, Oakland, CA, 94621 to the attention of Mike May.

12. All temporarily disturbed areas shall be restored to pre-construction or enhanced conditions, using only native plant species, immediately following cessation of construction activities in those areas. The Department shall provide photo-documentation of restored areas of temporary impact no later than 30 days from Project completion;

13. The Department shall implement the hydromodification measures described above in the section, *Hydromodification Modification*. Prior to Project commencement, the Department shall submit a modeling study to determine whether the pump station may provide sufficient hydromodification mitigation for 8.5 acres of impervious area.

14. Except as expressly allowed in this Certification, the discharge, or creation of the potential for discharge, to waters of the State of any construction wastes and/or soil materials including cement, fresh concrete, or washings thereof, silts, clay, sand, oil or petroleum products and other organic materials to waters of the State is prohibited;

15. This certification does not allow for the take, or incidental take, of any special status species. The Department shall use the appropriate protocols, as approved by the California Department of Fish and Game and the U.S. Fish and Wildlife Service, to ensure that Project activities do not impact the Beneficial Use of the Preservation of Rare and Endangered Species;

16. The Department shall maintain a copy of this water quality certification at the Project site so as to be available at all times to site operating personnel. It is the responsibility of the Department to assure that all personnel (employees, contractors, and subcontractors) are adequately informed and trained regarding the conditions of this certification;

17. This certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to Section 13330 of the California Water Code (CWC) and Section 3867 of Title 23 of the California Code of Regulations(23 CCR);

18. This certification action does not apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license, unless the pertinent certification application was filed pursuant to California Code of Regulations (CCR) Title 23, Subsection 3855(b) and that application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought; and,

19. Certification is conditioned upon total payment of the full fee required in State regulations (23 CCR Section 3833). Water Board staff received full payment of $640.00 on October 7, 2010.

We anticipate your cooperation in implementing these conditions. However, please be advised that any violation of water quality certification conditions is a violation of State law and subject to administrative civil liability pursuant to California Water Code (CWC) section 13350. Failure to respond, inadequate response, late response, or failure to meet any condition of this certification may subject you to civil liability imposed by the Water Board to a maximum of $5,000 per day per violation or $10 for each gallon of waste discharged in violation of this certification.

Conditions 2, 5, 6, 9, 12, and 13 are requirements for information and/or reports. Any requirement for a report made as a condition to this action is a formal requirement pursuant to

CWC section 13267, and failure or refusal to provide, or falsification of such required report is subject to civil liability as described in CWC section 13268.

We anticipate no further action on this request. Should new information come to our attention that indicates a water quality problem with this project, the Water Board may issue Waste Discharge Requirements pursuant to 23 CCR Section 3857.

If you have any question, please contact Brendan Thompson at (510) 622-2506, or via e-mail to BThompson@waterboards.ca.gov.

Sincerely,

Bruce H. Wolfe
Executive Officer

cc (via e-mail): Mr. Bill Orme SWRCB-DWQ
Mr. Jerry Roe, USFWS
Ms. Jane Hicks, Regulatory Branch, USACE
Ms. Holly Costa, Regulatory Branch, USACE
Mr. Cameron Johnson, USACE
Mr. Dale Bowyer, Water Board
Mr. Cyrus Vafai, Caltrans
Mr. Hardeep Takhar, Caltrans
Mr. Jason Brush, USEPA

PERMITS

STATE OF CALIFORNIA DEPARTMENT OF FISH AND GAME
NOTIFICATION OF LAKE OR STREAMBED ALTERATION
NOTIFICATION NO. 1600-2010-0372-R3

State of California – The Natural Resources Agency *EDMUND G. BROWN, Jr, Governor*
DEPARTMENT OF FISH AND GAME
Bay Delta Region
7329 Silverado Trail
Napa, California 94558
(707) 944-5520
www.dfg.ca.gov

February 16, 2011

Mr. Jeffrey G. Jensen
California Department of Transportation
111 Grand Avenue
Oakland, CA 94612

Subject: Notification of Lake or Streambed Alteration No. 1600-2010-0372-R3
State Route 84 Expressway Widening Project impacting Arroyo del Valle and Arroyo Mocho tributary to Arroyo de La Laguna

Dear Mr. Jensen:

The Department had until January 31, 2011, to submit a draft Lake or Streambed Alteration Agreement ("Agreement") to you or inform you that an Agreement is not required. The Department did not meet that date. As a result, by law, you may now complete the project described in your notification without an Agreement.

Please note that pursuant to Fish and Game Code section 1602(a)(4)(D), if you proceed with this project, it must be the same as described and conducted in the same manner as specified in the notification and any modifications to that notification received by the Department in writing prior to January 31, 2011. This includes completing the project within the proposed term and seasonal work period and implementing all avoidance and mitigation measures to protect fish and wildlife resources specified in the notification. If the term proposed in your notification has expired, you will need to re-notify the Department before you may begin your project. Beginning or completing a project that differs in any way from the one described in the notification may constitute a violation of Fish and Game Code section 1602.

Also note that while you are entitled to complete the project without an Agreement, you are still responsible for complying with other applicable local, state, and federal laws. These include, but are not limited to, the state and federal Endangered Species Acts and Fish and Game Code sections 5650 (water pollution) and 5901 (fish passage).

Finally, if you decide to proceed with your project without an Agreement, you must have a copy of this letter and your notification with all attachments available at all times at the work site. If you have any questions regarding this matter, please contact Marcia Grefsrud, Environmental Scientist, at (707) 644-2812 or mgrefsrud@dfg.ca.gov.

Sincerely,

Liam Davis
Habitat Conservation Supervisor
Bay Delta Region

cc: Marcia Grefsrud
Lieutenant Christensen
Nicole Rucker/California Department of Transportation

FOR DEPARTMENT USE ONLY				
Date Received	Amount Received	Amount Due	Date Complete	Notification No.
11/3/10	$ 4,482.75	$		1600-2010-0372-3

ck#020176 Actia

Escarcega Chustenson

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME

NOTIFICATION OF LAKE OR STREAMBED ALTERATION

Complete EACH field, unless otherwise indicated, following the enclosed instructions and submit ALL required enclosures. Attach additional pages, if necessary.

Fish & Game
NOV 03 2010
Yountville

1. APPLICANT PROPOSING PROJECT

Name	Mr. Jeffrey G. Jensen		
Business/Agency	CALIFORNIA DEPARTMENT OF TRANSPORTATION		
Street Address	111 Grand Avenue		
City, State, Zip	Oakland, CA 94612 P.O. Box 23660, Oakland, CA 94623-0660		
Telephone	(510) 622-8729	Fax	(510) 286-6301
Email			

2. CONTACT PERSON (*Complete only if different from applicant*)

Name	Nicole Rucker, Associate Environmental Planner		
Street Address	111 Grand Ave.		
City, State, Zip	Oakland, CA 94612		
Telephone	(510) 286-5634	Fax	
Email	nicole_rucker@dot.ca.gov		

3. PROPERTY OWNER (*Complete only if different from applicant*)

Name			
Street Address			
City, State, Zip			
Telephone		Fax	
Email			

4. PROJECT NAME AND AGREEMENT TERM

A. Project Name	State Route 84 Expressway Widening Project			
B. Agreement Term Requested	☑ Regular (*5 years or less*) ☐ Long-term (*greater than 5 years*)			
C. Project Term		D. Seasonal Work Period		E. Number of Work Days
Beginning (*year*)	Ending (*year*)	Start Date (*month/day*)	End Date (*month/day*)	
2011	2015	04/16	10/14	905.00

5. AGREEMENT TYPE

Check the applicable box. If box B, C, D, or E is checked, complete the specified attachment.

A.	☑ Standard *(Most construction projects, excluding the categories listed below)*	
B.	☐ Gravel/Sand/Rock Extraction (*Attachment A*)	*Mine I.D. Number:* _____
C.	☐ Timber Harvesting (*Attachment B*)	THP *Number:* _____
D.	☐ Water Diversion/Extraction/Impoundment (*Attachment C*)	*SWRCB Number:* _____
E.	☐ Routine Maintenance (*Attachment D*)	
F.	☐ DFG Fisheries Restoration Grant Program (FRGP)	*FRGP Contract Number:* _____
G.	☐ Master	
H.	☐ Master Timber Harvesting	

6. FEES

Please see the current fee schedule to determine the appropriate notification fee. Itemize each project's estimated cost and corresponding fee. ***Note: The Department may not process this notification until the correct fee has been received.***

	A. Project	B. Project Cost	C. Project Fee
1	State Route 84 Expressway Widening Project	$84,000,000.00	$4,482.75
2			
3			
4			
5			
		D. Base Fee *(if applicable)*	
		E. TOTAL FEE ENCLOSED	$4,482.75

7. PRIOR NOTIFICATION OR ORDER

A. Has a notification previously been submitted to, or a Lake or Streambed Alteration Agreement previously been issued by, the Department for the project described in this notification?

☐ Yes (*Provide the information below*) ☑ No

Applicant: _____ Notification Number: _____ Date: _____

B. Is this notification being submitted in response to an order, notice, or other directive ("order") by a court or administrative agency (including the Department)?

☑ No ☐ Yes (*Enclose a copy of the order, notice, or other directive. If the directive is not in writing, identify the person who directed the applicant to submit this notification and the agency he or she represents, and describe the circumstances relating to the order.*)

☐ *Continued on additional page(s)*

8. PROJECT LOCATION

A. Address or description of project location.

(Include a map that marks the location of the project with a reference to the nearest city or town, and provide driving directions from a major road or highway)

The project area is located between latitude 37.633 N and 37.691 N and between longitude 121.803 W and 121.805 W or T3S R2E on the Livermore U.S.G.S. 7.5 Minute Quadrangle at elevations ranging between 390 to 530 feet above mean sea level. The project follows the existing alignment of State Route (SR) 84 for 4.8 miles from Ruby Hill Drive to Jack London Boulevard (PM 22.5/27.3) in the City of Livermore, near the eastern boundary of the City of Pleasanton (Figure 1). The Project would conform to the Pigeon Pass Project (EA 172400) to the south and the I-580/Isabel Avenue Interchange Project (EA 171300) to the north.

SR 84 follows a discontinuous route consisting of two segments: an east-west segment running from Livermore to Fremont in Alameda County, crossing San Francisco Bay via the Dumbarton Bridge and continuing from Menlo Park to San Gregorio in San Mateo County. The other section is a north-west segment that begins in Rio Vista and ends at the Interstate 80 interchange in Sacramento. In eastern Alameda County, SR 84 provides local access for the cities of Pleasanton and Livermore, as well as an alternative east-west link between the Central Valley and the San Francisco Bay Area via the I-580 and I-680 corridors.

☐ *Continued on additional page(s)*

B. River, stream, or lake affected by the project.	Arroyo del Valle, Arroyo Mocho
C. What water body is the river, stream, or lake tributary to?	Arroyo de La Laguna
D. Is the river or stream segment affected by the project listed in the state or federal Wild and Scenic Rivers Acts?	☐ Yes ☑ No ☐ Unknown
E. County	Alameda

F. USGS 7.5 Minute Quad Map Name	G. Township	H. Range	I. Section	J. ¼ Section
Livermore	3S	1E	NA	NA

☐ *Continued on additional page(s)*

K. Meridian (*check one*) ☐ Humboldt ☑ Mt. Diablo ☐ San Bernardino

L. Assessor's Parcel Number(s)

Please see attachment with list of parcel numbers along entire route

☑ *Continued on additional page(s)*

M. Coordinates (*If available, provide at least latitude/longitude or UTM coordinates and check appropriate boxes*)

Latitude/Longitude	*Latitude:* 37.653205	*Longitude:* -121.805801	
	☐ Degrees/Minutes/Seconds	☑ Decimal Degrees	☐ Decimal Minutes
UTM	*Easting:*	*Northing:*	☐ Zone 10 ☐ Zone 11
Datum used for Latitude/Longitude or UTM	☐ NAD 27	☑ NAD 83 or WGS 84	

9. PROJECT CATEGORY AND WORK TYPE *(Check each box that applies)*

PROJECT CATEGORY	NEW CONSTRUCTION	REPLACE EXISTING STRUCTURE	REPAIR/MAINTAIN EXISTING STRUCTURE
Bank stabilization – bioengineering/recontouring	☐	☐	☐
Bank stabilization – rip-rap/retaining wall/gabion	☑	☐	☐
Boat dock/pier	☐	☐	☐
Boat ramp	☐	☐	☐
Bridge	☐	☐	☐
Channel clearing/vegetation management	☐	☐	☐
Culvert	☐	☐	☑
Debris basin	☐	☐	☐
Dam	☐	☐	☐
Diversion structure – weir or pump intake	☐	☐	☐
Filling of wetland, river, stream, or lake	☑	☐	☐
Geotechnical survey	☐	☐	☐
Habitat enhancement – revegetation/mitigation	☐	☐	☐
Levee	☐	☐	☐
Low water crossing	☐	☐	☐
Road/trail	☐	☐	☑
Sediment removal – pond, stream, or marina	☐	☐	☐
Storm drain outfall structure	☐	☐	☐
Temporary stream crossing	☐	☐	☐
Utility crossing : Horizontal Directional Drilling	☐	☐	☐
Jack/bore	☐	☐	☐
Open trench	☐	☐	☐
Other *(specify)*:	☐	☐	☐

10. PROJECT DESCRIPTION

A. Describe the project in detail. Photographs of the project location and immediate surrounding area should be included.

- Include any structures (e.g., rip-rap, culverts, or channel clearing) that will be placed, built, or completed in or near the stream, river, or lake.
- Specify the type and volume of materials that will be used.
- If water will be diverted or drafted, specify the purpose or use.

Enclose diagrams, drawings, plans, and/or maps that provide all of the following: site specific construction details; the dimensions of each structure and/or extent of each activity in the bed, channel, bank or floodplain; an overview of the entire project area (i.e., "bird's-eye view") showing the location of each structure and/or activity, significant area features, and where the equipment/machinery will enter and exit the project area.

The proposed project will be located in the western portion of central California, in the region known as the eastern San Francisco Bay Area, within the ecological subregion known as the Central California Coast Ranges. The project area traverses a variety of habitat types, including valley oak woodland, annual grassland, riparian forest and mining properties. For a more in depth description of plant communities and habitat types, please reference the Natural Environment Study (URS 2007). Adjacent land uses include agricultural (vineyards), urban, and resource development (mining). Areas in the southern project area, adjacent to Vallecitos Road contain the most intact and diverse natural communities in the project vicinity. The project area includes overpasses crossing Arroyo Mocho (an intermittent stream) and Arroyo del Valle (a perennial stream) as well as an intermittent unnamed tributary to Arroyo del Valle that parallels Vallecitos Road near Ruby Hills Drive.

The Project proposes to widen and upgrade SR 84 to expressway standards (55 mph) from just south of Ruby Hill Drive to Jack London Boulevard. SR 84 would be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and from two lanes to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment. As an expressway, access to SR 84 would be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, Discovery Drive and Jack London Boulevard would be widened and upgraded to accommodate future traffic movements. The Isabel Trail, a multi-use trail located on the east side of SR 84 between Jack London Boulevard and Alden Lane, would be extended to Vineyard Avenue. The project proposes to widen and upgrade SR 84 to expressway standards (55 mph) from just south of Ruby Hill Drive to Jack London Boulevard. The purpose of this project is to improve SR 84 as a regional route consistent with other committed projects on the route, improve local traffic circulation, upgrade SR 84 to an expressway facility with access control, and improve bicycle and pedestrian access.

☑ *Continued on additional page(s)*

B. Specify the equipment and machinery that will be used to complete the project.

Loaders, graders, compacters, rubber tired backhoes, sweepers, center line painting machine, end dump trucks, crane

☐ *Continued on additional page(s)*

C. Will water be present during the proposed work period (specified in box 4.D) in the stream, river, or lake (specified in box 8.B).	☑ Yes ☐ No (*Skip to box 11*)
D. Will the proposed project require work in the wetted portion of the channel?	☑ Yes (*Enclose a plan to divert water around work site*) ☐ No

11. PROJECT IMPACTS

A. Describe impacts to the bed, channel, and bank of the river, stream, or lake, and the associated riparian habitat. Specify the dimensions of the modifications in length (linear feet) and area (square feet or acres) and the type and volume of material (cubic yards) that will be moved, displaced, or otherwise disturbed, if applicable.

Please see the attached supplemental packet for a table of delineated waters and wetlands and the potential impacts (if any) to each feature. The perennial stream, Arroyo del Valle will have water in it during the dry season construction window.

☑ *Continued on additional page(s)*

B. Will the project affect any vegetation? ☑ Yes (*Complete the tables below*) ☐ No

Vegetation Type	Temporary Impact	Permanent Impact
Please see attached supplemental packet	Linear feet: _____ Total area: _____	Linear feet: _____ Total area: _____
	Linear feet: _____ Total area: _____	Linear feet: _____ Total area: _____

Tree Species	Number of Trees to be Removed	Trunk Diameter (range)
Quercus lobata	33	1.9"-41.8
Quercus douglasii	2	2.5-3"
Quercus agrifolia	5	2.5"-4.5"

☑ *Continued on additional page(s)*

C. Are any special status animal or plant species, or habitat that could support such species, known to be present on or near the project site?

☑ Yes *(List each species and/or describe the habitat below)* ☐ No ☐ Unknown

☑ *Continued on additional page(s)*

D. Identify the source(s) of information that supports a "yes" or "no" answer above in Box 11.C.

STATE ROUTE 84 EXPRESSWAY WIDENING PROJECT BIOLOGICAL EVALUATION (BE) (URS 2007)

☑ *Continued on additional page(s)*

E. Has a biological study been completed for the project site?

☑ Yes (*Enclose the biological study*) ☐ No

Note: A biological assessment or study may be required to evaluate potential project impacts on biological resources.

F. Has a hydrological study been completed for the project or project site?

☐ Yes (*Enclose the hydrological study*) ☑ No

Note: A hydrological study or other information on site hydraulics (e.g., flows, channel characteristics, and/or flood recurrence intervals) may be required to evaluate potential project impacts on hydrology.

12. MEASURES TO PROTECT FISH, WILDIFE, AND PLANT RESOURCES

A. Describe the techniques that will be used to prevent sediment from entering watercourses during and after construction.

Please see attached supplemental information packet.

☑ *Continued on additional page(s)*

B. Describe project avoidance and/or minimization measures to protect fish, wildlife, and plant resources.

General avoidance and minimization measures will be implemented as part of construction activities to minimize and avoid impacts to sensitive species and habitat, as well as common biological resources. The following general avoidance and minimization measures will be implemented during construction of the proposed project:

☑ *Continued on additional page(s)*

C. Describe any project mitigation and/or compensation measures to protect fish, wildlife, and plant resources.

Please see attached supplemental information packet

☑ *Continued on additional page(s)*

13. PERMITS

List any local, state, and federal permits required for the project and check the corresponding box(es). Enclose a copy of each permit that has been issued.

A.	401 Clean Water Certification with San Francisco RWQCB	☑ Applied	☐ Issued
B.	404 Pre-construction Notification for NWP 13 and 14 with USACE	☑ Applied	☐ Issued
C.	Biological Opinion for USFWS	☐ Applied	☑ Issued

D. Unknown whether ☐ local, ☐ state, or ☐ federal permit is needed for the project. (*Check each box that applies*)

☐ *Continued on additional page(s)*

14. ENVIRONMENTAL REVIEW

A. Has a draft or final document been prepared for the project pursuant to the California Environmental Quality Act (CEQA), National Environmental Protection Act (NEPA), California Endangered Species Act (CESA) and/or federal Endangered Species Act (ESA)?

☑ Yes (*Check the box for each CEQA, NEPA, CESA, and ESA document that has been prepared and enclose a copy of each*)

☐ No (*Check the box for each CEQA, NEPA, CESA, and ESA document listed below that will be or is being prepared*)

☐ Notice of Exemption	☐ Mitigated Negative Declaration	☐ NEPA document (*type*):
☑ Initial Study	☐ Environmental Impact Report	☑ CESA document (*type*): ITP/CD
☑ Negative Declaration	☑ Notice of Determination *(Enclose)*	☑ ESA document (*type*): Biological Opinion
☐ THP/ NTMP	☐ Mitigation, Monitoring, Reporting Plan	

B. State Clearinghouse Number (*if applicable*)	2007102077		
C. Has a CEQA lead agency been determined?	☑ Yes (*Complete boxes D, E, and F*)	☐ No (*Skip to box 14.G*)	
D. CEQA Lead Agency	Caltrans		
E. Contact Person	Ed Pang	F. Telephone Number	(510) 286-5609

G. If the project described in this notification is part of a larger project or plan, briefly describe that larger project or plan.

The State Route 84 Expressway widening project is a component of a series of projects designed to improve traffic flow and safety on SR 84 through Livermore. The already completed Pigeon Pass Curve Realignment Project ends on SR 84 where this project begins at the south end of this project. Another project, the U.S. Interstate 580/Isabel Ave. Interchange Construction Project, was also recently completed on the north side of this project.

☐ *Continued on additional page(s)*

H. Has an environmental filing fee (Fish and Game Code section 711.4) been paid?

☑ Yes (*Enclose proof of payment*) ☐ No (*Briefly explain below the reason a filing fee has not been paid)*

Note: If a filing fee is required, the Department may not finalize a Lake or Streambed Alteration Agreement until the filing fee is paid.

15. SITE INSPECTION

Check one box only.

☑ In the event the Department determines that a site inspection is necessary, I hereby authorize a Department representative to enter the property where the project described in this notification will take place at any reasonable time, and hereby certify that I am authorized to grant the Department such entry.

☐ I request the Department to first contact (*insert name*) _____ at (*insert telephone number*) _____ to schedule a date and time to enter the property where the project described in this notification will take place. I understand that this may delay the Department's determination as to whether a Lake or Streambed Alteration Agreement is required and/or the Department's issuance of a draft agreement pursuant to this notification.

16. DIGITAL FORMAT

Is any of the information included as part of the notification available in digital format (i.e., CD, DVD, etc.)?

☑ Yes (Please enclose the information via digital media with the completed notification form)

☐ No

17. SIGNATURE

I hereby certify that to the best of my knowledge the information in this notification is true and correct and that I am authorized to sign this notification as, or on behalf of, the applicant. I understand that if any information in this notification is found to be untrue or incorrect, the Department may suspend processing this notification or suspend or revoke any draft or final Lake or Streambed Alteration Agreement issued pursuant to this notification. I understand also that if any information in this notification is found to be untrue or incorrect and the project described in this notification has already begun, I and/or the applicant may be subject to civil or criminal prosecution. I understand that this notification applies only to the project(s) described herein and that I and/or the applicant may be subject to civil or criminal prosecution for undertaking any project not described herein unless the Department has been separately notified of that project in accordance with Fish and Game Code section 1602 or 1611.

Signature of Applicant or Applicant's Authorized Representative

Date 10/18/10

Jeffrey G. Jenson

Print Name

Box 10A

Impacts to Waters of the U.S., including wetlands within waters will occur at Arroyo Mocho (Intermittent Stream OW-1 on Sheet 6 of attached Project Impacts to Waters and Wetlands set of figures), Arroyo del Valle (Perennial Stream/Wetland – WL-2 on Sheet 5), a broadleaf cattail roadside ditch (Intermittent Drainage/Wetland - WL-5 on Sheet 1 and 2), that is tributary to Arroyo del Valle, near Ruby Hills Drive and removal and replacement of a portion of the culverted (OW-4) intermittent drainage that drains WL-5 under SR 84 to WL-6 (Sheet 2). Two 1' wide ephemeral roadside drainage ditches (OW-5 and OW-6 on Sheets 3 and 4) that drain to the south side of Arroyo del Valle that are bordered by disturbed/ruderal annual grassland will be removed by the expressway widening. New ephemeral roadside ditches, that convey roadway runoff will be created along the widened roadway in areas that are current uplands that will replace the function of OW-5 and OW-6.

Temporary and permanent impacts associated with the work at Arroyo Mocho will include the construction of extension support walls (bents) for the large culvert conveying the drainage under SR 84 (Isabel Ave.) and construction of walls and footings into the edge of the streambed just west and downstream of this crossing.

Temporary and permanent impacts associated with the work at Arroyo Del Valle will include the permanent fill and construction work within a portion of an outfall channel associated with a culverted roadside ditch (Ephemeral Drainage OW-3 on Sheet 5) draining to the northwest side of Arroyo del Valle. In addition, the impacts will include temporary and permanent work and fill in the floodplain and bed of Arroyo del Valle for a footing and armoring for construction of a pedestrian bridge on the upstream (eastern) side of SR 84 and the upstream extension of the bent under the stream overpass for the expressway widening. North of the SR 84 bridge crossing over Arroyo del Valle, there is an existing 42-in. culvert combining flows from the city of Livermore and highway runoff from the existing SR 84 drainage system. This 42-in. culvert currently discharges into Arroyo del Valle on the west side (downstream end) of the bridge. The SR 84 widening Project proposes to separate the city flows from Caltrans' highway runoff via two parallel pipes. It is proposed to construct a new drainage system, within the city's right of way, to discharge into Arroyo del Valle on the east end of the SR 84 bridge (upstream side). This new outfall would be 42-in. APC, proposed with a new headwall, flap gate, and rock slope protection. There would be temporary impacts in the creek as well as permanent fill.

Caltrans' highway runoff would discharge at the same location as the existing 42-in. culvert. This culvert would be the same size and in the same location. However, the following modifications are proposed: the outfall would have to be lowered, a new headwall would be provided, new rock slope protection would be added, and a new flap gate would be installed. There would be temporary construction impacts in the creek as well as additional permanent fill due to the change in flow line and additional rock slope protection.

The road widening at the southern most end of the project will result in permanent fill of an intermittent drainage/wetland (WL-5) that has emergent wetland in the bed and removal of the bordering remnant valley oak riparian woodland.

The road widening will also cause temporary and permanent fill in long sections of approximately 1' wide shallow, ephemeral roadside ditches that border either side of SR 84 (Isabel Ave) on the south side of Arroyo del Valle (OW-5 and OW-6). These roadside ephemeral ditches are bordered by bare ground and disturbed, ruderal annual grassland.

Box 10D

The construction area would be approximately 5 feet beyond the footprint of the rock slope protection proposed for the 42-inch outfalls (see Drainage Details). This construction area, within the low flow channel of the creek, would have to be bermed up, potentially with rock or sand bags to intercept the low flow channel upstream of the construction site and temporarily push it around the site, so it can continue to discharge downstream with minimal water quality impacts. Dewatering may be required to remove accumulated water in the construction area to build the concrete headwall and lay down the rock slope protection and rock slope protection fabric. Dewatering effluent that would be collected from the construction area would be subject to all requirements of the dewatering permit or RWQCB's Basin Plan, prior to discharge back into the creek. All efforts would be made to minimize work within the low flow channel.

Box 11A

Table 1 Potential "Waters of the U.S." in the Study Area and Affected Waters within the Project Area

Feature Type and Label	Length (ft)	Square Feet	Delineated Acres	Acres Affected
Alameda County				
OTHER WATERS OF THE U.S.				
Intermittent Stream OW-1 (Arroyo Mocho)	1,565	37,849	0.868	0.102
Ephemeral Stream OW-3 (Tributary to Arroyo del Valle)	149	527	0.012	0.009
Culverted Waters OW-4 Draining to WL-4 (Tributary to Arroyo del Valle)	98	391	0.009	0.005
Ephemeral Stream OW-5 (Roadside Ditch)	2,382	2,382	0.055	0.035
Ephemeral Stream OW-6 (Roadside Ditch)	1,731	1,731	0.040	0.008
Culverted Waters OW-7 (from OW-5)	140	140	0.003	0.000
Culverted Waters OW-8 (from OW-6)	198	198	0.005	0.000
OTHER WATERS OF THE U.S. SUBTOTAL	***6,263***	***43,218***	***0.992***	***0.159***
WETLANDS				
Perennial Drainage/Wetland WL-2 (Arroyo del Valle)	721	52,554	1.206	0.105
Intermittent Drainage/Wetland WL-4 (Tributary to Arroyo del Valle)	524	6,171	0.142	0.000
Intermittent Drainage/Wetland WL-5	1,694	5,284	0.121	0.115
Intermittent Stream/Wetland WL-6	2,117	33,254	0.763	0.000
WETLANDS SUBTOTAL	***5,056***	***97,263***	***2.232***	***0.220***
TOTAL WATERS OF THE U.S.	**11,319**	**140,481**	**3.224**	**0.379**

Source: URS 2010

Table 2. Proposed Impacts to Waters of the U.S. and Wetlands

	Delineated Area (acres)	Temporary Impacts (acres)	Permanent Impacts (acres)
Other Waters of the U.S.	0.992	0.103	0.056
Wetlands	2.232	0.074	0.146
TOTAL	**3.224**	**0.177**	**0.202**

Source: URS 2010

Table 3. Proposed Impacts to Waters of the U.S. and Wetlands

	Delineated Area (acres)	Temporary Impacts (acres)	Temporary Fill Impacts (cubic yards)	Permanent Fill Impacts (acres)	Permanent Fill Impacts (cubic yards)	Linear Feet of Streambank Affected
Other Waters of the U.S.	0.992	0.103	1652.0	0.056	1605.6	1009
Wetland	2.232	0.074	987.4	0.146	5341.2	2302
TOTAL	**3.224**	**0.177**	**2,639.4**	**0.202**	**6,946.8**	**3,311**

Source: URS 2010

BOX 11B

Table 4. Temporary and Permanent Impacts to Vegetation (with Associated Jurisdictional Feature(s))

Vegetation Type	Temporary Impacts		Permanent Impacts	
	Linear Feet	Area (Sq. Ft.)	Linear Feet	Area (Sq. Ft.)
CA Annual Grassland/Ruderal (Ephemeral roadside ditches OW-5 and OW-6)	590	590	1300	1305
Valley Oak Woodland (Intermittent Drainage/Wetland WL-5)	--	--	502	47,916
Mixed Willow Forest (Arroyo del Valle – Perennial Drainage/Wetland WL-2)	200	2955	117	1043
Broadleaf Cattail Wetland (Intermittent Drainage/Wetland WL-5)	--	--	725	5023
TOTAL	**790**	**3,545**	**2,644**	**55,287**

BOX 11C

A list of special status species with potential presence in the project area was developed by checking localized species occurrences in the CNDDB and other sources against information gathered during site visits.

The proposed project could potentially adversely impact the following species that are listed, proposed or candidates for listing under the Federal ESA:

Species	Listing Status

California tiger salamander (*Ambystoma californiense*)	FT/SSC
California red-legged frog (*Rana aurora draytonii*)	FT
San Joaquin kit fox (*Vulpes macrotis mutica*)	FE/ST

The following species are either known to occur or are assumed to be present in habitats that are appropriate for breeding and/or foraging based on field surveys, and the presence of these habitats within the biological study area (BSA) and project footprint:

Species	**Listing Status**
California tiger salamander (*Ambystoma californiense*)	FT/SSC
California red-legged frog (*Rana aurora draytonii*)	FT

In addition, the proposed project has the potential to impact the following sixteen other special-status species:

Wildlife:

Species	**Listing Status**
San Joaquin kit fox (*Vulpes macrotis mutica*)	FE/ST
Western pond turtle (*Emys marmorata marmorata*)	SSC
Alameda coachwhip (*Mastocophis flagellum*)	SSC
Two-striped garter snake (*Thamnophis hammondii*)	SSC
Western spadefoot toad (*Spea hammondii*)	SSC
Cooper's hawk (*Accipiter cooperii*)	SSC
Western burrowing owl (*Athene cunicularia hypugaea*)	SSC
Oak titmouse (*Baeolophus inornatus*)	BCC
Lawrence's goldfinch (*Carduelis lawrencei*)	SC
Northern harrier (*Circus cyaneus*)	SSC
White-tailed kite (*Elanus leucurus*)	FP
California horned lark (*Eremophila alpestris*)	SSC
Loggerhead shrike (*Lanius ludovicianus*)	SSC

Lewis' woodpecker (*Melanerpes lewisii*)	SC
Nuttall's woodpecker (*Picoides nuttallii*)	BCC
California thrasher (*Toxostoma redivivum*)	BCC

FE = Federally Listed as Endangered
FT = Federally Listed as Threatened
SC = Species of Concern for the National Marine Fisheries Service or U.S. Fish and Wildlife Service
SE = State Listed as Endangered
ST = State Listed as Threatened
SSC = State Species of Special Concern
FP = CDFG fully protected species
BCC = On the U.S watch list for birds of conservation concern by the American Bird Conservancy and the National Audubon Society

Migratory Birds:

The project has the potential to impact migratory birds protected under the Federal Migratory Bird Treaty Act and California Fish and Game Code.

Plants:

No special-status plants were identified during two rounds of rare plant surveys during the bloom period of 2005 (April and July). No rare plants or populations are expected to be affected by project activities. Two sensitive natural communities have the potential to be impacted by project construction, including: mixed willow riparian forest and valley oak woodland (CNDDB 2003).
Field surveys of vegetation, wildlife, and habitat in the project area and broader study area were conducted in the spring and summer of 2005. The surveys included vegetation mapping, special-status wildlife and vascular plant surveys and mapping of jurisdictional waters. Additional wetland and habitat surveys were conducted in the winter of 2007/2008. Acquired data were used to evaluate the potential for occurrence of plant and wildlife species, and to specify the portions of the right-of-way with suitable habitat.

Box 11D

State Route 84 Expressway Widening Project Natural Environment Study (NES) (URS 2007)
State Route 84 Expressway Widening Project Jurisdictional Delineation (JD) (URS 2008)
Final USFWS Biological Opinion (#81420-2008-F-0592) (USFWS 2008)
Approved USACE Jurisdictional Determination (File # SPN-2008-00396), February 24, 2009 (USACE 2009)

Box 12A

Erosion / Sedimentation / Water Quality

1) Clearing of vegetation during construction will be confined to the minimal area needed to conduct the construction activities.
2) All excavated material will be stored in upland habitat areas within the work area.
3) Any work near or adjacent to any drainage or wetland will be protected through installation of construction fencing backed by silt fencing. This will prevent all

excavated material, project equipment, and sediment from impacting sensitive habitat adjacent to or downslope from construction sites.

4) Construction work will be scheduled to maximize the dry summer months when construction activities are less likely to result in the mobilization of sediment.
5) An Erosion Control Plan will be implemented prior to the commencement of the Project to further reduce potential impacts to resources. Implementation of this plan will greatly reduce erosion potential and enhance the rehabilitation of the site.
6) A Stormwater Pollution Prevention Plan (SWPPP) will be prepared according to RWQCB requirements to further reduce potential impacts to resources.
7) An erosion control mixture will be applied as necessary to all disturbed areas. An herbaceous, native California seed mix will be added to the mixture and will germinate with early winter rains, vegetating disturbed areas.
8) After early resource evaluations, removal of oak trees has been significantly avoided through adjustments to the current project design. However, some oak tree removal will be required within the project area prior to construction. Oak tree impacts and details, including maps are included in the Natural Environment Study (URS 2007) for the project.

Dust

1) Dust control measures, including wetting construction sites, and a speed limit of 20 mph for project-related vehicles, will be practiced when construction could result in the mobilization of fine dust particles.

Ingress and Egress

1) During the roadway construction activities, all project-related vehicle and equipment traffic will be restricted to established roads or access routes, and will observe a 20-mile an hour speed limit within the work areas, except on County roads and highways. Prior to initiating project activities, the vehicle and equipment access routes and work area will be delineated using highly visible construction fencing.
2) All temporary work areas will be regraded to preexisting conditions following project implementation.
3) BMPs will be implemented on existing roads to ensure that construction activity does not result in increased erosion in the project area.

Staging and Equipment Maintenance

1) All fueling and maintenance of equipment and vehicles will be done at a designated maintenance area. This and all staging areas will be at least 100 feet from any aquatic areas, or as far away as available space allows in the project area. The construction personnel will ensure that contamination of habitat does not occur and will have clean-up equipment to promptly address any accidental spills.
2) Drip pans will be utilized during equipment maintenance activities, and all waste products will be disposed of in designated receptacles.

Environmentally sensitive area fencing will be installed at the perimeter of the construction right-of-way where it is located adjacent to wetlands and riparian areas to minimize impacts to wetland vegetation.

Box 12B

Avoidance and Minimization Measures for Plant Species

This section describes avoidance measures that were taken to minimize impacts to all special-status plant species that may be present in the project area. The U.S. Fish and Wildlife Service, California Department of Fish and Game (CDFG) and California Native Plant Society (CNPS) standards, which include:

- multiple surveys to ensure that seasonal variations in the special status species are covered;
- surveys during the appropriate time of year, in most cases the flowering period, for identification of special status plants to species or subspecies; and
- use of standard survey protocols.
- Two rounds of plant surveys were conducted in order to identify the presence or absence of special-status plant populations occurring within the project area.

No special status plants were identified in the project area.

The following avoidance and minimization measures will also be implemented:

1) Clearing of vegetation will be confined to the minimal area needed to conduct the construction activities.

General Avoidance and Minimization Measures for Wildlife

Surveys to determine absence or presence of all wildlife species in the project area were conducted by qualified wildlife biologists within appropriate habitat in the spring of 2005. Species-specific analyses and considerations are presented in the State Route 84 Expressway Widening Project Biological Evaluation (BE) (URS 2007).

Additionally, a pre-construction clearance survey will be conducted within two weeks prior to the initiation of work activities to determine if there are any active nests, burrows or colonies (burrow systems) located within the work area. If active, breeding species are found within work area footprints, the impacted breeding habitat will be avoided and fenced off from construction actions. If nest sites cannot be avoided, a species-specific calendar avoidance schedule will be implemented to time ground disturbing activities within periods where wildlife will not be expected to be present.

The following conditions summarize the standard approach to construction with concern for sensitive wildlife species on the proposed State Route 84 Expressway Widening Project:

1) If special status wildlife species are identified in the work area at any time, the USFWS and/or CDFG will be notified and consulted before work activities resume.

2) In habitats that potentially support listed species, the work areas will be defined by construction fencing. Construction fencing or other clearly marked exclusion techniques will be installed to delineate the work area to prevent equipment from entering adjacent habitat areas.
3) To reduce the potential for attracting sensitive wildlife species and their predators to the area, all trash will be properly contained and removed from the work site and disposed of regularly. All construction debris and trash will be removed from the site when work activities are complete.
4) All contaminated soils and materials will be excavated and removed from the site and disposed of appropriately to prevent sensitive animal species from becoming exposed to crude oil or other chemicals used during construction.
5) Erosion control materials will not include plastic netting, which could result in entanglement and death of small amphibians and reptiles within the material.

Box 12C

Per the Final Biological Opinion (Service # 81420-2008-F-0592) issued by the U.S. Fish and Wildlife Service (USFWS) on February 1st 2008, mitigation and compensation will include purchase of 34.08 acres of mitigation credits at an off-site USFWS approved mitigation bank with habitat occupied by the California tiger salamander and California red-legged frog, that is also considered habitat for the San Joaquin kit fox. Selected areas will include wetlands and ponds associated with breeding and foraging habitat for the amphibian species.

Other mitigation will include the planting of 71 native oak trees to replace 31 oak trees that are greater than 6" dbh and the reseeding of temporarily disturbed areas with a native grassland seed mix.

Other worker training, ESA fencing, biological monitoring and construction requirements are described in further detail in the Final Biological Opinion for the project.

PERMITS

UNITED STATES ARMY CORPS OF ENGINEERS
NON-REPORTING NATIONWIDE 404 PERMIT
FILE Number SPN-2008-00396 S

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET
SAN FRANCISCO, CALIFORNIA 94103-1398

APR 11 2011

Regulatory Division

SUBJECT: File Number SPN-2008-00396 S

Mr. Jeffrey Jensen
Office of Biological Sciences and Permits
California Department of Transportation, District 4
P.O. Box 23660
Oakland, California 94623-0660

Dear Mr. Jensen:

This letter is written in response to you October 22, 2010, request for a Department of the Army authorization to for the State Route 84 Expressway Widening Project. The project is located on State Route 84 between Ruby Hill Drive and Jack London Boulevard (Post Mile 22.5 and 27.3), in Alameda County, California.

The purpose of the project is to widen and upgrade State Route 84 to expressway standards, improve local traffic circulation, and improve bicycle and pedestrian access. The roadway would consist of 12-foot travel lanes and 10-foot shoulders. The road would be separated by concrete median barriers except at intersections. The median areas at intersections would be widened up to 36 feet to accommodate left-turn lanes. The highway will be widened from four lanes to six lanes between Stanley Boulevard and Jack London Boulevard. Access to the highway will be limited to intersections to improve circulation. Also as a part of the project, Isabel Avenue Trial will be extended to Vineyard Avenue. The project will temporarily impact 0.177 acres of waters of the U.S. and permanently impact 0.202 acres of waters of the U.S.

Based on a review of the information you submitted, your project qualifies for authorization under Department of the Army Nationwide Permit 14 for "Linear Transportation Projects" and Nationwide Permit 33 for "Temporary Construction, Access, and Dewatering" (72 Fed. Reg. 11092, March 12, 2007), pursuant to Section 404 of the Clean Water Act (33 U.S.C. Section 1344). See Enclosure 1. All work shall be completed in accordance with the plans and drawings titled:

- "Typical Section X-1" through "Typical Section X-6", last revised June 20, 2008
- "Layout L-1", "Layout L-2", "Layout L-5", and "Layout L-9" through "Layout L-18" last revised November 1, 2007;
- "Layout L-3", last revised March 13, 2008;
- "Layout L-4", "Layout L-6", "Layout L-7" last revised May 21, 2008; and
- "Layout L-8", last revised July 3, 2008 (see Enclosure 4)

The project must be in compliance with the General Conditions cited in Enclosure 2 for this Nationwide Permit authorization to remain valid. Non-compliance with any condition could result in the suspension, modification or revocation of the authorization for your project, thereby requiring you to obtain an Individual Permit from the Corps. This Nationwide Permit authorization does not obviate the need to obtain other State or local approvals required by law.

This verification is valid until the NWP is modified, reissued, or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2012. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit. Upon completion of the project and all associated mitigation requirements, you shall sign and return the Certification of Compliance, Enclosure 3, verifying that you have complied with the terms and conditions of the permit.

This authorization will not be effective until you have obtained a Section 401 water quality certification from the San Francisco Bay Regional Water Quality Control Board (RWQCB). If the RWQCB fails to act on a valid request for certification within two months after receipt of a complete application, the Corps will presume a waiver of water quality certification has been obtained. You shall submit a copy of the certification to the Corps prior to the commencement of work.

To ensure compliance with this Nationwide Permit authorization, the following special conditions shall be implemented:

1. This Corps permit does not authorize you to take an endangered species. In order to legally take a listed species, you must have a separate authorization under the Endangered Species Act (ESA) (e.g., an ESA Section 10 permit or a Biological Opinion (BO) under ESA Section 7 with "incidental take" provisions with which you must comply). The enclosed U.S. Fish and Wildlife Service (USFWS) BO dated February 1, 2008, contain mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that are also specified in the BO and letter of concurrence. Your authorization under this Corps permit is conditional upon your compliance with all of the mandatory terms and conditions associated with incidental take authorized by the attached BO, whose terms and conditions are incorporated by reference in this permit.

Failure to comply with the terms and conditions associated with incidental take of the BO, where a take of the listed species occurs, would constitute an unauthorized take and it would also constitute non-compliance with this Corps permit. The USFWS is the appropriate authority to determine compliance with the terms and conditions of their BO and with the ESA. (See Enclosure 5).

2. You shall employ sediment and erosion control best management practices as needed throughout the project area as described in Enclosure 7. No objects or fill shall be placed where they can be eroded or washed into drainage systems in the project area. All debris generated as a result of the project, shall be removed from the site and disposed of at an approved location outside of Corps jurisdiction. All project staging and equipment storage areas shall be located away from areas subject to the jurisdiction of the Corps. After construction, any materials used to dewater areas within the creeks shall be removed in their entirety.

3. To mitigate for the permanent loss of 0.115 acres of wetland ditch and 0.048 acres of other waters of the U.S., you shall enhance 0.115 acres of seasonal pond and install riparian scrub plantings on the Murray Ranch site as shown on the drawings entitled "Figure 1: Murray Ranch – Proposed Rt. 84 Mitigation Areas", dated March 2011 (see Enclosure 6).

   a. To insure long-term viability of the off-site enhanced areas, you shall provide proof of the establishment of an endowment and recordation of a conservation easement for the long-term management, maintenance, and protection of the Murray Ranch site by December 31, 2011 or 30 days prior to the start of construction, whichever comes first.

   b. The enhancement wetland area will be considered successful when it obtains 75% absolute over of native vegetation. Target species include spikerush (*Eleocharis* sp.), Mexican rush (*Juncus mexicanus*), and rabbitsfoot grass (*Polypogon mospeliensis*) which already do well in other wetland features in the area.

   c. Riparian scrub plantings will be considered successful if 75% of the shrubs planted survive by the end of the monitoring period. Target species include coyote bush (*Baccharis pilularis*) and red willow (*Salix laevigata*).

d. The off-site enhancement area and riparian scrub plantings shall be monitored for 5 years. Annual reports shall summarize overall site conditions, how the site has been managed, whether wetland and riparian scrub plantings are making progress towards or are meeting the success criteria, and any remedial actions taken or that will be required for the enhancement to be successful.

e. The off-site enhancement area shall be maintained in accordance with the May 9, 2008, "DRAFT Habitat Mitigation and Management Plan, Las Positas College Facilities Development Plan, Murray Ranch Site", prepared by H.T. Harvey and Associates.

4. Your responsibility to complete the required compensatory mitigation as set forth in Special Condition 2 will not be considered fulfilled until you have demonstrated mitigation success and have received written verification from the U.S. Army Corps of Engineers.

5. In the event of any unanticipated discoveries of potential cultural/historic resources, you shall immediately halt work in the vicinity of the discovery and contact the appropriate regulatory authorities. You shall complete consultation pursuant to 36 CFR 800 to the satisfaction of the SHPO prior to resuming work.

Should you have any questions regarding this matter, please call Andrea Meier or Cameron Johnson of our Regulatory Division at (415) 503-6798 or (415) 503-6773). Please address all correspondence to the Regulatory Division and refer to the File Number at the head of this letter. If you would like to provide comments on our permit review process, please complete the Customer Survey Form available online at http://per2.nwp.usace.army.mil/survey.html.

Sincerely,

Jane M. Hicks
Chief, Regulatory Division

Enclosures

Copies furnished without enclosures:

US EPA, San Francisco, CA
US FWS, Sacramento, CA
CA DFG, Yountville, CA
CA RWQCB, Oakland, CA

Enclosure 1.

2007 Nationwide Permits

14. ***Linear Transportation Projects.*** Activities required for the construction, expansion, modification, or improvement of linear transportation projects (e.g., roads, highways, railways, trails, airport runways, and taxiways) in waters of the United States. For linear transportation projects in non-tidal waters, the discharge cannot cause the loss of greater than 1/2-acre of waters of the United States. For linear transportation projects in tidal waters, the discharge cannot cause the loss of greater than 1/3-acre of waters of the United States. Any stream channel modification, including bank stabilization, is limited to the minimum necessary to construct or protect the linear transportation project; such modifications must be in the immediate vicinity of the project.

This NWP also authorizes temporary structures, fills, and work necessary to construct the linear transportation project. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. Temporary fills must be removed in their entirety and the affected areas returned to preconstruction elevations. The areas affected by temporary fills must be revegetated, as appropriate.

This NWP cannot be used to authorize non-linear features commonly associated with transportation projects, such as vehicle maintenance or storage buildings, parking lots, train stations, or aircraft hangars.
Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if: (1) The loss of waters of the United States exceeds 1/10 acre; or (2) there is a discharge in a special aquatic site, including wetlands. (See general condition 27.) (Sections 10 and 404)

Note: Some discharges for the construction of farm roads or forest roads, or temporary roads for moving mining equipment, may qualify for an exemption under Section 404(f) of the Clean Water Act (see 33 CFR 323.4).

33. ***Temporary Construction, Access, and Dewatering.*** Temporary structures, work, and discharges, including cofferdams, necessary for construction activities or access fills or dewatering of construction sites, provided that the associated primary activity is authorized by the Corps of Engineers or the U.S. Coast Guard. This NWP also authorizes temporary structures, work, and discharges, including cofferdams, necessary for construction activities not otherwise subject to the Corps or U.S. Coast Guard permit requirements. Appropriate measures must be taken to maintain near normal downstream flows and to minimize flooding. Fill must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. The use of dredged material may be allowed if the district engineer determines that it will not cause more than minimal adverse effects on aquatic resources. Following completion of construction, temporary fill must be entirely removed to upland areas, dredged material must be returned to its original location, and the affected areas must be restored to preconstruction elevations. The

Enclosure 3.

Permittee: Mr. Jeffrey Jensen
Office of Biological Sciences and Permits
California Department of Transportation, District 4
P.O. Box 23660
Oakland, California 94623-0660

File Number: SPN-2008-00396 S

Certification of Compliance
for
Nationwide Permit

"I hereby certify that the work authorized by the above referenced File Number and all required mitigation have been completed in accordance with the terms and conditions of this Nationwide Permit authorization."

_____ _____

(Permittee) (Date)

Return to:

Andrea Meier
U.S. Army, Corps of Engineers
San Francisco District
Regulatory Division, CESPN-R
1455 Market Street
San Francisco, CA 94103-1398

Enclosure 2. Nationwide Permit General Conditions

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as appropriate, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/ or Coastal Zone Management Act consistency for an NWP.

1. *Navigation.* (a) No activity may cause more than a minimal adverse effect on navigation.
(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. *Aquatic Life Movements.* No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. Culverts placed in streams must be installed to maintain low flow conditions.

3. *Spawning Areas.* Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. *Migratory Bird Breeding Areas.* Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. *Shellfish Beds.* No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48.

6. *Suitable Material.* No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. *Water Supply Intakes.* No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. *Adverse Effects From Impoundments.* If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. *Management of Water Flows.* To the maximum extent practicable, the preconstruction
course, condition,
capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the preconstruction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation
activities).

10. *Fills Within 100-Year Floodplains.* The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. *Equipment.* Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. *Soil Erosion and Sediment Controls.* Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. *Removal of Temporary Fills.* Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. *Proper Maintenance.* Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety.

15. *Wild and Scenic Rivers.* No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and

Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

16. *Tribal Rights.* No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

17. *Endangered Species.* (a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which ''may affect'' a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.
(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.
(c) Non-federal permittees shall notify the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. The district engineer will determine whether the proposed activity ''may affect'' or will have ''no effect'' to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have ''no effect'' on listed species or critical habitat, or until Section 7 consultation has been completed.
(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add speciesspecific regional endangered species conditions to the NWPs.
(e) Authorization of an activity by a NWP does not authorize the ''take'' of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with ''incidental take'' provisions, etc.) from the U.S. FWS or the NMFS, both lethal and non-lethal ''takes'' of protected species are in violation of the ESA. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide Web pages at *http://www.fws.gov/* and *http://www.noaa.gov/fisheries.html* respectively.

18. *Historic Properties.* (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.
(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.
(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the preconstruction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.
(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete preconstruction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed.
(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h–2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely

affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, explaining the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

19. *Designated Critical Resource Waters.* Critical resource waters include, NOAA-designated marine sanctuaries, National Estuarine Research Reserves, state natural heritage sites, and outstanding national resource waters or other waters officially designated by a state as having particular environmental or ecological significance and identified by the district engineer after notice and opportunity for public comment. The district engineer may also designate additional critical resource waters after notice and opportunity for comment.
(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, and 50 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.
(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 27, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

20. *Mitigation.* The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:
(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).
(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.
(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10 acre and require preconstruction notification, unless the district engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a projectspecific waiver of this requirement. For wetland losses of 1/10 acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.
(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream restoration, to ensure that the activity results in minimal adverse effects on the aquatic environment.
(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2 acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2 acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.
(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.
(g) Permittees may propose the use of mitigation banks, in-lieu fee arrangements or separate activityspecific compensatory mitigation. In all cases, the mitigation provisions will specify the party responsible for accomplishing and/or complying with the mitigation plan.
(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

21. *Water Quality.* Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The

district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

22. *Coastal Zone Management.* In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

23. *Regional and Case-By-Case Conditions.* The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

24. *Use of Multiple Nationwide Permits.* The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

25. *Transfer of Nationwide Permit Verifications.* If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature: ''When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.''

(Transferee)_____
(Date) _____

26. *Compliance Certification.* Each permittee who received an NWP verification from the Corps must submit a signed certification regarding the completed work and any required mitigation. The certification form must be forwarded by the Corps with the NWP verification letter and will include:
(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general or specific conditions;
(b) A statement that any required mitigation was completed in accordance with the permit conditions; and
(c) The signature of the permittee certifying the completion of the work and mitigation.

27. *Pre-Construction Notification.* (a) *Timing.* Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, as a general rule, will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity:
(1) Until notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
(2) If 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 17 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 18 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that is ''no effect'' on listed species or ''no potential to cause effects'' on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) is completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee cannot begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).
(b) *Contents of Pre-Construction Notification:* The PCN must be in writing and include the following information:
(1) Name, address and telephone numbers of the prospective permittee;
(2) Location of the proposed project;
(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to

determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided result in a quicker decision.);
(4) The PCN must include a delineation of special aquatic sites and other waters of the United States on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters of the United States, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, where appropriate;
(5) If the proposed activity will result in the loss of greater than 1/10 acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.
(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and
(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.
(c) *Form of Pre-Construction Notification:* The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.
(d) *Agency Coordination:* (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.
(2) For all NWP 48 activities requiring pre-construction notification and for other NWP activities requiring preconstruction notification to the district engineer that result in the loss of greater than 1/2-acre of waters of the United States, the district engineer will immediately provide (e.g., via facsimile transmission, overnight mail, or other expeditious manner) a copy of the PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will then have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the preconstruction notification. The district engineer will fully consider agency comments received within the specified time frame, but will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each preconstruction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.
(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.
(4) Applicants are encouraged to provide the Corps multiple copies of pre-construction notifications to expedite agency coordination.
(5) For NWP 48 activities that require reporting, the district engineer will provide a copy of each report within 10 calendar days of receipt to the appropriate regional office of the NMFS.
(e) *District Engineer's Decision:* In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If the proposed activity requires a PCN and will result in a loss of greater than 1/10 acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed work are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any conditions the district engineer deems necessary. The district engineer must approve any compensatory mitigation proposal before the permittee commences work. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will

expeditiously review the proposed compensatory mitigation plan. The district engineer must review the plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP.

If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (1) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (2) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (3) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period. The authorization will include the necessary conceptual or specific mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan.

28. *Single and Complete Project.* The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

PERMITS

CalOSHA UNDERGROUND CLASSIFICATION
#'S: C046-001-11T Thru C052-001-11T

STATE OF CALIFORNIA ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT
2211 Park Towne Circle, Suite 2
Sacramento, California 95825

Telephone (916) 574-2540
FAX (916) 574-2542

December 7, 2010

URS Corporation
100 W. San Fernando Street, Suite 200
San Jose, CA 95113

Attention: Ramsey Hissen

Subject: Underground Classification #'s: C046-001-11T thru C052-001-11T

Route 84 Expressway Widening Project

Mr. Hissen:

The information provided to this office relative to the above project has been reviewed. On the basis of this analysis, Underground Classification of "Potentially Gassy with Special Conditions" has been assigned to the tunnel(s) identified on your submittal. Please retain the original Classification for your records and deliver a true and correct copy of the Classification to the tunnel contractor(s) for posting at the job site.

When the contractor who will be performing the work is selected, please advise them to notify this office to schedule the mandated Prejob Conference with the Division prior to commencing any activity associated with boring of the tunnel(s).

Should you have another bore under construction that is not required to have an Underground Classification (i.e.: less than 30 inches in diameter), please contact the Mining and Tunneling Unit prior to any employee entry of such a space.

If you have any questions on this subject, please contact this office at your earliest convenience.

Sincerely,

John R. Leahy
Senior Engineer

cc: R. Brockman
File

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C046-001-11T

DEPARTMENT OF TRANSPORTATION

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of PO Box 23660, Oakland, CA 94623

(MAILING ADDRESS)

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The eight 36-inch diameter by 94 feet deep drilled shafts located at the Arroyo Del Valle Bridge, approximately 550 feet north of the intersection of Route 84 and Vineyard Avenue, Livermore, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date December 7, 2010

John R Leahy

(SENIOR ENGINEER)

John R. Leahy

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C047-001-11T

DEPARTMENT OF TRANSPORTATION

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of PO Box 23660, Oakland, CA 94623

(MAILING ADDRESS)

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

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2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 36-inch diameter by 164 feet long bored tunnel located at the intersection of Route 84 and Vallecitos Road, Livermore, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date December 7, 2010

John R Leahy

(SENIOR ENGINEER)

John R. Leahy

03 77089

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C048-001-11T

DEPARTMENT OF TRANSPORTATION

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of PO Box 23660, Oakland, CA 94623

(MAILING ADDRESS)

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 42-inch diameter by 123 feet long bored tunnel located approximately 150 feet south of the intersection of Route 84 and Vineyard Avenue, Livermore, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date December 7, 2010

John R. Leahy

(SENIOR ENGINEER)

John R. Leahy

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C049-001-11T

DEPARTMENT OF TRANSPORTATION

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of PO Box 23660, Oakland, CA 94623

(MAILING ADDRESS)

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 36-inch diameter by 86 feet long bored tunnel located approximately 1,000 feet north of the intersection of Route 84 and Vineyard Avenue, Livermore, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date December 7, 2010

John R. Leahy

(SENIOR ENGINEER)

John R. Leahy

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C050-001-11T

DEPARTMENT OF TRANSPORTATION

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of PO Box 23660, Oakland, CA 94623

(MAILING ADDRESS)

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 36-inch diameter by 234 feet long bored tunnel located approximately 125 feet south of the intersection of Route 84 and Vineyard Avenue, Livermore, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date December 7, 2010

John R Leahy

(SENIOR ENGINEER)

John R. Leahy

03 77089

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C051-001-11T

DEPARTMENT OF TRANSPORTATION

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of PO Box 23660, Oakland, CA 94623

(MAILING ADDRESS)

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 60-inch diameter by 220 feet long bored tunnel located approximately 0.6 miles south of the intersection of Route 84 and Jack London Boulevard, Livermore, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date December 7, 2010

John R. Leahy

(SENIOR ENGINEER)

John R. Leahy

03 77089

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C052-001-11T

DEPARTMENT OF TRANSPORTATION

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of PO Box 23660, Oakland, CA 94623

(MAILING ADDRESS)

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

(LOCATION)

has been classified as *** POTENTIALLY GASSY with Special Conditions***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 36-inch diameter by 218 feet long bored tunnel located approximately 575 feet south of the intersection of Route 84 and Jack London Boulevard, Livermore, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date December 7, 2010

John R. Leahy

(SENIOR ENGINEER)

John R. Leahy

03 77089

PERMITS

CALIFORNIA DEPARTMENT OF FISH AND GAME
INCIDENTAL TAKE PERMIT

No. 2081-2011-013-03

California Department of Fish and Game
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558

California Endangered Species Act
Incidental Take Permit No. 2081-2011-013-03

State Route 84 Expressway Widening Project

Authority: This California Endangered Species Act (CESA) Incidental Take Permit (ITP) is issued by the Department of Fish and Game (DFG) pursuant to Fish and Game Code section 2081, subdivisions (b) and (c), and California Code of Regulations, Title 14, section 783.0 et seq. CESA prohibits the take[1] of any species of wildlife designated by the California Fish and Game Commission as an endangered, threatened, or candidate species.[2] DFG may authorize the take of any such species by permit if the conditions set forth in Fish and Game Code section 2081, subdivisions (b) and (c), are met. (See also Cal. Code Regs., tit. 14, § 783.4.)

Permittee:	**California Department of Transportation (Caltrans)**
Principal Officer:	**Jeffrey G. Jensen, District Office Chief**
Contact Person:	**Nicole Rucker, (510) 286-5634**
Mailing Address:	**Post Office Box 23660** **Oakland, CA 94623-0660**

Effective Date and Expiration Date of this ITP:

This ITP shall be executed in duplicate original form and shall become effective once a duplicate original is acknowledged by signature of the Permittee on the last page of this ITP and returned to DFG's Habitat Conservation Planning Branch at the address listed in the Notices section of this ITP. Unless renewed by DFG, this ITP's authorization to take the Covered Species shall expire on **December 31, 2015**.

Notwithstanding the expiration date on the take authorization provided by this ITP, Permittee's obligations pursuant to this ITP do not end until DFG accepts as complete the Permittee's Final Mitigation Report required by Condition 7.7 of this ITP.

Project Location:

The State Route 84 Expressway Widening Project (Project) is located at State Route (SR) 84 from Ruby Hills Drive to Jack London Boulevard (Post Mile (PM) 22.9 through 27.1) within the

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[1] Pursuant to Fish and Game Code section 86, "'Take' means hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture or kill." See also *Environmental Protection Information Center v. California Department of Forestry and Fire Protection* (2008) 44 Cal.4th 459, 507 (for purposes of incidental take permitting under Fish and Game Code section 2081, subdivision (b), "'take' ... means to catch, capture or kill").

[2] The definition of an endangered, threatened, and candidate species for purposes of CESA are found in Fish and Game Code sections 2062, 2067, and 2068, respectively.

City of Livermore, Alameda County (see Figure 1).

Project Description:

The Project includes widening and upgrading of 4.8 miles of SR 84 to expressway standards (55 miles per hour (mph)). SR 84 will be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and from two lanes to six lanes between Stanley Boulevard and Jack London Boulevard. In general, the widening will conform to the existing roadway alignment. As an expressway, access to SR 84 will be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, Discovery Drive, and Jack London Boulevard will be widened and upgraded to accommodate future traffic movements. The Isabel Trail, a multi-use trail located on the eastern side of SR 84 between Jack London Boulevard and Alden Lane, will be extended to Vineyard Avenue. The Project also includes new private-access bridges and widening of existing bridges across the Arroyo Del Valle and Arroyo Mocho drainages.

The roadway cross section will consist of 12-foot-wide travel lanes and 10-foot-wide shoulders separated by a concrete median barrier. Roadway slopes will vary in steepness depending on safety requirements. Where practical, side slopes will be 1:4 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 1:2 or flatter. The roadway median area at intersections will be widened up to 36 feet to accommodate left-turn lanes. No concrete barriers will be provided at the intersection approaches, and a crash cushion will protect the blunt end of the barriers.

Key elements of the Project include the following:

- Widen and upgrade SR 84 to expressway standards (55 mph) from just south of Ruby Hill Drive to Jack London Boulevard. SR 84 will be widened from two to four lanes between Ruby Hill Drive (PM 22.5) and Stanley Boulevard, and from two to six lanes between Stanley Boulevard and Jack London Boulevard (PM 27.3). In general, the widening will follow the existing roadway alignment, and conform to the SR 84 Pigeon Pass Safety Project to the south and the Interstate 580/Isabel Avenue Interchange Project to the north.

- Widen bridges at Arroyo Del Valle and Arroyo Mocho to accommodate the road widening described above.

- Construct two new bridge crossings, adjacent to the widened bridges, at Arroyo Del Valle and at Arroyo Mocho.

- Relocate existing private driveway access to signalized intersections on SR 84, including constructing a new bridge crossing at Arroyo Mocho for access to Pacific

Gas and Electric, Zone 7, and City of Livermore facilities with access from Discovery Drive.

- Extend the multi-use trail, located on the eastern side of SR 84 between Jack London Boulevard and Concannon Boulevard, from Vineyard Avenue to the proposed new bridge crossing at Arroyo Del Valle. The 24-inch gas main and 15-inch sanitary sewer will also be relocated from the existing Arroyo Del Valle Bridge to the new Arroyo Del Valle trail bridge.

- Widen and upgrade signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, Discovery Drive, and Jack London Boulevard to accommodate year 2030 traffic demand. To address safety concerns for an expressway facility, the Vallecitos Road intersection will be relocated approximately 450 feet to the north.

The Project will create approximately 45 acres of new pavement. The total Project area, including permanent and temporary work areas, is approximately 88 acres. Partial right-of-way acquisition from 30 parcels (totaling approximately 13 acres) will be required to accommodate the road widening and intersection improvements. No land acquisition will be required from an existing conservation easement area on the eastern side of SR 84 between Ruby Hill Drive and Vallecitos Road.

Covered Species Subject to Take Authorization Provided by this ITP:

This ITP covers the following species:

Name	**CESA Status**
California tiger salamander (*Ambystoma californiense*)	Threatened[3]

This species and only this species is the "Covered Species" for purposes of this ITP.

Impacts of the Taking on Covered Species:

Project activities and their resulting impacts are expected to result in the incidental take of individuals of the Covered Species. The activities described above expected to result in incidental take of individuals of the Covered Species include cutting, clearing and grubbing, grading, compaction, overlay of pavement and underlying road materials, spreading, striping, excavation, pouring concrete, construction and removal of forms, falsework and localized cofferdams, equipment storage, installing fencing, dewatering, welding, pile driving, installation of traffic signals and lighting, and other activities (Covered Activities). Incidental take in the form of mortality ("kill") may occur as a result of Covered Activities that crush,

[3] See Cal. Code Regs., tit. 14, § 670.5, subd. (b)(3)(G).

fatally injure, entomb, starve, or desiccate individuals of the Covered Species. Incidental take of individuals of the Covered Species may also occur from Covered Activities in the form of pursue, catch, capture, or the attempt to do so, as a result of relocation or attempted relocation otherwise authorized by this ITP. Take could occur in undeveloped, natural habitats (e.g., grassland, woodland) from the southern end of the Project at Ruby Hills Drive, northward to Arroyo Del Valle, including the channel of Arroyo Del Valle (collectively, the Project Area). The Project will also cause the permanent loss of 11.36 acres of habitat for the Covered Species. Impacts of the authorized taking also include adverse impacts to the Covered Species related to temporal losses, increased habitat fragmentation and edge effects, and the Project's incremental contribution to cumulative impacts (indirect impacts). These impacts to the Covered Species include: stress resulting from noise and vibrations from tunneling and capture and relocation, and long-term effects due to increased pollution, displacement from preferred habitat, increased competition for food and space, and increased vulnerability to predation.

Expected impacts to the Covered Species by habitat type and Covered Activity category are summarized below in Table 1. Of the 88 acres within the Project Area, approximately 11.36 acres of Covered Species' habitat will be permanently impacted by the Project as shown in Figure 2 by habitat area within the "Project Footprint."

Table 1: Impacts to California Tiger Salamander by Habitat Type

			CA Annual Grassland		Valley Oak Woodland		Mixed Willow		Landscape (Disturbed)		Total
	Figure	Bridge	Grading (Acre)	Overlay (Acre)	Grading (Acre)	Overlay (Acre)	Grading (Acre)	Overlay (Acre)	Grading (Acre)	Overlay (Acre)	Acre
Type of Area Impacted Due to Roadway	VI-1		0.18	0.42							0.600
	VI-2		0.21	1.72	0.30	0.66					2.890
	VI-3		0.76	1.71	0.14	0.00					2.610
	VI-4		0.70	0.35							1.050
	VI-5		1.32	0.31							1.630
	VI-6		0.99	0.09					0.17	0.01	1.260
	VI-7		0.05	0.09			0.26	0.00	0.72	0.18	1.300
Impacts in Creeks Due to Bridges		Arroyo Del Valle widen									0.015
		Arroyo Del Valle Trail									0.004
TOTAL			4.20	4.70	0.44	0.66	0.26	0.00	0.89	0.19	11.36

Covered Species Incidental Take Authorization:

This ITP authorizes incidental take of the Covered Species and only the Covered Species. With respect to incidental take of the Covered Species, DFG authorizes the Permittee, its employees, contractors, and agents to take Covered Species incidentally in carrying out the Covered Activities, subject to the limitations described in this section and the Conditions of Approval identified below. This ITP does not authorize take of Covered Species from activities outside the scope of the Covered Activities, take of Covered Species outside of the Project Area, take of Covered Species resulting from violation of this ITP, or intentional take of Covered Species, except for capture and relocation of Covered Species as authorized by this ITP.

Conditions of Approval:

Unless specified otherwise, the following measures apply to all Covered Activities within the Project Area, including areas used for vehicular ingress and egress, staging and parking, and noise and vibration generating activities that may cause take. DFG's issuance of this ITP and Permittee's authorization to take the Covered Species are subject to Permittee's compliance with and implementation of the following Conditions of Approval:

1. **Legal Compliance**. Permittee shall comply with all applicable state, federal, and local laws in existence on the effective date of this ITP or adopted thereafter.

2. **CEQA Compliance**. Permittee shall implement and adhere to the mitigation measures related to the Covered Species in the Biological Resources section of the Mitigated Negative Declaration and Initial Study (SCH No. 2007102077) adoped by the lead agency, California Department of Transportation (Caltrans), for the Project pursuant to the California Environmental Quality Act (CEQA) on September 4, 2008.

3. **LSA Agreement Compliance**. Permittee shall implement and adhere to the avoidance and mitigation measures that pertain to the Covered Species specified in the notification for a Lake and Streambed Alteration (LSA) agreement (Notification No. 1600-2010-0404-R3) that the Permittee submitted to DFG for the Project pursuant to Fish and Game Code section 1602 et seq. Pursuant to the notification, Permittee shall implement and complete the Project during the seasonal work period and within the time period as specified.

4. **ESA Compliance**. Permittee shall implement and adhere to the terms and conditions that apply to the Covered Species in the Biological Opinion (BO) for the SR 84 Expressway Widening Project, Alameda County, California (Caltrans EA 04-297600), issued by the U.S. Fish & Wildlife Service (Service) for the Project pursuant to the federal Endangered Species Act (BO No. 81420-2008-F-0592). Permittee shall implement the terms and conditions set forth in the federal BO for the Covered Species unless those terms and conditions are less protective of the Covered Species or otherwise conflict with

the conditions of this ITP, whereby the conditions set forth in the ITP shall control for purposes of CESA.

5. **ITP Time Frame Compliance**. Permittee shall fully implement and adhere to the conditions of this ITP within the time frames set forth below and as set forth in the Mitigation Monitoring and Reporting Program (MMRP), which is included as Attachment 1 to this ITP.

6. **General Provisions:**

6.1. Designated Representative. Before starting Covered Activities, Permittee shall designate a representative (Designated Representative) responsible for communications with DFG and overseeing compliance with this ITP. Permittee shall notify DFG in writing before starting Covered Activities of the Designated Representative's name, business address, and contact information, and shall notify DFG in writing if a substitute Designated Representative is selected or identified at any time during the term of this ITP.

6.2. Designated Biologist(s). Permittee shall submit to DFG in writing the name, qualifications, business address, and contact information of one to three biological monitors (Designated Biologist[s]) at least two weeks before starting Covered Activities. Permittee shall ensure that the Designated Biologist(s) are knowledgeable and experienced in the biology and natural history of the Covered Species. The Designated Biologist(s) shall be responsible for monitoring Covered Activities to help minimize and fully mitigate or avoid the incidental take of individual Covered Species and to minimize disturbance of Covered Species' habitat. Permittee shall obtain DFG approval of the Designated Biologist(s) in writing before starting Covered Activities, and shall also obtain approval in advance in writing if the Designated Biologist(s) must be changed.

6.3. Designated Biologist(s)' Authority. To ensure compliance with the Conditions of Approval of this ITP, the Designated Biologist(s) shall have authority to immediately stop any activity that is not in compliance with this ITP, and/or to order any reasonable measure to avoid the unauthorized take of an individual of the Covered Species.

6.4. Education Program. Permittee shall conduct an education program for all persons employed or otherwise working in the Project Area before performing any work. The program shall consist of a presentation from the Designated Biologist(s) that includes a discussion of the biology and general behavior of the Covered Species, information about the distribution and habitat needs of the Covered Species, sensitivity of the Covered Species to human activities, its status pursuant to CESA including legal protection, recovery efforts, penalties for violations and Project-specific protective measures described in this ITP. Permittee shall provide interpretation for non-English

speaking workers, and the same instruction shall be provided for any new workers before their performing work in the Project Area. Permittee shall prepare and distribute wallet-sized cards or a fact sheet handout containing this information for workers to carry in the Project Area. Upon completion of the program, employees shall sign a form stating they attended the program and understand all protection measures.

6.5. Construction Monitoring Notebook. The Designated Biologist(s) shall maintain a construction-monitoring notebook on-site throughout the construction period which shall include a copy of this ITP with attachments and a list of signatures of all personnel who have successfully completed the education program. Permittee shall ensure a copy of the construction-monitoring notebook is available for review at the Project site upon request by DFG.

6.6. Trash Abatement. Permittee shall initiate a trash abatement program before starting Covered Activities and shall continue the program for the duration of the Project. Permittee shall ensure that trash and food items are contained in closed (animal-proof) containers and removed regularly (at least once a week) to avoid attracting opportunistic predators such as ravens, coyotes, and feral dogs.

6.7. Dust Control. Permittee shall implement dust control measures during Covered Activities to facilitate visibility for monitoring of the Covered Species by the Designated Biologist(s). Permittee shall keep the amount of water used to the minimum amount needed, and shall not allow water to form puddles.

6.8. Erosion Control Materials. Permittee shall prohibit use of erosion control materials potentially harmful to Covered Species and other species, such as mono-filament netting (erosion control matting) or similar material, in potential Covered Species' habitat.

6.9. Firearms and Dogs. Permittee shall prohibit firearms and domestic dogs from the Project Area and site access routes during Covered Activities, except those in the possession of authorized security personnel or local, state, or federal law enforcement officials.

6.10. Delineation of Covered Activities Area. Before starting Covered Activities along each part of the route in active construction, Permittee shall clearly delineate the boundaries of the Covered Activities Area as shown on Figure 2 with fencing, stakes or flags. Permittee shall restrict all Covered Activities to within the fenced, staked or flagged areas. Permittee shall ensure that no project activities that may cause ground disturbance or take shall occur in any Covered Species habitat except within the Covered Activities Area. Permittee shall maintain all fencing, stakes and flags until the completion of Covered Activities in that area.

6.11. Delineation of Property Boundaries. Before starting Covered Activities, along each part of the route in active construction, Permittee shall clearly delineate the boundaries of the Project Area with fencing, stakes or flags. Permittee shall maintain all fencing, stakes and flags until the completion of Covered Activities in that area.

6.12. Delineation of Habitat. Permittee shall clearly delineate habitat of the Covered Species within the Project Area with posted signs, posting stakes, flags, and/or rope or cord, and place fencing as necessary to minimize the disturbance of Covered Species' habitat.

6.13. Project Access. Permittee shall, at the direction of the Designated Biologist(s), clearly delineate all potential Covered Species habitat with high visibility fencing. Additionally, at the direction of the Designated Biologist(s), Permittee shall in areas of potential upland habitat, install a temporary exclusion barrier consisting of silt fencing or plywood 35 inches high and buried 6 inches deep to prevent Covered Species from entering the construction site. Where construction work will take place adjacent to areas of potential aquatic habitat, and per the direction of the Designated Biologist(s), Permittee shall erect a temporary barrier consisting of ERTEC E-fencing, per manufacturer installation recommendations, immediately outside the high visibility fencing.

6.14. Staging Areas. Permittee shall confine all Project-related parking, storage areas, laydown sites, equipment storage, and any other surface-disturbing activities to the Covered Activities Area using, to the extent possible, previously disturbed areas. Additionally, Permittee shall not use or cross Covered Species' habitat outside of the marked Covered Activities Area.

6.15. Hazardous Waste. Permittee shall immediately stop and following pertinent state and federal statutes and regulations arrange for repair and clean up by qualified individuals of any fuel or hazardous waste leaks or spills at the time of occurrence, or as soon as it is safe to do so. Permittee shall exclude the storage and handling of hazardous materials from the Project Area and shall properly contain and dispose of any unused or leftover hazardous products off-site.

6.16. DFG Access. Permittee shall provide DFG staff with reasonable access to the Project and mitigation lands under Permittee control, and shall otherwise fully cooperate with DFG efforts to verify compliance with or effectiveness of mitigation measures set forth in this ITP.

6.17. Refuse Removal. Upon completion of Covered Activities, Permittee shall remove from the Project Area and properly dispose of all temporary fill and construction refuse, including, but not limited to, broken equipment parts, wrapping material, cords, cables, wire, rope, strapping, twine, buckets, metal or plastic containers, and boxes.

7. Monitoring, Notification and Reporting Provisions:

7.1. Notification before Commencement. The Designated Representative shall notify DFG 14 calendar days before starting Covered Activities and shall document compliance with all pre-Project Conditions of Approval before starting Covered Activities.

7.2. Notification of Non-compliance. The Designated Representative shall immediately notify DFG in writing if it determines that the Permittee is not in compliance with any Condition of Approval of this ITP, including but not limited to any actual or anticipated failure to implement measures within the time periods indicated in this ITP and/or the MMRP. The Designated Representative shall report any non-compliance with this ITP to DFG within 24 hours.

7.3. Compliance Monitoring. The Designated Biologist(s) shall be on-site daily when Covered Activities occur. The Designated Biologist(s) shall conduct compliance inspections to: (1) minimize incidental take of the Covered Species; (2) check for compliance with all measures of this ITP; (3) check all exclusion zones; and (4) ensure that signs, stakes, and fencing are intact, and that Covered Activities are only occurring in the Project Area. The Designated Representative or Designated Biologist(s) shall prepare daily written observation and inspection records summarizing: oversight activities and compliance inspections, observations of Covered Species and their sign, survey results, and monitoring activities required by this ITP. The Designated Biologist(s) shall conduct compliance inspections a minimum of weekly during periods of inactivity and after clearing, grubbing, and grading are completed.

7.4. Photographic Documentation of Covered Activities. Prior to commencement of work, Permittee shall flag a minimum of one photo point every 1/8 of a mile along the Project alignment. The photo points shall provide comprehensive views of the Covered Activities Area and any Covered Species habitat that would be impacted by the Project. Prior to construction, Permittee shall photograph the Covered Activities Area from each of the flagged points, noting the direction and magnification of each photo. On a monthly basis, Permittee shall photograph construction activities from flagged photo points using the same direction and magnification as pre-construction photos. Labeled copies of photographs taken at each photo point shall be sent to DFG as a component of required monthly compliance reports (see Condition 7.5).

7.5. Monthly Compliance Report. The Designated Representative or Designated Biologist(s) shall compile the observation and inspection records identified in Condition 7.3 and 7.4 into a Monthly Compliance Report and submit it to DFG along with a copy of the MMRP table with notes showing the current implementation status of each mitigation measure. Monthly Compliance Reports shall be submitted to DFG's Regional Office at the office listed in the Notices section of this ITP and via e-mail to DFG's Regional Representative. At the time of this ITP's approval, the DFG Regional

Representative is Marcia Grefsrud (mgrefsrud@dfg.ca.gov). DFG may at any time increase the timing and number of compliance inspections and reports required under this provision depending upon the results of previous compliance inspections. If DFG determines the reporting schedule must be changed, DFG will notify Permittee in writing of the new reporting schedule.

7.6. Annual Status Report. Permittee shall provide DFG with an Annual Status Report (ASR) no later than January 31 of every year beginning with issuance of this ITP and continuing until DFG accepts the Final Mitigation Report identified below. Each ASR shall include, at a minimum: (1) a summary of all Monthly Compliance Reports for that year identified in Condition 7.5; (2) a general description of the status of the Project Area and Covered Activities, including actual or projected completion dates, if known; (3) a copy of the table in the MMRP with notes showing the current implementation status of each mitigation measure; (4) an assessment of the effectiveness of each completed or partially completed mitigation measure in avoiding, minimizing and mitigating Project impacts; (5) all available information about Project-related incidental take of the Covered Species; and (6) information about other Project impacts on the Covered Species.

7.7. CNDDB Observations. The Designated Biologist(s) shall submit all observations of Covered Species to DFG's California Natural Diversity Database (CNDDB) and the Designated Biologist(s) shall include copies of the submitted forms with the next Monthly Compliance Report or ASR, whichever is submitted first relative to the observation.

7.8. Final Mitigation Report. No later than 45 days after completion of all mitigation measures, Permittee shall provide DFG with a Final Mitigation Report. The Designated Biologist(s) shall prepare the Final Mitigation Report which shall include, at a minimum: (1) a summary of all Monthly Compliance Reports and all ASRs; (2) a copy of the table in the MMRP with notes showing when each of the mitigation measures was implemented; (3) all available information about Project-related incidental take of the Covered Species; (4) information about other Project impacts on the Covered Species; (5) beginning and ending dates of Covered Activities; (6) an assessment of the effectiveness of this ITP's Conditions of Approval in minimizing and fully mitigating Project impacts of the taking on Covered Species; (7) recommendations on how mitigation measures might be changed to more effectively minimize take and mitigate the impacts of future projects on the Covered Species; and (8) any other pertinent information. The Final Mitigation must be approved in writing by DFG before the obligations of this ITP are deemed to be met.

7.9. Notification of Take. Permittee shall immediately notify the Designated Biologist(s) if a Covered Species is killed or taken by a Project-related activity, or if a Covered Species is otherwise found dead or injured within the vicinity of the Project. The Designated Biologist(s) or Designated Representative shall provide initial notification to DFG by

calling the Regional Office at (707) 944-5500 or Marcia Grefsrud at (707) 644-2812. The initial notification to DFG shall include information regarding the location, species, number of animals taken, and the ITP Number. Following initial notification, Permittee shall send DFG a written report within 2 calendar days. The report shall include the date and time of the finding or incident, location of the animal or carcass, and if possible provide a photograph, explanation as to cause of take, and any other pertinent information.

8. Take Minimization Measures:

The following requirements are intended to ensure the minimization of incidental take of Covered Species in the Project Area during Covered Activities. Permittee shall implement and adhere to the following conditions to minimize take of Covered Species:

8.1. Seasonal Riparian Work Restriction. Permittee shall confine all work within riparian areas to the period of June 15 to October 15.

8.2. Seasonal Upland Work Restriction. Permittee shall, if possible, confine all earthwork and vegetation clearing within areas of potential Covered Species upland habitat, to the period of April 15 to October 31.

8.3. Pond Work Restriction. Permittee shall ensure that no activities occur in ponds or pools known to or with the potential to be used for California tiger salamander breeding and metamorphosis and no activities occur within 200 feet of any such ponds or pools.

8.4. Rain Restriction. The Permittee shall monitor the National Weather Service (NWS) 72-hr forecast for the Project Area. If rain is predicted within 72 hours during Project activity, all activities shall cease until no further rain is forecast. If the ponds/pools remain dry after the rain, the Permittee may continue activities.

8.5. Pre-activity California Tiger Salamander Surveys. The Designated Biologist(s) shall complete walking surveys of the Project Area for California tiger salamanders prior to initiating Covered Activities and shall follow earthmoving equipment to look for California tiger salamanders. If a California tiger salamander is discovered by the Designated Biologist(s) or anyone else, the Designated Biologist(s) shall move the animal to a safe nearby location (e.g. mouth of ground-squirrel burrow outside of the construction area) and monitor it until it is determined that it is not imperiled by predators or other dangers.

8.6. Pipe and Culverts. Because California tiger salamanders are attracted to cave-like structures, such as pipes, and may enter stored pipes and become trapped, all construction pipes, culverts, or similar structures that are stored at a construction site for one or more overnight periods will be either securely capped prior to storage or

thoroughly inspected by the on-site biologist and/or the construction foreman/manager for these animals before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a California tiger salamander is discovered inside a pipe by the Designated Biologist(s) or anyone else, the Designated Biologist(s) shall move the animal to a safe nearby location and monitor it until it is determined that it is not imperiled by predators, or other dangers.

8.7. California Tiger Salamander Relocation. The Designated Biologist(s) shall relocate any California tiger salamanders found within the Project Areas to be impacted to an active rodent burrow system or appropriate breeding pond located no more than 300 feet outside of the Project Area unless otherwise approved by DFG. Relocation areas shall be identified by the Designated Biologist(s) based upon best suitable habitat available and approved by DFG prior to the start of Covered Activities.

8.8. Escape Ramp. Permittee shall at the end of each work day, create an escape ramp at each end of any open trench to allow any animals that may have become entrapped in the trench to climb out overnight. The ramp may be constructed of either dirt fill or wood planking or other suitable material that is placed at an angle no greater than 30 degrees.

8.9. Covered Species Injury. If a Covered Species is injured as a result of Project-related activities, the Designated Biologist(s) shall immediately take it to a DFG approved wildlife rehabilitation or veterinary facility. Permittee shall identify the facility before starting Covered Activities. Permittee shall bear any costs associated with the care or treatment of such injured Covered Species. The Permittee shall notify DFG of the injury to the Covered Species immediately by telephone and e-mail followed by a written incident report. Notification shall include the date, time, location and circumstances of the incident, and the name of the facility where the animal was taken.

9. Habitat Management Land Acquisition and Restoration:

DFG has determined that permanent protection and perpetual management of compensatory habitat is necessary and required pursuant to CESA to fully mitigate Project-related impacts of the taking on the Covered Species that will result with implementation of the Covered Activities. This determination is based on factors including an assessment of the importance of the habitat in the Project Area, the extent to which the Covered Activities will impact the habitat, and DFG's estimate of the acreage required to provide for adequate compensation.

To meet this requirement, the Permittee shall provide for the permanent protection and management of 34.08 acres of Habitat Management (HM) lands by completing the transfer of fee title to a DFG-approved public agency or the recordation of a conservation easement pursuant to Civil Code 815 et seq. (Condition 9.2), and calculation and deposit of the management funds (Condition 9.3). Permanent protection and perpetual

management of compensatory habitat must be complete before starting Covered Activities or within 18 months of the effective date of this ITP if Security is provided pursuant to Condition 10 below.

9.1. Cost Estimates. DFG has estimated the cost of acquisition, protection, and perpetual management of the HM lands as follows:

9.1.1. Land Acquisition. Land acquisition costs for the HM lands identified in Condition 9.2, below, estimated at $15,000/acre for 34.08 acres: $511,200. Land acquisition costs are estimated using local fair market current value for lands with habitat values meeting mitigation requirements;

9.1.2. Start-up. Start-up costs for HM lands, including initial site protection and enhancement costs as described in Condition 9.2.5, below, estimated at $27,264.

9.1.3. Interim Management. Interim management period funding as described in Condition 9.2.6, below, estimated at $11,000.

9.1.4. Long-term Management. Long-term management funding as described in Condition 9.4, below, estimated at $800/acre, at an annual capitalization rate of 3.5%, for 34.08 acres: $778,971. The long-term management endowment fund is estimated initially for the purpose of providing Security to ensure implementation of HM land management.

9.1.5. Related Transaction Fees. Related transaction fees including but not limited to account set-up fees, administrative fees, title and documentation review and related title transactions, expenses incurred from other state agency reviews, and overhead related to transfer of HM Lands to DFG as described in Condition 9.5, below, estimated at $3,000.

9.2. Habitat Acquisition and Protection. To provide for the acquisition and protection of the HM lands, the Permittee shall:

9.2.1. Fee Title/Conservation Easement. Transfer fee title to the HM lands to DFG pursuant to terms approved by DFG. Alternatively, a DFG-approved non-profit organization qualified pursuant to California Government Code section 65965 or DFG-approved public agency (collectively "approved entity") may hold fee title or act as grantee for a conservation easement over the HM lands. If an approved entity holds fee title, Permittee shall record a conservation easement in favor of DFG or a DFG-approved entity as grantee. If an approved entity holds a conservation easement, DFG shall be named third-party beneficiary. The Permittee shall obtain DFG approval of any conservation easement before its recordation;

9.2.2. HM Lands Approval. Obtain DFG approval of the HM lands before acquisition and/or transfer of the land by submitting, at least three months before acquisition and/or transfer of the HM lands, a formal Proposed Lands for Acquisition Form (see Attachment 2B) identifying the land to be purchased or property interest conveyed to an approved entity as mitigation for the Project's impacts on Covered Species;

9.2.3. HM Lands Documentation. Provide a recent preliminary title report, initial hazardous materials survey report, and other necessary documents identified on a Habitat Management Lands Checklist (see Attachment 2A). All documents conveying the HM lands and all conditions of title are subject to the approval of DFG, and if applicable, the Wildlife Conservation Board and the Department of General Services;

9.2.4. Land Manager. Designate an interim and long-term land manager. Permittee may select the conservation easement grantee, land owner, or other party as the land manager. Documents related to land management shall identify the land manager. Permittee shall notify DFG of any subsequent changes in the land manager within 30 days of the change. If DFG will hold fee title to the mitigation land, DFG will also act as long-term land manager unless otherwise specified.

9.2.5. Start-up Activities. Provide for the implementation of start-up activities, including the initial site protection and enhancement of HM lands, once the HM lands have been approved by DFG. Start-up activities include, at a minimum: (1) preparing a final management plan for DFG approval (see http://www.dfg.ca.gov/habcon/conplan/mitbank/); (2) conducting a baseline biological assessment and land survey report within 4 months of recording or transfer; (3) developing and transferring Geographic Information Systems (GIS) data if applicable; (4) establishing initial fencing; (5) conducting litter removal; (6) conducting initial habitat restoration or enhancement, if applicable; and (7) installing signage;

9.2.6. Interim Management (Initial and Capital). Provide for the interim management of the HM lands. The interim management period shall be a minimum of 3 years from the date of HM land acquisition and protection and full funding of the Endowment and includes expected annual management (described in the final management plan) following start-up activities. Interim management period activities include fence repair, continuing trash removal, site monitoring, and vegetation management. Permittee shall either (1) provide a security for the 3-year interim management amount that the land owner, Permittee, or land manager agrees to manage at their own expense, (2) establish an escrow account with instructions to pay the land manager annually in advance, (3) establish a short-term enhancement sub-account with the National Fish and

Wildlife Foundation (NFWF) for annual payment to the land manager, or (4) establish a short-term enhancement account with DFG for annual payment to the land manager.

9.3. Endowment Fund. After obtaining DFG approval of the HM lands, Permittee shall provide long-term management funding for the in-perpetuity management of the HM lands by establishing a long-term management fund (Endowment Fund). The Endowment Fund is a sum of money, held in a DFG-authorized trust fund that provides funds for the perpetual management, maintenance, monitoring, and other activities on the HM lands consistent with the management plan(s) required by Condition 9.2.5. "Endowment Fund" as used in this ITP shall refer to the endowment deposit and all interest, dividends, other earnings, additions and appreciation thereon.

9.3.1. Identify an Endowment Fund Manager. The Endowment Fund shall be held by NFWF or DFG;

9.3.2. Calculate the Endowment Funds Deposit. After obtaining DFG approval of the HM lands, long-term management plan, and Endowment Fund Manager, Permittee shall prepare a Property Analysis Record (PAR) to calculate the amount of funding necessary to ensure the long-term management of the HM lands (Endowment Deposit Amount). The Permittee shall submit to DFG for review and approval the results of the PAR before transferring funds to the Endowment Fund Manager.

9.3.2.1. Capitalization Rate and Fees. Permittee shall obtain the capitalization rate from the selected Endowment Fund Manager for use in calculating the PAR and adjust for any additional administrative, periodic, or annual fees.

9.3.2.2. Endowment Buffers/Assumptions. Permittee shall include in PAR assumptions the following buffers for endowment establishment and use that will substantially ensure long-term viability and security of the Endowment Fund:

9.3.2.2.1. 10 Percent Contingency. A 10 percent contingency shall be added to each endowment calculation to hedge against underestimation of the fund, unanticipated expenditures, inflation, or catastrophic events.

9.3.2.2.2. Three Years Delayed Spending. The endowment shall be established assuming spending will not occur for the first three years after full funding.

9.3.2.2.3. Non-annualized Expenses. For all large capital expenses to occur periodically but not annually such as fence replacement or well replacement, payments shall be withheld from the annual disbursement until the year of anticipated need or upon request to Endowment Fund Manager and DFG.

9.3.3. Transfer Long-term Endowment Funds. Permittee shall transfer the long-term endowment funds to the Endowment Fund Manager upon DFG approval of the Endowment Deposit Amount identified above. The approved Endowment Fund Manager may pool the Endowment Fund with other endowments for the operation, management, and protection of HM lands for local populations of the Covered Species but shall maintain separate accounting for each Endowment Fund.

9.4. Reimburse DFG. Permittee shall reimburse DFG for all reasonable expenses incurred by DFG such as transaction fees, account set-up fees, administrative fees, title and documentation review and related title transactions, expenses incurred from other state agency reviews, and overhead related to transfer of HM Lands to DFG.

10. Performance Security

The Permittee may proceed with Covered Activities only after the Permittee has ensured funding (Security) to complete any activity required by Condition 9 that has not been completed before Covered Activities begin. Permittee shall provide Security as follows:

10.1. Security Amount. The Security shall be in the amount of $1,331,435. This amount is based on the cost estimates identified in Condition 9.1 above;

10.2. Security Form. Permittee may proceed with ground- or vegetation-disturbing activities before completing all of the required mitigation (including acquisition of HM Lands), monitoring, and reporting activities only if Permittee ensures funding to complete those activities by providing to DFG prior to commencing ground- or vegetation disturbing activities, a funding assurance letter stating that sufficient funds to fully mitigate impacts (Security) have been budgeted in the Interstate State Route 84 Widening Project Expenditure Authorization. The funding assurance letter shall be signed by the District Deputy Director of Project Management and the District Deputy Director of Environmental and approved by DFG's Office of the General Counsel. The Security shall appropriate sufficient funds to implement the ITP's mitigation, monitoring and reporting requirements, including land acquisition costs, costs of enhancing HM Lands, and an endowment.

10.3. Security Timeline. The Security shall be provided to DFG before Covered Activities begin or within 30 days after the effective date of this ITP, whichever occurs first;

10.4. Security Holder. The Security shall be held by DFG or in a manner approved in advance in writing by DFG;

Even if Security is provided, the Permittee must complete the required acquisition, protection and transfer of all HM lands and record any required conservation easements no later than 18 months from the effective date of this ITP. DFG may require the Permittee to provide additional HM lands and/or additional funding to ensure the impacts of the taking are minimized and fully mitigated, as required by law, if the Permittee does not complete these requirements within the specified timeframe.

Amendment:

This ITP may be amended as provided by California Code of Regulations, Title 14, section 783.6, subdivision (c), and other applicable law. This ITP may be amended without the concurrence of the Permittee as required by law, including if DFG determines that continued implementation of the Project as authorized under this ITP conditions would jeopardize the continued existence of the Covered Species, or where Project changes or changed biological conditions necessitate an ITP amendment to ensure that all Project-related impacts of the taking to the Covered Species are minimized and fully mitigated.

Stop-Work Order:

DFG may issue Permittee a written stop-work order requiring the Permittee to suspend any Covered Activity for an initial period of up to 25 days to prevent or remedy a violation of this ITP, including but not limited to the failure to comply with reporting, monitoring, or habitat acquisition obligations, or to prevent the unauthorized take of any CESA endangered, threatened, or candidate species. Permittee shall stop work immediately as directed by DFG upon receipt of any such stop-work order. Upon written notice to Permittee, DFG may extend any stop-work order issued to Permittee for a period not to exceed 25 additional days. Suspension and revocation of this ITP shall be governed by California Code of Regulations, Title 14, section 783.7, and other applicable law. Neither the Designated Biologist nor DFG shall be liable for any costs incurred in complying with stop-work orders.

Compliance with Other Laws:

This ITP sets forth DFG's requirements for the Permittee to implement the Project pursuant to CESA. This ITP does not necessarily create an entitlement to proceed with the Project. Permittee is responsible for complying with all other applicable federal, state, and local law.

Notices:

The Permittee shall deliver a fully executed duplicate original ITP by registered first class mail or overnight delivery to the following address:

Habitat Conservation Planning Branch
California Department of Fish and Game

Attention: CESA Permitting Program
1416 Ninth Street, Suite 1260,
Sacramento, CA 95814

Written notices, reports and other communications relating to this ITP shall be delivered to DFG by registered first class mail at the following addresses, or at addresses DFG may subsequently provide the Permittee. Notices, reports, and other communications shall reference the Project name, Permittee, and ITP Number (2081-2011-013-3) in a cover letter and on any other associated documents.

Original cover with attachment(s) to:

Carl Wilcox, Regional Manager
Bay Delta Region
California Department of Fish and Game
7329 Silverado Trail
Napa, CA 94558
Phone (707) 944-5500, Fax (707) 944-5563

Copy of cover without attachment(s) to:

Office of the General Counsel
California Department of Fish and Game
1416 Ninth Street, 13th Floor
Sacramento, CA 95814

And:

Habitat Conservation Planning Branch
California Department of Fish and Game
1416 Ninth Street, Suite 1260
Sacramento, CA 95814

Unless Permittee is notified otherwise, DFG's Regional Representative for purposes of addressing issues that arise during implementation of this ITP is:

Marcia Grefsrud, Environmental Scientist
Bay Delta Region
California Department of Fish and Game
7329 Silverado Trail
Napa, CA 94558
Phone (707) 644-2812, Fax (707) 944-5563

Compliance with CEQA:

DFG's issuance of this ITP is subject to CEQA. DFG is a responsible agency pursuant to CEQA with respect to this ITP because of prior environmental review of the Project by the lead agency, Caltrans. (See generally Pub. Resources Code, §§ 21067, 21069.) The lead agency's prior environmental review of the Project is set forth in a Mitigated Negative Declaration (SCH No. 2007102077) adopted by Caltrans for the Project on September 4, 2008. At the time the lead agency adopted the Mitigated Negative Declaration and approved the Project, it also adopted various mitigation measures for the Covered Species as conditions of Project approval.

This ITP, along with DFG's related CEQA findings, which are available as a separate document, provide evidence of DFG's consideration of the lead agency's Mitigated Negative Declaration for the Project. (CEQA Guidelines, § 15096, subd. (f).) DFG finds that issuance of this ITP will not result in any previously undisclosed potentially significant effects on the environment or a substantial increase in the severity of any potentially significant environmental effects previously disclosed by the lead agency. Furthermore, to the extent the potential for such effects exists, DFG finds adherence to and implementation of the Conditions of Project Approval adopted by the lead agency, as well as adherence to and implementation of the Conditions of Approval imposed by DFG through the issuance of this ITP, will avoid or reduce to below a level of significance any such potential effects. DFG consequently finds that issuance of this ITP will not result in any significant, adverse impacts on the environment.

Findings Pursuant to CESA:

These findings document DFG's compliance with the specific findings requirements set forth in CESA and related regulations. (Fish & G. Code, § 2081, subs. (b), (c); Cal. Code Regs., tit. 14, §§ 783.4, subds, (a)-(b), 783.5, subd. (c)(2).)

DFG finds based on substantial evidence in the ITP application, the results of site visits and consultations, and the administrative record of proceedings, that issuance of this ITP complies and is consistent with the criteria governing the issuance of ITPs pursuant to CESA:

(1) Take of Covered Species as defined in this ITP will be incidental to the otherwise lawful activities covered under this ITP;

(2) Impacts of the taking on Covered Species will be minimized and fully mitigated through the implementation of measures required by this ITP and as described in the MMRP. Measures include: (1) permanent habitat protection; (2) establishment of avoidance zones; (3) worker education; and (4) Monthly Compliance Reports. DFG evaluated factors including an assessment of the importance of the habitat in the Project Area, the extent to which the Covered Activities will impact the habitat, and DFG's estimate

of the acreage required to provide for adequate compensation. Based on this evaluation, DFG determined that the protection and management in perpetuity of 34.08 acres of compensatory habitat that is contiguous with other protected Covered Species habitat and/or is of higher quality than the habitat being destroyed by the Project, along with the minimization, monitoring, reporting, and funding requirements of this ITP minimizes and fully mitigates the impacts of the taking caused by the Project;

(3) The take avoidance and mitigation measures required pursuant to the conditions of this ITP and its attachments are roughly proportional in extent to the impacts of the taking authorized by this ITP;

(4) The measures required by this ITP maintain Permittee's objectives to the greatest extent possible;

(5) All required measures are capable of successful implementation;

(6) This ITP is consistent with any regulations adopted pursuant to Fish and Game Code sections 2112 and 2114;

(7) Permittee has ensured adequate funding to implement the measures required by this ITP as well as for monitoring compliance with, and the effectiveness of, those measures for the Project; and

(8) Issuance of this ITP will not jeopardize the continued existence of the Covered Species based on the best scientific and other information reasonably available, and this finding includes consideration of the species' capability to survive and reproduce, and any adverse impacts of the taking on those abilities in light of (1) known population trends; (2) known threats to the species; and (3) reasonably foreseeable impacts on the species from other related projects and activities. Moreover, DFG's finding is based, in part, on DFG's express authority to amend the terms and conditions of this ITP without concurrence of the Permittee as necessary to avoid jeopardy and as required by law.

Attachments:

FIGURE 1	Map of Project
FIGURE 2	Map Showing Project Footprint / Covered Activities Area
ATTACHMENT 1	Mitigation Monitoring and Reporting Program
ATTACHMENT 2A, 2B	Habitat Management Lands Checklist; Proposed Lands for Acquisition Form

ISSUED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME

on November 9, 2011

Carl Wilcox, Regional Manager
BAY DELTA REGION

APPROVED AS TO FORM:

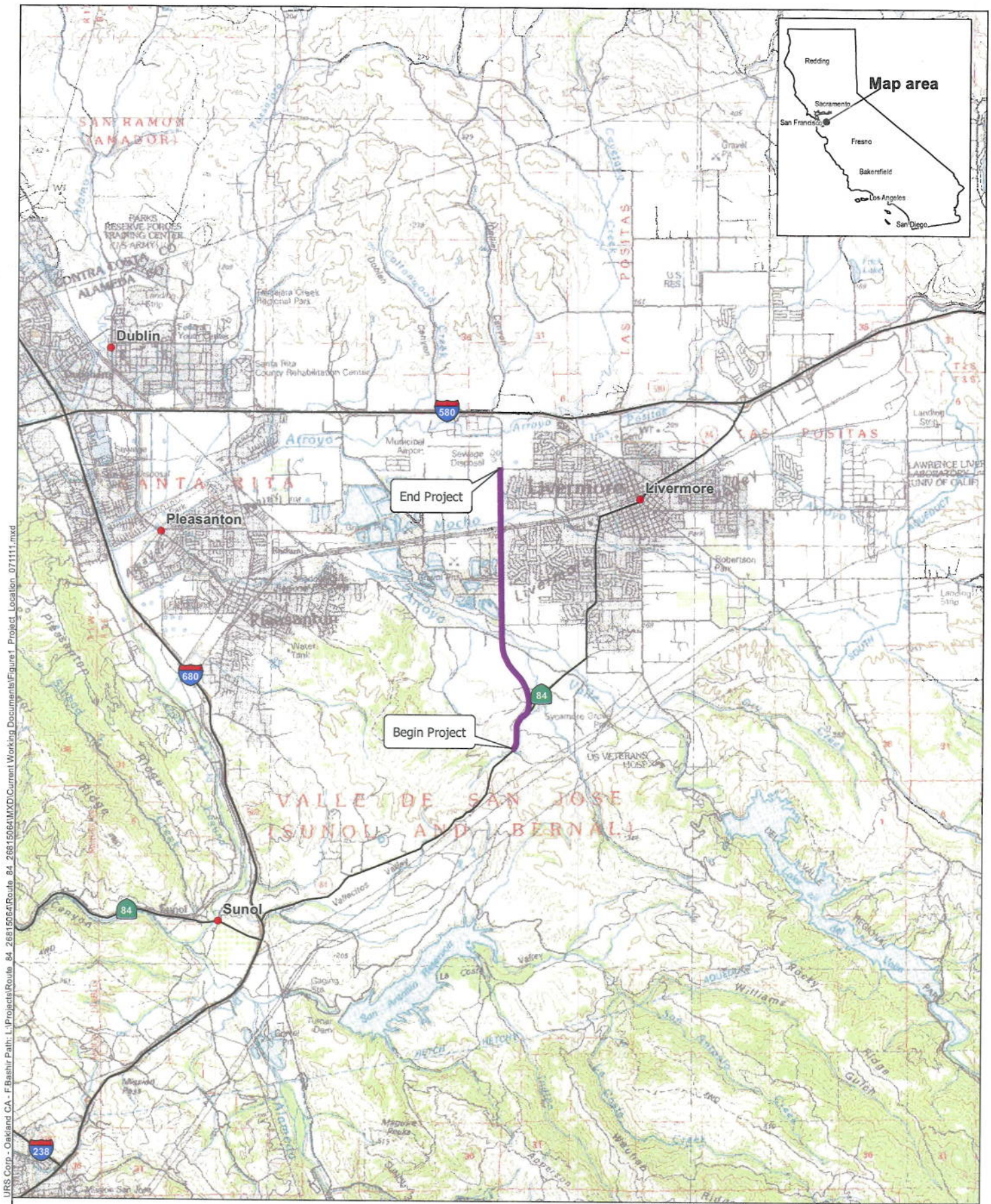
John H. Mattox
Staff Counsel IV

ACKNOWLEDGMENT

The undersigned: (1) warrants that he or she is acting as a duly authorized representative of the Permittee, (2) acknowledges receipt of this ITP, and (3) agrees on behalf of the Permittee to comply with all terms and conditions

By: _____ Date: 11/10/11

Printed Name: Jeffrey G. Jensen Title: Office Chief
Caltrans D-4



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ALA 84-PM 22.9/27.1
04-297600

PROJECT LOCATION AND REGIONAL SETTING

Route 84
Expressway widening

July 2011

FIGURE 1

NOTE:

1. Permanent and temporary impacts to potential California tiger salamander were developed per guidance provided by John Cleckler of USFWS during field meeting on November 20, 2007 and follow-up phone conversation on December 18, 2007. Areas considered potential habitat for California tiger salamander would be undeveloped, natural habitats (e.g. grassland, woodland) from south end of project at Ruby Hills northward to Arroyo del Valle, and the channel of Arroyo del Valle. Temporary and permanent impacts within these potential habitats are quantified below:

2. Impact shown on these maps are relevant only for the areas considered habitat for California Tiger Salamander.

LEGEND:

- PROJECT FOOTPRINT
- GRADING IMPACT TO CA ANNUAL GRASSLAND
- GRADING IMPACT TO VALLEY OAK WOODLAND
- GRADING IMPACT TO LANDSCAPE (DISTURBED)
- IMPACT TO MIXED WILLOW
- BSA
- OVERLAY IMPACT TO CA ANNUAL GRASSLAND
- OVERLAY IMPACT TO VALLEY OAK WOODLAND
- OVERLAY IMPACT TO LANDSCAPE (DISTURBED)
- PERMANENT IMPACT IN CREEKS DUE TO BRIDGES
- TEMPORARY IMPACT IN CREEKS DUE TO BRIDGES

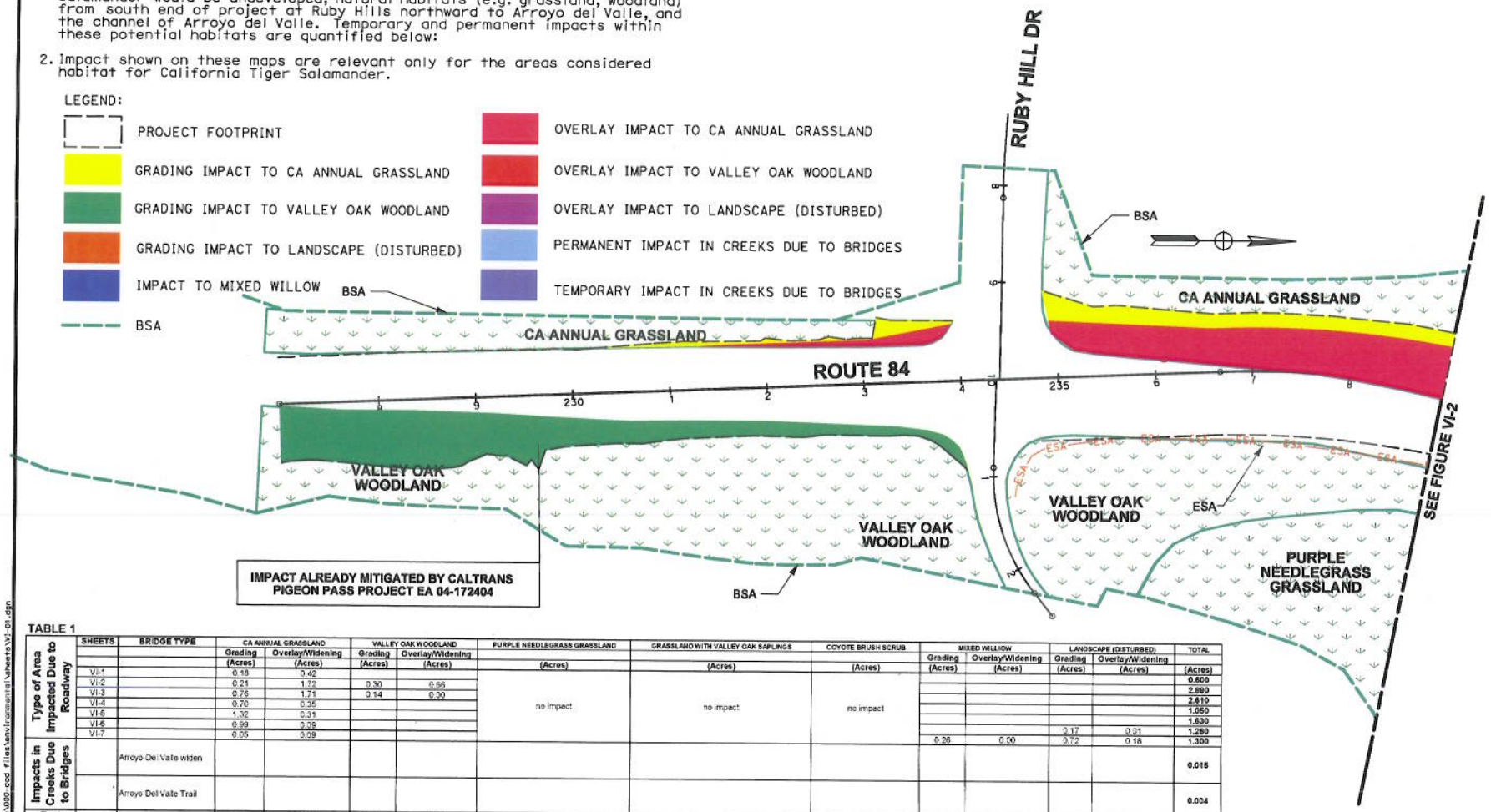

TABLE 1

Type of Area Impacted Due to Roadway	SHEETS	BRIDGE TYPE	CA ANNUAL GRASSLAND		VALLEY OAK WOODLAND		PURPLE NEEDLEGRASS GRASSLAND	GRASSLAND WITH VALLEY OAK SAPLINGS	COYOTE BRUSH SCRUB	MIXED WILLOW		LANDSCAPE (DISTURBED)		TOTAL
			Grading (Acres)	Overlay/Widening (Acres)	Grading (Acres)	Overlay/Widening (Acres)	(Acres)	(Acres)	(Acres)	Grading (Acres)	Overlay/Widening (Acres)	Grading (Acres)	Overlay/Widening (Acres)	(Acres)
	VI-1*		0.18	0.42										0.600
	VI-2		0.21	1.72	0.30	0.66								2.890
	VI-3		0.76	1.71	0.14	0.00								2.610
	VI-4		0.70	0.35			no impact	no impact	no impact					1.050
	VI-5		1.32	0.31										1.630
	VI-6		0.99	0.09										1.080
	VI-7		0.05	0.09								0.17	0.31	1.260
										0.26	0.00	0.72	0.16	1.300
Impacts in Creeks Due to Bridges		Arroyo Del Valle widen												0.015
		Arroyo Del Valle Trail												0.004
Total			4.20	4.70	0.44	0.66				0.26	0.00	0.89	0.19	11.36

ABBREVIATIONS
BSA Biological Study Area
ESA Environmental Sensitive Area

URS

ROUTE 84 EXPRESSWAY WIDENING
ALA 84 - PM 22.9/ 27.1
04 - 29760

IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure VI-1
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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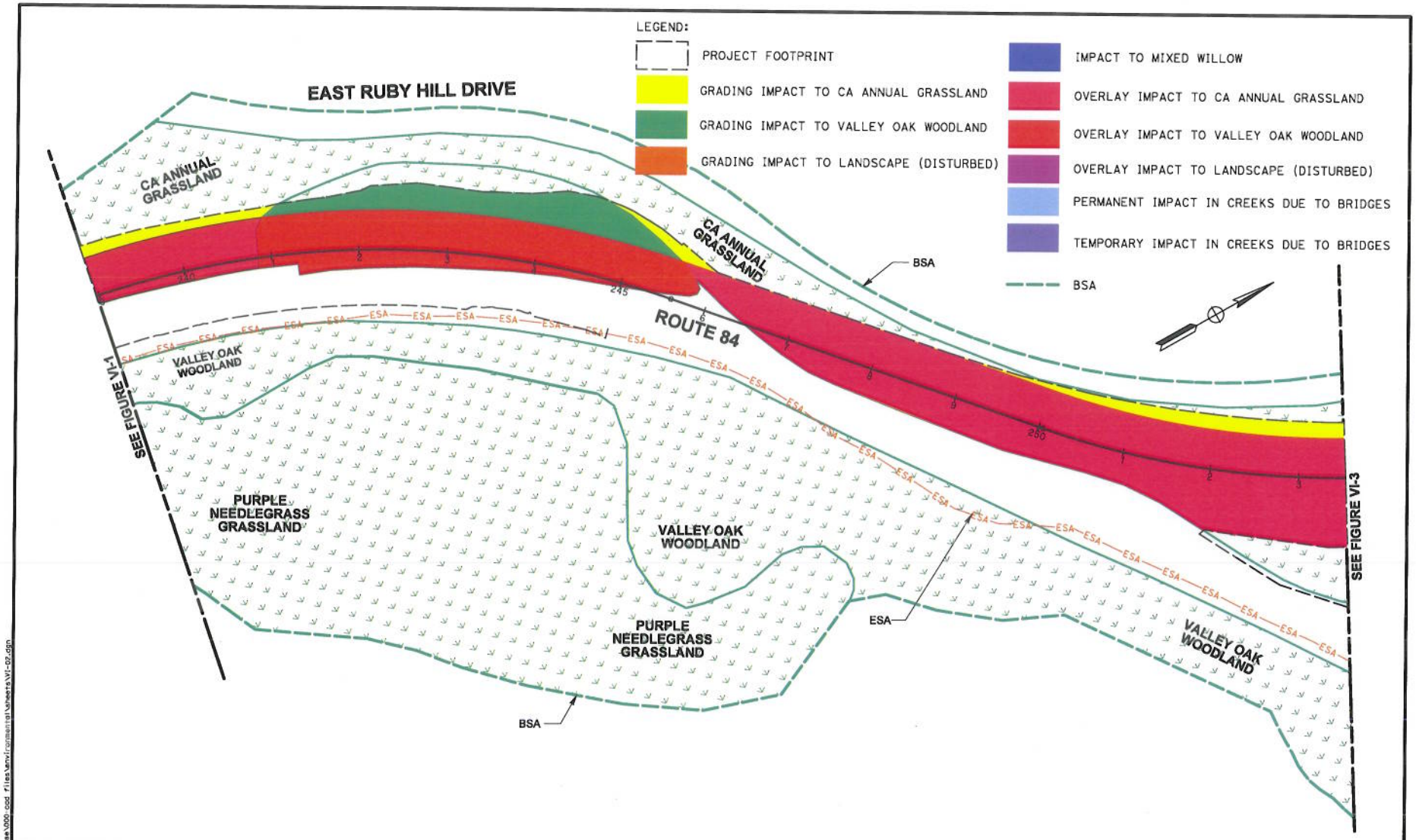

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04 - 297600

IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-2
December 2010

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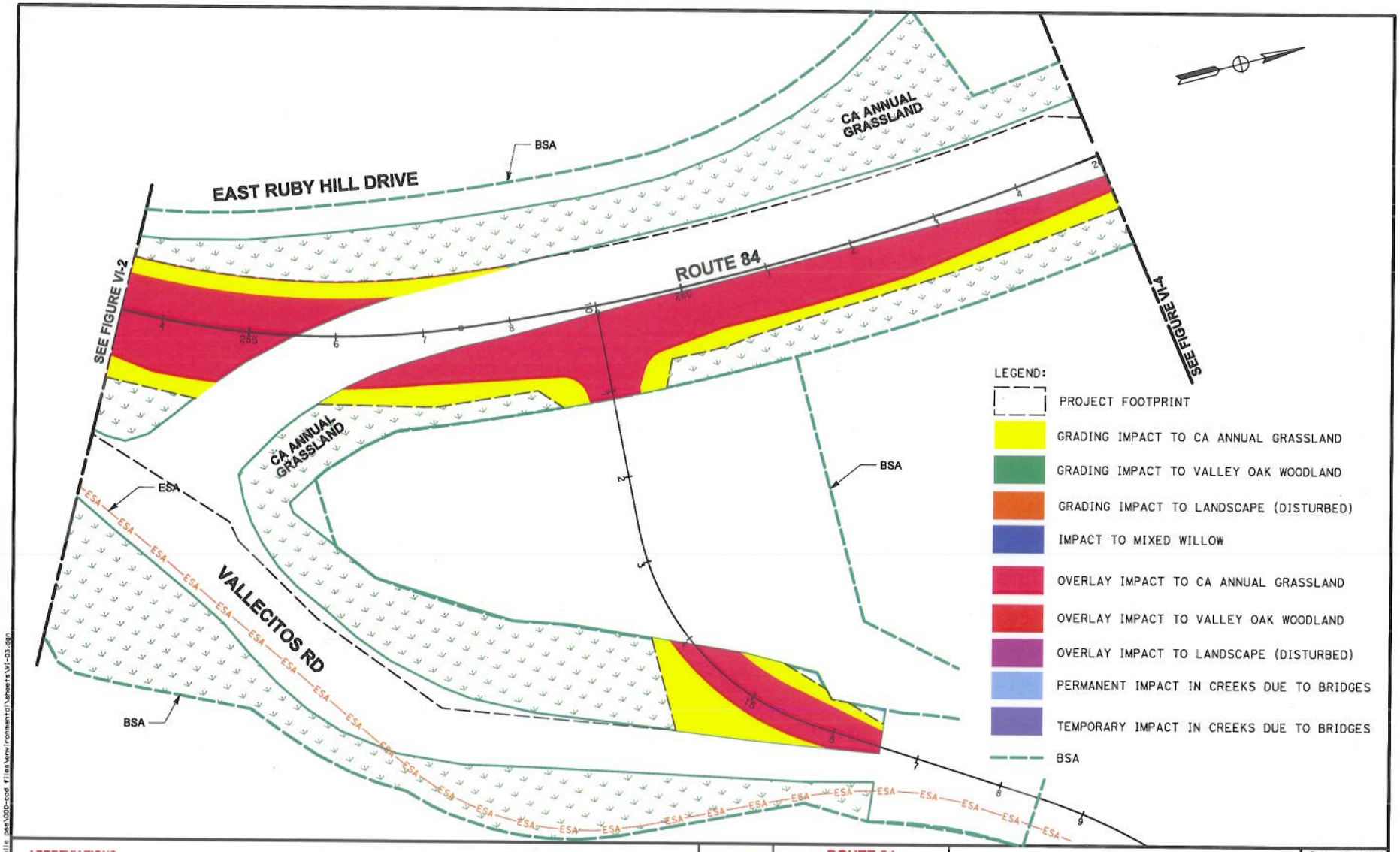

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI - 3
December 2010

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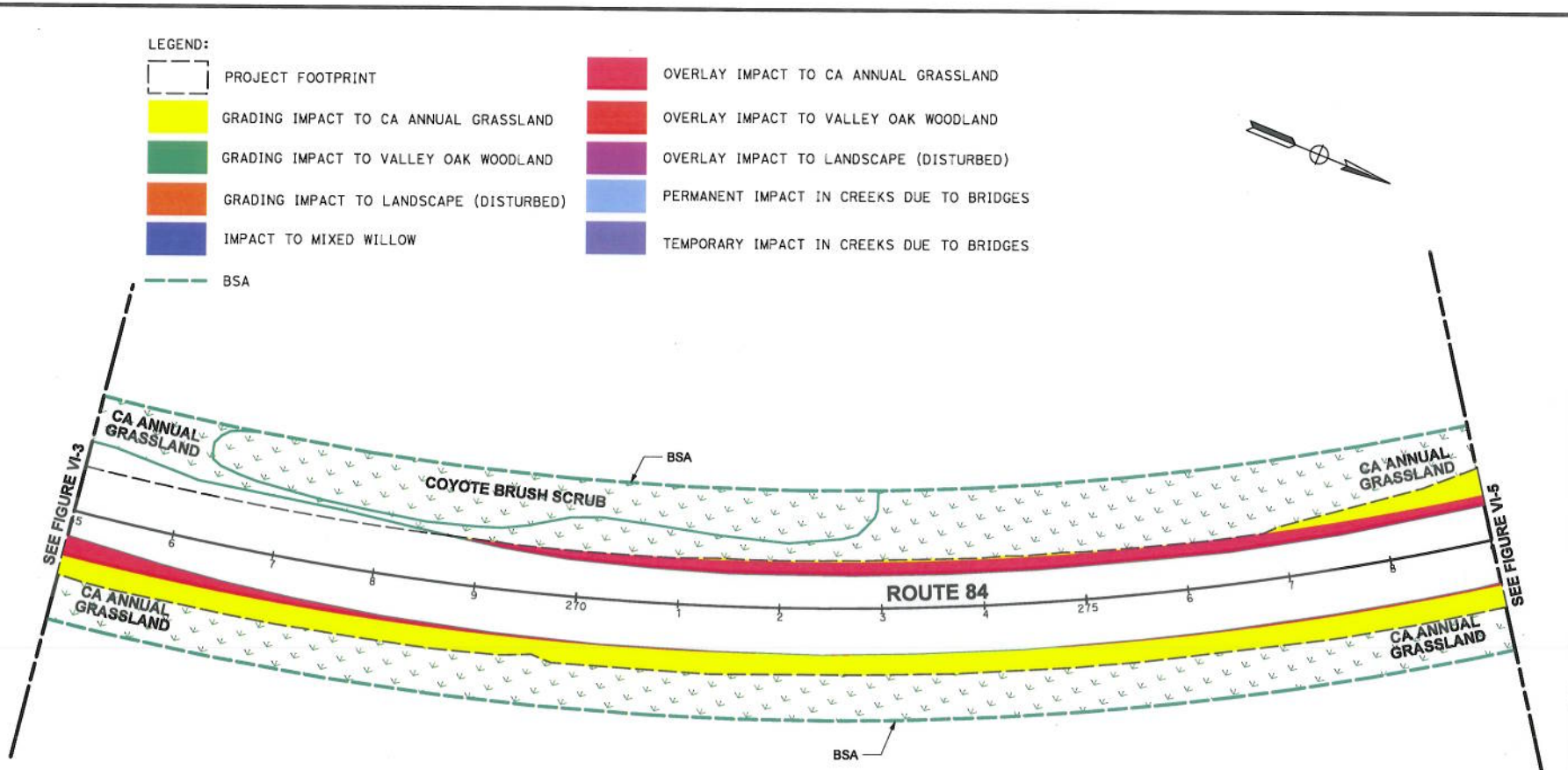

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-4
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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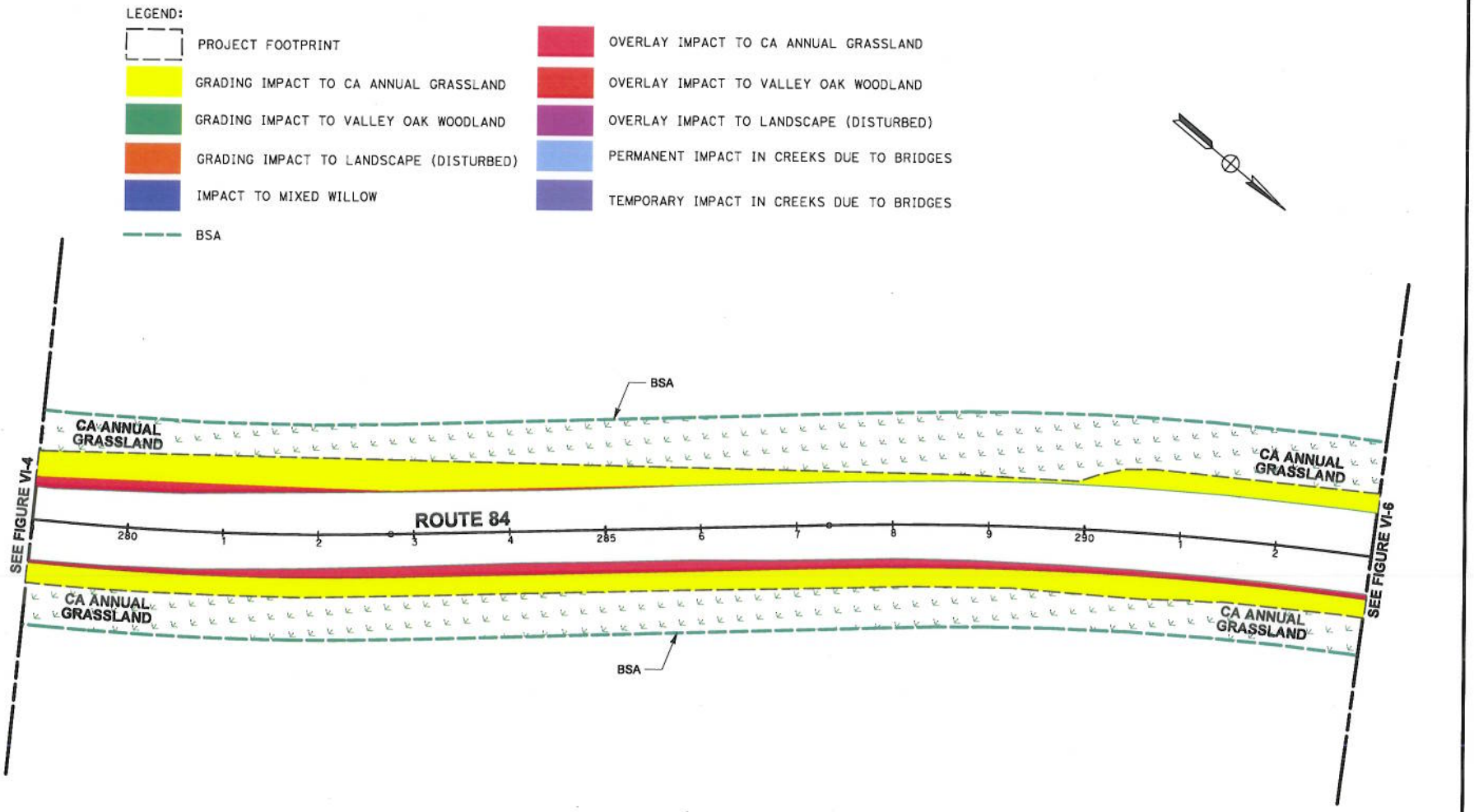

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04 - 29760

IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-5
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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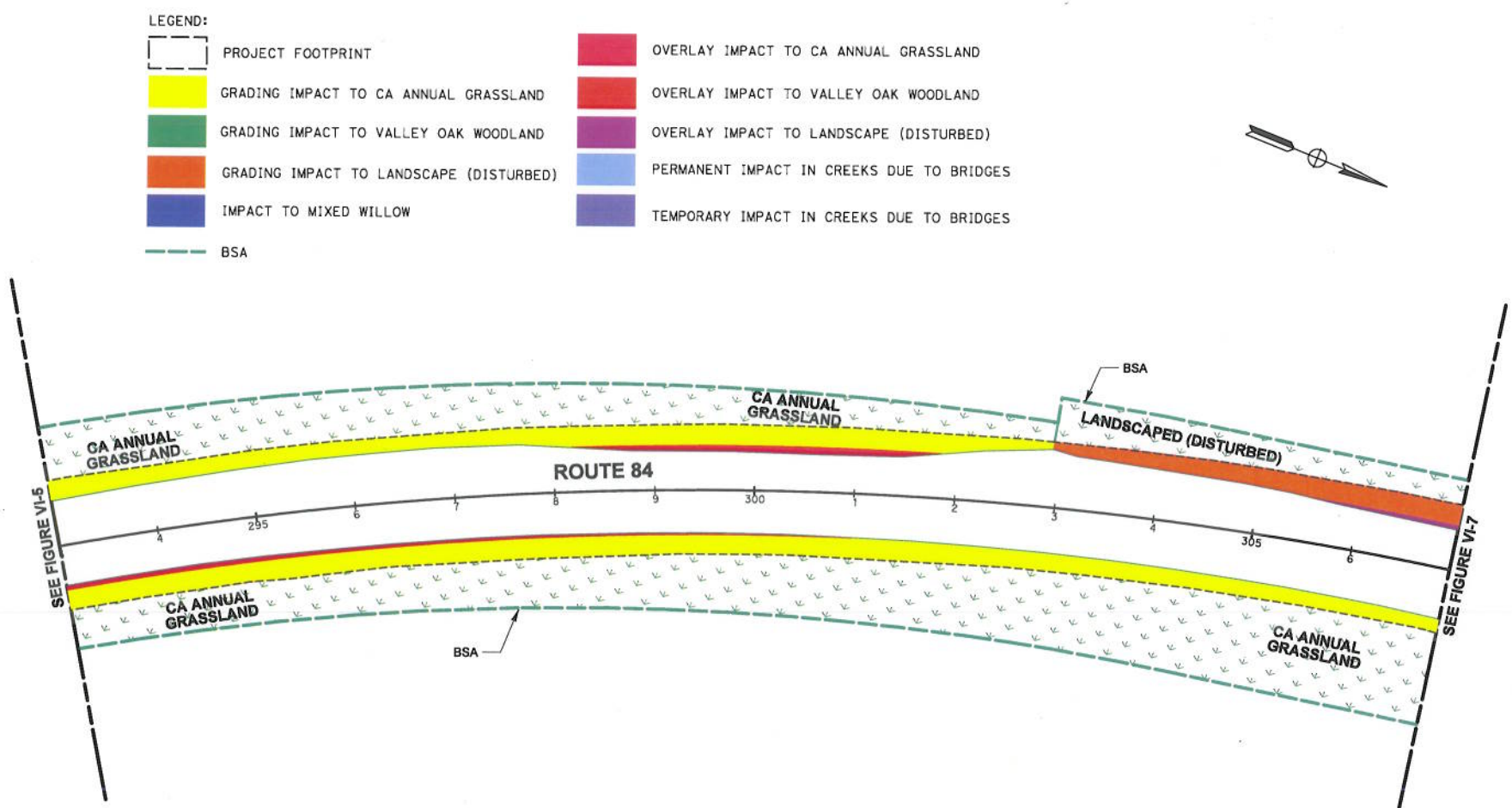

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-6
December 2010

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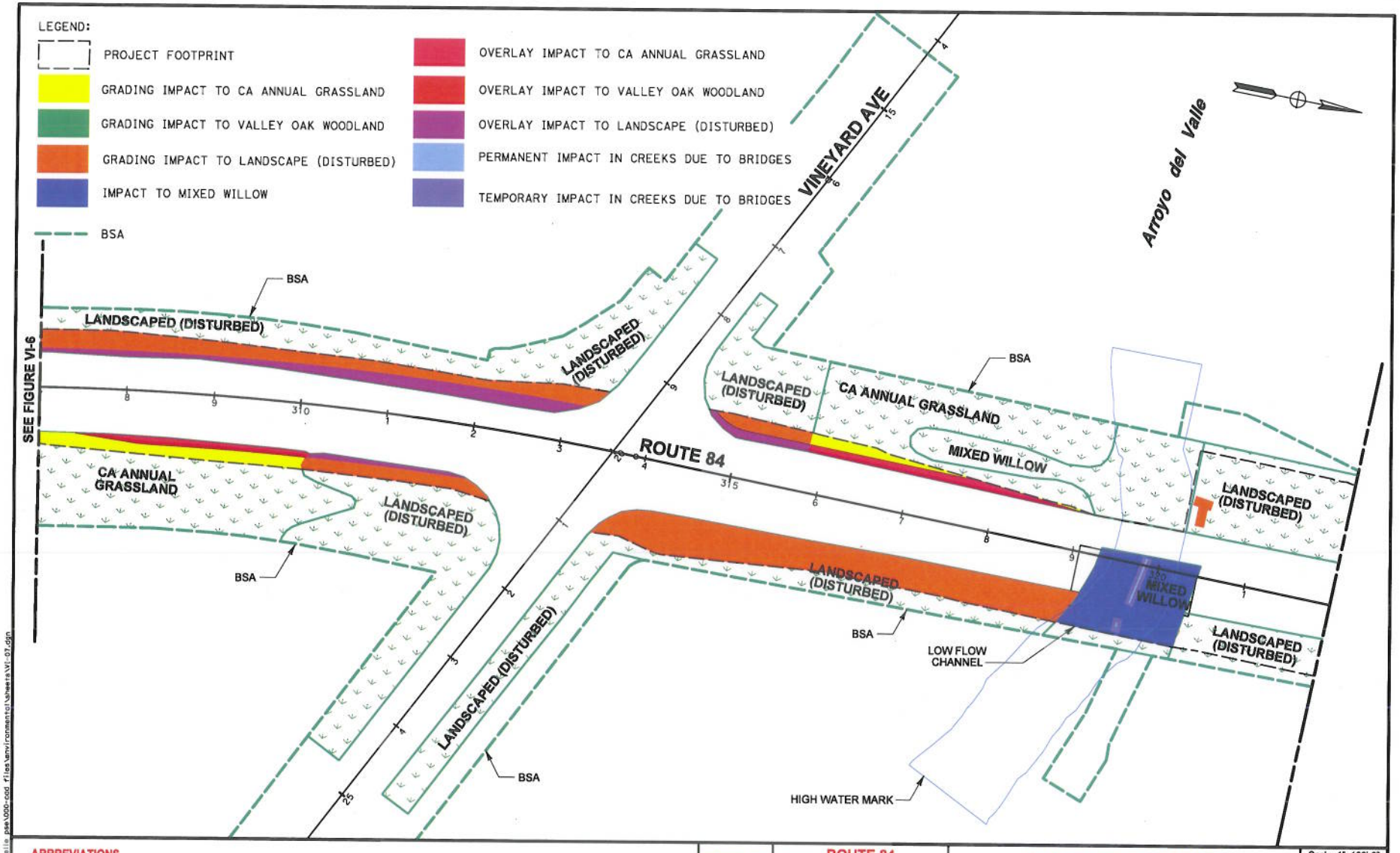

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Scale: 1"=100'-0"
Figure
VI-7
December 2010

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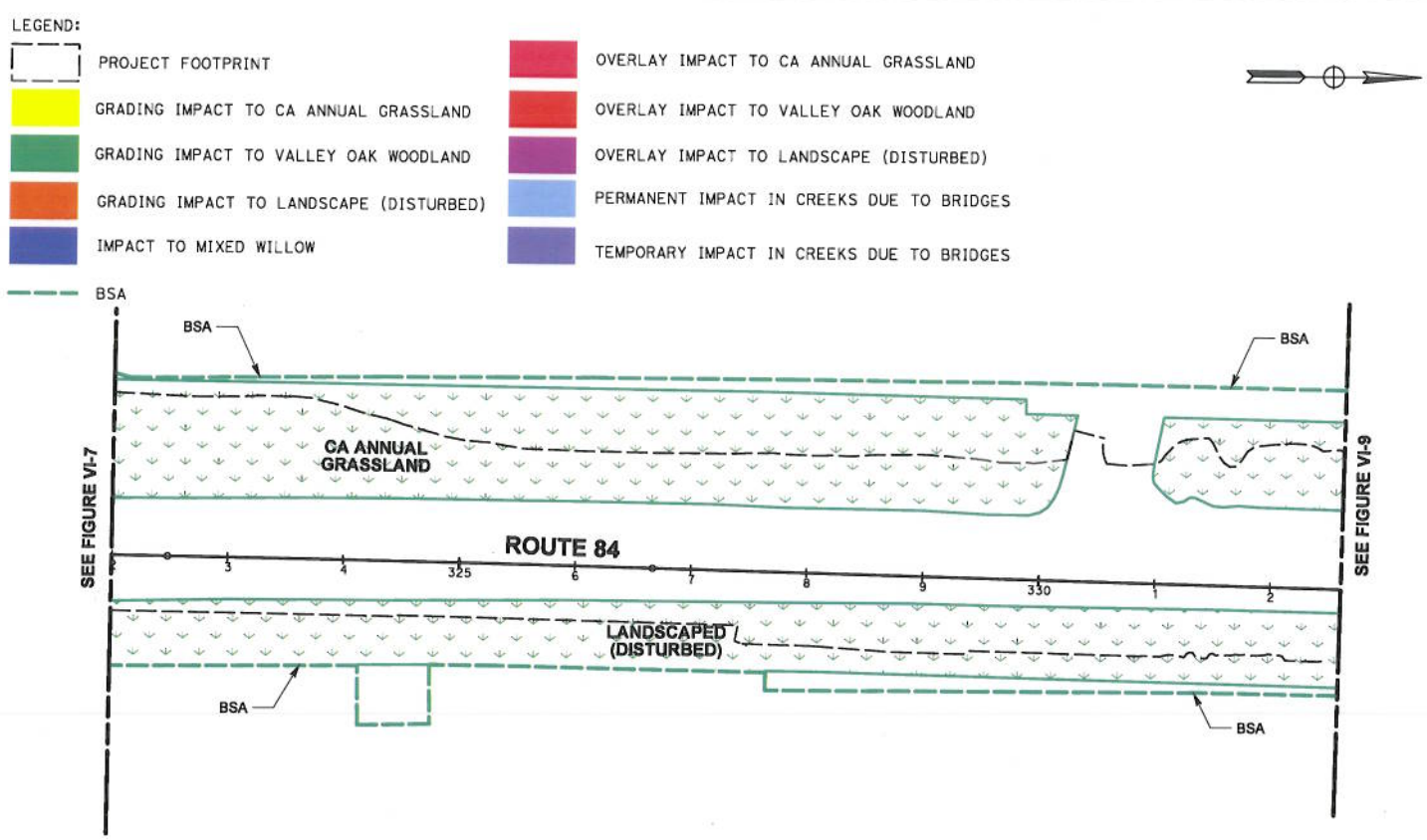

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-8
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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LEGEND:

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- GRADING IMPACT TO CA ANNUAL GRASSLAND
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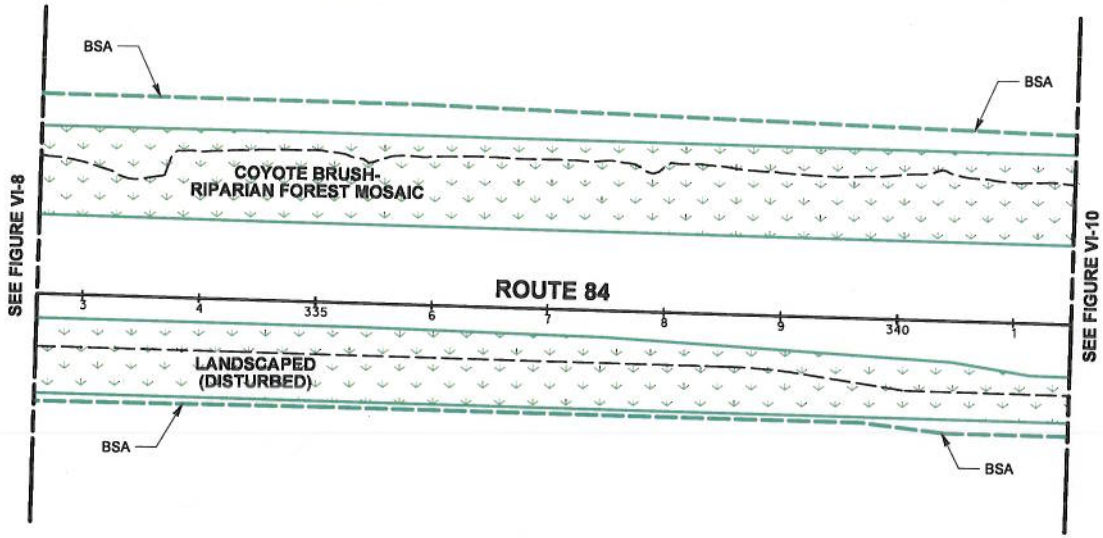

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-9
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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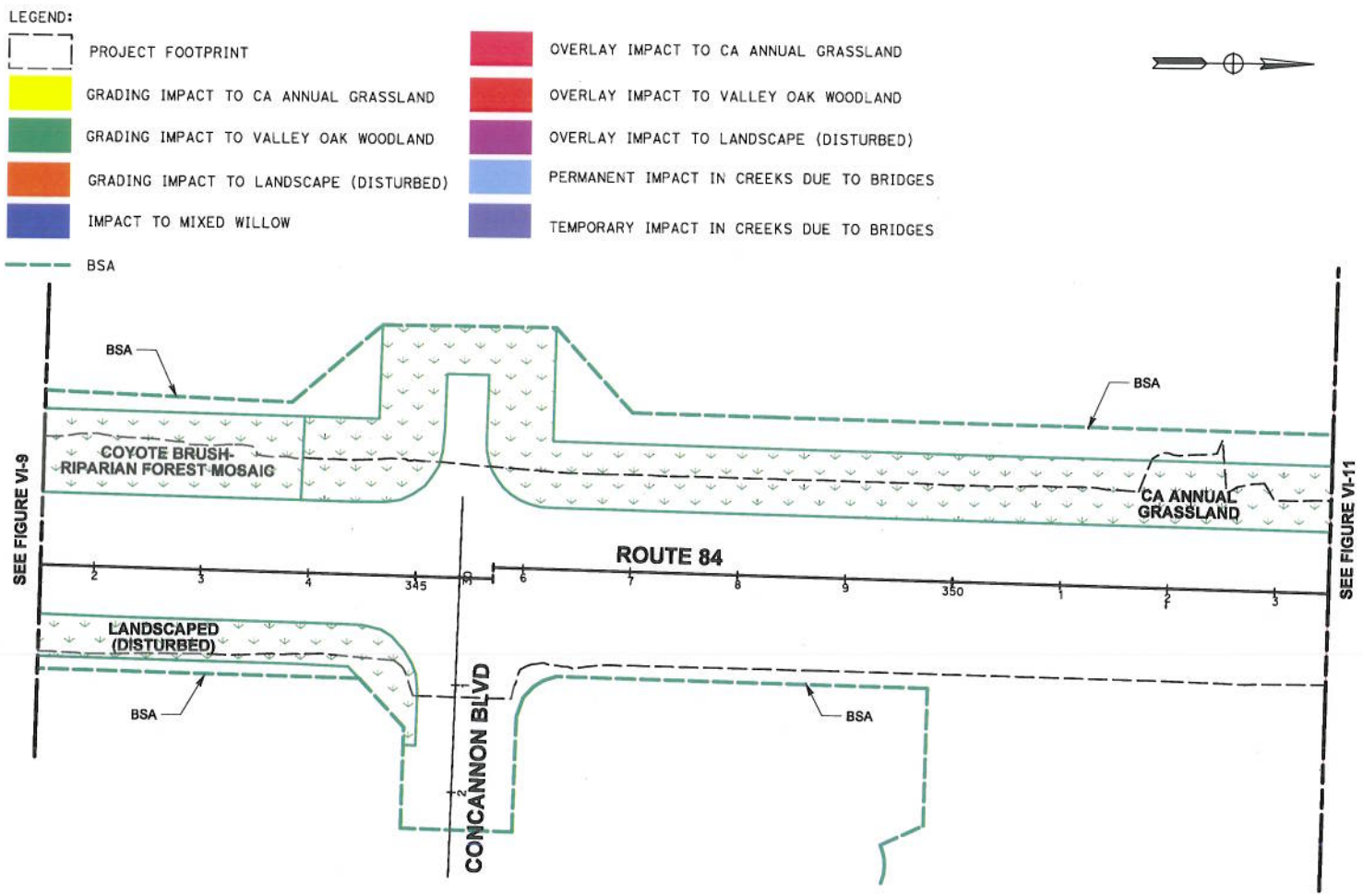

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-10
December 2010

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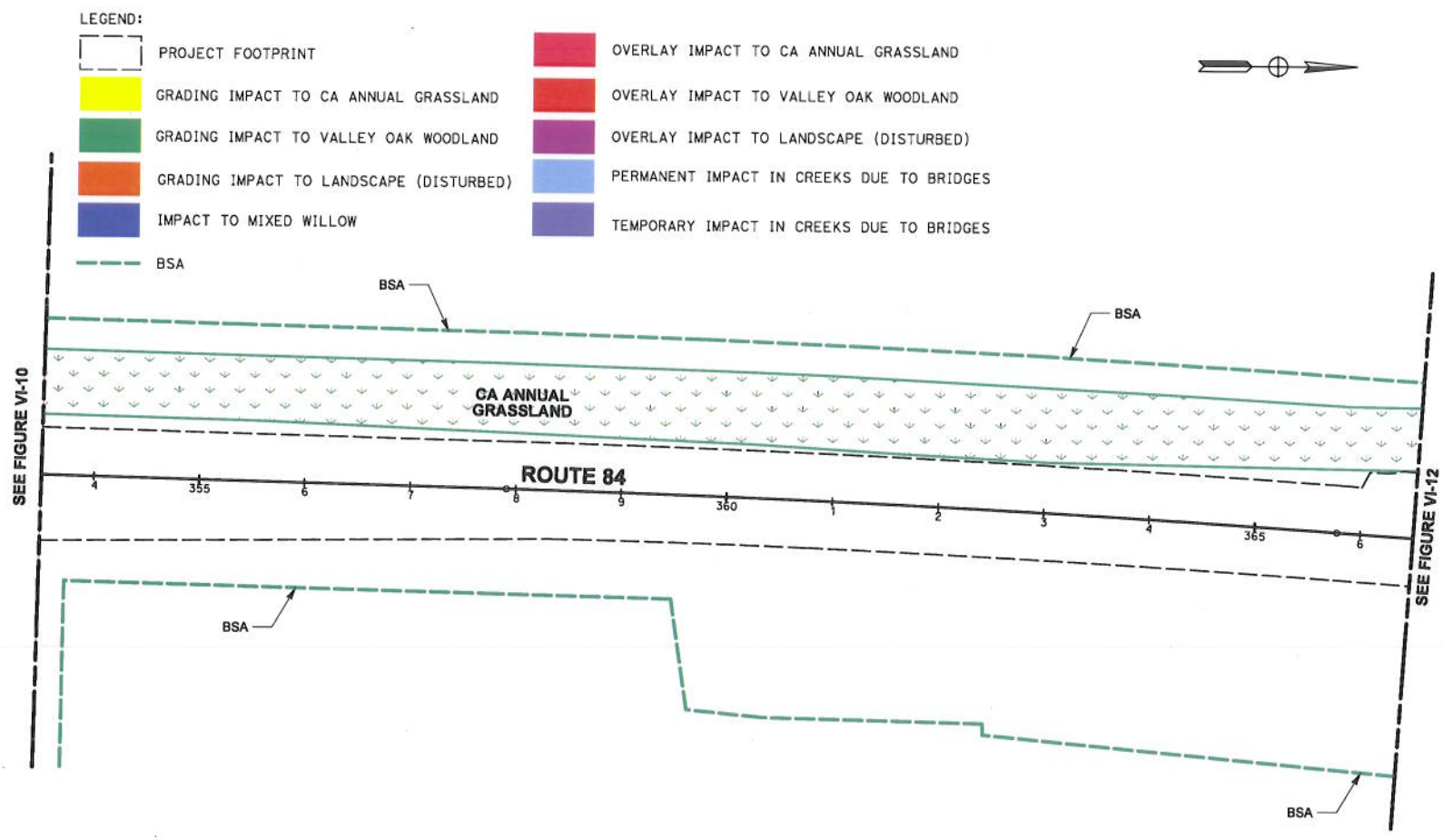

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-11
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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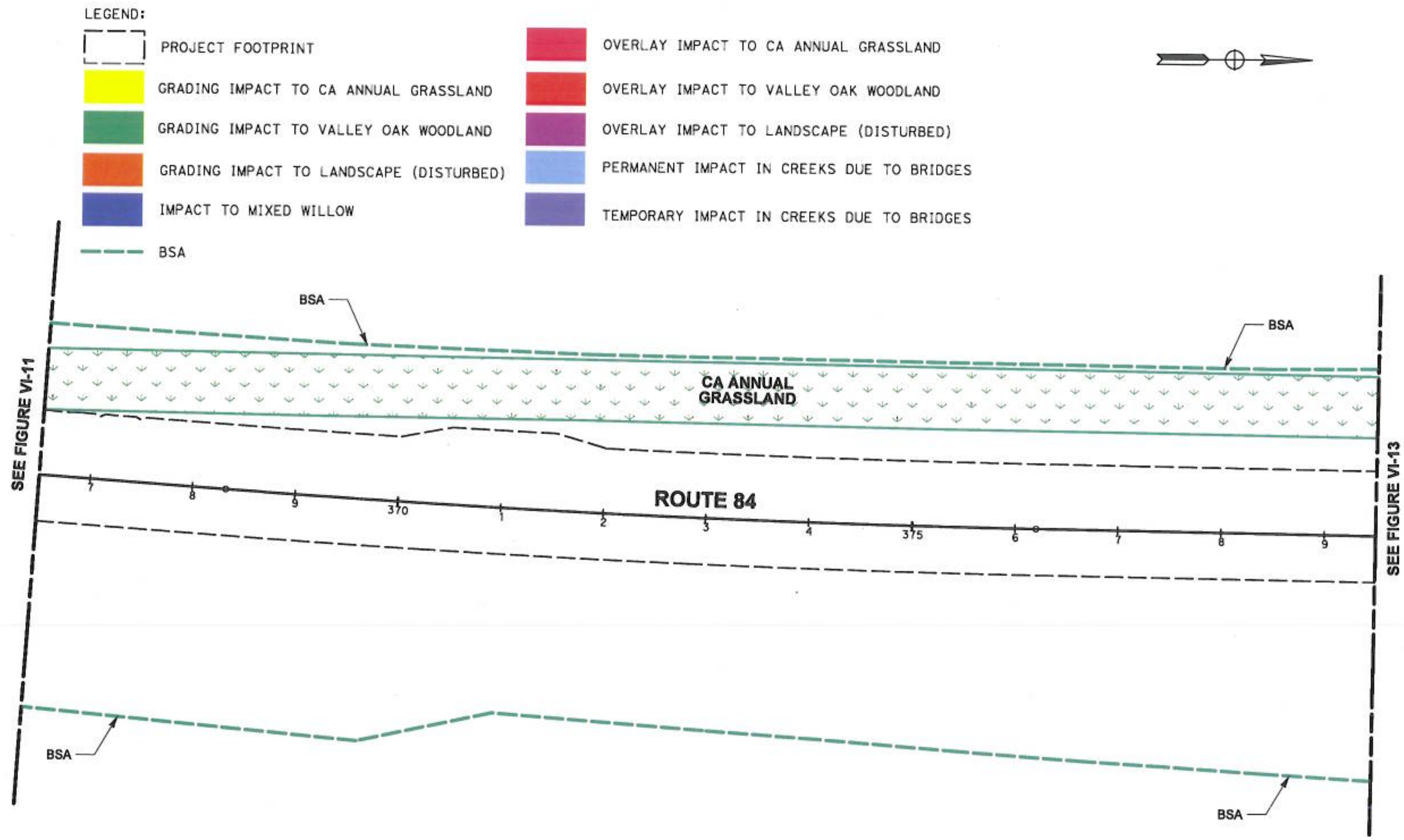

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-12
December 2010

✱ Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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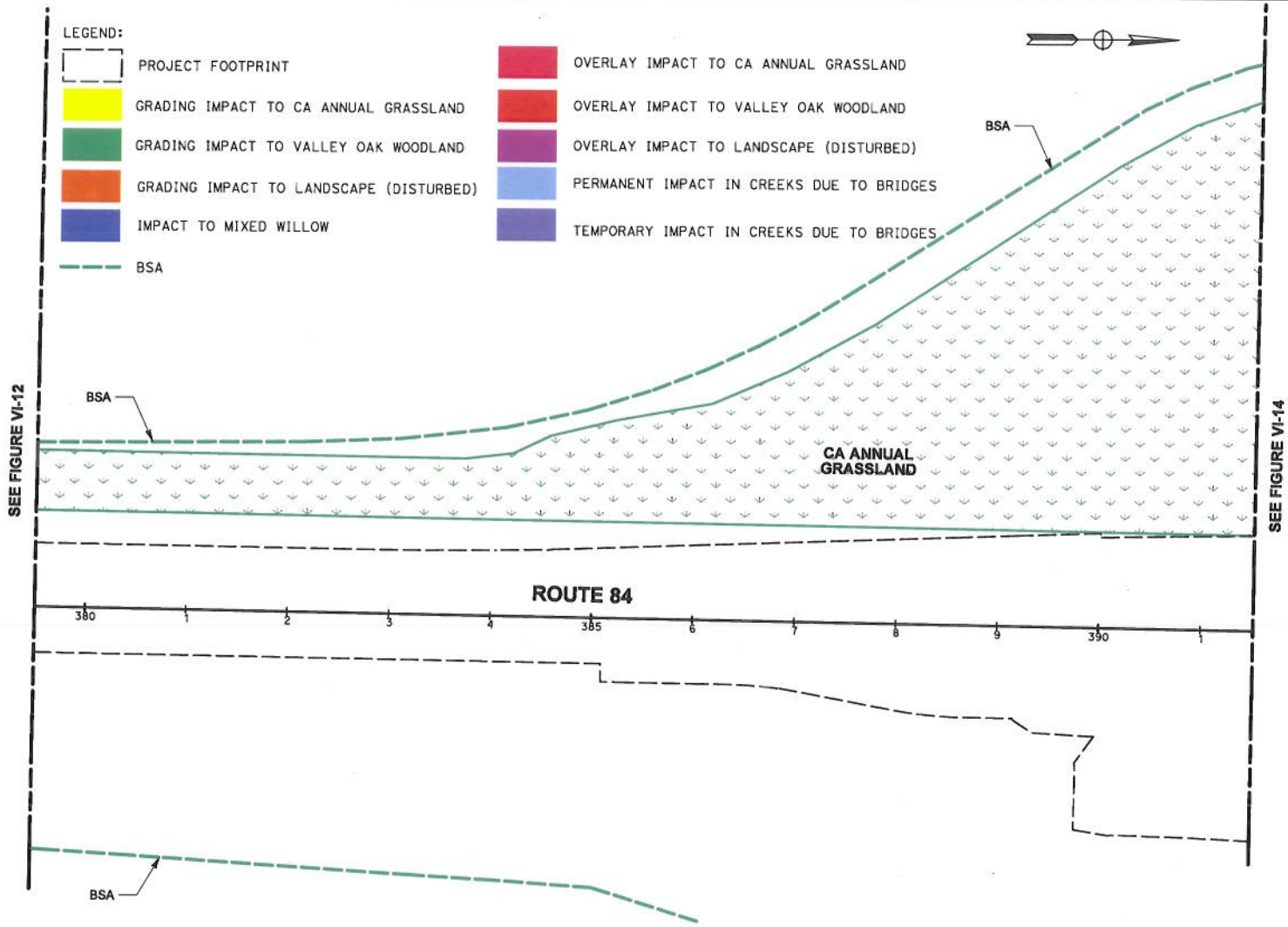

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-13
December 2010

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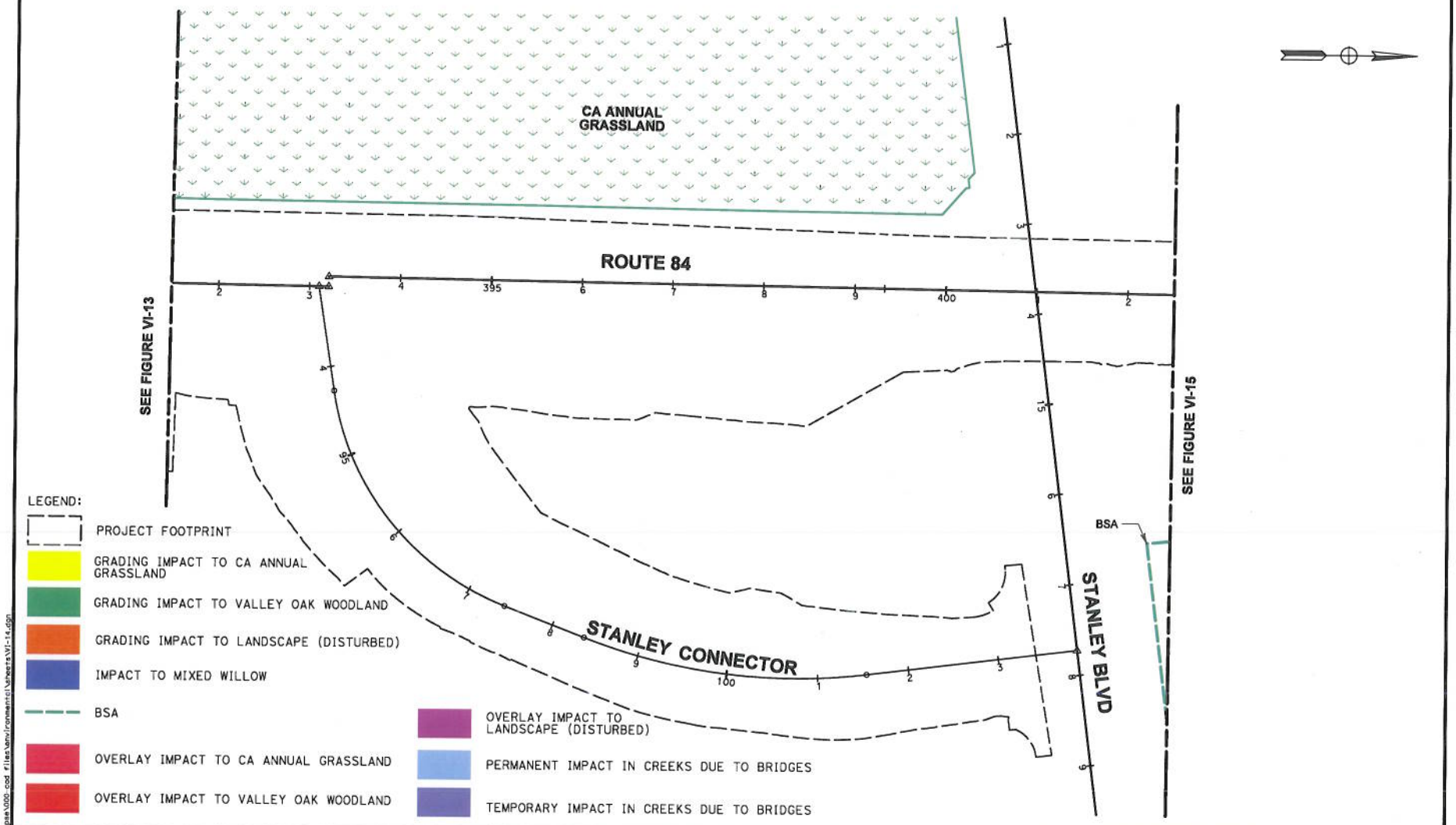

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Scale: 1"=100'-0"
Figure
VI-14
December 2010

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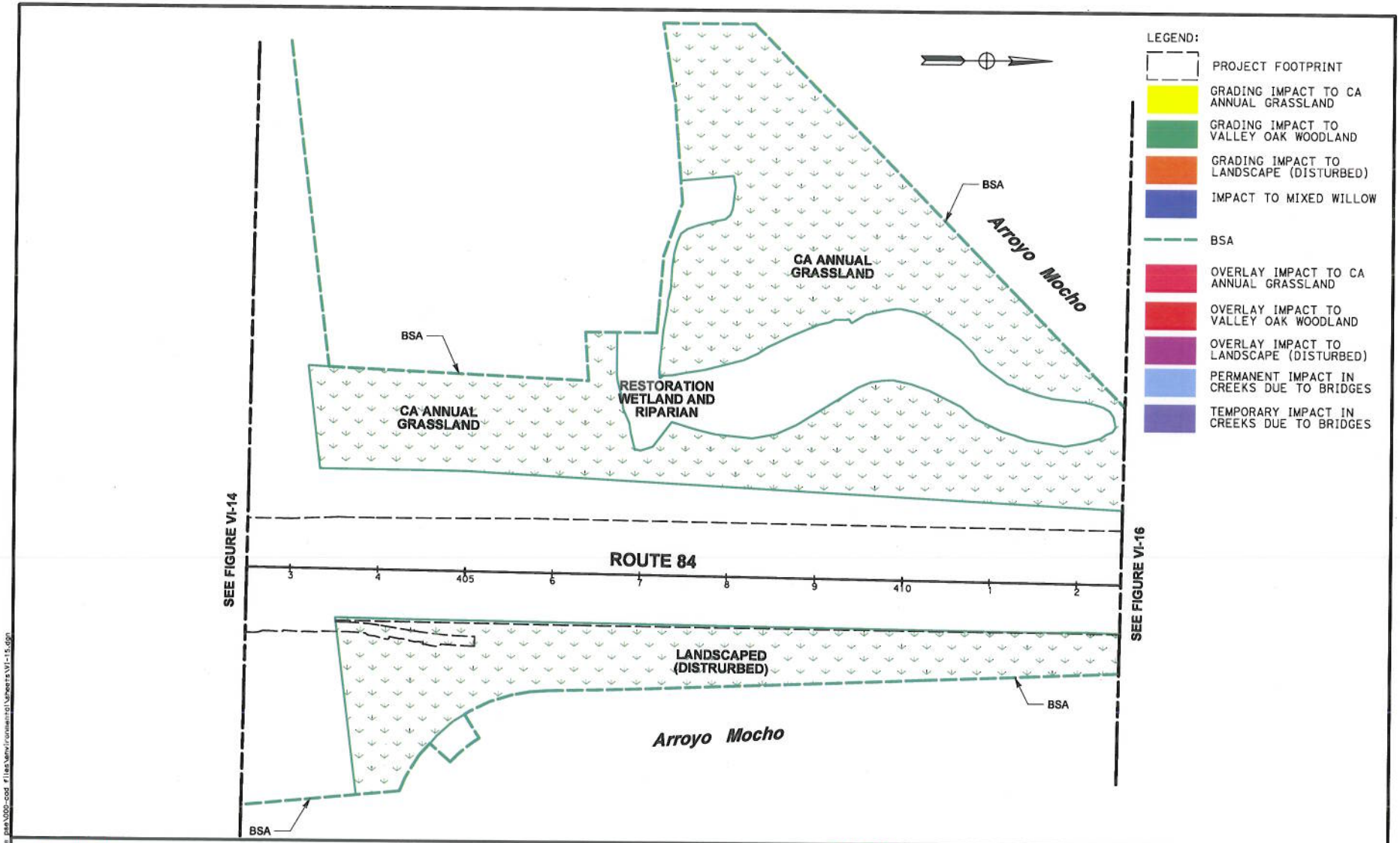

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Scale: 1"=100'-0"
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VI-15
December 2010

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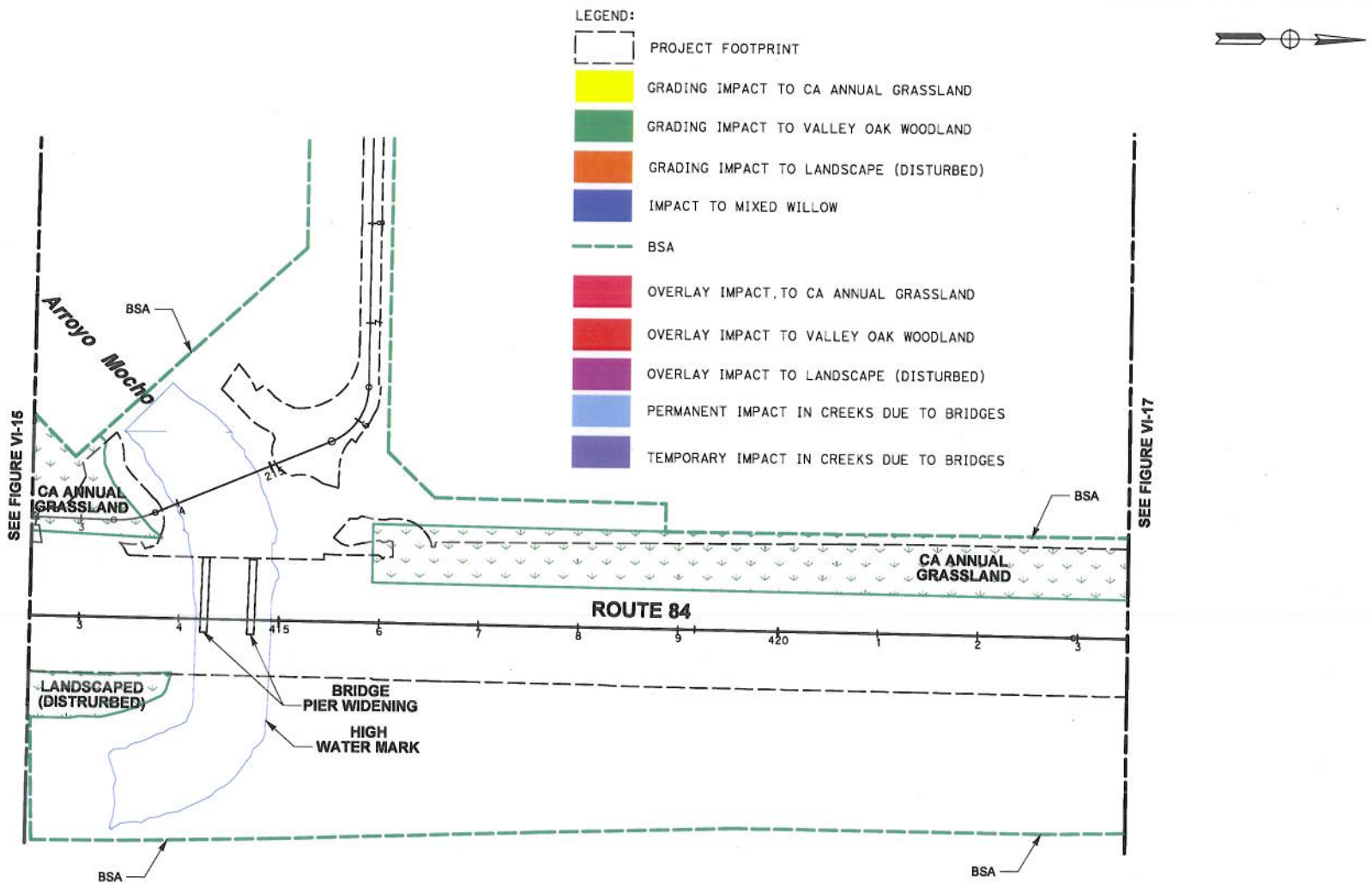

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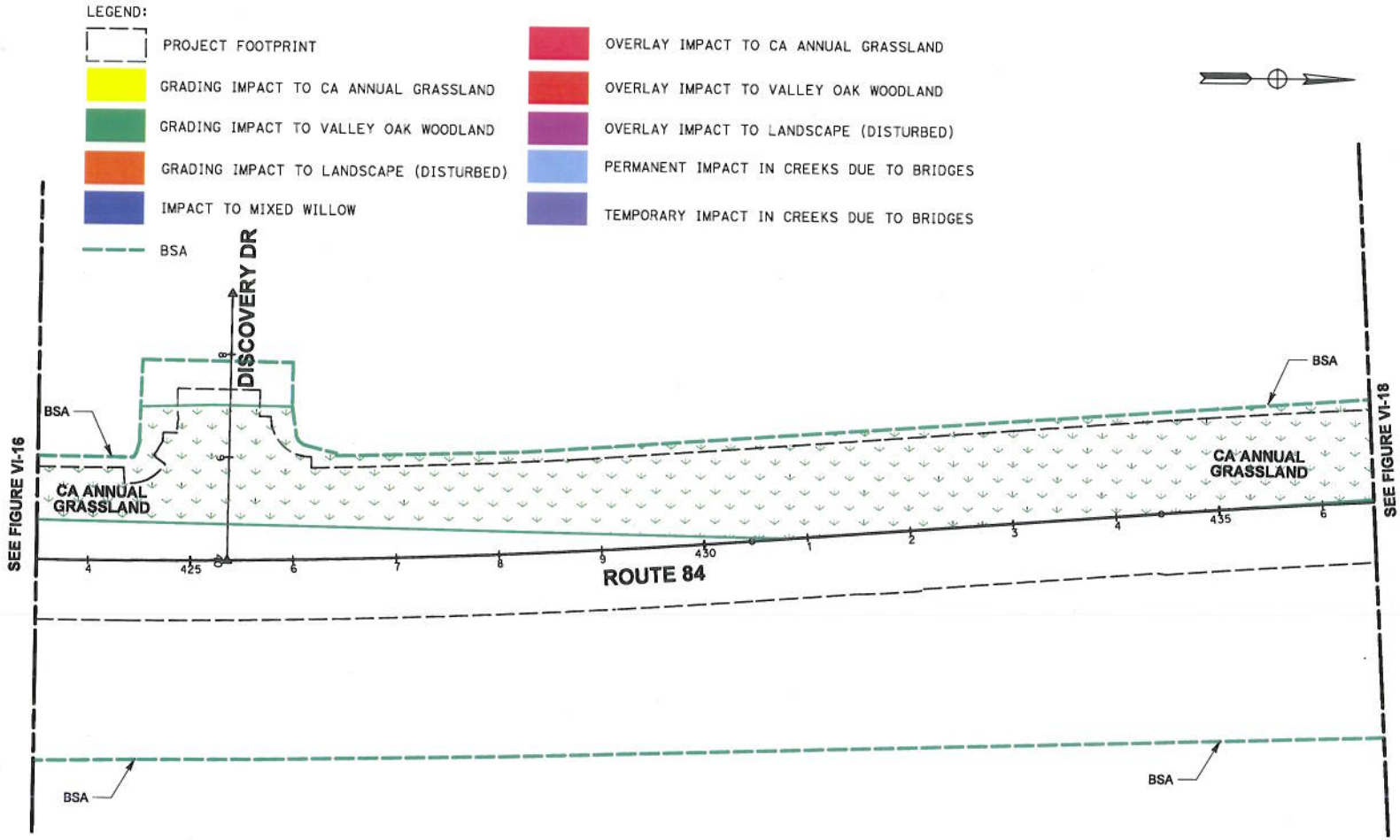
Scale: 1"=100'-0"
Figure
VI-16
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

x:\384-isabella pas\009-cad files\environmental\sheets\VI-16.dgn



ABBREVIATIONS
BSA Biological Study Area
ESA Environmental Sensitive Area

URS

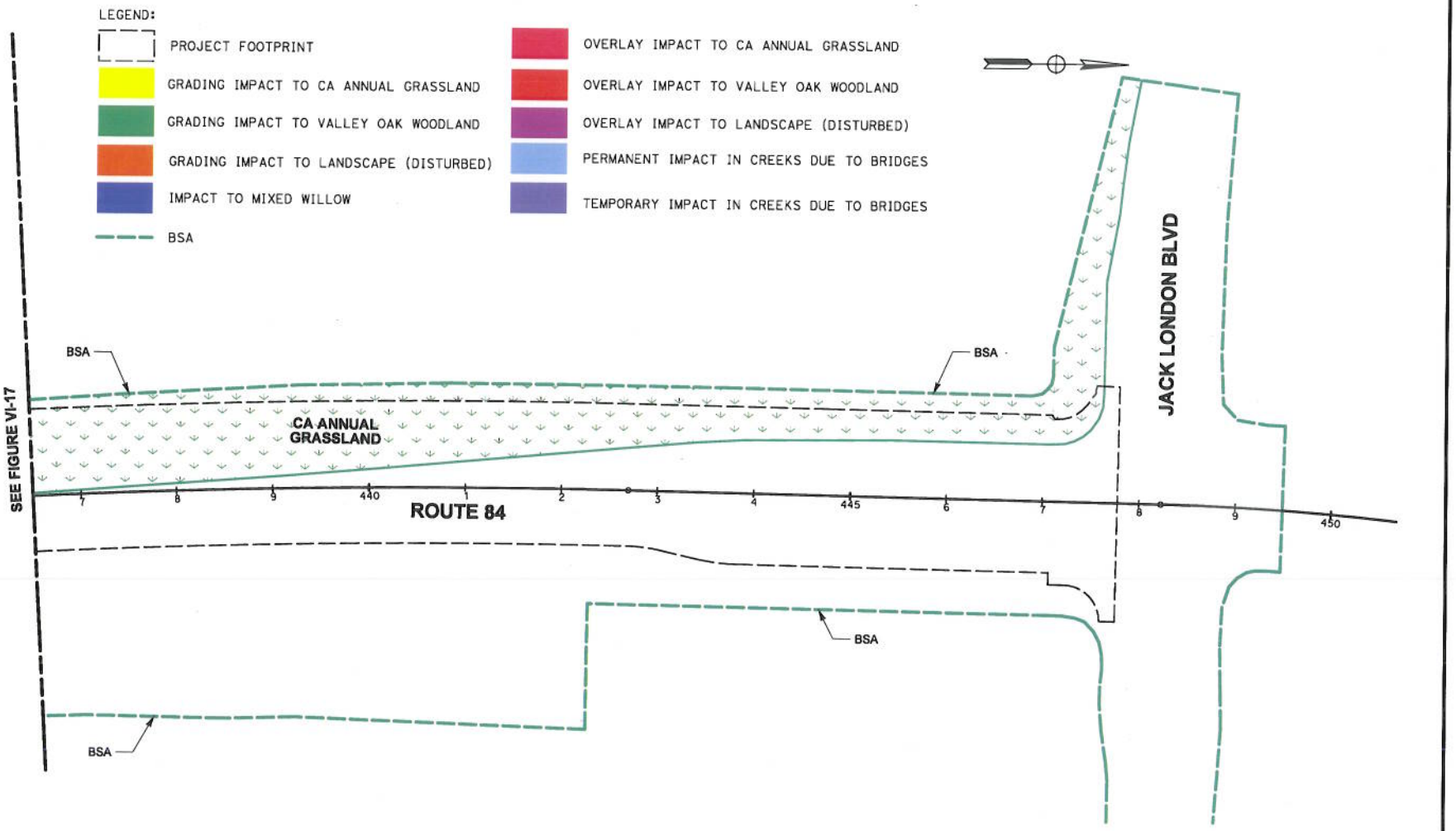
ROUTE 84 EXPRESSWAY WIDENING
ALA 84 - PM 22.9/ 27.1
04 - 29760

IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-17
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

x:\84-isabella_psr\000-cad files\environmental\sheets\VI-17.dgn



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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-18
December 2010

* Upland vegetation types are labeled on the maps and are therefore not listed in the legend.

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Attachment 1

CALIFORNIA DEPARTMENT OF FISH AND GAME
MITIGATION MONITORING AND REPORTING PROGRAM (MMRP)
CALIFORNIA ENDANGERED SPECIES ACT

INCIDENTAL TAKE PERMIT NO. 2081-2011-013-03

PERMITTEE: California Department of Transportation (Caltrans)

PROJECT: State Route 84 Expressway Widening Project

PURPOSE OF THE MMRP

The purpose of the MMRP is to ensure that the impact minimization and mitigation measures required by the Department of Fish and Game (DFG) for the above-referenced Project are properly implemented, and thereby to ensure compliance with section 2081(b) of the Fish and Game Code and section 21081.6 of the Public Resources Code. A table summarizing the mitigation measures required by DFG is attached. This table is a tool for use in monitoring and reporting on implementation of mitigation measures, but the descriptions in the table do not supersede the mitigation measures set forth in the California Incidental Take Permit (ITP) and in attachments to the ITP, and the omission of a permit requirement from the attached table does not relieve the Permittee of the obligation to ensure the requirement is performed.

OBLIGATIONS OF PERMITTEE

Mitigation measures must be implemented within the time periods indicated in the table that appears below. Permittee has the primary responsibility for monitoring compliance of all mitigation measures and for reporting to DFG on the progress in implementing those measures. These monitoring and reporting requirements are set forth in the ITP itself and are summarized at the front of the attached table.

VERIFICATION OF COMPLIANCE, EFFECTIVENESS

DFG may, at its sole discretion, verify compliance with any mitigation measure or independently assess the effectiveness of any mitigation measure.

TABLE OF MITIGATION MEASURES

The following items are identified for each mitigation measure: Mitigation Measure, Source, Implementation Schedule, Responsible Party, and Status/Date/Initials. The Mitigation Measure column summarizes the mitigation requirements of the ITP. The Source column identifies the ITP condition that sets forth the mitigation measure. The Implementation Schedule column shows the date or phase when each mitigation measure will be implemented. The Responsible Party column identifies the person or agency that is primarily responsible for implementing the mitigation measure. The Status/Date/Initials column shall be completed by the Permittee during preparation of each Status Report and the Final Mitigation Report, and must identify the implementation status of each mitigation measure, the date that status was determined, and the initials of the person determining the status.

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
BEFORE DISTURBING SOIL OR VEGETATION					
1	Before starting Covered Activities, Permittee shall designate a representative (Designated Representative) responsible for communications with DFG and overseeing compliance with the ITP. Permittee shall notify DFG in writing before starting Covered Activities of the Designated Representative's name, business address, and contact information, and shall notify DFG in writing if a substitute Designated Representative is selected or identified at any time during the term of the ITP.	ITP Condition # 6.1	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	
2	Permittee shall submit to DFG in writing the name, qualifications, business address, and contact information of one to three biological monitors (Designated Biologist[s]) at least two weeks before starting Covered Activities. Permittee shall ensure that the Designated Biologist(s) are knowledgeable and experienced in the biology and natural history of the Covered Species. The Designated Biologist(s) shall be responsible for monitoring Covered Activities to help minimize and fully mitigate or avoid the incidental take of individual Covered Species and to minimize disturbance of Covered Species' habitat. Permittee shall obtain DFG approval of the Designated Biologist(s) in writing before starting Covered Activities, and shall also obtain approval in advance in writing if the Designated Biologist(s) must be changed.	ITP Condition # 6.2	Before commencing ground- or vegetation-disturbing activities	Permittee	
3	Permittee shall conduct an education program for all persons employed or otherwise working in the Project Area before performing any work. The program shall consist of a presentation from the Designated Biologist(s) that includes a discussion of the biology and general behavior of the Covered Species, information about the distribution and habitat needs of the Covered Species, sensitivity of the Covered Species to human activities, its status pursuant to CESA including legal protection, recovery efforts, penalties for violations and Project-specific protective measures described in the ITP. Permittee shall provide interpretation for non-English speaking workers, and the same instruction shall be provided for any new workers before their performing work in the Project Area. Permittee shall prepare and distribute wallet-sized cards or a fact sheet handout containing this information for workers to carry in the Project Area. Upon completion of the program, employees shall sign a form stating they attended the program and understand all protection measures.	ITP Condition # 6.4	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	
4	Permittee shall initiate a trash abatement program before starting Covered Activities and shall continue the program for the duration of the Project. Permittee shall ensure that trash and food items are contained in closed (animal proof) containers and removed regularly (at least once a week) to avoid attracting opportunistic predators such as ravens, coyotes, and feral dogs.	ITP Condition # 6.6	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	
5	Permittee shall implement dust control measures during Covered Activities to facilitate visibility for monitoring of the Covered Species by the Designated Biologist(s). Permittee shall keep the amount of water used to the minimum amount needed, and shall not allow water to form puddles.	ITP Condition # 6.7	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	
6	Before starting Covered Activities, along each part of the route in active construction, Permittee shall clearly delineate the boundaries of the Project Area with fencing, stakes or flags. Permittee shall restrict all Covered Activities to within the fenced, staked or flagged areas. Permittee shall maintain all fencing, stakes and flags until the completion of Covered Activities in that area.	ITP Condition # 6.10	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	
7	Before starting Covered Activities, along each part of the route in active construction, Permittee shall clearly delineate the boundaries of the Project Area with fencing, stakes or flags. Permittee shall maintain all fencing, stakes and flags until the completion of Covered Activities in that area.	ITP Condition # 6.11	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
8	Permittee shall clearly delineate habitat of the Covered Species within the Project Area with posted signs, posting stakes, flags, and/or rope or cord, and place fencing as necessary to minimize the disturbance of Covered Species' habitat.	ITP Condition # 6.12	Before commencing ground- or vegetation-disturbing activities	Permittee	
9	Permittee shall, at the direction of the Designated Biologist(s), clearly delineate all potential Covered Species habitat with high visibility fencing. Additionally, at the direction of the Designated Biologist(s), Permittee shall in areas of potential upland habitat, install a temporary exclusion barrier consisting of silt fencing or plywood 35 inches high and buried 6 inches deep to prevent Covered Species from entering the construction site. Where construction work will take place adjacent to areas of potential aquatic habitat, and per the direction of the Designated Biologist(s), Permittee shall erect a temporary barrier consisting of ERTEC E-fencing, per manufacturer installation recommendations, immediately outside the high visibility fencing.	ITP Condition # 6.13	Before commencing ground- or vegetation-disturbing activities	Permittee	
10	The Designated Representative shall notify DFG 14 calendar days before starting Covered Activities and shall document compliance with all pre-Project Conditions of Approval before starting Covered Activities.	ITP Condition # 7.1	Before commencing ground- or vegetation-disturbing activities	Permittee	
11	Prior to commencement of work, Permittee shall flag a minimum of one photo point every 1/8 of a mile along the Project alignment. The photo points shall provide comprehensive views of the Covered Activities Area and any Covered Species habitat that would be impacted by the Project. Prior to construction, Permittee shall photograph the Covered Activities Area from each of the flagged points, noting the direction and magnification of each photo. On a monthly basis, Permittee shall photograph construction activities from flagged photo points using the same direction and magnification as pre-construction photos. Labeled copies of photographs taken at each photo point shall be sent to DFG as a component of required monthly compliance reports.	ITP Condition # 7.4	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	
12	The Designated Biologist(s) shall complete walking surveys of the Project Area for California tiger salamanders prior to initiating Covered Activities and shall follow earthmoving equipment to look for California tiger salamanders. If a California tiger salamander is discovered by the Designated Biologist(s) or anyone else, the Designated Biologist(s) shall move the animal to a safe nearby location (e.g. mouth of ground-squirrel burrow outside of the construction area) and monitor it until it is determined that it is not imperiled by predators or other dangers.	ITP Condition # 8.5	Before commencing ground- or vegetation-disturbing activities/ Entire Project	Permittee	
13	DFG has determined that permanent protection and perpetual management of compensatory habitat is necessary and required pursuant to CESA to fully mitigate Project-related impacts of the taking on the Covered Species that will result with implementation of the Covered Activities. This determination is based on factors including an assessment of the importance of the habitat in the Project Area, the extent to which the Covered Activities will impact the habitat, and DFG's estimate of the acreage required to provide for adequate compensation. To meet this requirement, the Permittee shall provide for the permanent protection and management of 34.08 acres of Habitat Management (HM) lands by completing the transfer of fee title to a DFG-approved public agency or the recordation of a conservation easement pursuant to Civil Code 815 et seq., and calculation and deposit of the management funds. Permanent protection and perpetual management of compensatory habitat must be complete before starting Covered Activities or within 18 months of the effective date of the ITP if Security is provided.	ITP Condition #9	Before commencing ground- or vegetation-disturbing activities (or within 18 months of issuance of the ITP if Security is provided)	Permittee	

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
14	To provide for the acquisition and protection of the HM lands, the Permittee shall: • Transfer fee title to the HM lands to DFG pursuant to terms approved by DFG. Alternatively, a DFG-approved non-profit organization qualified pursuant to California Government Code section 65965 or DFG-approved public agency (collectively "approved entity") may hold fee title or act as grantee for a conservation easement over the HM lands. If an approved entity holds fee title, Permittee shall record a conservation easement in favor of DFG or a DFG-approved entity as grantee. If an approved entity holds a conservation easement, DFG shall be named third-party beneficiary. The Permittee shall obtain DFG approval of any conservation easement before its recordation; • Obtain DFG approval of the HM lands before acquisition and/or transfer of the land by submitting, at least three months before acquisition and/or transfer of the HM lands, a formal Proposed Lands for Acquisition Form identifying the land to be purchased or property interest conveyed to an approved entity as mitigation for the Project's impacts on Covered Species; • Provide a recent preliminary title report, initial hazardous materials survey report, and other necessary documents identified on a Habitat Management Lands Checklist. All documents conveying the HM lands and all conditions of title are subject to the approval of DFG, and if applicable, the Wildlife Conservation Board and the Department of General Services; • Designate an interim and long-term land manager. Permittee may select the conservation easement grantee, land owner, or other party as the land manager. Documents related to land management shall identify the land manager. Permittee shall notify DFG of any subsequent changes in the land manager within 30 days of the change. If DFG will hold fee title to the mitigation land, DFG will also act as long-term land manager unless otherwise specified; • Provide for the implementation of start-up activities, including the initial site protection and enhancement of HM lands, once the HM lands have been approved by DFG. Start-up activities include, at a minimum: (1) preparing a final management plan for DFG approval (see http://www.dfg.ca.gov/habcon/conplan/mitbank/); (2) conducting a baseline biological assessment and land survey report within 4 months of recording or transfer; (3) developing and transferring Geographic Information Systems (GIS) data if applicable; (4) establishing initial fencing; (5) conducting litter removal; (6) conducting initial habitat restoration or enhancement, if applicable; and (7) installing signage; • Provide for the interim management of the HM lands. The interim management period shall be a minimum of 3 years from the date of HM land acquisition and protection and full funding of the Endowment and includes expected annual management (described in the final management plan) following start-up activities. Interim management period activities include fence repair, continuing trash removal, site monitoring, and vegetation management. Permittee shall either (1) provide a security for the 3-year interim management amount that the land owner, Permittee, or land manager agrees to manage at their own expense, (2) establish an escrow account with instructions to pay the land manager annually in advance, (3) establish a short-term enhancement sub-account with the National Fish and Wildlife Foundation (NFWF) for annual payment to the land manager, or (4) establish a short-term enhancement account with DFG for annual payment to the land manager.	ITP Condition # 9.2	Before commencing ground- or vegetation-disturbing activities (or within 18 months of issuance of the ITP if Security is provided)	Permittee	

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
15	After obtaining DFG approval of the HM lands, Permittee shall provide long-term management funding for the in-perpetuity management of the HM lands by establishing a long-term management fund (Endowment Fund). The Endowment Fund is a sum of money, held in a DFG-authorized trust fund that provides funds for the perpetual management, maintenance, monitoring, and other activities on the HM lands consistent with the management plan(s) required by Condition 9.2.5. "Endowment Fund" as used in the ITP shall refer to the endowment deposit and all interest, dividends, other earnings, additions and appreciation thereon. • The Endowment Fund shall be held by NFWF or DFG; • After obtaining DFG approval of the HM lands, long-term management plan, and Endowment Fund Manager, Permittee shall prepare a Property Analysis Record (PAR) to calculate the amount of funding necessary to ensure the long-term management of the HM lands (Endowment Deposit Amount). The Permittee shall submit to DFG for review and approval the results of the PAR before transferring funds to the Endowment Fund Manager. • Permittee shall obtain the capitalization rate from the selected Endowment Fund Manager for use in calculating the PAR and adjust for any additional administrative, periodic, or annual fees. • Permittee shall include in PAR assumptions the following buffers for endowment establishment and use that will substantially ensure long-term viability and security of the Endowment Fund: – A 10 percent contingency shall be added to each endowment calculation to hedge against underestimation of the fund, unanticipated expenditures, inflation, or catastrophic events. – The endowment shall be established assuming spending will not occur for the first three years after full funding. – For all large capital expenses to occur periodically but not annually such as fence replacement or well replacement, payments shall be withheld from the annual disbursement until the year of anticipated need or upon request to Endowment Fund Manager and DFG. • Permittee shall transfer the long-term endowment funds to the Endowment Fund Manager upon DFG approval of the Endowment Deposit Amount identified above. The approved Endowment Fund Manager may pool the Endowment Fund with other endowments for the operation, management, and protection of HM lands for local populations of the Covered Species but shall maintain separate accounting for each Endowment Fund.	ITP Condition # 9.3	Before commencing ground- or vegetation-disturbing activities (or within 18 months of issuance of the ITP if Security is provided)	Permittee	
16	Permittee shall reimburse DFG for all reasonable expenses incurred by DFG such as transaction fees, account set-up fees, administrative fees, title and documentation review and related title transactions, expenses incurred from other state agency reviews, and overhead related to transfer of HM Lands to DFG.	ITP Condition # 9.4	Before commencing ground- or vegetation-disturbing activities (or within 18 months of issuance of the ITP if Security is provided)	Permittee	

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
17	The Permittee may proceed with Covered Activities only after the Permittee has ensured funding (Security) to complete any activity required by Condition 9 that has not been completed before Covered Activities begin. Permittee shall provide Security as follows: • The Security shall be in the amount of $1,229,195. This amount is based on the cost estimates identified in Condition 9.1 above; • Permittee may proceed with ground- or vegetation-disturbing activities before completing all of the required mitigation (including acquisition of HM Lands), monitoring, and reporting activities only if Permittee ensures funding to complete those activities by providing to DFG prior to commencing ground- or vegetation disturbing activities, a funding assurance letter stating that sufficient funds to fully mitigate impacts (Security) have been budgeted in the Interstate State Route 84 Widening Project Expenditure Authorization. The funding assurance letter shall be signed by the District Deputy Director of Project Management and the District Deputy Director of Environmental and approved by DFG's Office of the General Counsel. The Security shall appropriate sufficient funds to implement the ITP's mitigation, monitoring and reporting requirements, including land acquisition costs, costs of enhancing HM Lands, and an endowment. • The Security shall be provided to DFG before Covered Activities begin or within 30 days after the effective date of the ITP, whichever occurs first; • The Security shall be held by DFG or in a manner approved in advance in writing by DFG. Even if Security is provided, the Permittee must complete the required acquisition, protection and transfer of all HM lands and record any required conservation easements no later than 18 months from the effective date of the ITP. DFG may require the Permittee to provide additional HM lands and/or additional funding to ensure the impacts of the taking are minimized and fully mitigated, as required by law, if the Permittee does not complete these requirements within the specified timeframe.	ITP Condition # 10	Before commencing ground- or vegetation-disturbing activities	Permittee	
DURING CONSTRUCTION					
18	The Designated Biologist(s) shall maintain a construction-monitoring notebook on-site throughout the construction period which shall include a copy of the ITP with attachments and a list of signatures of all personnel who have successfully completed the education program. Permittee shall ensure a copy of the construction-monitoring notebook is available for review at the Project site upon request by DFG.	ITP Condition # 6.5	Entire Project	Permittee	
19	Permittee shall prohibit use of erosion control materials potentially harmful to Covered Species and other species, such as mono-filament netting (erosion control matting) or similar material, in potential Covered Species' habitat.	ITP Condition # 6.8	Entire Project	Permittee	
20	Permittee shall prohibit firearms and domestic dogs from the Project Area and site access routes during Covered Activities, except those in the possession of authorized security personnel or local, State, or federal law enforcement officials.	ITP Condition # 6.9	Entire Project	Permittee	
21	Permittee shall confine all Project-related parking, storage areas, laydown sites, equipment storage, and any other surface-disturbing activities to the Covered Activities Area using, to the extent possible, previously disturbed areas. Additionally, Permittee shall not use or cross Covered Species' habitat outside of the marked Covered Activities Area.	ITP Condition # 6.14	Entire Project	Permittee	

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
22	Permittee shall immediately stop and following pertinent state and federal statutes and regulations arrange for repair and clean up by qualified individuals of any fuel or hazardous waste leaks or spills at the time of occurrence, or as soon as it is safe to do so. Permittee shall exclude the storage and handling of hazardous materials from the Project Area and shall properly contain and dispose of any unused or leftover hazardous products off-site.	ITP Condition # 6.15	Entire Project	Permittee	
23	Permittee shall provide DFG staff with reasonable access to the Project and mitigation lands under Permittee control, and shall otherwise fully cooperate with DFG efforts to verify compliance with or effectiveness of mitigation measures set forth in the ITP.	ITP Condition # 6.16	Entire Project	Permittee	
24	The Designated Representative shall immediately notify DFG in writing if it determines that the Permittee is not in compliance with any Condition of Approval of the ITP, including but not limited to any actual or anticipated failure to implement measures within the time periods indicated in the ITP. The Designated Representative shall report any non-compliance with the ITP to DFG within 24 hours.	ITP Condition # 7.2	Entire Project	Permittee	
25	The Designated Biologist(s) shall be on-site daily when Covered Activities occur. The Designated Biologist(s) shall conduct compliance inspections to: (1) minimize incidental take of the Covered Species; (2) check for compliance with all measures of the ITP; (3) check all exclusion zones; and (4) ensure that signs, stakes, and fencing are intact, and that Covered Activities are only occurring in the Project Area. The Designated Representative or Designated Biologist(s) shall prepare daily written observation and inspection records summarizing: oversight activities and compliance inspections, observations of Covered Species and their sign, survey results, and monitoring activities required by the ITP. The Designated Biologist(s) shall conduct compliance inspections a minimum of weekly during periods of inactivity and after clearing, grubbing, and grading are completed.	ITP Condition # 7.3	Entire Project	Permittee	
26	The Designated Representative or Designated Biologist(s) shall compile the observation and inspection records identified in Conditions 7.3 and 7.4 into a Monthly Compliance Report and submit it to DFG along with a copy of the MMRP table with notes showing the current implementation status of each mitigation measure. Monthly Compliance Reports shall be submitted to DFG's Regional Office at the office listed in the Notices section of the ITP and via e-mail to DFG's Regional Representative. At the time of the ITP's approval, the DFG Regional Representative is Marcia Grefsrud (mgrefsrud@dfg.ca.gov). DFG may at any time increase the timing and number of compliance inspections and reports required under this provision depending upon the results of previous compliance inspections. If DFG determines the reporting schedule must be changed, DFG will notify Permittee in writing of the new reporting schedule.	ITP Condition # 7.5	Entire Project	Permittee	
27	Permittee shall provide DFG with an Annual Status Report (ASR) no later than January 31 of every year beginning with issuance of the ITP and continuing until DFG accepts the Final Mitigation Report identified below. Each ASR shall include, at a minimum: (1) a summary of all Monthly Compliance Reports for that year identified in Condition 7.5 (2) a general description of the status of the Project Area and Covered Activities, including actual or projected completion dates, if known; (3) a copy of the table in the MMRP with notes showing the current implementation status of each mitigation measure; (4) an assessment of the effectiveness of each completed or partially completed mitigation measure in avoiding, minimizing and mitigating Project impacts; (5) all available information about Project-related incidental take of the Covered Species; and (6) information about other Project impacts on the Covered Species.	ITP Condition # 7.6	Entire Project	Permittee	

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
28	The Designated Biologist(s) shall submit all observations of Covered Species to DFG's California Natural Diversity Database (CNDDB) and the Designated Biologist(s) shall include copies of the submitted forms with the next Monthly Compliance Report or ASR, whichever is submitted first relative to the observation.	ITP Condition # 7.7	Entire Project	Permittee	
29	Permittee shall immediately notify the Designated Biologist(s) if a Covered Species is killed or taken by a Project-related activity, or if a Covered Species is otherwise found dead or injured within the vicinity of the Project. The Designated Biologist(s) or Designated Representative shall provide initial notification to DFG by calling the Regional Office at (707) 944-5500 or Marcia Grefsrud at (707) 644-2812. The initial notification to DFG shall include information regarding the location, species, number of animals taken, and the ITP Number. Following initial notification, Permittee shall send DFG a written report within 2 calendar days. The report shall include the date and time of the finding or incident, location of the animal or carcass, and if possible provide a photograph, explanation as to cause of take, and any other pertinent information.	ITP Condition # 7.9	Entire Project	Permittee	
30	Permittee shall confine all work within riparian areas to the period of June 15 to October 15.	ITP Condition # 8.1	Entire Project	Permittee	
31	Permittee shall, if possible, confine all earthwork and vegetation clearing within areas of potential Covered Species upland habitat, to the period of April 15 to October 31.	ITP Condition # 8.2	Entire Project	Permittee	
32	Permittee shall ensure that no activities occur in ponds or pools known to or with the potential to be used for California tiger salamander breeding and metamorphosis and no activities occur within 200 feet of any such ponds or pools.	ITP Condition # 8.3	Entire Project	Permittee	
33	The Permittee shall monitor the National Weather Service (NWS) 72-hour forecast for the Project Area. If rain is predicted within 72 hours during Project activity, all activities shall cease until no further rain is forecast. If the ponds/pools remain dry after the rain, the Permittee may continue activities.	ITP Condition # 8.4	Entire Project	Permittee	
34	The Designated Biologist(s) shall complete walking surveys of the Project Area for California tiger salamanders prior to initiating Covered Activities and shall follow earthmoving equipment to look for California tiger salamanders. If a California tiger salamander is discovered by the Designated Biologist(s) or anyone else, the Designated Biologist(s) shall move the animal to a safe nearby location (e.g. mouth of ground-squirrel burrow outside of the construction area) and monitor it until it is determined that it is not imperiled by predators or other dangers.	ITP Condition # 8.5	Entire Project	Permittee	
35	Because California tiger salamanders are attracted to cave-like structures, such as pipes, and may enter stored pipes and become trapped, all construction pipes, culverts, or similar structures that are stored at a construction site for one or more overnight periods will be either securely capped prior to storage or thoroughly inspected by the on-site biologist and/or the construction foreman/manager for these animals before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a California tiger salamander is discovered inside a pipe by the Designated Biologist(s) or anyone else, the Designated Biologist(s) shall move the animal to a safe nearby location and monitor it until it is determined that it is not imperiled by predators, or other dangers.	ITP Condition # 8.6	Entire Project	Permittee	

	Mitigation Measure	Source	Implementation Schedule	Responsible Party	Status / Date / Initials
36	The Designated Biologist(s) shall relocate any California tiger salamanders found within the Project Areas to be impacted to an active rodent burrow system or appropriate breeding pond located no more than 300 feet outside of the Project Area unless otherwise approved by DFG. Relocation areas shall be identified by the Designated Biologist(s) based upon best suitable habitat available and approved by DFG prior to the start of Covered Activities.	ITP Condition # 8.7	Entire Project	Permittee	
37	Permittee shall at the end of each work day, create an escape ramp at each end of any open trench to allow any animals that may have become entrapped in the trench to climb out overnight. The ramp may be constructed of either dirt fill or wood planking or other suitable material that is placed at an angle no greater than 30 degrees.	ITP Condition # 8.8	Entire Project	Permittee	
38	If a Covered Species is injured as a result of Project-related activities, the Designated Biologist(s) shall immediately take it to a DFG approved wildlife rehabilitation or veterinary facility. Permittee shall identify the facility before starting Covered Activities. Permittee shall bear any costs associated with the care or treatment of such injured Covered Species. The Permittee shall notify DFG of the injury to the Covered Species immediately by telephone and e-mail followed by a written incident report. Notification shall include the date, time, location and circumstances of the incident, and the name of the facility where the animal was taken.	ITP Condition # 8.9	Entire Project	Permittee	
POST-CONSTRUCTION					
39	Upon completion of Covered Activities, Permittee shall remove from the Project Area and properly dispose of all temporary fill and construction refuse, including, but not limited to, broken equipment parts, wrapping material, cords, cables, wire, rope, strapping, twine, buckets, metal or plastic containers, and boxes.	ITP Condition # 6.17	Post-construction	Permittee	
40	No later than 45 days after completion of all mitigation measures, Permittee shall provide DFG with a Final Mitigation Report. The Designated Biologist(s) shall prepare the Final Mitigation Report which shall include, at a minimum: (1) a summary of all Monthly Compliance Reports and all ASRs; (2) a copy of the table in the MMRP with notes showing when each of the mitigation measures was implemented; (3) all available information about Project-related incidental take of the Covered Species; (4) information about other Project impacts on the Covered Species; (5) beginning and ending dates of Covered Activities; (6) an assessment of the effectiveness of the ITP's Conditions of Approval in minimizing and fully mitigating Project impacts of the taking on Covered Species; (7) recommendations on how mitigation measures might be changed to more effectively minimize take and mitigate the impacts of future projects on the Covered Species; and (8) any other pertinent information. The Final Mitigation must be approved in writing by DFG before the obligations of the ITP are deemed to be met.	ITP Condition # 7.8	Post-construction and after completion of mitigation	Permittee	

ATTACHMENT 2A

DEPARTMENT OF FISH AND GAME

HABITAT MANAGEMENT LAND ACQUISITION PACKAGE CHECKLIST FOR PROJECT APPLICANTS

The following checklist is provided to inform you of what documents are necessary to expedite Department processing of your Habitat Management Land acquisition proposal. Any land acquisition processing requests which are incomplete when received, will be returned. The Region contact will review and approve the document package and forward it to the Habitat Conservation Planning Branch Senior Land Agent with a request to process the land acquisition for formal acceptance.

To: Carl Wilcox, Bay Delta Region
Regional Manager, Region Name

From: Caltrans, District 4
Project Applicant

Phone: _____

Tracking #: 2081-2011-013-03
CDFG assigned permit or agreement #

Project Name: State Route 84 Expressway Widening Project

Enclosed is the complete package for the ☐ Conservation Easement OR ☐ Grant Deed

Documents in this package include:

☐ Fully executed, approved as to form Conservation Easement Deed or Grant Deed.

Date executed: _____

☐ Proposed Lands for Acquisition Form (PLFAF)

☐ Phase I Environmental Site Assessment Report Date on report: _____
(An existing report may be used, but it must be less than two years old.)

☐ Preliminary Title Report(s) for subject property is enclosed and has been reviewed for encumbrances and other easements. The title report must be less than six months old when final processing is conducted.

Included are additional documents:

- ☐ document(s) to support title exceptions
- ☐ document(s) to explain title encumbrances
- ☐ a plot or map of easements/encumbrances on the property

☐ Policy of Title Insurance (an existing title policy is not acceptable)

☐ County Assessor Parcel Map(s) for subject property

☐ Site Location Map (Site location with property boundaries outline on a USGS 1:24,000 scale topo)

☐ Final Permit or Agreement (or other appropriate instrument)

Type of agreement: ☐ Bank Agreement ☐ Mitigation Agreement

☐ Permit _____ Other: _____
(write in type of permit)

☐ Final Management Plan (if required prior to finalizing permit or agreement or if this package is for a Grant Deed)

☐ Biological Resources Report

☐ Draft Summary of Transactions ☐ hard copy ☐ electronic copy (both are required)

ATTACHMENT 2B

PROPOSED LANDS FOR ACQUISITION FORM ("PLFAF")

Date: _____

TO: Regional Representative
Marcia Grefsrud, Environmental Scientist
Department of Fish and Game, Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
Facsimile: (707) 944-5563

FROM: _____
Caltrans, District 4
_____
_____

Applicant proposes that the following parcel of land be considered for approval by the Department as suitable for purposes of habitat management lands to replace the adverse environmental impacts of the Project:

Section	Township	Range	Number of Acres
_____	_____	_____	_____

Current Legal Owner(s), include Parcel Number(s):
_____
_____
_____

Location of Parcel:
_____
_____
_____
_____
_____

APPROVED ___ By: _____ DATE: _____
REJECTED ___
_____
Region

Explanation: _____
_____
_____

Jan 2003

AGREEMENTS

UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE
(Biological Opinion)

DATED 2/1/2008

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:
81420-2008-F-0592

FEB - 1 2008

Mr. James Richards
Attn: Margaret Gabil
California Department Transportation
111 Grand Avenue
Oakland, California 94612
P.O. Box 23660
Oakland, California 94623-0660

Subject: Biological Opinion for the State Route 84 Expressway Widening Project, Alameda County, California (Caltrans EA 04-297600) on the threatened California tiger salamander, the threatened California red-legged frog, and the endangered San Joaquin kit fox

Dear Mr. Richards:

This is in response to your October 22, 2007, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed State Route 84 Expressway Widening Project in Alameda County, California. Your request was received in this office on October 23, 2007, via an electronic mail message and included the request for formal consultation on the threatened California red-legged frog (*Rana aurora draytonii*), threatened California tiger salamander (*Ambystoma californiense*), and the endangered San Joaquin kit fox (*Vulpes macrotis mutica*).

This document represents the Service's biological opinion on the effects of the proposed action on these three listed species. This document has been prepared in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act).

This biological opinion is based on: (1) a June 2007 Biological Evaluation; (2) additional project information provided by the California Department of Transportation (Caltrans) and the Alameda County Transportation Improvement Authority (ACTIA) on August 31, September 24, October 23, and December 11, 2007; (3) affects acreage information provided by the applicant's consultation, URS Corporation, on December 19, 2007; (4) a January 29, 2008, electronic mail message from Caltrans requesting finalization of the draft biological opinion; (5) miscellaneous correspondence and electronic mail concerning the proposed action between the Service and Caltrans/ACTIA; and (5) other information available to the Service.

TAKE PRIDE IN AMERICA

Consultation History

June 15, 2007	The Service received a letter dated June 8, 2007, from Caltrans requesting informal consultation for the proposed State Route 84 Expressway Widening Project. The request was accompanied by a Biological Evaluation dated June 2007. In the Biological Evaluation, Caltrans determined that the proposed project may affect, but is not likely to adversely affect the California red-legged frog, California tiger salamander, and San Joaquin kit fox.
August 31, 2007	The Service received additional project information from Caltrans.
September 24, 2007	The Service received a 2004 special status species evaluation report from ACTIA completed for the Vulcan Materials gravel mine which is located immediately adjacent to the west side of the State Route 84 Expressway Widening Project alignment between Stanley Boulevard and Arroyo del Valle. The Vulcan Materials property report was provided as supplemental species survey information.
October 3, 2007	The Service sent Caltrans a request for additional information (Service File: 1-1-07-I-1688) to adequately review the determination of the effects of the project on listed species. The letter included a recommendation for formal consultation on the California red-legged frog, California tiger salamander, and San Joaquin kit fox. This recommendation was based on the project location, habitats within the action area, the biology and ecology of the species, and regulatory requirements by which Caltrans completed formal consultation for these three listed species on the adjoining two phases of the State Route 84 Corridor Plan.
October 23, 2007	The Service received additional information, dated October 22, 2007, from Caltrans via an electronic mail message in response to the October 3, 2007, information request. In their response, Caltrans and ACTIA requested formal consultation for the California red-legged frog, California tiger salamander, and the San Joaquin kit fox.
November 20, 2007	The Service visited the action area with Caltrans/ACTIA to discuss remaining issues. Caltrans/ACTIA agreed to review and revise their project description for inclusion in the biological opinion.
December 11, 2007	The Service received a revised project description from Caltrans/ACTIA.
December 19, 2007	The Service received revised affects acreage information from the ACTIA consultant, URS Corporation, via an electronic mail message. The revised calculations included affects to the California tiger salamander from

Arroyo del Valle to the south end of the action area, totaling 11.86 acres. Calculations for the affects to California red-legged frog habitat included the bridge widening activities at Arroyo Mocho and activities from Arroyo del Valle to the south end of the action area, totaling 11.89 acres.

December 19, 2007 The Service received acreage information from URS Corporation via an electronic mail message that identified the area at the south end of the project that had already been included in consultation on the Pigeon Pass Realignment Project. This area accounted for 0.5 acres of the 84 Expressway project. This area of project overlap will be covered in this consultation but habitat compensation for the California red-legged frog, California tiger salamander was achieved as part of the formal consultation for the Pigeon Pass Realignment Project.

December 27, 2007 The Service issued a draft biological opinion to Caltrans/ACTIA.

January 24, 2008 The Service had a phone conference meeting with Caltrans and ACTIA to discuss the draft biological opinion (Service File #: 81420-2008-I-0592).

January 29, 2008 The Service received an electronic mail message from Caltrans/ACTIA requesting that the finalization of the draft biological opinion as issued on December 27, 2007.

BIOLOGICAL OPINION

Description of the Proposed Action

Caltrans and the Federal Highway Administration (FHWA), in cooperation with ACTIA and the City of Livermore, is proposing to widen and upgrade 4.8 miles of State Route 84 to expressway standards between Ruby Hill Drive and Jack London Boulevard in the City of Livermore, Alameda County, California. The project also includes new private access bridges and widening of existing bridges across the Arroyo Del Valle and Arroyo Mocho drainages. The purpose of this project is to improve State Route 84 as a regional route consistent with other committed projects on the route, improve local traffic circulation, upgrade State Route 84 to an expressway facility with access control, and improve bicycle and pedestrian access. The total action area will be 113.5 acres of which 36 acres are occupied by existing hardscape/pavement (Caltrans 2007b).

Other committed projects within the State Route 84 Corridor Plan include the Isabel Avenue Intersection Project to the north and the Pigeon Pass Realignment Project to the south. The biological opinion for the Isabel Avenue project on the north end of the corridor was issued on August 1, 2007 (Service File # 1-1-07-F-0280). The biological opinion for the Pigeon Pass project on the south end of the corridor was issued on February 28, 2005 (Service File # 1-1-04-F-0115).

General Scope of Work
State Route 84 would be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment. As an expressway, access on to State Route 84 would be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, Discovery Drive and Jack London Boulevard would be widened and upgraded to accommodate future traffic movements. The Isabel Trail, a multi-use trail located on the east side of State Route 84 between Jack London Boulevard and Alden Lane, would be extended to Vineyard Avenue, using the proposed new bridge at Arroyo del Valle.

The roadway cross section would consist of 12-foot traveled lane and 10- foot shoulder widths separated by a concrete median barrier. Roadway slopes would vary in steepness depending on safety requirements. Where practical, side slopes would be 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, sideslopes would be 2:1 or flatter. The roadway median at intersections would be locally widened up to 36 feet to accommodate left-turn lanes.

Construction Schedule
Construction for the State Route 84 Expressway project is anticipated to begin in the Spring of 2010 and be completed in the Summer of 2012. Full funding for the project will be from federal, state, and local sources. Funding sources will include ACTIA Measure B, State Transportation Improvement Program (STIP) and Tri-Valley Transportation Council funds.

Construction Activities
The key elements of the proposed project are summarized as follows:

1. Widen and upgrade State Route 84 to expressway standards (55 mph) from just south of Ruby Hill Drive to Jack London Boulevard. State Route 84 would be widened from 2 to 4 lanes between Ruby Hill Drive (post mile 22.5) and Stanley Boulevard, and from 2 to 6 lanes between Stanley Boulevard and Jack London Boulevard (post mile 27.3). The widening would generally follow the existing roadway alignment, and conform to the State Route 84 Pigeon Pass Safety Project to the south, and the I-580/Isabel Avenue Interchange Project to the north.

2. Widen Arroyo Del Valle Bridge and Arroyo Mocho Bridge to accommodate the widening described above.

3. Construct two new bridge crossings, adjacent to the widened bridges, at Arroyo del Valle and at Arroyo Mocho

4. Relocate existing private driveway access to signalized intersections on State Route 84, including constructing a new bridge crossing at Arroyo Mocho for access to PG&E, Zone 7, and City of Livermore facilities with access from Discovery Drive.

5. Extend the multi-use trail, located on the east side of State Route 84 between Jack London Boulevard and Concannon Boulevard, to Vineyard Avenue on to the proposed new bridge crossing at Arroyo Del Valle. The 24-inch gas main and 15-inch sanitary sewer will also be relocated from the existing Arroyo del Valle bridge to the new Arroyo del Valle trail bridge.

6. Widen and upgrade signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, Discovery Drive and Jack London Boulevard to accommodate year-2030 traffic demand. To address safety concerns for an expressway facility, the Vallecitos Road intersection would be relocated approximately 450 feet to the north.

The project would create about 45 acres of new pavement. The total action area of the project, including permanent and temporary work areas, is estimated at 88 acres. Partial right-of-way acquisition from 30 parcels (totaling about 13 acres) would be required to accommodate roadway widening and intersection improvements. The majority of the acquisition involves partial takes from privately and publicly owned parcels fronting State Route 84. No land acquisition is required from the existing environmental conservancy area between Ruby Hill Drive and Vallecitos Road.

The proposed project would include construction activities within or adjacent to three environmentally sensitive areas within the Biological Study Area[a] (BSA) of the project:

1. BSA Focus Area 1 - State Route 84 would also be realigned and widened to avoid impacts to an environmental conservancy area, located east of the highway between Ruby Hill Drive and Vallecitos Road.

2. BSA Focus Area 2 - Arroyo Del Valle to widen the existing highway bridge and to construct a new trail access bridge.

3. BSA Focus Area 3 - Arroyo Mocho to widen the existing highway bridge and to construct a new private access bridge.

(1) Ruby Hill Drive to Vineyard Avenue
This section of roadway includes residential development on the west side of State Route 84 (the Ruby Hill Development) and environmental and agricultural (vineyard) conservancy areas on the east side of State Route 84. The Tri-Valley Conservancy and the City of Livermore are the co-holders of easements over these conservancy areas which are held in perpetuity.

[a] The BSA extends beyond the action area and encompasses the entire area that biological studies were conducted for the project. In some areas the BSA extended significantly beyond the action area to allow geometric design options to be investigated.

State Route 84 would be realigned to avoid encroachment into the adjacent tributary of Arroyo Del Valle and the environmental conservancy area located to the south and east.

Portions of the alignment are moved closer to the Ruby Hill Development and a special retaining wall to the west is required to retain the cut slope adjacent to East Ruby Hill Drive. The retaining wall height would vary from 5 feet to 30 feet, portions of which would require soil nail wall construction, or similar techniques. A short retaining wall is also required on the east side of State Route 84 to provide a buffer to the environmental sensitive area. The retaining wall height would vary from 0 feet to 9 feet. An 'L' shaped footing is proposed for this retaining wall to allow wall construction to be performed from the State Route 84 side. A temporary high visibility fence will be placed to delineate the environmental sensitive area limits during construction of the State Route 84 Expressway Project.

The profile grade of superelevated (banked) sections of State Route 84 between Ruby Hill Drive and Vallecitos Road would be hinged around either the left or right edge of traveled way to maintain the existing structural section. Roadway widening section excavations are expected to be approximately 3 feet deep. To address safety concerns for an expressway facility, the Vallecitos Road intersection would be relocated approximately 450 feet to the north of its current location. Minor modifications to the Ruby Hill Drive intersection would be required including relocation of signals and lighting poles.

(2) Vallecitos Road to Vineyard Avenue
State Route 84 would generally be widened to the east along this segment and incorporate the existing roadway pavement. A retaining wall is required along a portion of the west side of the road. The retaining wall height would vary from 5 feet to 30 feet, portions of which would require soil nail wall construction, or similar techniques. The intersection at Vineyard Avenue would be widened and upgraded including relocation of signals and lighting poles. Vineyard Avenue would also be widened on each approach to the intersection to accommodate extended turn lanes. A 6 feet high soundwall may be considered on the west side of State Route 84, to reduce noise levels for the Ruby Hill tennis courts and recreation area, located just south of Vineyard Avenue.

(3) Vineyard Avenue to Stanley Boulevard
This section of roadway includes residential development and a multi-use trail on the east side of State Route 84 (between Stanley Boulevard and Alden Lane) and an active gravel mining quarry on the west side of State Route 84.

State Route 84 would be widened to the east between Vineyard Avenue and Concannon Boulevard, and to the west for the remainder of this segment. The signalized intersection at Concannon Boulevard would be widened and upgraded including relocation of signals and lighting poles requiring foundation depths up to 10 feet. Driveway access to the quarry, west of State Route 84, would also be realigned to this intersection with an unpaved access road constructed parallel to Route 84 to maintain access within the quarry site. A retaining wall would support the unpaved access road. The retaining wall height would vary from 0 feet to 6

feet. To improve traffic operations at the State Route 84/Concannon Boulevard intersection, an extended northbound merge lane is proposed north of the intersection. This would require realignment of a portion of the multi-use trail and a partial take from the Orchid Ranch property. A 1300-feet long retaining wall is required along the east side of State Route 84 north of Concannon Boulevard. The retaining wall height would vary from 0 feet to 6 feet.

There are existing and planned expansions of gravel mining operations occurring on both sides of State Route 84 within this segment, which are independent of the proposed highway improvements. Mining operations will occur to within 50 feet of the existing right of way limits. Significant mining operations up to depths of 240 feet are planned on the west side of State Route 84 between Vineyard Avenue and Stanley Boulevard, and also on the east side between Vineyard Avenue and Alden Lane. After mining is completed in approximately 2030, an adopted Reclamation Plan would include the formation of basins to create groundwater storage, conveyance and recharge facilities collectively referred to as the Chain of Lakes. The Zone 7 Water Agency, which is the Tri-Valley water wholesaler serving Livermore, Pleasanton, and Dublin, would operate and maintain these facilities. When mining is completed, the Arroyo Del Valle crossing will become a concrete spillway between the two lakes. The State Route 84 project roadway cross-sections, driveway access, drainage systems, and utility relocations will be coordinated with both the mining operations and the Zone 7 Reclamation Plan.

BSA Focus Area 2

The existing 40 feet wide and 121 feet long, two-span bridge at Arroyo Del Valle would be widened by 54 feet to the east to accommodate the roadway widening. The flow channel passes on the south side of the bridge pier and may require rock slope protection to prevent scour. An unpaved maintenance road passes on the north side of the bridge pier. Excavation and pile foundations will be required for widening the two abutments and bridge pier by 54 feet. Bridge foundation work will occur outside of the flow channel but bridge pier foundation work may impact adjacent riparian areas. To minimize affects to riparian areas, temporary sheet piles (cofferdams) will be used for the bridge pier foundation excavation. The existing abutments, bridge pier, and rock slope protection would be extended to accommodate the widened structure. Excavation at the key of the rock slope protection is required to an approximate depth of 5 feet.

A new, two-span bridge would be constructed across Arroyo Del Valle to accommodate the Isabel Trail extension. The flow channel will pass on the south side of the bridge pier and may require rock slope protection to prevent scour. An unpaved maintenance road will pass on the north side of the bridge pier. Abutments and bridge pier for the new bridge will be constructed outside of riparian areas. Excavation and driven pile foundations will be required for the 15 feet wide abutments and bridge pier. Bridge foundation work will occur outside of the flow channel but bridge pier foundation work may impact adjacent riparian areas. To minimize impacts to riparian areas, temporary sheet piles (cofferdams) will be used for the bridge pier foundation excavation. Excavation at the key of the rock slope protection is required to an approximate depth of 5 feet.

Construction for both bridges in the Arroyo Del Valle creek area (including deck falsework) will be limited to the designated dry season and will take approximately thirteen months overall. To reduce mobilization costs, it is anticipated that the contractor will construct both bridges concurrently. Staging areas for abutments and pier construction will be provided outside Arroyo Del Valle. Temporary supports for falsework will be installed in Arroyo Del Valle, outside the live stream area. Once temporary falsework supports are installed, construction work within Arroyo Del Valle will be very limited. Foundations for bridge piers will be constructed during one dry season. Construction activities will be limited to outside Arroyo Del Valle during the dry season, between June 15th and October 15th.

Construction activity in Arroyo Del Valle will generally begin with construction of temporary cofferdams for both bridge piers. Bridge foundation construction will involve installation of shoring followed by excavation to the required footing depth. If seepage of water into the excavations occurs, a submersible sump pump will be used to pump accumulated water back into the arroyo. Dewatering operations will include approved construction Best Management Practices (BMPs) to remove sediments from water to be pumped from excavations.

A pile driving rig and crane will be required for bridge pile installation. The footprint of the pile driving equipment will be approximately 10 feet by 20 feet. Concrete for the foundations will be poured from outside the arroyo banks.

Removal of the existing bridge overhang (east side of bridge only) will require heavy equipment on the bridge deck and will likely be achieved by saw cutting the deck and then using a backhoe equipped with a demolition kit and dump trucks for hauling the demolition material offsite. Bridge falsework will be boarded over to prevent debris from falling into the watercourse. Abutment construction will require heavy equipment on the channel banks. Bridge foundation construction may require installation of temporary sheet piling using a driving rig. A backhoe will be used for the abutment foundation excavations.

Access to the Arroyo Del Valle channel area to construct the bridge piers will be from the existing quarry access road. A backhoe will be used for the bridge pier foundation excavations. Stockpiles of soils and materials (i.e., steel piles, steel sheets, steel reinforcement bars, and plywood and wood stakes) will be located outside Arroyo Del Valle. Cofferdams will be removed once installation is completed. Backfill and grading operations by backhoe and bulldozer will restore the Arroyo Del Valle grades to pre-existing conditions. Native topsoil will be stockpiled prior to excavation activities and reused for the final grading.

(4) Stanley Boulevard to Jack London Boulevard

This section of roadway includes residential development and a multi-use trail on the east side of State Route 84 and newly constructed light industrial park (Oaks Business Park) on the west side of State Route 84, north of Arroyo Mocho. State Route 84 is depressed in an underpass under Stanley Boulevard and the Union Pacific Railroad. Stanley Boulevard is connected to State Route 84 by a connector road with signalized intersections at each end. The channel of Arroyo Mocho was realigned as part of the Isabel Avenue Extension Project (circa 2001) and constructed

with channel improvements for flood protection purposes. An existing wetland mitigation site for the past creek realignment is located to the west of State Route 84 (north of the UPRR bridge) outside of the action area.

The intersection at State Route 84 and Stanley Boulevard, and the connector road between State Route 84 and Stanley Boulevard, would be widened with roadway sections up to 3 feet in depth and signals and lighting poles relocated at each end of the connector road.
State Route 84 would be widened on both sides including retaining walls where it passes under the existing Stanley bridges, then widened to the west for the remainder of this segment. No modifications to the Stanley bridge structures are proposed. A retaining wall is required along the west side of the multi-use trail. The intersections at Jack London Boulevard and Discovery Drive would be widened and upgraded including relocation of signals and lighting poles

BSA Focus Area 3
The existing 61 feet wide and 123 feet long, three-span bridge at Arroyo Mocho would be widened by 71 feet to the west to accommodate the roadway widening. The flow channel passes between the two bridge piers and may require additional rock slope protection to prevent scour. No changes to the channel are proposed. Excavation and driven pile foundations will be required for widening the bridge abutment and pier foundations by 70 feet. Bridge foundation work will occur outside of the flow channel but bridge pier foundation work may impact adjacent riparian areas. To minimize impacts to adjacent riparian areas, temporary sheet piles (cofferdams) will be used for the bridge pier foundation excavation. The existing abutments, piers, and rock slope protection would be extended to accommodate the widened structure. Excavation at the key of the rock slope protection is required to an approximate depth of 5 feet.

A new, single span bridge would be constructed across Arroyo Mocho to provide private access to PG&E, City of Livermore, and Zone 7 facilities. The flow channel may require rock slope protection to prevent scour. Abutments for the new bridge will be constructed outside of riparian areas of the Arroyo Mocho. Excavation and driven pile foundations will be required for the 15 feet wide abutments and bridge pier. Bridge foundation work will occur outside of the flow channel. Excavation at the key of the rock slope protection is required to an approximate depth of 5 feet.

Construction for both bridges in the Arroyo Mocho creek area (including deck falsework) will be limited to the designated dry season and will take approximately thirteen months overall. To reduce mobilization costs, it is anticipated that the contractor will construct both bridges concurrently. Staging areas for abutments and pier construction will be provided outside Arroyo Mocho. Temporary supports for falsework will be installed in Arroyo Mocho, outside the live stream area. Once temporary falsework supports are installed, construction work within Arroyo Mocho will be very limited. Foundations for bridge piers will be constructed during one dry season. Construction activities will be limited to outside Arroyo Mocho during the dry season, between June 15th and October 15th.

Construction activity in Arroyo Mocho will generally begin with construction of temporary cofferdams for widened bridge piers. Bridge foundation construction will involve installation of shoring followed by excavation to the required footing depth. If seepage of water into the excavations occurs, a submersible sump pump will be used to pump accumulated water back into the arroyo. Dewatering operations will include approved construction BMPs to remove sediments from water to be pumped from excavations.

A pile driving rig and crane will be required for bridge pile installation. The footprint of the pile driving equipment will be approximately 10 feet by 20 feet. Concrete for the foundations will be poured from outside the arroyo banks.

Removal of the existing bridge overhang (west side of bridge only) will require heavy equipment on the bridge deck and will likely be achieved by sawcutting the deck and then using a backhoe equipped with a demolition kit and dump trucks for hauling the demolition material offsite. Bridge falsework will be boarded over to prevent debris from falling into the watercourse. Abutment construction will require heavy equipment on the channel banks. Bridge foundation construction may require installation of temporary sheet piling using a driving rig. A backhoe will be used for the abutment foundation excavations.

Access to the Arroyo Mocho channel area to construct the bridge piers will be from the existing Zone 7 channel access road. A backhoe will be used for the bridge pier foundation excavations. Stockpiles of soils and materials (i.e., steel piles, steel sheets, steel reinforcement bars, and plywood and wood stakes) will be located outside Arroyo Mocho. Cofferdams will be removed once installation is completed. Backfill and grading operations by backhoe and bulldozer will restore the Arroyo Mocho grades to pre-existing conditions. Native topsoil will be stockpiled prior to excavation activities and reused for the final grading.

Drainage and Utilities

Roadway runoff would be conveyed by gutters and ditches to existing drainage systems. The outfalls for the drainage systems would be at Arroyo Del Valle, Arroyo Mocho, and Arroyo Las Positas.

The 48-inch outfall on the north side of Arroyo Del Valle is located within an active quarry area and will be relocated within state right of way. Improvements at this outlet would include reinforced concrete pipe, concrete headwalls, and rip rap. The existing outfall on the south side of Arroyo Del Valle will be maintained. The existing outfall to Arroyo Mocho (located approximately 1,000 feet upstream of the Arroyo Mocho Bridge crossing) is for discharge from an existing storm water pump station located between the Stanley bridges. Modifications to the pump station inlet chamber facility would be required to avoid conflicts with the proposed underpass retaining walls. No changes to the Arroyo Mocho outfall are proposed. The outfall to Arroyo Las Positas will be constructed by the Interstate-580/Isabel Avenue Interchange Project and will be installed prior to construction of the State Route 84 Expressway Project.

All storm water from the project action area will be treated (e.g. reduced sediments) prior to discharging into natural watercourses using Caltrans BMPs for water quality. BMPs proposed for the project include bioswales and retention/detention facilities.

Existing gas, sanitary sewer, storm drain, electrical, cable and telephone utilities lie within the proposed right of way for the State Route 84 Expressway Project and need to be relocated to comply with Caltrans expressway standards.

The study area for this project includes provision of utility corridors outside of state right of way to accommodate relocation of private utilities. Final design may require the relocation of several utilities to accommodate the State Route 84 Expressway Project. These relocations may include 24-inch gas line (Pacific Gas & Electric) and 15-inch to 39-inch sanitary sewer line (City of Livermore). Other utilities located in the State Route 84 Expressway Project area would be protected in-place.

Utility crossings for a 24-inch gas main and 15-inch sanitary sewer will be relocated from the existing Arroyo Del Valle Bridge to the new Arroyo Del Valle Trail Bridge. The sanitary sewer pipeline would be protected from damage by being placed inside a larger steel pipe (sleeve) for the water crossing.

Wildlife Crossings
Existing opportunities for wildlife crossings within the limits of the project are at the two arroyo crossings and at cross culverts located along the highway. There is a 66-inch culvert under Kalthoff Common (opposite Ruby Hill Drive). This culvert runs to the east of Route 84 and an unnamed tributary of Arroyo del Valle flows through it (located near station 230+40). There is a 48-inch cross culvert between Ruby Hill Drive and Vallecitos Road (near station 240+00). Overflow from Detjen Pond in the Ruby Hill development indirectly flows to this culvert. There is also a 36-inch cross culvert draining water from the Ruby Hill Development Golf Course (near station 309+20). The culvert drains into a retention pond on the east side of Route 84. Caltrans/ACTIA propose to maintain these crossings.

Other than the arroyo crossings, there are limited opportunities for wildlife crossings, north of Vineyard Avenue. There are residential developments along the east side of the highway with a fenced multi-use trail lying between the developments and the highway. Between Vineyard Avenue and Stanley Boulevard there are active gravel mining quarries, and north of Arroyo Mocho there is a light industrial park on the west side of State Route 84.

The 48-inch culvert cross culvert between Ruby Hill Drive and Vallecitos Road will be extended to accommodate the roadway widening and will provide an opportunity for California tiger salamander to migrate between Detjen Pond and the creek to the east of State Route 84.

The existing roadway (within the project limits) is a two-lane undivided highway with no median barrier. The proposed project will construct a concrete median barrier from just north of Vallecitos Road to just south of Discovery Drive. The concrete median barrier will not be

continuous for the length of the project. There will be breaks in the concrete median barrier (approximately 1,300 feet in length) at Vineyard Avenue, Concannon Boulevard and at the Stanley Connector signalized intersections. Holes will be considered in the base of the concrete barrier at regular intervals to provide additional opportunities for the wildlife passage of small animals.

Other Projects in the Regional Area
There are other projects planned or proposed in the regional area, which are considered for cumulative impacts in this technical study:

Table 1. Other Project in the Regional Area

Project	Location	Description	Anticipated Schedule
Interstate-580 Isabel Avenue Interchange Construction Project	At Isabel Avenue and Interstate-580, between Jack London Boulevard and Portola Avenue, directly north of the State Route 84 Expressway Widening Project	Constructing a new modified partial cloverleaf interchange, including a new bridge crossing Interstate-580, roadway improvements on Isabel Avenue to Jack London Boulevard, and local street improvements	Begin Construction 2008, Open to traffic 2010
State Route 84 Realignment and Widening (Pigeon Pass "SHOPP Project")	On State Route 84 between Ruby Hill Drive intersection and the Vallecitos Hills/Pigeon Pass area, directly south of the State Route 84 Expressway Widening Project	Upgrade State Route 84 within the project limits to expressway design standards, involving realignment of horizontal and vertical curves, and addition of climbing lanes in the Pigeon Pass area.	Begin Construction 2007, Open to traffic 2009
Interstate-580 Eastbound High Occupancy Vehicle (HOV) Lane	Along eastbound Interstate-580 between Santa Rita Road and Greenville Road	Create an eastbound HOV lane from west of Santa Rita Road to east of Greenville Road; create eastbound auxiliary lanes between El Charro Road and Airway Boulevard, and between First Street and Vasco Road; make median barrier and drainage improvements.	Begin Construction 2009, Open to traffic 2012

Table 1. Other Project in the Regional Area (continued)

Project	Location	Description	Anticipated Schedule
Gravel Mining Operations (Vulcan Materials Quarry)	Adjacent to the west side of State Route 84 Isabel Avenue, between Stanley Boulevard and Arroyo Del Valle	Vulcan Materials have mining rights to extract gravel deposits up to 50 feet of existing right of way line to depths up to 240 feet.	Ongoing until approx. 2030
Gravel Mining Operations (Cemex Quarry)	Both sides of State Route 84 between Vineyard Avenue and Alden Lane	Cemex has mining rights to extract gravel deposits up to 50 feet of existing right of way line to depths up to 240 feet.	Ongoing until approx. 2030

Effects by Habitat Type

The Service defines temporary effects as those construction areas that are restored to baseline habitat values or higher within one year following the initial disturbance. Given that the action for the State Route 84 Expressway Widening Project will each require more than one year of construction it is unlikely that any areas of effects will be temporary in nature. This includes areas used for staging. Given the scope and duration of the project, the entire proposed action area will be permanently affected by the proposed project. Caltans/ACTIA has the option of reinitiating consultation for the purposes of revising the amount habitat compensation if it can be documented that portions of the action area subject to construction have been successfully restored as determined by the Service. The Service does not consider areas that will be subjected to ongoing maintenance as areas of temporary effects even if they are restored within one year following the initial disturbance.

The following summarizes the expected effects and subsequent restoration by habitat type as follows:

Grasslands

For disturbance in annual grassland and dryland cultivated plant communities, restoration of habitat values is anticipated within one year after final grading and site stabilization. Restoration methods such as the use native vegetation for hydroseeding and plug planting is included in Caltrans standardized BMPs.

Waters of the US

Disturbance in Arroyo del Valle and Arroyo Mocho refers to areas that are permanently lost as waters of the United States due to placement of permanent fill. For example, the replacement of piers in the channel for support of bridge widening and construction will result in some permanent loss of waters of the United States.

Scrubland/scrub and Riparian Forests and Woodland

Within the willow scrub riparian habitat along Arroyo del Valle and Arroyo Mocho, areas will be paved, filled or otherwise modified for bridge widening and construction so that they could never again support riparian vegetation. Other areas will be restored upon final grading and site stabilization with appropriate riparian revegetation. Restoration of habitat values is expected within three to five years of installation of on-site plantings.

Disturbances within the stream environment zone of Arroyo del Valle and Arroyo Mocho is considered permanent, even in areas where no permanent paving or fill will be placed and where riparian revegetation can occur. This is specific to any woody riparian vegetation within the bed and banks of Arroyo del Valle and Arroyo Mocho. Any woody vegetation that may be removed is considered a permanent impact because there is no guarantee that the vegetation will replace itself naturally.

Construction Site Restoration

Storage and staging areas will be restored following completion of construction. These areas will be regraded, if appropriate, and revegetated with seeds and/or cuttings of appropriate plant species to promote restoration of the area to pre-project conditions. A restoration plan will be prepared that will be submitted to the Service for approval prior to initial ground breaking. To the maximum extent practicable (i.e., presence of natural lands), topsoil will be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from run-off or erosion will be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape or disperse routes of listed animal species.

Equipment

The equipment expected to be used to construct the project is typical of roadway and bridge construction and may include the following:

- Road work and embankments: scrapers, motor graders, backhoe loaders, tractors, bulldozers, excavators, compactors, asphalt pavers, rollers and haul trucks.

- Bridge work: backhoe loaders, haul trucks, pile drivers, cranes, concrete pumps, bid-well bridge pavers, and concrete mixer trucks.

Proposed Conservation Measures

Caltrans/ACTIA proposes to avoid or minimize for effects to listed species by implementing the following measures:

Habitat Compensation

1. The effects to 11.39 acres of California red-legged frog habitat shall be compensated t a 3:1 ratio (34.17 acres) of occupied California red-legged frog habitat. The effects to 11.36 acres of California tiger salamander habitat shall be compensated at a 3:1 ratio

(34.08 acres) of occupied California tiger salamander habitat. This does not include the 0.5 acres of project overlap that was compensated for under Pigeon Pass Realignment Project consultation. Compensation may be co-located in shared habitat for the listed frog and salamander and will be located within the northern range of the San Joaquin kit fox. Compensation less than 3:1 may be appropriate if the acquired habitat is considered to have special value to the species.

Caltrans will expend the funds to either purchase credits at a Service-approved approved conservation bank, contribute to habitat acquisition, or contribute to an in lieu fee program that complies with FHWA policy for Federal aid participation.

Caltrans under the NEPA 404 Delegation is providing the proposed compensatory mitigation for the anticipated impacts to Vernal pool (Wetland Habitat) and associated Natural habitat under the statutory authority provide under 23 CFR part 710.513 and 23 CFR part 777 outlined by the U.S. Department of Transportation, Federal Highways Administration, Office of Chief Counsel, Memorandum – Dated march 10th, 2005, HEPN-30.

On-site Biologist- Employee Training and Restrictions

2. A Service-approved biologist will be designated for the project. This qualified biologist(s) will be on-site during all activities that may result in the take of the San Joaquin kit fox, California tiger salamander, and/or California red-legged frog. The qualifications of the biologist(s) will be presented to the Service for review and written approval prior to ground-breaking at the project site. The biologist(s) will be given the authority, through the Resident Engineer, to stop any work that may result in take of these listed animal species. If the biologist(s) exercises this authority, the Service and the California Department of Fish and Game will be notified by telephone and electronic mail within one working day. The Service contact will be Chris Nagano, Deputy Field Supervisor, Endangered Species Division at the Sacramento Fish and Wildlife Office at telephone (916) 414-6600.

3. The Resident Engineer will halt work and immediately contact the Service-approved, project biologist and the Service in the event that a San Joaquin kit fox, California tiger salamander, or California red-legged frog gain access to a construction zone. The Resident Engineer will suspend all construction activities in the immediate construction zone until the animal leaves the site voluntarily or is removed by the biologist to a release site using Service-approved transportation techniques.

4. All construction personnel will attend an environmental education program delivered by the Service-approved biologist prior to working on the project site. The program will include an explanation as how best to avoid the accidental take of San Joaquin kit fox, California tiger salamander, and California red-legged frog. The Service-approved biologist(s) will conduct a training session that would be scheduled as a mandatory

informational field meeting by the Caltrans Resident Engineer for contractors and all construction personnel. The field meeting will include topics on species identification, life history, descriptions, and habitat requirements during various life stages. Emphasis will be placed on the importance of the habitat and life stage requirements within the context of project maps showing areas where minimization and avoidance measures are being implemented will be included as part of this education program. The program will include an explanation of appropriate federal and state laws protecting endangered species as well as the importance of compliance with Caltrans and various resource agency conditions.

5. To minimize temporary disturbances, all project-related vehicle traffic will be restricted to established roads, construction areas, and other designated areas. These areas also should be included in pre-construction surveys and, to the maximum extent possible, should be established in locations disturbed by previous activities to prevent further adverse effects. Project-related vehicles will observe a 20-mile per hour speed limit within construction areas, except on local streets and state highways; this is particularly important at night when the San Joaquin kit fox, California tiger salamander, and California red-legged frog are most active. To the maximum extent possible, night-time construction will be minimized. Off-road traffic outside of designated project areas will be prohibited.

6. Project employees will be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards.

7. To eliminate an attraction to predators of the San Joaquin kit fox, California tiger salamander, and/or California red-legged frog, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed at least once a day from the entire project site.

8. To avoid injury or death of the San Joaquin kit fox, California tiger salamander, and/or California red-legged frog, no firearms will be allowed on the project site except for those carried by authorized security personnel, or local, State, or Federal law enforcement officials.

9. To prevent harassment, injury or mortality of San Joaquin kit fox, California tiger salamander, and/or California red-legged frog or destruction of their dens or burrows by dogs or cats, no canine or feline pets will be permitted in the action area.

10. Use of rodenticides and herbicides in the action area will be utilized in such a manner to prevent primary or secondary poisoning of San Joaquin kit foxes, and the depletion of prey populations on which they depend. All uses of such compounds will observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Food and Agriculture, and other appropriate State and Federal regulations,

as well as additional project-related restrictions deemed necessary by the Service or the California Department of Fish and Game.

11. All fueling and maintenance of vehicles and other equipment will occur at least 65 feet from any riparian habitat or aquatic habitat.

12. All grindings and asphaltic-concrete waste will be stored within previously disturbed areas absent of habitat and at a minimum of 150 feet from any culvert, or drainage feature.

Construction Windows/Exclusionary Fencing

13. For seasonal avoidance of the California red-legged frog, construction will not occur from November 1 through March 31 to the extent practicable. If any work remains to be completed after November 1, exclusion fencing will be placed in those areas where construction needs to be completed.

14. Caltrans will install exclusion fencing for the California tiger salamander around any work area if necessary to continue construction activities outside the working window of April 16 to October 14. Exclusionary fencing will consist of taut silt fabric; 24 inches in height, staked at 10-foot intervals, with the bottom buried 6 inches below grade. Exclusion fencing will be maintained so that it is intact during rain events and 24 hours after any rain event.

15. The construction area will be delineated with high visibility temporary fencing at least four feet in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto any sensitive areas during project work activities. Such fencing will be inspected and maintained daily by the on-site biologist until completion of the project. The fencing will be removed only when all construction equipment is removed from the site. Actions within the project area will be limited to vehicle and equipment operation on existing roads. No project activities will occur outside the delineated project construction area.

On-site Inspection by the Service and the California Department of Fish and Game

16. If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans will allow access by Service and/or California Department of Fish and Game personnel to the project site to inspect project effects to the San Joaquin kit fox, California tiger salamander, and California red-legged frog, and their habitats.

Pre-Construction Surveys/Capture and Handling

17. Prior to any ground disturbance, pre-construction surveys will be conducted by a Service-approved biologist for the San Joaquin kit fox, California tiger salamander, and

California red-legged frog. These surveys will consist of walking surveys of the project limits and adjacent areas accessible to the public to determine presence of the species.

18. Only Service-approved biologist(s) who are familiar with the biology and ecology of the California tiger salamander and California red-legged frog will capture or handle these species.

19. Biologist will take precautions to prevent introduction of amphibian diseases to the action area by disinfecting equipment and clothing as directed in the October 2003 California tiger salamander survey protocol titled, Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander and the recommended equipment decontamination procedures within the Service's California Red-Legged Frog Survey Guidance. Both items are available at the Service's Sacramento office website (http://www.fws.gov/sacramento/es/protocol.htm). Disinfecting equipment and clothing is especially important when biologists are coming to the action area to handle salamanders or frogs after working in other aquatic habitats.

20. To prevent inadvertent entrapment of San Joaquin kit foxes, California tiger salamanders, and California red-legged frogs during construction, all excavated, steep-walled holes or trenches more than 2 feet deep will be covered at the close of each working day by plywood or similar materials, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled, they must be thoroughly inspected for trapped animals. If at any time a trapped listed animal is discovered, the on-site biologist will immediately place escape ramps or other appropriate structures to allow the animal to escape, or the Service and/or California Department of Fish and Game will be contacted by telephone for guidance. The Service will be notified of the incident by telephone and electronic mail within one working day.

21. San Joaquin kit foxes are attracted to den-like structures such as pipes and may enter stored pipe becoming trapped or injured. All replacement pipes, culverts, or similar structures with a diameter of 4 inches or greater that are stored in the action area for one or more overnight periods will be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe will not be moved until the Service has been consulted by telephone. If necessary, and under the direct supervision of the on-site biologist, the pipe may be moved once to remove it from the path of construction activity, until the fox has escaped.

22. Plastic mono-filament netting (erosion control matting) or similar material will not be used at the project site because California tiger salamander or California red-legged frog may become entangled or trapped in it. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds.

San Joaquin Kit Fox Pre-Construction Surveys

23. Biologist(s) will determine the presence of San Joaquin kit fox dens (natural or in pipes and culverts) within the action area by performing the following:

    (1) Pre-construction surveys within the action area will be conducted no more than 30 calendar days prior to the start of construction in accordance with the most current protocols approved by the Service and the California Department of Fish and Game.

    (2) Surveys for dens will be conducted by qualified biologists with demonstrated experience in identifying San Joaquin kit fox dens.

    (3) Pipes and culverts will be searched for kit foxes prior to being moved or sealed to ensure that an animal has not been trapped.

24. All potential San Joaquin kit fox dens will be protected to the maximum extent practicable as determined by the on-site biologist.

25. The type (natal or non-natal) and status (occupied or unoccupied) of all potential San Joaquin kit fox dens will be identified based on the extant Service guidance (Service 1999):

    (1) A known den is any existing natural den or human-made structure for which conclusive evidence or circumstantial evidence can show that the den is used or has been used at any time in the past by the San Joaquin kit fox.

    (2) A potential den is any natural den or burrow within the range of the species that has entrances of appropriate dimensions (4 to 12 inches in diameter) to accommodate San Joaquin kit foxes. Caltrans will survey and investigate using photo-detection equipment, track plate, or other methods to determine species utilization. If no information is collected that would indicate use by other species, the den will be treated as a potential kit fox den.

    (3) A pupping den is any known San Joaquin kit fox den (as defined) used by kit foxes to whelp and/or rear their pups.

    (4) An atypical den is any known San Joaquin kit fox den that has been established in, or in association with, a human made structure.

26. Caltrans will identify and execute the following appropriate action(s) regarding notification, buffers, excavation and fill, or seal-off in regards to the San Joaquin kit fox:

    (1) If an occupied natal den is visible or encountered within the project limits, or other accessible land, or on publicly accessible land within 1,000 feet of the project

construction area, the Service and the California Department of Fish and Game will be contacted immediately to determine appropriate protection measures.

(2) A buffer or exclusion zone will be established to protect the physical den and surrounding habitat of unoccupied natal dens and all non-natal dens that can be avoided:

(a) Unoccupied natal dens will be surrounded with a 200-foot buffer and the Service and the California Department of Fish and Game will be contacted. Occupied and unoccupied non-natal dens will be surrounded with a 100-foot buffer.

(b) When occupied dens have been found on or near the project site, the Service and the California Department of Fish and Game will be contacted immediately to determine appropriate protection measures.

(c) During this period, project activities within 0.3 miles of occupied natal dens are prohibited. Buffer zones will be delineated with a temporary fence or other suitable barrier that does not prevent disbursal of the fox. Alternatively, the project construction area can be delineated with temporary fence, flagging, or other barrier.

(3) Unless necessary for pedestrian or driver safety, the project site will not be lighted between sunset and sunrise.

(4) Pipes or culverts with a diameter greater than 4 inches will be capped or taped closed when it is ascertained that no San Joaquin kit fox is present. Any kit fox found in a pipe or culvert will be allowed to escape unimpeded.

(5) If a natural den cannot be avoided and must be destroyed, the following guidelines will be followed:

(a) Prior to the destruction of any den, the den will be monitored for at least three consecutive days to determine its current status. Activity at the den will be monitored by placing tracking medium at the entrance and by standard spotlighting detection techniques. If no kit fox activity is observed during this period, the den will be destroyed immediately to preclude subsequent use. If kit fox activity is observed at the den during this period, the den will be monitored for at least five consecutive days from the time of observation to allow any resident animal to move to another den during its normal activities. Use of the den can be discouraged during this period by partially plugging the entrance(s) with soil in such a manner that any resident animal can escape easily. Destruction of the den may begin when, in the judgment of a Service or Service-approved biologist, it is temporarily vacant, for example during the animal's normal foraging activities.

(b) All dens will be excavated by hand, by or under the supervision of, a Service-approved biologist.

(c) The den will be fully excavated and then filled with dirt and compacted to ensure that kit foxes cannot reenter or use the den during the construction period. If, at any point during excavation a kit fox is discovered inside the den, the excavation activity will cease immediately and monitoring of the den will be resumed. Destruction of the den may be resumed, when in the judgment of the Service-approved biologist, the animal has escaped from the partially destroyed den.

(d) Non-natal dens may be excavated at any time of the year. Natal dens will only be excavated between August 15 and November 1.

27. Within ten working days of the completion of earthmoving, Caltrans will replace all excavated kit fox dens with artificial dens on a 2:1 basis. The location and design of the artificial dens will be approved by the Service prior to installation.

Restoration of Disturbed Areas

28. Upon completion of the proposed action, all San Joaquin kit fox, California tiger salamander, and California red-legged frog habitat subject to temporary ground disturbances, including storage and staging areas, temporary roads, etc. will be regraded, if appropriate, and revegetated with seeds and/or cuttings of appropriate plant species to promote restoration of the area to pre-project conditions. An area subject to "temporary" disturbance means any area that is disturbed during the project, but that after project completion will not be subject to further disturbance and has the potential to be revegetated. Caltrans will submit to the Service their draft proposal for the restoration and revegetation plan at least sixty (60) calendar days prior to initial ground breaking; the final plan will be submitted for approval by the Service prior to ground breaking at the proposed project. To the maximum extent practicable (i.e., presence of natural lands), topsoil will be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from run-off or erosion will be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape or dispersal routes of listed animal species. The draft and final plan will contain specific quantifiable criteria to evaluate the success of the restoration. A biologist will ensure that areas subject to temporary disturbance have been adequately restored.

Reporting

29. Injured San Joaquin kit foxes, California tiger salamanders, and/or California red-legged frogs will be cared for by a licensed veterinarian or other qualified person such as the on-site biologist; dead individuals of any of these three listed species will be preserved according to standard museum techniques and held in a secure location. The Service and

the California Department of Fish and Game will be notified within one (1) working day of the discovery of death or injury to a San Joaquin kit fox, California tiger salamander, and/or California red-legged frog that occurs due to project related activities or is observed at the project site. Notification will include the date, time, and location of the incident or of the finding of a dead or injured animal clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. The Service contacts are Chris Nagano, Deputy Assistance Field Supervisor, Endangered Species Program at the Sacramento Fish and Wildlife Office (916/414-6600), and Scott Heard, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Mr. Ron Schlorff at 1416 9th Street, Sacramento, California 95814, (916) 654-4262.

30. Caltrans will submit a post-construction compliance report prepared by the on-site biologist to the Sacramento Fish and Wildlife Office within sixty calendar days following project completion or within sixty calendar days of any break in construction activity lasting more than sixty calendar days. This report will detail (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting compensation and other conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on the San Joaquin kit fox, California tiger salamander, and California red-legged frog, if any; (v) occurrences of incidental take of any of these three species; (vi) documentation of employee environmental education; and (vii) other pertinent information. The reports will be addressed to the Deputy Assistant Field Supervisor of the Endangered Species Program, Sacramento Fish and Wildlife Office.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the proposed action, the action area includes all lands associated with the approximately 113.5 acre project footprint and roads (except for County roads, and State and Federal highways) and other areas accessed by project vehicles.

Status of the Species and Environmental Baseline

San Joaquin Kit Fox

The San Joaquin kit fox was listed as an endangered species on March 11, 1967 (Service 1967) and it was listed by the State of California as a threatened species on June 27, 1971. The *Recovery Plan for Upland Species of the San Joaquin Valley, California* includes this listed canine (Service 1998).

Before 1930 in the San Joaquin Valley, the range of the San Joaquin kit fox extended from southern Kern County north to Tracy in San Joaquin County, on the west side, and near La Grange in Stanislaus County, on the east side (Grinnell *et al.* 1937; Service 1998). Historically, this species occurred in several San Joaquin Valley native plant communities. In the southernmost portion of the range, these communities included Valley Sink Scrub, Valley Saltbush Scrub, Upper Sonoran Subshrub Scrub, and Annual Grassland. San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by man. This fox species is present in many oil fields, grazed pasturelands, and "wind farms" (Cypher 2000). Kit foxes can inhabit the margins and fallow lands near irrigated row crops, orchards, and vineyards, and may forage occasionally in these agricultural areas (Service 1998). There are a limited number of observations of San Joaquin kit foxes foraging in trees in urban areas (Murdoch *et al.* 2005). The San Joaquin kit fox seems to prefer more gentle terrain and decreases in abundance as terrain ruggedness increases (Grinnell *et al.* 1937; Morrell 1972; Warrick and Cypher 1999).

Adult San Joaquin kit foxes are typically solitary during late summer and fall. Adult females begin to excavate and enlarge natal dens in September and October (Morrell 1972). Adult males then join the females in October or November (Morrell 1972). Pups are typically born between February and late March following a gestation period of 49 to 55 days (Egoscue 1962; Morrell 1972; Spiegel and Tom 1996; Service 1998). Mean litter sizes reported for San Joaquin kit foxes include 2.0 pups on the Carrizo Plain (White and Ralls 1993), 3.0 at Camp Roberts (Spencer *et al.* 1992), 3.7 in the Lokern area (Spiegel and Tom 1996), and 3.8 at the Naval Petroleum Reserve (Cypher *et al.* 2000). Pups typically appear above ground between the age of 3 to 4 weeks, and are typically weaned between the ages of 6 and 8 weeks. Adult San Joaquin kit fox reproductive rates (the proportion of females bearing young) vary annually with environmental conditions, particularly food availability. Annual reproductive rates range from 0 to 100 percent, and reported mean rates include 61 percent at the Naval Petroleum Reserve (Cypher *et al.* 2000), 64 percent in the Lokern area (Spiegel and Tom 1996), and 32 percent at Camp Roberts (Spencer *et al.* 1992). Although some yearling female kit foxes will produce young, most do not reproduce until they have reached 2 years-of-age (Spencer *et al.* 1992; Spiegel and Tom 1996; Cypher *et al.* 2000). Sometimes juvenile foxes (<1 year old), particularly females, will delay dispersal and may assist their parents in raising the following year's litter of pups (Spiegel and Tom 1996). The young kit foxes begin to forage for themselves at about 4 to 5 months of age (Koopman *et al.* 2000; Morell 1972).

Although most young kit foxes disperse less than 5 miles (8 kilometers) from their natal home ranges (Scrivner *et al.* 1987), dispersal distances of up to 76.3 miles (122.8 kilometers) have been documented for the San Joaquin kit fox (Scrivner *et al.* 1987; Service 1998). Dispersal can be through disturbed habitats, including agricultural fields, and across highways and aqueducts. The age at dispersal ranges from 4 to 32 months (Cypher 2000). A study of juvenile kit foxes at the Naval Petroleum Reserve found that 49 percent of the male and 24 percent of the female pups dispersed from natal home ranges by July 1 (Koopman *et al.* 2000). Among dispersing kit foxes, 87 percent did so during their first year of age. Of the dispersing juveniles at the Naval Petroleum Reserve, 65.2 percent died within 10 days of leaving their natal home range (Koopman *et al.* 2000). Some kit foxes delay dispersal and may inherit their natal home range.

San Joaquin kit foxes are reputed to be poor diggers, and their dens are usually located in areas with loose-textured, friable soils (Morrell 1972; O'Farrell 1983). However, the depth and complexity of their dens suggest that they possess good digging abilities, and occupied kit fox dens have been observed on a variety of soil types (Service 1998). Some studies suggest that where hardpan layers predominate, kit foxes create their dens by enlarging the burrows of California ground squirrels (*Spermophilus beecheyi*) or American badgers (*Taxidea taxus*) (Jensen 1972; Morrell 1972; Orloff *et al.* 1986). In parts of their range, particularly in the foothills, kit foxes often use enlarged ground squirrel burrows for dens (Orloff *et al.* 1986). Kit fox dens are commonly located on flat terrain or on the lower slopes of hills. About 77 percent of all kit fox dens are at or below midslope (O'Farrell 1983), with the average slope at den sites ranging from 0 to 22 degrees (California Department of Fish and Game 1980; O'Farrell 1983; Orloff *et al.* 1986). Natal and pupping dens are generally found in flatter terrain. Common locations for dens include washes, drainages, and roadside berms. Kit foxes also commonly den in human-made structures such as culverts and pipes (O'Farrell 1983; Spiegel *et al.* 1996).

San Joaquin kit fox natal and pupping dens often include multiple entrances and are usually larger than dens that are not used for reproduction (O'Farrell *et al.* 1980; O'Farrell and McCue 1981). Natal dens may be reused in subsequent years (Egoscue 1962). It has been speculated that natal dens are located in the same location as ancestral breeding sites (O'Farrell 1983). Active natal dens are generally 1.2 to 2 miles (1.9 to 3.2 kilometers) from the dens of other mated kit fox pairs (Egoscue 1962; O'Farrell and Gilbertson 1979). Natal and pupping dens usually can be identified by the presence of scat, prey remains, matted vegetation, and mounds of excavated soil (i.e. ramps) outside the dens (O'Farrell 1983). However, some active dens in areas outside the valley floor often do not show evidence of obvious use (Orloff *et al.* 1986). During telemetry studies of kit foxes in the northern portion of their range, 70 percent of the dens that were known to be active showed no sign of use (e.g., tracks, scats, ramps, or prey remains) (Orloff *et al.* 1986). In another more recent study in the Coast Range, 79 percent of active kit fox dens lacked evidence of recent use other than signs of recent excavation (Jones and Stokes Associates 1997).

A San Joaquin kit fox can use more than 100 dens throughout its home range, although on average, an animal will use approximately 12 dens a year for shelter and escape cover (Cypher *et al.* 2001). Kit foxes typically use individual dens for only brief periods, often for only one day before moving to another den (Ralls *et al.* 1990). Possible reasons for changing dens include infestation by ectoparasites (parasites that live on but not within their hosts), local depletion of prey, or avoidance of coyotes (*Canis latrans*) or other predators. Kit foxes tend to use dens that are located in the same general area, and clusters of dens can be surrounded by hundreds of acres/hectares of similar habitat devoid of other dens (Egoscue 1962). In the southern San Joaquin Valley, kit foxes were found to use up to 39 dens within a denning range of 320 to 482 acres (129.5 to 195 hectares) (Morrell 1972). An average den density of one den per 69 to 92 acres (27.9 to 37.2 hectares) was reported by O'Farrell (1984) in the southern San Joaquin Valley.

Non-natal Dens are used by San Joaquin kit foxes for temperature regulation, shelter from adverse environmental conditions, and escape from predators. Kit foxes excavate their own dens, use those constructed by other animals, and use human-made structures (culverts, abandoned pipelines, and banks in sumps or roadbeds). Kit foxes often change dens and may use many dens throughout the year; however, evidence that a den is being used by kit foxes may be absent. San Joaquin kit foxes have multiple dens within their home range and individual animals have been reported to use up to 70 different dens (Hall 1983). At the Naval Petroleum Reserve, individual kit foxes used an average of 11.8 dens per year (Koopman *et al.* 1998). Den switching by the San Joaquin kit fox may be a function of predator avoidance, local food availability, or external parasite infestations (e.g., fleas) in dens (Egoscue 1956).

The diet of the San Joaquin kit fox varies geographically, seasonally, and annually, based on temporal and spatial variation in abundance of potential prey. Known prey species of the kit fox include white-footed mice (*Peromyscus* species), various insects, California ground squirrels, kangaroo rats (*Dipodomys* species), San Joaquin antelope squirrels (*Ammospermophilus nelsoni*), black-tailed hares (*Lepus californicus*), and chukar (*Alectoris chukar*) (Jensen 1972; Archon 1992). Kit foxes also prey on desert cottontails (*Sylvilagus audubonii*), ground-nesting birds, and pocket mice (*Perognathus* species).

The diets and habitats selected by coyotes and San Joaquin kit foxes living in the same areas are often quite similar. Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, Central California. Competition for resources between coyotes and kit foxes may result in kit fox mortalities. Coyote-related injuries accounted for 50-87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserve (Cypher and Scrivner 1992; Standley *et al.* 1992).

San Joaquin kit foxes are primarily nocturnal, although individuals are occasionally observed resting or playing (mostly pups) near their dens during the day (Grinnell *et al.* 1937). Kit foxes occupy home ranges that vary in size from 1.7 to 4.5 square miles (2.7 to 7.2 square kilometers) (White and Ralls 1993). These home ranges are typically occupied by a mated pair of kit foxes and their current litter of pups (White and Ralls 1993; Spiegel 1996; White and Garrott 1997). This social unit can include other adults, usually offspring from previous litters (Koopman *et al.* 2000), but individuals often move independently within their home range (Cypher 2000). Ralls *et al.* (2001) found that foxes sometimes share dens with foxes from other groups; many of these cases involved unpaired individuals and appeared to be unsuccessful attempts at pair formation. Average distances traveled each night range from 5.8 to 9.1 miles (9.3 to 14.6 kilometers) and are greatest during the breeding season (Cypher 2000).

Kit foxes maintain core home range areas that are exclusive to mated pairs and their offspring. This territorial spacing behavior eventually limits the number of foxes that can inhabit an area owing to shortages of available space and per capita prey. Hence, as habitat is fragmented or destroyed, the carrying capacity of an area is reduced and a larger proportion of the population is

forced to disperse. Increased dispersal generally leads to lower survival rates and, in turn, decreased abundance because greater than 65 percent of dispersing juvenile foxes die within 10 days of leaving their natal range (Koopman *et al.* 2000).

Estimates of fox density vary greatly throughout its range, and have been reported as high as 3.11 per square mile (1.94 per square kilometer) in optimal habitats in good years (Service 1998). At the Elk Hills in Kern County, density estimates varied from 1.86 foxes per square mile (1.16 per square kilometer) in the early 1980s to 0.03 foxes per square mile (0.02 per square kilometer) in 1991 (Service 1998). Kit fox home ranges vary in size from approximately 1 to 12 square miles (1.6 to 19.3 square kilometers) (Spiegel *et al.* 1996; Service 1998). Knapp (1978) estimated that a home range in agricultural areas is approximately 1.0 square mile (1.6 square kilometers). Individual home ranges overlap considerably, at least outside the core activity areas (Morrell 1972; Spiegel *et al.* 1996b).

Mean annual survival rates reported for adult San Joaquin kit foxes include 0.44 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.53 at Camp Roberts (Standley *et al.* 1992), 0.56 at the Lokern area (Spiegel and Disney 1996), and 0.60 on the Carrizo Plain (Ralls and White 1995). However, survival rates widely vary among years (Spiegel and Disney 1996; Cypher *et al.* 2000). Mean survival rates for juvenile San Joaquin kit foxes are lower than rates for adults. The survival rate to 1 year-of-age was 0.14 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.20 at Camp Roberts (Standley *et al.* 1992), and 0.21 on the Carrizo Plain (Ralls and White 1995). For both adults and juveniles, survival rates of males and females are similar. San Joaquin kit foxes have been known to survive as long as 10 years in captivity (McGrew 1979) and 8 years in the wild (Berry *et al.* 1987), but most kit foxes do not likely live past 2 to 3 years of age.

The status (i.e., distribution, abundance) of the kit fox has decreased since its listing in 1967. This trend is reasonably certain to continue into the foreseeable future unless measures to protect, sustain, and restore suitable habitats, and alleviate other threats to their survival and recovery, are implemented. Threats that are seriously affecting kit foxes are described in further detail in the following sections.

Loss of Habitat

Less than 20 percent of the habitat within the historical range of the kit fox remained when the animal was listed as federally-endangered in 1967, and there has been a substantial net loss of habitat since that time. Historically, San Joaquin kit foxes occurred throughout California's Central Valley and adjacent foothills. Extensive land conversions in the Central Valley began as early as the mid-1800s with the Arkansas Reclamation Act. By the 1930's, the range of the kit fox had been reduced to the southern and western parts of the San Joaquin Valley (Grinnell *et al.* 1937). The primary factor contributing to this restricted distribution was the conversion of native habitat to irrigated cropland, industrial uses (e.g., hydrocarbon extraction), and urbanization (Laughrin 1970; Jensen 1972; Morrell 1972, 1975). Approximately one-half of the natural communities in the San Joaquin Valley were tilled or developed by 1958 (Service 1980).

This rate of loss accelerated following the completion of the Central Valley Project and the State Water Project, which diverted and imported new water supplies for irrigated agriculture (Service 1995a). Approximately 1.97 million acres (0.79 million hectares) of habitat, or about 66,000 acres (26,709 hectares) per year, were converted to other land uses in the San Joaquin region between 1950 and 1980 (Cowardin *et al.* 1979). The counties specifically noted as having the highest wild land conversion rates included Kern, Tulare, Kings and Fresno, all of which are occupied by the kit fox. From 1959 to 1969 alone, an estimated 34 percent of natural lands were lost within the then-known kit fox range (Laughrin 1970).

By 1979, only approximately 370,000 acres (149,734 hectares) of non-developed land remained in the approximately 8.5 million-acre (3.4 million-hectare) San Joaquin Valley floor (Williams 1985; Service 1980). Data from the California Department of Fish and Game (1985) and Service file information from between 1977 and 1988 indicates that essential habitat for the blunt-nosed leopard lizard (*Gambelia silus*), a species that occupies habitat in the southern San Joaquin Valley that is also suitable for kit foxes, declined from 311,680 acres (126,133 hectares) to 63,060 acres (25,520 hectares). This represented a loss of approximately 80 percent and an average of approximately 22,000 acres (8903 hectares) per year (Biological Opinion for the Interim Water Contract Renewal, Service file 1-1-00-F-0056, February 29, 2000). Virtually all of the documented loss of essential blunt-nosed leopard lizard habitat was the result of conversion to irrigated agriculture.

During 1990 to 1996, a gross total of approximately 71,500 acres (28,935 hectares) of habitat were converted to farmland in 30 counties (total area 23.1 million acres [9.3 million hectares]) within the Conservation Program Focus area of the Central Valley Project. This area includes 42,520 acres (17,207 hectares) of grazing land and 28,854 acres (11,677 hectares) of "other" land, which is predominantly comprised of native habitat. During this same time period, approximately 101,700 acres (41,157 hectares) were converted to urban land use within the Conservation Program Focus area (California Department of Conservation 1994, 1996, 1998). This area includes 49,705 acres (20,115 hectares) of farmland, 20,476 acres (8286 hectares) of grazing land, and 31,366 acres (12,693 hectares) of "other" land, which is predominantly comprised of native habitat. Because these assessments included a substantial portion of the Central Valley and the adjacent foothills, they provide the best scientific and commercial information currently available regarding the patterns and trends of land conversion within the kit fox's geographic range. More than 1 million acres (0.4 million hectares) of suitable habitat for kit foxes have been converted to agricultural, municipal, or industrial uses since the listing of the kit fox. In contrast, less than 500,000 acres (202,343 hectares) have been preserved or are subject to community-level conservation efforts designed, at least in part, to further the conservation of the kit fox (Service 1998).

Land conversions contribute to declines in kit fox abundance through direct and indirect mortalities, displacement, reduction of prey populations and denning sites, changes in the distribution and abundance of larger canids that compete with kit foxes for resources, and reductions in carrying capacity. Kit foxes may be buried in their dens during land conversion activities (C. Van Horn, Endangered Species Recovery Program, Bakersfield, personal

communication to S. Jones, Fish and Wildlife Service, Sacramento, California, 2000), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972; Morrell 1975). Furthermore, even moderate fragmentation or loss of habitat may significantly impact the abundance and distribution of kit foxes. Capture rates of kit foxes at the Naval Petroleum Reserve in Elk Hills were negatively associated with the extent of oil-field development after 1987 (Warrick and Cypher 1999). Likewise, the California Energy Commission found that the relative abundance of kit foxes was lower in oil-developed habitat than in nearby undeveloped habitat on the Lokern (Spiegel 1996). Researchers from both studies inferred that the most significant effect of oil development was the lowered carrying capacity for populations of both foxes and their prey species attributed to the changes in habitat characteristics or the loss and fragmentation of habitat (Spiegel 1996; Warrick and Cypher 1999).

Dens are essential for the survival and reproduction of kit foxes that use them year-round for shelter and escape, and in the spring for rearing young. Hence, kit foxes generally have dozens of dens scattered throughout their territories. However, land conversion reduces the number of typical earthen dens available to kit foxes. For example, the average density of typical, earthen kit fox dens at the Naval Hills Petroleum Reserve was negatively correlated with the intensity of petroleum development (Zoellick *et al.* 1987), and almost 20 percent of the dens in developed areas were found to be in well casings, culverts, abandoned pipelines, oil well cellars, or in the banks of sumps or roads (Service 1983). These results are important because the California Energy Commission found that, even though kit foxes frequently used pipes and culverts as dens in oil-developed areas of western Kern County, only earthen dens were used to birth and wean pups (Spiegel 1996). Similarly, kit foxes in Bakersfield use atypical dens, but have only been found to rear pups in earthen dens (Patrick Kelly, Endangered Species Recovery Program, Fresno, California, personal communication to P. White, Service, Sacramento, California, April 6, 2000). Hence, the fragmentation of habitat and destruction of earthen dens could adversely affect the reproductive success of kit foxes. Furthermore, the destruction of earthen dens may also affect kit fox survival by reducing the number and distribution of escape refuges from predators.

Land conversions and associated human activities can lead to widespread changes in the availability and composition of mammalian prey for kit foxes. For example, oil field disturbances in western Kern County have resulted in shifts in the small mammal community from the primarily granivorous species that are the staple prey of kit foxes (Spiegel 1996), to species adapted to early successional stages and disturbed areas (e.g., California ground squirrels)(Spiegel 1996). Because more than 70 percent of the diets of kit foxes usually consist of abundant rabbits (*Lepus*, *Sylvilagus*) and rodents (e.g., *Dipodomys* species), and kit foxes often continue to feed on their staple prey during ephemeral periods of prey scarcity, such changes in the availability and selection of foraging sites by kit foxes could influence their reproductive rates, which are strongly influenced by food supply and decrease during periods of prey scarcity (White and Garrott 1997, 1999).

Extensive habitat destruction and fragmentation have contributed to smaller, more-isolated populations of kit foxes. Small populations have a higher probability of extinction than larger populations because their low abundance renders them susceptible to stochastic (i.e., random) events such as high variability in age and sex ratios, and catastrophes such as floods, droughts, or disease epidemics (Lande 1988; Frankham and Ralls 1998; Saccheri *et al.* 1998). Similarly, isolated populations are more susceptible to extirpation (localized extinction) by accidental or natural catastrophes because their recolonization has been hampered. These chance events can adversely affect small, isolated populations with devastating results. Extirpation can even occur when the members of a small population are healthy, because whether the population increases or decreases in size is less dependent on the age-specific probabilities of survival and reproduction than on raw chance (sampling probabilities). Owing to the probabilistic nature of extinction, many small populations will eventually lose out and go extinct when faced with these stochastic risks (Caughley and Gunn 1995).

Oil fields in the southern half of the San Joaquin Valley also continue to be an area of expansion and development activity. This expansion is reasonably certain to increase in the near future owing to market-driven increases in the price of oil. The cumulative and long-term effects of oil extraction activities on kit fox populations are not fully known, but recent studies indicate that moderate- to high-density oil fields may contribute to a decrease in carrying capacity for kit foxes attributed to habitat loss or changes in habitat characteristics (Spiegel 1996; Warrick and Cypher 1999). There are no limiting factors or regulations that are likely to retard the development of additional oil fields. Hence, it is reasonably certain that development will continue to destroy and fragment kit fox habitat into the foreseeable future.

Competitive Interactions with Other Canids

Several species prey upon San Joaquin kit foxes. Predators (such as coyotes, bobcats [*Lynx rufus*], non-native red foxes [*Vulpes vulpes*], badgers, and golden eagles [*Aquila chrysaetos*]) will kill kit foxes. Badgers, coyotes, and red foxes may also compete with kit foxes for den sites (Service 1998). The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar (Cypher and Spencer 1998). Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Land conversions and associated human activities have led to changes in the distribution and abundance of coyotes, which compete with kit foxes for resources.

Coyotes occur in most areas with abundant populations of San Joaquin kit foxes and, during the past few decades, coyote abundance has increased in many areas due to a decrease in ranching operations, favorable landscape changes, and reduced control efforts (Orloff *et al.* 1986; Cypher and Scrivner 1992; White and Ralls 1993; White *et al.* 1995). Coyotes may attempt to lessen resource competition with kit foxes by killing them. In past studies, coyote-related injuries accounted for 50-87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992; Standley *et al.* 1992; Ralls and White 1995; Spiegel 1996). Coyote-related

deaths of adult foxes appear to be largely additive (i.e., in addition to deaths caused by other mortality factors such as disease and starvation) rather than compensatory (i.e., tending to replace deaths due to other mortality factors; White and Garrott 1997). Hence, the survival rates of adult foxes decrease significantly as the proportion of mortalities caused by coyotes increase (Cypher and Spencer 1998; White and Garrott 1997), and increases in coyote abundance may contribute to significant declines in kit fox abundance (Cypher and Scrivner 1992; Ralls and White 1995; White *et al.* 1996). There is some evidence that the proportion of juvenile foxes killed by coyotes increases as fox density increases (White and Garrott 1999). This density-dependent relationship would provide a feedback mechanism that reduces the amplitude of kit fox population dynamics and keeps foxes at lower densities than they might otherwise attain. In other words, coyote-related mortalities may dampen or prevent fox population growth, and accentuate, hasten, or prolong population declines.

Land-use changes also contributed to the expansion of non-native red foxes into areas inhabited by the San Joaquin kit fox. Historically, the geographic range of the red fox did not overlap with that of the kit fox. By the 1970's, however, introduced and escaped red foxes established breeding populations in many areas inhabited by San Joaquin kit foxes (Lewis *et al.* 1993). The larger and more aggressive red foxes are known to kill kit foxes (Ralls and White 1995), and could displace them, as has been observed in the arctic when red foxes expanded into the ranges of smaller arctic foxes (*Alopex lagopus*) (Hersteinsson and Macdonald 1982). The increased abundance and distribution of nonnative red foxes will also likely adversely affect the status of kit foxes because they are closer morphologically and taxonomically related, and would likely have higher dietary overlap than coyotes; potentially resulting in more intense competition for resources. Two documented deaths of kit foxes due to red foxes have been reported (Ralls and White 1995), and red foxes appear to be displacing kit foxes in the northwestern part of their range (Lewis *et al.* 1993). At Camp Roberts, red foxes have usurped several dens that were used by kit foxes during previous years (California Army National Guard, Camp Roberts Environmental Office, unpublished data). In fact, opportunistic observations of red foxes in the cantonment area of Camp Roberts have increased 5-fold since 1993, and no kit foxes have been sighted or captured in this area since October 1997. Also, a telemetry study of sympatric red foxes and kit foxes in the Lost Hills area has detected spatial segregation between these species, suggesting that kit foxes may avoid or be excluded from red fox-inhabited areas (Patrick Kelly, personal communication to P.J. White, April 6, 2000). Such avoidance would limit the resources available to local populations of kit foxes and possibly result in decreased fox abundance and distribution.

Disease

Wildlife diseases do not appear to be a primary mortality factor that limits kit fox populations throughout their range (McCue and O'Farrell 1988; Standley and McCue 1992). However, central California has a high incidence of wildlife rabies cases (Schultz and Barrett 1991), and high seroprevalences of canine distemper virus and canine parvovirus indicate that kit fox populations have been exposed to these diseases (McCue and O'Farrell 1988; Standley and McCue 1992). Hence, disease outbreaks could cause substantial mortality or contribute to

reduced fertility in seropositive (presence of a certain antibody in a blood sample) females, as was noted in the closely-related swift fox (*Vulpes velox*).

For example, there are some indications that the rabies virus may have contributed to a catastrophic decrease in kit fox abundance at Camp Roberts, San Luis Obispo County, California, during the early 1990's. San Luis Obispo County had the highest incidence of wildlife rabies cases in California from 1989 to 1991, and striped skunks (*Mephitis mephitis*) were the primary vector (Barrett 1990; Schultz and Barrett 1991; Reilly and Mangiamele 1992). A rabid skunk was trapped at Camp Roberts during 1989 and two foxes were found dead due to rabies in 1990 (Standley *et al.* 1992). Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals from 1988 to 1991. Captures of kit foxes were positively correlated with captures of skunks from 1988 to 1997, suggesting that some factor(s) such as the rabies virus was contributing to concurrent decreases in the abundances of these species. Also, captures of kit foxes at Camp Roberts were negatively correlated with the proportion of rabid skunks trapped by County Public Health Department personnel two years previously. These data suggest that a rabies outbreak may have occurred in the skunk population and spread to the fox population. A similar time lag in disease transmission and subsequent population reductions was observed in Ontario, Canada, although in this instance the transmission was from red foxes to striped skunks (MacDonald and Voigt 1985).

Pesticides and Rodenticides

Pesticides and rodenticides pose a threat to kit foxes through direct or secondary poisoning. Kit foxes may be killed if they ingest rodenticide in a bait application, or if they eat a rodent that has consumed the bait. Even sublethal doses of rodenticides may lead to the death of these animals by impairing their ability to escape predators or find food. Pesticides and rodenticides may also indirectly affect the survival of kit foxes by reducing the abundance of their staple prey species.

For example, the California ground squirrel, the staple prey item in the northern portion of the kit fox range, was thought to have been eliminated from Contra Costa County in 1975, after extensive rodent eradication programs. Field observations indicated that the long-term use of ground squirrel poisons in this county severely reduced kit fox abundance through secondary poisoning and the suppression of populations of its staple prey (Orloff *et al.* 1986).

Kit foxes occupying habitats adjacent to agricultural lands are also likely to come into contact with insecticides applied to crops and subsequently discharged through runoff or aerial drift. Kit foxes could be affected through direct contact with chemical sprays and treated soils, or through consumption of contaminated prey. Data from the California Department of Pesticide Regulation indicate that acephate, aldicarb, azinphos methyl, bendiocarb, carbofuran, chlorpyrifos, endosulfan, s-fenvalerate, naled, parathion, permethrin, phorate, and trifluralin are used within one mile (1.6 kilometer) of kit fox habitat. A wide variety of crops (alfalfa, almonds, apples, apricots, asparagus, avocados, barley, beans, beets, bok choy, broccoli, cantaloupe, carrots, cauliflower, celery, cherries, chestnuts, chicory, Chinese cabbage, Chinese greens, Chinese radish, collards, corn, cotton, cucumbers, eggplants, endive, figs, garlic, grapefruit, grapes, hay,

kale, kiwi fruit, kohlrabi, leeks, lemons, lettuce, melons, mustard, nectarines, oats, okra, olives, onions, oranges, parsley, parsnips, peaches, peanuts, pears, peas, pecans, peppers, persimmons, pimentos, pistachios, plums, pomegranates, potatoes, prunes, pumpkins, quinces, radishes, raspberries, rice, safflower, sorghum, spinach, squash, strawberries, sugar beets, sweet potatoes, Swiss chard, tomatoes, walnuts, watermelons, and wheat), as well as buildings, Christmas tree plantations, commercial/industrial areas, greenhouses, nurseries, landscape maintenance, ornamental turf, rangeland, rights of way, and uncultivated agricultural and non-agricultural land, occur in close proximity to San Joaquin kit fox habitat.

Efforts have been underway to reduce the risk of kit foxes coming into contact with rodenticides to kit foxes (Service 1993). The Federal government began controlling the use of rodenticides in 1972 with a ban of Compound 1080 on Federal lands pursuant to Executive Order. Above-ground application of strychnine within the geographic ranges of listed species was prohibited in 1988. A July 28, 1992, biological opinion regarding the Animal Damage Control (now known as Wildlife Services) Program by the U.S. Department of Agriculture found that this program was likely to jeopardize the continued existence of the kit fox due to the potential for rodent control activities to "take" the fox. As a result, several reasonable and prudent measures were implemented, including a ban on the use of M-44 devices, toxicants, and fumigants within the recognized occupied range of the kit fox. Zinc phosphide, a compound known to be minimally toxic to kit foxes, was the only chemical authorized for use by Wildlife Services within the occupied range of the kit fox (Service 1993).

Despite these efforts, the use of other pesticides and rodenticides still pose a significant threat to the kit fox, as evidenced by the death of two kit foxes at Camp Roberts in 1992 due to secondary poisoning from chlorophacinone applied as a rodenticide, (Berry *et al.* 1992; Standley *et al.* 1992). Detectable residues of the anticoagulant rodenticides chlorophacinone, brodifacoum, and bromadiolone were found in the livers of three kit foxes recovered in the City of Bakersfield in 1999 (California Department of Fish and Game 1999).

To date, no specific research has been conducted on the effects of different pesticide or rodent control programs on the kit fox (Service 1998). This lack of information is problematic because Williams (in litt. 1989) documented widespread pesticide use in known kit fox and Fresno kangaroo rat habitat adjoining agricultural lands in Madera County. In a separate report, Williams (in litt. 1989) documented another case of pesticide use near Raisin City in Fresno County, where treated grain was placed within an active Fresno kangaroo rat (*Dipodomys nitratoides exilis*) precinct. Also, farmers have been allowed to place bait on Bureau of Reclamation property to maximize the potential for killing rodents before they entered adjoining fields (Biological Opinion for the Interim Water Contract Renewal, Service file 1-1-00-F-0056, February 29, 2000).

A September 22, 1993, biological opinion issued by the Service to the U.S. Environmental Protection Agency regarding the regulation of pesticide use (31 registered chemicals) through administration of the Federal Insecticide, Fungicide, and Rodenticide Act found that use of the following chemicals would likely jeopardize the continued existence of the kit fox: (1) aluminum

and magnesium phosphide fumigants; (2) chlorophacinone anticoagulants; (3) diphacinone anticoagulants; (4) pival anticoagulants; (5) potassium nitrate and sodium nitrate gas cartridges; and (6) sodium cyanide capsules (Service 1993). Reasonable and prudent alternatives to avoid jeopardy included restricting the use of aluminum/magnesium phosphide, potassium/sodium nitrate within the geographic range of the kit fox to qualified individuals, and prohibiting the use of chlorophacinone, diphacinone, pival, and sodium cyanide within the geographic range of the kit fox, with certain exceptions (e.g., agricultural areas that are greater than 1 mile [1.6 kilometers] from any kit fox habitat) (Service 1999).

Endangered Species Act Section 9 Violations and Noncompliance with the Terms and Conditions of Existing Biological Opinions

The intentional or unintentional destruction of habitat occupied by the San Joaquin kit fox is an issue of serious concern. Section 9 of the Act prohibits the "take" (e.g., harm, harass, pursue, injure, kill) of federally-listed wildlife species. "Harm" is further defined to include habitat modification or degradation that kills or injures wildlife by impairing essential behavioral patterns including breeding, feeding, or sheltering. Congress established two provisions (under sections 7 and 10 of the Act) that allow for the incidental take of listed wildlife species by Federal agencies, non-Federal government agencies, and private parties. Incidental take is defined as take that is "...incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." If no permit is obtained for the incidental take of listed species, the individuals or entities responsible for these actions could be liable under section 9 of the Act if any unauthorized take occurs. There are numerous examples of potential section 9 violations and possible non-compliance with the terms and conditions of existing biological opinions.

Risk of Chance Extinction Due to Small Population Size, Isolation, and High Natural Fluctuations in Abundance

Historically, kit foxes may have existed in a metapopulation (a group of spatially separated populations of the same species which interact at some level) structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Today's kit fox populations exist in an environment drastically different from the historic one, however, and extensive habitat fragmentation will result in geographic isolation, smaller population sizes, and reduced genetic exchange among populations; all of which increase the vulnerability of kit fox populations to extirpation. Populations of kit foxes are extremely susceptible to the risks associated with small population size and isolation because they are characterized by marked instability in population density. For example, the relative abundance of kit foxes at the Naval Petroleum Reserves, California, decreased 10-fold from 1981 to 1983, increased 7-fold from 1991 to 1994, and then decreased 2-fold in 1995 (Cypher and Scrivner 1992; Cypher and Spencer 1998).

Many kit fox populations are at risk of chance extinction due to small population size and isolation. This risk has been prominently illustrated during recent, drastic declines in the populations of kit foxes at Camp Roberts and Fort Hunter Liggett. Captures of kit foxes during

annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals between 1988 and 1991. This decline continued through 1997 when only three kit foxes were captured (White *et al.* 2000). A similar decrease in kit fox abundance occurred at nearby Fort Hunter Liggett, and only two kit foxes have been observed on this installation since 1995 (L. Clark, Wildlife Biologist, Fort Hunter Liggett, personal communication to P.J. White, February 15, 2000). It is unlikely that the current low abundances of kit foxes at Camp Roberts and Fort Hunter Liggett will increase substantially in the near future due to the limited potential for recruitment. The chance of substantial immigration is low because the nearest core population on the Carrizo Plain is distant (greater than 16 miles [25.7 kilometers]) and separated from these installations by barriers to kit fox movement such as roads, developments, and irrigated agricultural areas. Also, there is a relatively high abundance of sympatric predators and competitors on these installations that contribute to low survival rates for kit foxes and, as a result, may limit population growth (White *et al.* 2000). Hence, these populations may be on the verge of extinction.

The destruction and fragmentation of habitat could also eventually lead to reduced genetic variation in populations of kit foxes that are small and geographically isolated. Historically, kit foxes likely existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Preliminary genetic assessments indicate that historic gene flow among populations was quite high, with effective dispersal rates of at least one to four dispersers per generation (M. Schwartz, University of Montana, Missoula, Montana, personal communication to P.J. White, March 23, 2000). This level of genetic dispersal should allow for local adaptation while preventing the loss of any rare alleles. Based on these results, it is likely that northern populations of kit foxes were once panmictic (i.e., randomly mating in a genetic sense), or nearly so, with southern populations. In other words, there were no major barriers to dispersal among populations.

Current levels of gene flow appear to be adequate, however, extensive habitat loss and fragmentation continues to form more or less geographically distinct populations of foxes, which could reduce genetic exchange among them. An increase in inbreeding and the loss of genetic variation could increase the extinction risk for small, isolated populations of kit foxes by interacting with demography to reduce fecundity, juvenile survival, and lifespan (Lande 1988; Frankham and Ralls 1998; Saccheri *et al.* 1998).

An area of particular concern is Santa Nella in western Merced County where pending development plans threaten to eliminate the little suitable habitat that remains and provides a dispersal corridor for kit foxes between the northern and southern portions of their range. Preliminary estimates of expected heterozygosity (the fraction of individuals in a population that have different alleles at a locus on homologous chromosomes) from foxes in this area indicate that this population already may have reduced genetic variation. Other populations that may be showing the initial signs of genetic isolation are those in the Lost Hills area and the Salinas-Pajaro River watershed (i.e., Camp Roberts and Fort Hunter Liggett). Preliminary estimates of the mean number of alleles per locus from foxes in these populations indicate that allelic diversity is lower than expected. Although these results may, in part, be due to the small number

of foxes sampled in these areas, they may also be indicative of an increase in the amount of inbreeding due to further population subdivision (M. Schwartz, personal communication. to P. J. White, March 23, 2000). Further sampling and analyses are necessary to adequately assess the effects of these potential genetic bottlenecks.

Arid systems are characterized by unpredictable fluctuations in precipitation, which lead to high frequency, high amplitude fluctuations in the abundance of mammalian prey for kit foxes (Goldingay *et al.* 1997; White and Garrott 1999). Because the reproductive and neonatal (newborn) survival rates of kit foxes are strongly depressed at low prey densities (White and Ralls 1993; White and Garrott 1997, 1999), periods of prey scarcity due to drought or excessive rain events can contribute to population crashes and marked instability in the abundance and distribution of kit foxes (White and Garrott 1999). In other words, unpredictable, short-term fluctuations in precipitation and, in turn, prey abundance can generate frequent, rapid decreases in kit fox density that increase the extinction risk for small, isolated populations.

The primary goal of the recovery strategy for kit foxes identified in the Recovery Plan for Upland Species of the San Joaquin Valley, California (Service 1998) is to establish a complex of interconnected core and satellite populations throughout the species' range. The long-term viability of each of these core and satellite populations depends partly upon periodic dispersal and genetic flow between them. Therefore, kit fox movement corridors between these populations must be preserved and maintained. In the northern range, from the Ciervo Panoche region in Fresno County northward, kit fox populations are small and isolated, and have exhibited significant decline. The core populations are the Ciervo Panoche area, the Carrizo Plain area, and the western Kern County population. Satellite populations are found in the urban Bakersfield area, Porterville/Lake Success area, Creighton Ranch/Pixley Wildlife Refuge, Allensworth Ecological Reserve, Semitropic/Kern National Wildlife Refuge (NWR), Antelope Plain, eastern Kern grasslands, Pleasant Valley, western Madera County, Santa Nella, Kesterson NWR, and Contra Costa County. Major corridors connecting these population areas are on the east and west side of the San Joaquin Valley, including the Millerton Lake area of Fresno County, around the bottom of the Valley, and cross-valley corridors in Kern, Fresno, and Merced counties.

From 1991 to 2000, the Service authorized incidental take for 13 projects in Alameda, Contra Costa, San Joaquin, and Stanislaus Counties that have resulted in the loss or degradation of approximately 2,644 acres (1,070 hectares) of San Joaquin kit fox habitat (Service 2001b). Compensation measures for these projects protected or will protect 3,016 acres (1,221 hectares) of kit fox habitat within this area. However, much of these conservation measures are in the form of conservation easements, and for the most part, the lands are not actively managed for kit fox. The Service also recently issued an incidental permit for projects occurring in San Joaquin County as identified in the San Joaquin Multi-species Open Space and Conservation Plan. Since the issuance of this section 10(a)(1)(B) permit in July of 2001, three projects within the kit fox corridor have been or are in the process of being permitted. These projects will impact approximately 204 acres (83 hectares) of kit fox habitat. The San Joaquin County Council of Governments will purchase lands at a ratio of 3:1 for natural lands and 1:1 for disturbed lands to

mitigate for these impacts. In 2002, the McDonald Kit Fox Preserve was acquired in southwest San Joaquin County to compensate for impacts of current and future actions that will affect the kit fox (San Joaquin County 2003).

Although there have been sightings of kit fox in the northern range through the years by qualified biologists, population studies in this area have been limited. In 1982 and 1983, a family of kit foxes was radio collared and monitored near Bethany Reservoir (Hall 1983). From 1985 to 1989, kit fox surveys in the Kellogg Creek watershed found a total of 114 potential and possibly active dens, most of which were associated with ground squirrel colonies (Jones & Stokes Associates 1989).

The small size of the population and its isolation from other established populations make this northern most population vulnerable to extinction due to predation and competition from coyotes and red foxes, inbreeding, catastrophic events, and disease epidemics (White *et al.* 2000). Genetic studies conducted by Schwartz *et al.* (2005) found that individuals in the Los Banos population near San Luis Reservoir only breed with animals in the northern population in Alameda and Contra Costa counties. Thus, projects in Alameda and Contra Costa counties that significantly reduce travel corridors and population size could potentially impact the Los Banos kit fox population. The long term viability of both populations depends, at least in part, on periodic immigration and gene flow from between the populations.

Habitat in the northern range is highly fragmented by highways, canals, and development. Interstate 580 runs southeast to northwest as it splits from Interstate 5, and turns west through the Altamont Pass area; thus it impedes both north-south and west-east movement of San Joaquin kit foxes. Although the canal system facilitates north-south migration along its length, it also impedes lateral east-west kit fox travel. Recent development proposals, including those described above will further impede the movement of kit fox and isolate the northern population from more southern populations. These and other developments are slowly diminishing the last remaining kit fox habitat, and development pressures are expected to increase in the future (see Cumulative Effects section of this biological opinion). The protection of the remaining travel corridor, including grasslands west of Interstate 580, and lands between the California aqueduct and the Delta Mendota Canal, is vital to the survival of this population.

The Service considers the action area to be within the current range of the species and included the San Joaquin kit fox in recently completed formal consultation for other two segments of the State Route 84 Corridor Plan (U.S. Interstate 580/Isabel Avenue Interchange Construction Project, Service File: 1-1-07-F-0280 and the Pigeon Pass Curve Realignment Project, Service File: 1-1-04-F-0115). The San Joaquin kit fox has also been included in the formal consultations for other project along the State Route 580 corridor including the proposed expansion of the adjacent Los Positas College (Service File: 1-1-07-F-0201), the I-580/Fallon Road Interchange Project (1-1-07-F-0257), reinitiation of the Dublin Ranch Project (1-1-04-F-0127), the Braddock & Logan Fallon Village Project (1-1-06-F-0156), and the South Bay Aqueduct Improvement and Enlargement Project (1-1-06-F-0129).

Caltrans states that there is a CNDDB record of the listed canine within 7 miles of the action area that was observed in 2002 (Caltrans 2007a). There are a minimum of four recorded observations of San Joaquin kit fox within 10 miles of the action area (CDFG 2007). There is suitable kit fox habitat within the action area, and contiguous within a 10-mile radius of the southern end of the project. This listed canine is a wide ranging species that is capable of traveling 15 miles (24.1 kilometers) or more within suitable habitat given the lack of significant barriers to movement. Dispersing San Joaquin kit foxes have the potential to move even greater distances. In addition, individuals of this species have been recorded to move as far as 9 miles (2.7 kilometers) or more in a single night (Service 1998).

There are ground squirrels which provide dens and a prey base for the kit fox and other prey species and other smaller prey species in the action area and action area vicinity, in the form of the western fence lizards (*Sceloporus occidentalis*), black-tailed jack rabbits (*Lepus californicus*), and snakes. A red fox (*Vulpes vulpes*) carcass was found within the action area during the November 2007, site visit (Maral Kasparian personal observation, November 2007), suggesting that action area provides resources for similar canid species.

San Joaquin kit foxes residing in the vicinity of Livermore could forage and disperse through the 11.86 acre portion of the action area from Arroyo del Valle to the south end of the road alignment and the start of the Pigeon Pass Curve Realignment Project. Therefore, the Service believes that the San Joaquin kit fox is reasonably certain to occur within approximately 1.7-mile southern end of the action area because the listed species is documented to inhabit eastern Alameda County, there are recent records of the animal within dispersal distance of the proposed project, the biology and ecology of the species, and this portion of the action area contains habitat suitable for foraging, resting, movement, and other essential behaviors.

California Tiger Salamander

The final rule listing the California tiger salamander as a threatened species was published on August 4, 2004 (Service 2004a).

The California tiger salamander is endemic to California and historically inhabited the low-elevation grassland and oak savanna plant communities of the Central Valley, adjacent foothills, and inner coast ranges (Jennings and Hayes 1994; Storer 1925; Shaffer *et al.* 1993). The species has been recorded from near sea level to approximately 3,900 feet (1,189 meters) in the coast ranges and to approximately 1,600 feet (488 meters) in the Sierra Nevada foothills (Shaffer *et al.* 2004). Along the Coast Ranges, the species occurred from the Santa Rosa area of Sonoma County, south to the vicinity of Buellton in Santa Barbara County. The historic distribution in the Central Valley and surrounding foothills included northern Yolo County southward to northwestern Kern County and northern Tulare County. Three distinct California tiger salamander populations are recognized and correspond to Santa Maria area within Santa Barbara County, the Santa Rosa Plain in Sonoma County, and vernal pool/grassland habitats throughout the Central Valley.

The California tiger salamander is a large, stocky, terrestrial salamander with a broad, rounded snout. Recorded adult measurements have been as much as 8.2 inches (20.8 centimeters) long (Petranka 1998; Stebbins 2003). Tiger salamanders exhibit sexual dimorphism (differences in body appearance based on gender) with males tending to be larger than females. Tiger salamander coloration generally consists of random white or yellowish markings against a black body. The markings on adults California tiger salamanders tend to be more concentrated on the lateral sides of the body, whereas other tiger salamander species tend to have brighter yellow spotting that is heaviest on the dorsal surface.

The tiger salamander has an obligate biphasic life cycle (Shaffer *et al.* 2004). Although the larvae develop in the vernal pools and ponds in which they were born, tiger salamanders are otherwise terrestrial and spend most of their post-metamorphic lives in widely dispersed underground retreats (Shaffer *et al.* 2004; Trenham *et al.* 2001). Because they spend most of their lives underground, tiger salamanders are rarely encountered even in areas where salamanders are abundant. Subadult and adult tiger salamanders typically spend the dry summer and fall months in the burrows of small mammals, such as California ground squirrels and Botta's pocket gopher (*Thomomys bottae*) (Storer 1925; Loredo and Van Vuren 1996; Petranka 1998; Trenham 1998a). Although ground squirrels have been known to eat tiger salamanders, the relationship with their burrowing hosts is primarily commensal (an association that benefits one member while the other is not affected) (Loredo *et al.* 1996; Semonsen 1998).

Tiger salamanders may also use landscape features such as leaf litter or desiccation cracks in the soil for upland refugia. Burrows often harbor camel crickets and other invertebrates that provide likely prey for tiger salamanders. Underground refugia also provide protection from the sun and wind associated with the dry California climate that can cause excessive drying of amphibian skin. Although California tiger salamanders are members of a family of "burrowing" salamanders, they are not known to create their own burrows. This may be due to the hardness of soils in the California ecosystems in which they are found. Tiger salamanders depend on persistent small mammal activity to create, maintain, and sustain sufficient underground refugia for the species. Burrows are short lived without continued small mammal activity and typically collapse within approximately 18 months (Loredo *et al.* 1996).

Upland burrows inhabited by tiger salamanders have often been referred to as aestivation sites. However, "aestivation" implies a state of inactivity, while most evidence suggests that tiger salamanders remain active in their underground dwellings. A recent study has found that tiger salamanders move, feed, and remain active in their burrows (Van Hattem 2004). Because tiger salamanders arrive at breeding ponds in good condition and are heavier when entering the pond than when leaving, researchers have long inferred that tiger salamanders are feeding while underground. Recent direct observations have confirmed this (Trenham 2001; Van Hattem 2004). Thus, "upland habitat" is a more accurate description of the terrestrial areas used by tiger salamanders.

Tiger salamanders typically emerge from their underground refugia at night during the fall or winter rainy season (November-May) to migrate to their breeding ponds (Stebbins 1985, 1989; Shaffer *et al.* 1993; Trenham *et al.* 2000). The breeding period is closely associated with the rainfall patterns in any given year with less adults migrating and breeding in drought years (Loredo and Van Vuren 1996; Trenham *et al.* 2000). Male salamander are typically first to arrive and generally remain in the ponds longer than females. Results from a 7-year study in Monterey County suggested that males remained in the breeding ponds for an average of 44.7 days while females remained for an average of only 11.8 days (Trenham *et al.* 2000). Historically, breeding ponds were likely limited to vernal pools, but now include livestock stockponds and other artificial aquatic habitat. Ideal breeding ponds are typically fishless, and seasonal or semi-permanent (Barry and Shaffer 1994; Petranka 1998).

While in the ponds, adult salamanders mate and then the females lay their eggs in the water (Twitty 1941; Shaffer *et al.* 1993; Petranka 1998). Egg laying typically reaches a peak in January (Loredo and Van Vuren 1996; Trenham *et al.* 2000). Females attach their eggs singly, or in rare circumstances, in groups of two to four, to twigs, grass stems, vegetation, or debris (Storer 1925; Twitty 1941). Eggs are often attached to objects, such as rocks and boards in ponds with no or limited vegetation (Jennings and Hayes 1994). Clutch sizes from a Monterey County study had an averaged of 814 eggs (Trenham *et al.* 2000). Seasonal pools may not exhibit sufficient depth, persistence, or other necessary parameters for adult breeding during times of drought (Barry and Shaffer 1994). After breeding and egg laying is complete, adults leave the pool and return to their upland refugia (Loredo *et al.* 1996; Trenham 1998a). Adult salamanders often continue to emerge nightly for approximately the next two weeks to feed amongst their upland habitat (Shaffer *et al.* 1993).

Tiger salamander larvae typically hatch within 10 to 24 days after eggs are laid (Storer 1925). The peak emergence of these metamorphs is typically between mid-June to mid-July (Loredo and Van Vuren 1996; Trenham *et al.* 2000). The larvae are totally aquatic and range in length from approximately 0.45 to 0.56 inches (1.14 to 1.42 centimeters) (Petranka 1998). They have yellowish gray bodies, broad fat heads, large, feathery external gills, and broad dorsal fins that extend well up their back. The larvae feed on zooplankton, small crustaceans, and aquatic insects for about six weeks after hatching, after which they switch to larger prey (J. Anderson 1968). Larger larvae have been known to consume the tadpoles of Pacific treefrogs (*Pseudacris regilla*), Western spadefoot toads (*Spea hammondii*), and California red-legged frogs (J. Anderson 1968; P. Anderson 1968; University of California 2005). Tiger salamander larvae are among the top aquatic predators in seasonal pool ecosystems. When not feeding, they often rest on the bottom in shallow water but are also found throughout the water column in deeper water. Young salamanders are wary and typically escape into vegetation at the bottom of the pool when approached by potential predators (Storer 1925).

The tiger salamander larval stage is typically completed in 3 to 6 months with most metamorphs entering upland habitat during the summer (Petranka 1998). In order to be successful, the aquatic phase of this species' life history must correspond with the persistence of its seasonal aquatic

habitat. Most seasonal ponds and pools dry up completely during the summer. Amphibian larvae must grow to a critical minimum body size before they can metamorphose (change into a different physical form) to the terrestrial stage (Wilbur and Collins 1973).

Larval development and metamorphosis can vary and is often site-dependent. In one study, larvae collected near Stockton in the Central Valley during April varied between 1.88 to 2.32 inches (4.78 to 5.89 centimeters) in length (Storer 1925). Feaver (1971) found that larvae metamorphosed and left breeding pools 60 to 94 days after eggs had been laid, with larvae developing faster in smaller, more rapidly drying pools. Longer ponding duration typically results in larger larvae and metamorphosed juveniles that are more likely to survive and reproduce (Pechmann *et al.* 1989; Semlitsch *et al.* 1988; Morey 1998; Trenham 1998b). Larvae will perish if a breeding pond dries before metamorphosis is complete (P. Anderson 1968; Feaver 1971). Pechmann *et al.* (1988) found a strong positive correlation between ponding duration and total number of metamorphosing juveniles in five salamander species. In Madera County, Feaver (1971) found that only 11 of 30 sampled pools supported larval California tiger salamanders, and 5 of these dried before metamorphosis could occur. Therefore, out of the original 30 pools, only 6 (20 percent) provided suitable conditions for successful reproduction that year. Size at metamorphosis is positively correlated with stored body fat and survival of juvenile amphibians, and negatively correlated with age at first reproduction (Semlitsch *et al.* 1988; Scott 1994; Morey 1998).

Following metamorphosis, juveniles leave their pools and enter upland habitat. This emigration can occur in both wet and dry conditions (Loredo and Van Vuren 1996; Loredo *et al.* 1996). Wet conditions are more favorable for upland travel but rare summer rain events seldom occur as metamorphosis is completed and ponds begin to dry. As a result, juveniles may be forced to leave their ponds on rainless nights. Under dry conditions, juveniles may be limited to seeking upland refugia in close proximity to their aquatic larval pool. These individuals often wait until the next winter's rains to move further into more suitable upland refugia. Although likely rare, larvae may over-summer in permanent ponds (University of California 2005). Juveniles remain active in their upland habitat, emerging from underground refugia during rainfall events to disperse or forage (Trenham and Shaffer 2005). Depending on location and other development factors, metamorphs will not return as adults to aquatic breeding habitat for 2 to 5 years (Loredo and Van Vuren 1996; Trenham *et al.* 2000).

Lifetime reproductive success for tiger salamander species is low. Results from one study suggest that the average female tiger salamander bred 1.4 times and produced 8.5 young per reproductive effort that survived to metamorphosis (Trenham *et al.* 2000). This resulted in the output of roughly 11 metamorphic offspring over a breeding female's lifetime. The primary reason for low reproductive success may be that this relatively short-lived species requires two or more years to become sexually mature (Shaffer *et al.* 1993). Some individuals may not breed until they are four to six years old. While California tiger salamanders may survive for more than ten years, many breed only once, and in one study, less than 5 percent of marked juveniles survived to become breeding adults (Trenham 1998b). With such low recruitment, isolated

populations are susceptible to unusual, randomly occurring natural events as well human-caused factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated pools can quickly extirpate a population.

Dispersal and migration movements made by tiger salamanders can be grouped into two main categories: (1) breeding migration; and (2) interpond dispersal. Breeding migration is the movement of salamanders to and from a pond from the surrounding upland habitat. After metamorphosis, juveniles move away from breeding ponds into the surrounding uplands, where they live continuously for several years. At a study in Monterey County, it was found that upon reaching sexual maturity, most individuals returned to their natal/ birth pond to breed, while 20 percent dispersed to other ponds (Trenham *et al.* 2001). After breeding, adult tiger salamanders return to upland habitats, where they may live for one or more years before attempting to breed again (Trenham *et al.* 2000).

Tiger salamanders are known to travel large distances between breeding ponds and their upland refugia. Generally it is difficult to establish the maximum distances traveled by any species, but tiger salamanders in Santa Barbara County have been recorded dispersing up to 1.3 miles (2.1 kilometers) from their breeding ponds (Sweet 1998). Tiger salamanders are also known to travel between breeding ponds. One study found that 20 to 25 percent of the individuals captured at one pond were recaptured later at other ponds approximately 1,900 and 2,200 feet (579 to 671 meters) away (Trenham *et al.* 2001). In addition to traveling long distances during juvenile dispersal and adult migration, tiger salamanders may reside in burrows far from their associated breeding ponds.

Although previously sited information indicates that tiger salamanders can travel long distances, they typically remain close to their associated breeding ponds. A trapping study conducted in Solano County during the winter of 2002-03 suggested that juveniles dispersed and used upland habitats further from breeding ponds than adults (Trenham and Shaffer 2005). More juvenile salamanders were captured at traps placed at 328, 656, and 1,312 feet (100, 200, and 400 meters) from a breeding pond than at 164 feet (50 meters). Approximately 20 percent of the captured juveniles were found at least 1,312 feet (400 meters) from the nearest breeding pond. The associated distribution curve suggested that 95 percent of juvenile salamanders were within 2,099 feet (640 meters) of the pond, with the remaining 5 percent being found at even greater distances. Preliminary results from the 2003-04 trapping efforts at the same study site detected juvenile tiger salamanders at even further distances, with a large proportion of the captures at 2,297 feet (700 meters) from the breeding pond (Trenham *et al.*, unpublished data). Surprisingly, most juveniles captured, even those at 2,100 feet (640 meters), were still moving away from ponds (Ben Fitzpatrick, University of California at Davis, personal communication, 2004). In Santa Barbara County, juvenile California tiger salamanders have been trapped approximately 1,200 feet (366 meters) away while dispersing from their natal pond (Science Applications International Corporation, unpublished data). These data show that many California tiger salamanders travel far while still in the juvenile stage. Post-breeding movements away from breeding ponds by adults appear to be much smaller. During post-breeding emigration from

aquatic habitat, radio-equipped adult tiger salamanders were tracked to burrows between 62 to 813 feet (19 to 248 meters) from their breeding ponds (Trenham 2001). These reduced movements may be due to adult California tiger salamanders exiting the ponds with depleted physical reserves, or drier weather conditions typically associated with the post-breeding upland migration period.

California tiger salamanders are also known to use several successive burrows at increasing distances from an associated breeding pond. Although previously sited studies provide information regarding linear movement from breeding ponds, upland habitat features appear to have some influence on movement. Trenham (2001) found that radio-tracked adults were more abundant in grasslands with scattered large oaks (*Quercus* species), than in more densely wooded areas. Based on radio-tracked adults, there is no indication that certain habitat types are favored as terrestrial movement corridors (Trenham 2001). In addition, captures of arriving adults and dispersing new metamorphs were evenly distributed around two ponds completely encircled by drift fences and pitfall traps. Thus, it appears that dispersal into the terrestrial habitat occurs randomly with respect to direction and habitat types.

Documented or potential tiger salamanders predators include coyotes (*Canis latrans*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), egrets (*Egretta* species), great blue herons (*Ardea herodias*), crows (*Corvus brachyrhynchos*), ravens (*Corvus corax*), garter snakes (*Thamnophis* species), bullfrogs, California red-legged frogs, mosquito fish (*Gambusia affinis*), and crayfish (*Procrambus* species). Domestic dogs have been observed eating California tiger salamanders at Lake Lagunitas at Stanford University (Sean Barry, University of California, Davis, personal communication to C. Nagano, July 2004).

The California tiger salamander is imperiled throughout its range due to a variety of human activities (Service 2004b). Current factors associated with declining tiger salamander populations include continued habitat loss and degradation due to agriculture and urbanization; hybridization with the non-native eastern tiger salamander (*Ambystoma tigrinum*) (Fitzpatrick and Shaffer 2004; Riley *et al.* 2003); and predation by introduced species. California tiger salamander populations are likely threatened by multiple factors but continued habitat fragmentation and colonization of non-native salamanders may represent the most significant current threats. Habitat isolation and fragmentation within many watersheds have precluded dispersal between sub-populations and jeopardized the viability of metapopulations (broadly defined as multiple subpopulations that occasionally exchange individuals through dispersal, and are capable of colonizing or "rescuing" extinct habitat patches). Other threats include predation and competition from introduced exotic species; possible commercial over-utilization; diseases; various chemical contaminants; road kill; illegal collection; and certain unrestrictive mosquito and rodent control operations. Currently, these various primary and secondary threats are largely not being offset by existing federal, state, or local regulatory mechanisms. The tiger salamander is also prone to chance environmental or demographic events, to which small populations are particularly vulnerable.

The specific effects of disease on the Central California tiger salamander are not known. Pathogens, fungi, water mold, bacteria, and viruses have been known to adversely affect other tiger salamander species or other amphibians. Pathogens are suspected of causing global amphibian declines (Davidson *et al.* 2003). Pathogen outbreaks have not been documented in the Central California tiger salamander, but Chytrid fungus infections (chytridiomycosis) have been detected in Central California tiger salamanders (Padgett-Flohr and Longcore 2004). Chytridiomycosis and ranaviruses are a potential threat to the California tiger salamander because these diseases have been found to adversely affect other amphibians, including tiger salamanders (Longcore in litt. 2003; Lips in litt. 2003). Nonnative species, such as bullfrogs and nonnative tiger salamanders, are both located within the range of the Central California tiger salamander and have been identified as potential carriers of these diseases. Human activities can facilitate the spread of disease by encouraging the further introduction of non-native carriers and by acting as carriers themselves (i.e. contaminated boots or fishing equipment). Human activities can also introduce stress by other means, such as habitat fragmentation, that results in tiger salamanders being more susceptible to the effects of disease. Disease will likely become a growing threat because of the relatively small, fragmented remaining Central California tiger salamander breeding sites, the many stresses on these sites due to habitat losses and alterations, and the many other potential disease-enhancing anthropogenic changes which have occurred both inside and outside the species' range.

Thirty-one percent (221 of 711 records and occurrences) of all Central California tiger salamander records and occurrences are in Alameda, Santa Clara, San Benito (excluding the extreme western end of the County), southwestern San Joaquin, western Stanislaus, western Merced, and southeastern San Mateo counties. Of these counties, most of the records are from eastern Alameda and Santa Clara counties (Buckingham in litt. 2003; California Department of Fish and Game 2003; Service 2004b). The California Department of Fish and Game (2003) now considers 13 of these records from the Bay Area region as extirpated or likely to be extirpated.

The East Bay and Livermore Valley areas have undergone intensive urban development in recent years (California Department of Conservation 1996, 1998, 2000, 2002). The total human population of the counties in the Bay Area region increased by approximately 17 percent between 1990 and 2000 (4.5 million to 5.3 million people) (California Department of Forestry 1998). Most of the California tiger salamander natural historic habitat (vernal pool grasslands) available in this region has been lost due to urbanization and conversion to intensive agriculture (Keeler-Wolf and Elaml 1998). California tiger salamanders are now primarily restricted to artificial breeding ponds, such as bermed ponds or stock ponds which are typically located at higher elevations (California Department of Fish and Game 2003).

Of the 140 California tiger salamander localities where wetland habitat was identified, only 7 percent were located in vernal pools (California Department of Fish and Game 2003). The Bay Area region occurs within the Central Coast and Livermore vernal pool regions (Keeler-Wolf *et al.* 1998). Vernal pools within the Coast Range are more sporadically distributed than vernal pools in the Central Valley (Holland 2003). In San Benito and Santa Clara counties, Central

Coast vernal pools have been destroyed and degraded due to agriculture. The vernal pools at Stanford in Santa Clara County have been destroyed and degraded due to recreation and development (Keeler-Wolf *et al.* 1998). The annual loss of vernal pools from 1994 to 2000 in Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura counties was 2 to 3 percent. This rate of loss suggests that vernal pools in these counties are disappearing faster than previously reported (Holland 2003). Most of the vernal pools in the Livermore Region in Alameda County have been destroyed or degraded by urban development, agriculture, water diversions, poor water quality, and long-term overgrazing (Keeler-Wolf *et al.* 1998). During the 1980s and 1990s, vernal pools were lost at a 1.1 percent annual rate in Alameda County (Holland 1998).

Due to the extensive losses of vernal pool complexes and their limited distribution in the Bay Area region, many California tiger salamander breeding sites consist of artificial water bodies. Overall, 89 percent (124) of the identified water bodies are stock, farm, or berm ponds used for cattle and/or as a temporary water source for small farm irrigation (California Department of Fish and Game 2003). This possibly places the California tiger salamander at great risk of hybridization with non-native tiger salamanders, especially in Santa Clara and San Benito counties. Without long-term maintenance, the longevity of artificial breeding habitats is uncertain relative to naturally occurring vernal pools that are dependent on the continuation of seasonal weather patterns (Shaffer in litt. 2003).

Shaffer *et al.* (1993) found that the East Bay counties of Alameda and Contra Costa supported the greatest concentrations of California tiger salamander. California tiger salamander populations in the Livermore Valley are severely threatened by the ongoing conversion of grazing land to subdivisions and vineyards (Stebbins 1989; East Bay Regional Park District 1999). Proposed land conversion continues to target large areas of California tiger salamander habitat. One such project in Alameda County totals 700 acres (283 hectares) (East Bay Regional Parks District 2003). Other proposed projects located within the California tiger salamander's distribution include another 310-acre (125-hectare) project in Alameda County, two in San Joaquin County totaling 12,427 acres (5,029 hectares), and a 19-acre (7.7-hectare) project in Santa Clara County.

According to Biological Evaluation, the Ruby Hills California Tiger Salamander Habitat Reserve is located approximately 0.25 miles from the southern boundary of the action area (Caltrans 2007a). According to their assessment, Caltrans considers the California tiger salamander to occur south of Arroyo del Valle where the project may affect upland refugia (Caltrans 2007a). There are a minimum of five recorded observations of California red-legged frogs within 2 miles of the action area (CDFG 2007). Given the proximity of documented breeding habitat, upland areas within the action area are likely to be used by this listed amphibian for aestivation, foraging, and dispersal habitat. There is a possibility for the listed amphibian could inhabit or move through the entire 11.86 acres of road construction action area south of Arroyo de Valle.

Therefore, the Service believes that the California tiger salamander is reasonably certain to occur within the action area south of Arroyo de Valle because there are recent records of the listed species within dispersal distance of the proposed project, the biology and ecology of the species, and the action area south of Arroyo de Valle contains habitat suitable for dispersal and upland cover.

California Red-legged Frog

The red-legged frog was listed as a threatened species on May 23, 1996 (Service 1996). Please refer to the final rule and the Recovery Plan for the California Red-Legged Frog (*Rana aurora draytonii*) (Service 2002) for additional information on this species.

This species is the largest native frog in the western United States (Wright and Wright 1949), ranging from 1.5 to 5.1 inches (3.81 to 12.95 centimeters) in length (Stebbins 2003). The abdomen and hind legs of adults are largely red, while the back is characterized by small black flecks and larger irregular dark blotches with indistinct outlines on a brown, gray, olive, or reddish background color. Dorsal spots usually have lighter centers (Stebbins 2003) and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3.1 inches (1.52 to 7.87 centimeters) in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

Red-legged frogs have paired vocal sacs and vocalize in air (Hayes and Krempels 1986). Female frogs deposit egg masses on emergent vegetation, allowing the egg mass floats on the surface of the water (Hayes and Miyamoto 1984). Red-legged frogs breed from November through March with earlier breeding records occurring in southern localities (Storer 1925). Individuals occurring in coastal drainages are active year-round (Jennings *et al.* 1992), whereas those found in interior sites are normally less active during the cold season.

The historic range of the red-legged frog extended coastally from the vicinity of Elk Creek in Mendocino County, California, and inland from the vicinity of Redding, Shasta County, California, southward to northwestern Baja California, Mexico (Fellers 2005; Jennings and Hayes 1985; Hayes and Krempels 1986). The red-legged frog was historically documented in 46 counties but the taxa now remains in 238 streams or drainages within 23 counties. This represents a loss of 70 percent of its former range (Service 2002). Red-legged frogs are still locally abundant within portions of the San Francisco Bay area and the central coast. Within the remaining distribution of the species, only isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse Ranges. The species is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (California Department of Fish and Game 2004).

Adult red-legged frogs prefer dense, shrubby or emergent riparian vegetation closely associated with deep (>2.3 feet [0.7 meters]), still, or slow-moving water (Hayes and Jennings 1988). However, frogs also have been found in ephemeral creeks and drainages and in ponds that may or

may not have riparian vegetation. The largest densities of red-legged frogs currently are associated with deep pools with dense stands of overhanging willows (*Salix* species) and an intermixed fringe of cattails (*Typha latifolia*) (Jennings 1988). Red-legged frogs disperse upstream and downstream of their breeding habitat to forage and seek sheltering habitat.

According to Feller and Kleeman (2007), non-breeding dry season habitat includes several characteristics: 1) sufficient moisture to allow the frogs to survive throughout the non-breeding season that may be up to 11 months long ; 2) sufficient cover to moderate temperatures during the warmest and coldest times of the year; and 3) protection (e.g., deep pools in a stream, or complex cover such as root masses or thick vegetation) from predators such as hawks and owls, herons, and small carnivores.

During other parts of the year, habitat includes nearly any area within 1-2 miles (1.6-3.2 kilometers) of a breeding site that stays moist and cool through the summer (Fellers 2005). According to Fellers (2005), this can include vegetated areas with coyote bush (*Baccharis pilularis*), California blackberry thickets (*Rubus ursinus*), and root masses associated with willow (*Salix* species) and California bay trees (*Umbellularis californica*). Sometimes the non-breeding habitat used by red-legged frogs is extremely limited in size. For example, non-breeding red-legged frogs have been found in a 6-foot (1.8-meter) wide coyote bush thicket growing along a tiny intermittent creek surrounded by heavily grazed grassland (Fellers 2005). Sheltering habitat for red-legged frogs is potentially all aquatic, riparian, and upland areas within the range of the species and includes any landscape features that provide cover, such as existing animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris. Agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay stacks may also be used. Incised stream channels with portions narrower and depths greater than 18 inches (45.7 centimeters) also may provide important summer sheltering habitat. Accessibility to sheltering habitat is essential for the survival of red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival.

Red-legged frogs do not have a distinct breeding migration (Fellers 2005). Adult frogs are often associated with permanent bodies of water. Some frogs remain at breeding sites all year while others disperse. Dispersal distances are typically less than 0.5 mile (0.8 kilometers), with a few individuals moving up to 1-2 miles (1.6-3.2 kilometers) (Fellers 2005). Movements are typically along riparian corridors, but some individuals, especially on rainy nights, move directly from one site to another through normally inhospitable habitats, such as heavily grazed pastures or oak-grassland savannas (Fellers 2005). Dispersing frogs in northern Santa Cruz County traveled distances from 0.25 miles (0.4 kilometers) to more than 2 miles (3.2 kilometers) without apparent regard to topography, vegetation type, or riparian corridors (Bulger *et al.* 2003). Fellers and Kleeman (2007) and Bulger et al. (2003) found that California red-legged frog migration corridors can be less "pristine" (e.g., closely grazed fields, plowed agricultural lands) than breeding or non-breeding habitats. Bulger et al. (2003) observed that this listed ranid did not avoid or prefer any landscape feature or vegetation type. They tracked individuals that crossed agricultural land, including recently tilled fields and areas with mature crops. The threats facing

migrating California red-legged frogs during their movements include being run over by vehicles on roads (Gibbs 1998; Vos and Chardon 1998), degradation of habitat (Vos and Stumpel 1995; Findlay and Houlahan 1997; Gibbs 1998), predation (Gibbs 1998), and dessication (Rothermel and Semlistch 2002; Mazerolle and Desrochers 2003).

Egg masses contain about 2,000 to 5,000 moderate sized (0.08 to 0.11 inches [0.2 to 0.3 centimeters] in diameter), dark reddish brown eggs and are typically attached to vertical emergent vegetation, such as bulrushes (*Scirpus* species) or cattails (Jennings *et al.* 1992). Red-legged frogs are often prolific breeders, laying their eggs during or shortly after large rainfall events in late winter and early spring (Hayes and Miyamoto 1984). Eggs hatch in 6 to 14 days (Jennings 1988). In coastal lagoons, the most significant mortality factor in the pre-hatching stage is water salinity (Jennings *et al.* 1992). Eggs exposed to salinity levels greater than 4.5 parts per thousand results in 100 percent mortality (Jennings and Hayes 1990). Increased siltation during the breeding season can cause asphyxiation of eggs and small larvae. Larvae undergo metamorphosis 3.5 to 7 months after hatching (Storer 1925; Wright and Wright 1949; Jennings and Hayes 1990). Of the various life stages, larvae probably experience the highest mortality rates, with less than 1 percent of eggs laid reaching metamorphosis (Jennings *et al.* 1992). Sexual maturity normally is reached at 3 to 4 years of age (Storer 1925; Jennings and Hayes 1985). Red-legged frogs may live 8 to 10 years (Jennings *et al.* 1992). Populations of red-legged frogs fluctuate from year to year. When conditions are favorable red-legged frogs can experience extremely high rates of reproduction and thus produce large numbers of dispersing young and a concomitant increase in the number of occupied sites. In contrast, red-legged frogs may temporarily disappear from an area when conditions are stressful (e.g., drought).

The diet of red-legged frogs is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food items. According to their data, vertebrates, such as Pacific tree frogs and California mice (*Peromyscus californicus*) represent over half the prey mass eaten by larger frogs (Hayes and Tennant 1985). Hayes and Tennant (1985) found juvenile frogs to be active diurnally and nocturnally, whereas adult frogs were largely nocturnal. Feeding activity probably occurs primarily along the shoreline and on the surface of the water (Hayes and Tennant 1985). The diet of red-legged frogs is not well studied, but their diet is likely similar to other ranid frogs that feed on algae, diatoms, and detritus by grazing on the surface of rocks and vegetation (Fellers 2005; Kupferberg 1996a, 1996b).

Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs in systems supporting bullfrogs (Jennings and Hayes 1990; Twedt 1993), red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*), and several species of warm water fish including sunfish (*Lepomis* species), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and mosquitofish (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). Habitat loss, non-native species introduction, and urban encroachment are the primary factors that have adversely affected the red-legged frog throughout its range.

Several researchers in central California have noted the decline and eventual disappearance of red-legged frog populations once bullfrogs became established at the same site (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). This has been attributed to predation, competition, and reproduction interference. Twedt (1993) documented bullfrog predation of juvenile northern red-legged frogs (*Rana aurora aurora*), and suggested that bullfrogs could prey on subadult northern red-legged frogs as well. Bullfrogs may also have a competitive advantage over red-legged frogs. For instance, bullfrogs are larger and possess more generalized food habits (Bury and Whelan 1984). In addition, bullfrogs have an extended breeding season (Storer 1933) during which an individual female can produce as many as 20,000 eggs (Emlen 1977). Further more, bullfrog larvae are unpalatable to predatory fish (Kruse and Francis 1977). Bullfrogs also interfere with red-legged frog reproduction. Both California and northern red-legged frogs have been observed in amplexus (mounted on) with both male and female bullfrogs (Jennings and Hayes 1990; Twedt 1993; M. Jennings, in litt.1993; R. Stebbins in litt. 1993). Thus bullfrogs are able to prey upon and out-compete red-legged frogs, especially in sub-optimal habitat.

The urbanization of land within and adjacent to red-legged frog habitat has also adversely affected red-legged frogs. These declines are attributed to channelization of riparian areas, enclosure of the channels by urban development that blocks red-legged frog dispersal, and the introduction of predatory fishes and bullfrogs. The conversion and isolation of perennial pool habitats resulting from urbanization is an ongoing impact to red-legged frogs.

The California red-legged frog may be susceptible to many of the same pathogens, fungi, water mold, bacteria, and viruses have been known to adversely affect tiger salamander species or other amphibians. As with the California tiger salamander, Chytridiomycosis and ranaviruses may be a particular developing concern for California red-legged frog populations. Mao *et al.* (1999 cited in Fellers 2005) reported northern red-legged frogs infected with an iridovirus, which was also presented in sympatric three-spined sticklebacks (*Gasterosteus aculeatus*) in northwestern California. Ingles (1932a, 1932b, and 1933 cited in Fellers 2005) reported four species of trematodes from red-legged frogs, but he later synonymized two of them (found them to be the same as the other two). As mentioned for the California tiger salamander, nonnative species, such as bullfrogs and nonnative tiger salamanders, are both located within the range of the California red-legged frog and have been identified as potential carriers of these diseases. Human activities can facilitate the spread of disease by encouraging the further introduction of non-native carriers and by acting as carriers themselves (i.e. contaminated boots or fishing equipment). Human activities can also introduce stress by other means, such as habitat fragmentation, that results in red-legged frogs being more susceptible to the effects of disease. Disease will likely become a growing threat because of the relatively small, fragmented remaining California red-legged frog breeding sites, the many stresses on these sites due to habitat losses and alterations, and the many other potential disease-enhancing anthropogenic changes which have occurred both inside and outside the species' range.

The recovery plan for red-legged frogs identifies eight Recovery Units (Service 2002). The establishment of these Recovery Units is based on the Recovery Team's determination that various regional areas of the species' range are essential to its survival and recovery. The status of the red-legged frog will be considered within the smaller scale of Recovery Units as opposed to the overall range. These Recovery Units are delineated by major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the California red-legged frog. The goal of the draft recovery plan is to protect the long-term viability of all extant populations within each Recovery Unit. Within each Recovery Unit, core areas have been delineated and represent contiguous areas of moderate to high red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability within existing populations. This management strategy will allow for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of red-legged frogs.

The State Route 84 Expressway Widening Project is within Recovery Unit 4 (South and East San Francisco Bay) (Service 2002). The action area falls within Core Area #16 (East San Francisco Bay) of that Recovery Unit (Service 2002). This core unit extends from the northernmost portion of Contra Costa County, includes a portion of San Joaquin County south to Santa Clara County, includes the eastern portion of San Mateo County, and all of San Francisco County (Service 2002). Contra Costa and Alameda counties contain the majority of known California red-legged frog localities within the eastern San Francisco Bay area. Within this recovery unit, the listed amphibian seem to have been nearly eliminated from the western lowland areas near urbanization, they still occur in isolated populations in the East Bay Foothills (between Interstate 580 and Interstate 680), and are abundant in several areas in the eastern portions of Alameda and Contra Costa counties. This recovery unit is essential to the survival and recovery of California red-legged frogs, as it contains the largest number of occupied drainages in the northern portion of its range. The eastern and western edges of this area are heavily urbanized and the northern and southern edges are bounded by major highways. However, there are numerous small drainages flowing underneath both Interstate 580 and Highway 84 that California red-legged frogs could disperse through. Therefore, this area is connected to other populations of red-legged frogs in the foothills of central Alameda and Contra Costa Counties and the populations found in eastern Alameda County. The conservation needs for the East San Francisco Bay core area are: (1) protecting existing populations; (2) studying the effects of grazing on habitat; (3) reducing grazing impacts; (4) protecting habitat connectivity; (5) minimizing impacts from off-road travel and other recreational activities; (6) reducing impacts of urban development; and (7) protecting habitat buffers from nearby urbanization.

The action area includes aquatic and upland California red-legged frog habitat and this listed amphibian species has been observed nearby. California red-legged frog adults and egg masses were observed within 0.25 miles from the action area, in the Ruby Hills California Tiger Salamander Habitat Reserve in 2003 (Caltrans 2007a). According to Caltrans, red-legged frogs have also been found approximately 0.1 miles of the action area in Detjen Pond within the

Vineyard Estates housing development (Caltrans 2007a). California red-legged frogs have also been found in a tributary to the drainage that parallels State Route 84, north and south of Ruby Hills Drive (Caltrans 2007a). Caltrans identified seasonal and perennial streams, ponds, riparian and oak woodlands, and grassland habitat adjacent to the action area that is likely used by this listed amphibian (Caltrans 2007a). There are a minimum of five recorded observations of California red-legged frogs within 2 miles of the action area (CDFG 2007).

Based on the preceding information, the Service has determined it is reasonable to conclude the California red-legged frog inhabits the 11.89 acres which include Arroyo Mocho, Arroyo del Valle, and the action area south of Arroyo del Valle, based on the biology and ecology of the species, the presence of suitable habitat, and the recent records of this species.

Effects of the Proposed Action

Habitat Fragmentation and Movement Barriers

Range-wide habitat loss, fragmentation, and degradation from multiple factors are the primary threats to the San Joaquin kit fox, California tiger salamander, and California red-legged frog (Service 1996, 2004c). Loss of natural lands continues to occur further reducing the habitat available for these listed animals. However, the amount of historical and current habitat loss directly attributable to road loss has not been calculated, but the effect of habitat fragmentation on the San Joaquin kit fox, California tiger salamander, and California red-legged frog is significant. Fragmentation can reduce access to habitat as well as habitat suitability, increase mortality of animals that are moving between habitat patches due to increased risk of predation, and disrupt movements, dispersal, and gene flow.

The proposed project will reduce or eliminate the ability of the San Joaquin kit fox, California tiger salamander, and California red-legged frog to move along and across State Route 84 over the short and long term. The short term temporal effect will occur because habitat will be lost when the upland and riparian vegetation is removed for construction of the highway, and also due to the improved ability of predators to hunt the listed amphibians. The increased width of the highway likely will discourage movement by all three species. The inhibition of animal movements caused by roads and other similar structures produces a significant effect by fragmenting habitats and populations (Mader 1984; Joly and Morand 1997; Yanes *et al.* 1995). Van Gelder (1973) and Cooke (1995) have examined the effect of roads on amphibians; because of their activity patterns, population structure, and preferred habitats, aquatic breeding amphibians are more vulnerable to traffic mortality than some other species. Vos and Chardon (1998) found a significant negative effect of road density on the occupation probability of ponds by the moor frog (*Rana arvalis*) in the Netherlands. In addition, Hilty and Merenlender (2004) found that, in contrast to native species, non-native mammalian predators were more active in narrow and denuded riparian corridors and in large expanses of agricultural land (vineyards) far from core habitat.

The direction and type of habitat used by dispersing animals is especially important in fragmented environments (Forys and Humphrey 1996). Models of habitat patch geometry predict that individual animals will exit patches at more "permeable" areas (Buechner 1987; Stamps *et al.* 1987). A landscape corridor may increase the patch-edge permeability by extending patch habitat (La Polla and Barrett 1993), and allow individuals to move from one patch to another. The geometric and habitat features that constitute a "corridor" must be determined from the perspective of the animal (Forys and Humphrey 1996). The culvert extensions proposed by Caltrans/ACTIA may not adequately minimize the reduction or elimination of the movement of the California red-legged frog. The long term viability of any designated wildlife crossing is questionable unless crossing locations and the habitat on both sides of the crossing are set aside as open space or have a conservation easement or some other designation that limits development. In addition, it is unclear if hog wire will be placed on the bottom one foot of the highway perimeter fence to deter frogs from entering the roadway and guide them towards safe crossings south of Arroyo del Valle. The extended culverts may not be high enough to allow the animals to see through them to the other side of the roadway, improper placement in areas where the animals will not use them, and the uncertainty of maintenance and silt removal at drainage-associated culverts could eliminate their potential use by the frogs. A lack of hog wired guidance fences will result in individuals crossing the roadway where they are more likely to be killed b vehicles.

The installation of a concrete median will present a definitive barrier to San Joaquin kit fox, California tiger salamander, and California red-legged frog movement over the road. It is unclear if frogs will use long corregated culverts across an 80-foot or wider roadway that are not day-lighted, do not have a natural bottom, and are subject to being filled with sediment and debris without regular maintenance. The dimension of the tunnels is considered one of the most important variables in the design of passage ways for vertebrates (Yanes *et al.* 1995; Rodriguez *et al.* 1996); although no studies have determined a minimum width for the San Joaquin kit fox, California tiger salamander, and California red-legged frog, passages made for small vertebrates, such as salamanders, should be wide enough to enable animals to clearly see to the opposite end of the culvert, or there is lighting along the culvert provided by overhead grates. Ng *et al.* (2004) note that culverts typically are installed to accommodate water flow, the installation of such passage ways solely for listed species and wildlife, especially across major roadways, is justified if no other passages or crossings exist and there is suitable habitat. It is also important that the crossing attract target listed species and wildlife; fencing or other measures be incorporated into a wildlife crossing to guide animals to the preferred crossing; the crossing be placed strategically to enhance habitat connectivity; and that the adjacent land use be conducive to long-term habitat protection (Portland State University 2003). Larger culverts, e.g. at least 72 inches tall, grates placed midway on the culvert to allow lighting to encourage the animals to use them, placement in areas where the animals are moving through, and regular, e.g. at least once a year, maintenance and silt removal, and the use of properly sized hog wire along the bottom of the highway perimeter fence to guide the San Joaquin kit fox, California tiger salamander, and California red-legged frog to the culverts should increase the potential for these animals to move between habitat areas on either side of State Route 84.

Road studies suggest that properly designed culverts can significantly reduce wildlife (including frog) mortality (Dodd et al. 2004) The town of Amherst, Massachusetts installed two culverts with guiding fences to facilitate spotted salamander (*Ambystoma maculatum*) migration from their wintering burrows during spring. Before the placement of these culverts under Henry Street, a two-lane street, salamander mortality was high. After installation, approximately 75.9% of animals that reached the tunnel entrances successfully passed through them (Jackson 1996). Though the intent of wildlife culverts and crossings are to ensure safe passage of listed species and wildlife, they are also a benefit to human safety. Deer-automobile collisions, estimated by the Insurance Information Institute to occur at a rate of 500,000 per year, result in over $1 billion worth of vehicular damages, 29,000 human injuries, and 200 human fatalities each year (Cornell University). Culverts large enough to accommodate species such as deer (*Odocoileus* species) and mountain lion (*Felis concolor*), while maintaining substrates for the California red-legged frog and smaller wildlife, could reduce roadway collisions for a variety of species. For example, wildlife crossings of the Trans-Canada Highway in Canada's Banff National Park have reduced wildlife road mortality by 80%, and as much as 96% for ungulates (Robbins 2003).

Given the amount of traffic on State Route 84 it is unlikely that frogs will be able to successfully cross the road even if they do manage to find gaps or openings in the planned concrete median. Construction of this barrier is likely to adversely affect the local population and will reduce or possibly eliminate the continuity on either side of State Route 84, opportunities to recolonize formerly occupied habitat, and overall population viability.

California red-legged frog crossing should be designed and sited to enhance movement of this listed species. Recent conservation and minimization measures for this amphibian and other listed species (East Contra Costa County Habitat Conservation Plan Association 2006) has included:

1. Crossing Frequency. Large wildlife crossings will be placed approximately once every mile along new or substantially expanded roads that cross wildlife movement routes and small wildlife crossings should be placed approximately every 1,000 feet along new or substantially expanded roads. Within these parameters, undercrossings should be placed where wildlife are most likely to use them, rather than evenly spaced.

2. Culvert Designs. Tunnels or culverts must be the minimum length, height, and width necessary to provide safe passage under the road. Culvert designs will be based on the best available data at the time. Culverts should be as wide as possible. Culverts should, when feasible, provide a natural substrate on which wildlife can travel (e.g., open bottom). It is also recommended that wildlife undercrossings using tunnels or culverts use grating on the inactive part of the roadbed (e.g., road shoulders) to allow filtration of ambient light and moisture but minimize noise intrusion. Artificial lighting inside tunnels or culverts is not recommended; these devices have not been shown to be effective and may deter nocturnal wildlife.

3. Fencing Design. Fencing will be used along the roadway to direct wildlife to undercrossings and minimize their access to the road. Fencing designs will be customized for the wildlife expected to use the undercrossing and will be based on the best available data at the time. Fencing must be continuous along the road and must be attached to the undercrossing to facilitate its use. Fencing must also extend well beyond the target undercrossing to reduce the chance of wildlife moving around the fence.

   Fencing must be monitored regularly by the applicant and repairs made promptly to ensure effectiveness. Wildlife undercrossings must be at the same or similar elevation as the fencing (e.g., along elevated roadways) to increase chances of their use. Vegetation must be managed along small mammal and amphibian fencing to reduce the opportunity for these species to climb the fence. Fencing designed for small mammal or amphibian exclusion must be installed at least 8 inches deep into the soil to prevent small mammal burrows providing access under the fence.

Because their habitats have been fragmented, many endangered and threatened species exist as metapopulations (Verboom and Apeldom 1990; Verboom *et al.* 1991). A metapopulation is a collection of spatially discrete subpopulations that are connected by the dispersal movements of the individuals (Levins 1970; Hanski 1991). For metapopulations of listed species, a prerequisite to recovery is determining if unoccupied habitat patches are vacant due to the attributes of the habitat patch (food, cover, and patch area) or due to patch context (distance of the patch to other patches and distance of the patch to other features). Subpopulations on patches with higher quality food and cover are more likely to persist because they can support more individuals. Large populations have less of a chance of extinction due to stochastic events (Gilpin and Soule 1986). Similarly, small patches will support fewer individuals, increasing the rate of extinction. Patches that are near occupied patches are more likely to be recolonized when local extinction occurs and may benefit from emigration of individuals via the "rescue" effect (Hanski 1982; Gotelli 1991; Holt 1993; Fahrig and Merriam 1985). For the metapopulation to persist, the rate of patches being colonized must exceed the rate of patches going extinct (Levins 1970). If some subpopulations go extinct regardless of patch context, recovery actions should be placed on patch attributes. Patches could be managed to increase the availability of food and/or cover. Movements and dispersal corridors likely are critical to California red-legged frog population dynamics, particularly because the animals likely currently persist as metapopulations with disjunct population centers. Movement and dispersal corridors are important for alleviating over-crowding and intraspecific competition, and also they are important for facilitating the recolonization of areas where the animal has been extirpated. Movement between population centers maintains gene flow and reduced genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects. The survival of wildlife species in fragmented habitats may ultimately depend on their ability to move among patches to access necessary resources, retain genetic diversity, and maintain reproductive capacity within populations (Hilty and Merenlender 2004; Petit *et al.* 1995; Buza *et al.* 2000).

San Joaquin Kit Fox

Construction of the interchange project will result in the loss and degradation of approximately 11.39 acres of the habitat of the San Joaquin kit fox within the action area from Arroyo del Valle to the south end of the road alignment and the start of the Pigeon Pass Curve Realignment Project. This acreage does not include the 0.5 acres of fox habitat at the southern end of the project that was accounted for in the consultation for the Pigeon Pass Realignment Project. The proposed action likely will result in a number of adverse effects to this listed canine. There is a likelihood of direct injury or mortality to the animal resulting from either being crushed or entombed in the dens due to construction activities, vehicle strikes, falling into trenches or pits, being shot, being buried after becoming trapped in pipes, injured or killed by house cats (*Felis domesticus*) or dogs owned by project personnel, poisoned by rodenticides or other pesticides, injured or killed by predators attracted to food or trash at the site, or harassment from noise and vibration. San Joaquin kit foxes may be adversely affected by construction activities temporarily blocking travel corridors in grassland and agricultural areas, or by evening construction activities disturbing night time foraging.

San Joaquin kit fox mortality and injury may occur when the animals attempt to cross roads and are hit by cars, trucks, or motorcycles. The majority of strikes likely occur at night when the animals are most active. Driver visibility also is lower at night increasing the potential for strikes. Such strikes are usually fatal for an animal the size of a kit fox. Thus, vehicle strikes are a direct source of mortality for the San Joaquin kit fox. If vehicle strikes are sufficiently frequent in a given locality, they could result in reduced kit fox abundance. The death of kit foxes during the November-January breeding season could result in reduced reproductive success. Death of females during gestation or prior to pup weaning could result in the loss of an entire litter of young, and therefore, reduced recruitment of new individuals into the population.

The improved expressway will result in increased speed of local traffic and the inclusion of a concrete median. Following the completion of the proposed project, vehicles will travel through the area at a higher rate of speed which will likely result in a higher risk of vehicle strikes, locally, for San Joaquin kit foxes or other wildlife attempting to cross State Route 84.

Occurrences of vehicle strikes involving San Joaquin kit foxes have been well documented, and such strikes occur throughout the range of the species. Sources of kit fox mortality were examined during 1980-1995 at the Naval Petroleum Reserves in California in western Kern County (Cypher *et al.* 2000). During this period, 341 adult San Joaquin kit foxes were monitored using radio telemetry, and 225 of these animals were recovered dead. Of these, 20 were struck by vehicles; 9 percent of adult kit mortalities were attributed to vehicles, and 6 percent of all monitored adults were killed by vehicles. During this same period, 184 juvenile (<1 year old) kit foxes were monitored. Of these, 142 were recovered dead and 11 were killed by vehicles; 8 percent of juvenile kit fox mortalities were attributed to vehicles and 6 percent of all monitored juveniles were killed by vehicles. For both adults and juveniles, vehicle strikes accounted for less than 10 percent of all San Joaquin kit fox deaths in most years. However, in some years,

vehicles accounted for about 20 percent of deaths. Predators, primarily coyotes and bobcats, were the primary source of mortality at the Naval Petroleum Reserves. In addition, 70 kit foxes, both radio collared and non-collared, were found dead on roads in and around the Naval Petroleum Reserves during 1980-1991 (U.S. Department of Energy 1993). Of these, 34 were hit by vehicles on the approximately 990 miles (1,600 kilometers) of roads at the Reserve, and 36 were struck on the approximately 50 miles (80 kilometers) of State and County roads (e.g., State Route 119, Elk Hills Road), where traffic volumes and average vehicle speeds were higher. In western Merced County, 28 San Joaquin kit foxes were radio-collared during 1985-1987 (Briden *et al.* 1992). Seventeen were found dead and 2 (12 percent) of these deaths were attributed to vehicles. In the City of Bakersfield, 113 San Joaquin kit foxes were radio-collared and monitored during 1997-2000 (Cypher 2000). Thirty-five were recovered dead (123 adults and 12 pups); 9 adults (39 percent) and 6 pups (50 percent) were attributed to vehicle strikes. At this urban site, coyotes and bobcats are rare, and vehicles are the primary source of kit fox mortality. However, survival rates are higher than rates among kit foxes in non-urban areas, and vehicles do not appear to be limiting the population size.

Vehicles constitute a consistent source of mortality for the kit fox, based on the frequency with which vehicle strikes occur. However, the precise effect of vehicle strikes on the San Joaquin kit fox has not been adequately investigated. According to Morrell (1970), "The automobile is by far the major cause of reported San Joaquin kit fox deaths - 128 of 152 deaths reported were caused by automobiles." Morrell acknowledged that the numbers were based on non-radio-collared kit foxes and therefore were biased because road-killed foxes are conspicuous and easily observed compared to animals dying from other causes. Predators such as coyotes, bobcats, non-native red foxes, and domestic dogs likely constitute a higher source of mortality than vehicle strikes (Service 1998; Cypher 2000). Vehicle-related mortality has significantly affected other listed or rare species. Vehicles caused 49 percent of the mortality documented among endangered Florida panthers (*Puma concolor coryi*) (Maehr *et al.* 1991). With a remaining population of 20-30 animals, the loss of any to vehicles likely constitutes a significant population effect. Similarly, at least 15 percent of the remaining 250-300 key deer (*Odocoileus virginianus clavium*) are killed annually by vehicles (Tubak 1999), and this mortality is considered to be a limiting factor for this endangered species (Service 1985). Mortality from vehicles was the primary source of mortality for endangered ocelots (*Felis pardalis*) in Texas (Tubak 1999), and also contributed to the failure of a lynx (*Lynx canadensis*) reintroduction project in New York (Aubrey *et al.* 1999). Rudolph *et al.* (1999) estimated that road-associated mortality may have depressed populations of Louisiana pine snakes (*Pituophis ruthveni*) and timber rattlesnakes (*Crotalus horridus*) by over 50 percent in eastern Texas, and this mortality may be a primary factor in local extirpations of timber rattlesnakes (Rudolph *et al.* 1998). Mortality from vehicles also is contributing to the reduction in the status of the prairie garter snake (*Thamnophis radix radix*) in Ohio (Dalrymple and Reichenbach 1984), and was a limiting factor in the recovery of the endangered American crocodile (*Crocodylus acutus*) in Florida (Kushland 1988). In Florida, threatened Florida scrub-jays (*Aphelocoma coerulescens*) suffered higher mortality in territories near roads, as well as reduced productivity due to vehicle strikes of both breeding adults and young (Mumme *et al.* 1999).

Road construction and improvement activities associated with the proposed action may result in a disturbance effect on nearby San Joaquin kit foxes. Disturbance can result from noise, vibration, odors, or human activity. Disturbance may affect the kit foxes by interfering with sensory perception which could interfere with their ability to locate prey, pups, or mates, or detect approaching predators. Disturbance could induce stress which may affect physiological parameters or behavior. The resulting effects could include increase energetic requirements, decrease reproductive output, decrease immunological functions, altered space use patterns, displacement, or possibly death. Observations from a variety of sources and situations suggest that San Joaquin kit foxes may not be significantly affected by disturbance, even when the source is prolonged or continuous (Cypher 2000). However, individual animals may be more affected than others, and it is unknown whether disturbance may result in reduced local abundance.

An increase in the ambient noise level is not, in itself, likely to cause direct harm to kit foxes. No specific research has been performed on this species but a "safe, short-term level" for humans has been determined to be 75 decibels (dBA) (NIH 1990; Burglund and Lindvall 1995). The mechanisms leading to permanent hearing damage are the same for all mammals (NIH 1990). However, the enlarged pinna and reduced tragi of kit foxes indicate that hearing is more acute than in humans (Jameson and Peeters 1988). Hearing loss in humans has been correlated with cognitive dysfunction (NIH 1990). However, variation in response to intense noise has been found to vary, in humans, by as much as 30 to 50 dBA between individuals (NIH 1990). Similar variation has been found in animal studies as well (NIH 1990). Hearing loss was greater in male than in female humans; however, this may be caused by environmental factors (NIH 1990). Also, younger animals have been shown to be more susceptible to noise-induced hearing loss (NIH 1990). The ability to habituate to noise appears to vary widely between species (NPS 1994). Typical construction machinery produces noise in the range of 75 dBA (arc-welder) to 85 dBA (bulldozer) (Burglund and Lindvall 1995). Long-term noise levels of 85 dBA are recognized to cause permanent hearing damage in humans (NIH 1990). Noise at the 85 dBA level has been correlated with hypertension in Rhesus monkeys (*Macaca fasicularis*) (Cornman 2001). Increased reproductive failure in laboratory mice (*Mus musculus*) was found to occur after a level of 82-85 dBA for one week (Cornman 2001). However, measurable loss of hearing was found to occur in chinchillas (*Chinchilla laniger*) at a sustained level of 70 dBA (Peters 1965). Hearing loss from motorcycle traffic has been documented for the kangaroo rat (*Dipodomys* species) (Bondello and Brattstrom 1979) and desert kangaroo rats (*Dipodomys deserti*) showed a significant reduction in reaction distance to the sidewinder (*Crotalus cerastes*) after exposure to 95 dBA (Cornman 2001). Other desert mammals appear to sustain the same effects (Bondello and Brattstrom 1979). Aircraft noise has produced accelerated heart-rates in pronghorn (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*), and elk (*Cervus elaphus*) (MacArthur 1976; Workman *et al.* 1992; all in NPS 1994).

Hearing loss is correlated with distance from the source of the noise. At a level of 110 dBA, guinea pigs (*Cavia porcellus*) suffered long-term hearing loss at distances of 75 and 150 feet (46 meters), temporary loss at a distance of 300 feet (91.4 meters), and no measurable loss at 4,500 feet (1,372 meters) (Gonzales *et al.* 1970). In water, noise is reduced at a rate of 5 dBA for each

doubling of the distance to the source (Komanoff & Shaw 2000). For instance, a noise that measured 20 dBA at 60 feet (18.3 meters) registers 15 dBA at 120 feet (36.6 meters).

Harassment from long-term noise may cause kit foxes to eventually vacate the project site and adjacent areas. California condors (*Gymnogyps californianus*) have been shown to abandon nesting sites in response to vehicle noise (Shaw 1970). Grizzly bears (*Ursus arctos*), mountain goats (*Oreamnos canadensis*), caribou (*Rangifer* species), and bighorn sheep (*Ovis* species) have all been found to abandon foraging or calving areas in response to aircraft noise (Chadwick 1973; McCourt *et al.* 1974; Ballard 1975; Krausman and Hervert 1983; Gunn *et al.* 1985; Bleich 1990; all in NPS 1994).

Project effects on San Joaquin kit foxes are expected to be greater during the den selection, pregnancy, and early pup dependency periods of the breeding cycle (December through July) than at other times of the year. San Joaquin kit foxes may exhibit increased sensitivity to disturbance during this period and therefore, ideally, surface-disturbing activities should occur between August and November. Where this is possible, it is anticipated that surface-disturbing activities and other actions likely to result in harassment will be minimized in the vicinity of San Joaquin kit fox natal dens. Habitat compensation measures are anticipated to minimize habitat affects due to project implementation.

The proposed action could result in the introduction of chemical contaminants to the action area. Contaminants could be introduced in several ways. Substances used in project construction could leach out or wash off into adjacent habitat. Vehicle exhaust emissions can include hazardous substances which may concentrate in soils along roads. Heavy metals such as lead, aluminum, iron, cadmium, copper, manganese, titanium, nickel, zinc, and boron are all emitted in vehicle exhaust (Trombulak and Frissell 2000). Concentrations of organic pollutants (e.g., Dioxins, polychlorinated biphenyls) are higher in soils along roads (Benfenati *et al.* 1992). Ozone levels are higher in the air near roads (Trombulak and Frissell 2000). Vehicles may leak hazardous substances such as motor oil and antifreeze. Although the quantity leaked by a given vehicle may be minute, these substances can accumulate on roads and then get washed into the adjacent environment by runoff during rain storms. An immense variety of substances could be introduced during accidental spills of materials. Such spills can result from small containers falling off passing vehicles, or from accidents resulting in whole loads being spilled. Large spills may be partially or completely mitigated by clean-up efforts, depending on the substance.

San Joaquin kit foxes using areas adjacent to the road could be exposed to any contaminants that are present in the action area. Exposure pathways could include inhalation, dermal contact, direct ingestion, ingestion of contaminated soil or plants, or consumption of contaminated prey. Exposure to contaminants could cause short- or long-term morbidity, possibly resulting in reduced productivity or mortality. Carcinogenic substances could cause genetic damage resulting in sterility, reduced productivity, or reduced fitness among progeny. Contaminants also may have the same effect on kit fox prey species. This could result in reduced prey abundance and diminished local carrying capacity for the kit fox.

Little information is available on the effects of contaminants on the San Joaquin kit fox. The effects may be difficult to detect. Morbidity (signs of harm) or mortality (death) would likely occur after the animals had left the contaminated site, and more subtle effects such as genetic damage could only be detected through intensive study and monitoring. However, effects have been detected on some occasions. At the Naval Petroleum Reserve, three kit foxes are known to have been killed by drowning in spills of crude oil (Cypher *et al.* 2000). Spiegel and Disney (1996) reported that a kit fox was found covered with crude oil at the Midway-Sunset oil field and this individual died despite treatment. Other animals, some of which were prey species for the kit fox, were found drowned in crude oil at the Naval petroleum reserve (U.S. Department of Energy 1993). Such spills potentially can cause local reductions in the abundance of kit foxes and their prey.

Disturbed areas adjacent to roads provide favorable habitat conditions for a number of non-native plant species. Some of these taxa are aggressively invasive and can alter natural communities and potentially affect habitat quality. A problematic species within the range of the San Joaquin kit fox is yellow star thistle (*Centaurea melitensis*). Dense stands of this plant can form along roadsides and then spread into adjacent habitat. This plant displaces native vegetation and competes with native plants for resources. It also does not appear to be used by kit fox prey and start thistle often forms dense, spiny thickets that may be difficult for kit foxes to move through (Cypher 2000). Other invasive plant species that often benefit from road-side disturbance include mustards (*Brassica* species) and Russian thistle (*Salsola tragus*) (Tellman 1997).

Disturbed soils and reduced competition from native plants are some of the conditions that facilitate invasion along roadways by non-native plant species. Nitrogen from vehicle exhaust is deposited in habitats adjacent to roads, and the resulting enhanced nitrogen levels appear to promote growth of non-native species, particularly exotic grasses (Weiss 1999). These grasses, such as red brome (*Bromus madritensis rubens*) create dense ground cover in the San Joaquin Valley, and this dense cover appears to reduce habitat quality for various small mammal species, such as kangaroo rats, which are an important prey for kit foxes (Goldingay *et al.* 1997; Cypher 2000).

The proposed road construction project will contribute to further fragmentation and loss of foraging, denning, and dispersal habitat for the San Joaquin kit fox. However, the bridges over Arroyo Mocho and Arroyo del Valle will continue to provide wildlife passage for the listed fox under this segment of State Route 84. The purchase of 34.17 acres of open grassland habitat in Alameda County that is contiguous with other open habitat will benefit the long term sustainability of the San Joaquin kit fox in Alameda County.

California Tiger Salamander and California Red-legged Frog

The proposed project could have direct effects to the California tiger salamanders and the California red-legged frogs through direct mortality, injury, or harassment of individual juveniles and adults. According to the biological assessment for this project, no permanent or seasonal

wetlands or ponds appropriate for California tiger salamander or California red-legged frog breeding would be affected by the proposed action. However, implementation of the proposed action would result in the loss of 11.36 acres of California tiger habitat salamander, south of Arroyo del Valle and 11.39 acres of California red-legged frog habitat, within the action area which include Arroyo Mocho, Arroyo del Valle, and the action area south of Arroyo del Valle. These identified areas do not include the 0.5 acres of habitat shared by both amphibian species at the southern end of the project that were accounted for in the consultation for the Pigeon Pass Realignment Project.

Mortality, injury, or harassment of the California tiger salamander and the California red-legged frog could occur from being crushed by project related equipment or vehicles, construction debris, and worker foot traffic within the action area. Individuals of these two listed species also could fall into trenches, pits, or other excavations, and then be directly killed or unable to escape and be killed due to desiccation, entombment, or starvation. Work activities, including vibration, may cause red-legged frogs and tiger salamanders to leave the work site and surrounding areas. Individuals also may become trapped by plastic mono-filament netting used for erosion control or other purposes where they could be subject to death by predation, starvation, or desiccation (Stuart *et al.* 2001). This disturbance and displacement may increase the potential for predation, desiccation, competition for food and shelter, or strike by vehicles on roadways.

Various conservation measures such as minimizing the total area disturbed by project activities, and properly constructing exclusionary fencing may reduce mortality, injury, or harassment. Preconstruction surveys and the relocation of individual red-legged frogs or tiger salamanders may reduce injury or mortality. However, the capturing and handling of red-legged frogs and tiger salamanders to remove them from a work area may result in the harassment, mortality or injury of individuals. Stress, injury, and mortality may occur as a result of improper handling, containment, and transport of individuals. Death and injury of individual red-legged frogs or tiger salamanders could occur at the time of relocation or later in time subsequent to their release. Although survivorship for translocated red-legged frogs and tiger salamanders has not been estimated, survivorship of translocated wildlife, in general, is lower because of intraspecific competition, lack of familiarity with the location of potential breeding, feeding, and sheltering habitats, and increased risk of predation. Improper handling, containment, or transport of individuals would be reduced or prevented by use of a Service-approved biologist, by limiting the duration of handling, and requiring the proper transport of these species.

Various other work activities associated with the proposed project also may adversely affect California tiger salamanders and California red-legged frogs. Trash left during or after project activities could attract predators to work sites, which could subsequently harass or prey on the animals. For example, raccoons, crows, and ravens are attracted to trash and also prey opportunistically on amphibians. Accidental spills of hazardous materials or careless fueling or oiling of vehicles or equipment could degrade water quality or habitat to a degree where salamanders and frogs are adversely affected. Some potential also exists for disturbance of habitat which could result in the spread or establishment on non-native invasive plant species.

Biologists working in different areas and with different species may transmit diseases by introducing contaminated equipment. The chance of a disease being introduced into a new area is greater today than in the past due to the increasing occurrences of disease throughout amphibian populations in California and the United States. It is possible that chytrid fungus may exacerbate the effects of other diseases on amphibians or increase the sensitivity of the amphibian to environmental changes (e.g., water pH) that reduce normal immune response capabilities (Bosch et al. 2001). Implementation of the Declining Amphibian Populations Task Force Fieldwork Code of Practice" during any aquatic survey activity will likely prevent transfer of diseases through contaminated equipment or clothing.

The proposed road construction project will contribute to further fragmentation and loss of foraging, aestivation, and dispersal habitat for the California red-legged frog and California tiger salamander. However, the bridge across Arroyo Mocho and Arroyo del Valle and the 66-inch culvert under Kalthoff Common and the 48-inch culvert between Ruby Hill Drive and Vallecitos Road that connects to Detjen Pond likely will continue to provide passage for following construction for listed amphibians. The purchase of 34.17 acres of occupied habitat for both listed amphibians will benefit the long term sustainability of the California red-legged frog and California tiger salamander in Alameda County.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Numerous non-Federal activities continue to negatively affect the San Joaquin kit fox, California tiger salamander, and California red-legged frog in Alameda County. Habitats are lost or degraded as a result of road and utility construction and maintenance, overgrazing, agricultural expansion, and water irrigation and storage projects that may not be funded, permitted, or constructed by a Federal agency. Other threats include contamination, poisoning, increased predation, and competition from non-native species associated with human development. Small private actions that may impact listed species, such as conversion of land, small mammal population control, mosquito control, and residential development, may occur without consultation with or authorization by the Service or the California Department of Fish and Game pursuant to their respectively Endangered Species Act.

It is anticipated that population increases and development pressures will continue to affect land use and growth in Alameda County for the foreseeable future. Population growth in Alameda County was 10.7% between 1990 and 2000 (U.S. Census Bureau 2006). Increased demand for housing will likely result in loss of suitable habitat for all listed species discussed in this opinion as housing developments replace agricultural and ranch lands. Increased urbanization in the region will contribute to the degradation of water quality in streams, altered flow regimes,

increased contaminated road runoff, loss of upland habitat, and increased human presence in natural areas.

Livermore, Pleasanton, and Dublin were some of the fastest growing urban areas in Alameda County during the last decade. Dublin grew with 29 percent between 1990 and 2000, and is expected to continue to grow at similar rate, while growth of Livermore and Pleasanton slowed down during the same period. The growth inducing effects of the State Route 84 Expressway Widening Project will be limited by local growth-control initiatives.

The Alameda County Save Agriculture and Open Space Lands Initiative (Measure D), was approved by Alameda County voters in 2000. The County's Measure D draws urban growth boundaries around the three cities served by Zone 7 that can be changed only by a public vote. This measure halted the plans for developing 12,500 homes north of Livermore and protects open landscape for further urban expansion outside the growth boundaries. Through this amendment, Measure D added more than 60 new policies and programs limiting development potential in North Livermore and redrew the County's Urban Growth Boundary to remove North Livermore from development (City of Livermore 2007). The County's General Plan specifically states that the purpose of the Urban Growth Boundary is to "divide areas inside the boundary, next to existing cities, generally suitable for urban development, from areas outside suitable for long-term protection of natural resources, agriculture, public health, and safety, and buffers between the communities (City of Livermore 2007)." The General Plan mandates "the County shall approve only open space, park, recreational, agricultural, limited infrastructure, public facilities, and other similar and compatible uses outside the Urban Growth Boundary (Policy 54) (City of Livermore 2007)". Countywide voter approval would be required to approve any project deemed inconsistent with Measure D or to adjust the urban growth boundary line.

According to Caltrans and ACTIA, the purpose of the State Route 84 Expressway Widening Project is to conform with other sections of the roadway within the travel corridor and improve the local traffic circulation and is not growth inducing.

Several development projects are occurring or planned within the city limits and Urban Growth Boundary that affect aquatic and upland habitat used by amphibians. The accumulation of a large population also affects the species environment outside of the city boundaries, and within the western portion of the action area, through contamination, noise, human activities, and vehicle traffic. In addition, vineyards and golf courses have been, and are being, developed south of the cities of Livermore and Pleasanton.

As urban development continues, it will likely adversely affect upland areas that serve as primary habitat for the kit fox and serve as dispersal and aestivation habitat for red-legged frogs and tiger salamanders. Continued development and maintenance of roadways to serve expanding urban areas may further fragment and isolate populations of red-legged frogs, kit fox, and tiger salamanders from other nearby populations. Increased predation associated with domesticated pets or feral animals generally accompanies urban expansion. As urban development encroaches

on rural areas, the need increases for mosquito abatement programs that may introduce exotic fish into ponds used for breeding by red-legged frogs and tiger salamanders, thus impacting the reproductive success of these species.

Cattle-grazing is a common land use practice in rural Alameda County. Overgrazing results in degradation and loss of riparian vegetation, increased water temperatures, streambank and upland erosion, and decreased water quality in streams. Livestock operations may also degrade water quality with pesticides and nutrient contamination. However, light to moderate livestock grazing is generally thought to be compatible with continued successful use of rangelands by the kit fox, tiger salamander, red-legged frog, and other listed species, provided the grazed areas do not also have intensive burrowing rodent control efforts (T. Jones, in litt. 1993; Shaffer et al. 1993). The shorter vegetation associated with grazed areas may make the habitat more suitable for ground squirrels whose burrows are utilized by both red-legged frogs and tiger salamanders. Rodent control in rural areas in Alameda County could contribute to the decline of tiger salamanders and red-legged frogs in the region, as well as other sensitive species that utilize burrows created by burrowing rodents.

Agricultural development, impoundments, and irrigation can reduce stream flows, resulting in the loss of aquatic habitat during the summer for red-legged frogs. Discing is a common practice on agricultural lands which can result in substantial losses of upland habitat for red-legged frogs, tiger salamanders, and kit fox. Significant conversion of rural, undeveloped land to agricultural land, particularly vineyards, is currently occurring in Alameda County, resulting in loss of upland habitat for listed species.

Increased levels of vehicles and increased vehicle speeds on the three roads could lead to an increased mortality level for the San Joaquin kit fox, California tiger salamander, and the California red-legged frog. The cumulative local development will result in temporary and permanent habitat fragmentation. The results of fragmentation are inhibition of genetic exchange between populations and impediments to recolonization of habitats from which populations have been extirpated. Small, isolated populations are substantially more vulnerable to stochastic events (e.g., aberrant weather patterns, fluctuations in availability of food) and may exhibit reduced adaptability to environmental (natural or anthropogenic) changes.

There is a continued demand for new housing and commercial development in Alameda County and other road and development projects have been recently completed or are planned along the Interstate 580 corridor between Livermore and Dublin and State Route 84 between Interstates 580 and 680. These large developments and further infill will eliminate the habitat connectivity between listed species habitat remaining habitat north and east of the action area. Development of adjacent wildlife habitat will continue to result in the loss of not only breeding, resting, and foraging habitat, but the loss of dispersal corridors between breeding populations, thereby further isolating and fragmenting wildlife populations. Additionally, development of small reservoirs or water bodies, such as golf course hazards, and water diversions may occur which may pose

further threats such as disruption of dispersal corridors for terrestrial species, and competition or predation from with non-native species such as bullfrogs for aquatic species.

Cumulative effects to the San Joaquin kit fox, California tiger salamander, and California red-legged frog include continuing and future conversion of suitable breeding, foraging, sheltering, and dispersal habitat resulting from urban development. Additional urbanization can result in road widening and increased traffic on roads that bisect habitat, thereby increasing road-kill while reducing in size and further fragmenting remaining habitats.

California tiger salamanders and California red-legged frogs likely are exposed to a variety of pesticides and other chemicals throughout their ranges. These two amphibian species could also die from starvation due to the loss of their prey base. Hydrocarbon and other contamination from oil production and road runoff; the application of numerous chemicals for roadside maintenance; urban/suburban landscape maintenance; and rodent and vector control programs may all have negative effects on tiger salamander populations. In addition, tiger salamanders and red-legged frogs may be harmed through increased road kill due to the construction and use of new roads and increased traffic in the overall region and collection by amphibian enthusiast and others.

Further habitat fragmentation; additional non-native species introduction; and increased access to aquatic habitat could facilitate or increase the spread of amphibian diseases within the range of the California tiger salamander and the California red-legged frog. The global mass extinction of amphibians primarily due to chytrid fungus continues to be of significant concern (Norris 2007; Skerratt *et al* 2007).

The global average temperature has risen by approximately 0.6 degrees Celsius during the 20th Century (IFPC 2001, 2007; Adger *et al* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (IFPC 2001, 2007; Adger *et al.* 2007), and that it is "very likely" that it is largely due to manmade emissions of carbon dioxide and other greenhouse gases (Adger *et al.* 2007). Ongoing climate change (Anonymous 2007; Inkley *et al.* 2004; Adger *et al.* 2007; Kanter 2007) likely imperils the California tiger salamander, California red-legged frog, and the San Joaquin kit fox, and the resources necessary for their survival. Since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats and/or prey, and/or increased numbers of their predators, parasites, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

Conclusion

After reviewing the current status of the San Joaquin kit fox, California tiger salamander, and California red-legged frog the environmental baseline for the action area; the effects of the proposed State Route 84 Expressway Widening Project and the cumulative effects; it is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of these three listed species. We based these determinations on the

following: (1) pre-construction surveys will be conducted for California red-legged frogs and California tiger salamanders and individuals of both species found in the project work area will be relocated to suitable habitat; (2) pre-construction surveys will be conducted for kit fox and potential kit fox den sites and the minimization measures will be followed if kit fox or potential den sites are found; (3) a Service-approved biologist will monitor all activities that may result in the take of listed species; (4) Caltrans/ACTIA will purchase 34.17 acres of habitat that will benefit the California red-legged frog, California tiger salamander, and San Joaquin kit fox (5) other conservation measures, as described in the Project Description of this biological opinion, that will be fully implemented by the applicant. Critical habitat for the San Joaquin kit fox has not been proposed or designated, therefore, none will be affected by the proposed project. Critical habitat for the California tiger salamander, and California red-legged frog have been designated, however none is located in the action area, and therefore none will be affected by the proposed project.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by Caltrans so that they become binding conditions of any grant or permit issued to Caltrans as appropriate, in order for the exemption in section 7(o)(2) to apply. Caltrans has a continuing duty to regulate the activity covered by this Incidental Take Statement. If Caltrans (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service expects that incidental take of the San Joaquin kit fox will be difficult to detect or quantify because when kit fox are not foraging, mating, or conducting other surface activity, they inhabit dens or burrows; the animal may range over a large territory; it is primarily active at night; it is a highly intelligent animal that is often is extremely shy around humans; and the nature of the species and its cryptic behavior make the finding of an injured or dead individual unlikely, and the animal occurs in habitat that makes it difficult to detect. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers. No injury or mortality of kit fox is anticipated due to the implementation of pre-construction den surveys and other proposed conservation measures. Therefore, the Service is estimating that all of the kit foxes inhabiting or utilizing the 11.86 acre action area south of Arroyo del will be subject to incidental take in the form of harm and harassment due to the disturbance by project related activities. Incidental take in the form of harm also is expected to result from habitat loss and modification, construction-related disturbance, increased predation, and increased human activities.

As stated in the California Department of Fish and Game Code Section 2080.1, Caltrans should submit this biological opinion for the San Joaquin kit fox to the Department of Fish and Game for a consistency determination. Caltrans may be required to apply for a State Incidental Take Permit for the San Joaquin kit fox under section 2081(b) of the Fish and Game Code if the California Department of Fish and Game determines that this Federal document is not consistent with the California Endangered Species Act.

The Service anticipates that incidental take of the California tiger salamander will be difficult to detect because when this amphibian is not in their breeding ponds, or foraging, migrating, or conducting other surface activity, they inhabit the burrows of ground squirrels or other rodents; the burrows may be located a distance from the breeding ponds; the migrations occur on a limited period during rainy nights in the fall, winter, or spring; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Recent project monitoring suggests that California tiger salamanders are difficult to find during preconstruction clearance surveys that include excavation of potential upland salamander refugia in close proximity to breeding ponds. Losses of this species may also be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in the water regime at their breeding ponds, or additional environmental disturbances. Due to the difficulty in quantifying the number of California tiger salamander that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as all of the California tiger salamander inhabiting or utilizing the 11.86 acre action area south of Arroyo del Valle;. The incidental take is expected to be in the form of harm, harassment, injury, and mortality to adult California tiger salamanders from habitat loss/degradation, construction-related disturbance, and capture and relocation.

The Service anticipates that incidental take of the California red-legged frog will be difficult to detect because when California red-legged frogs are not in their breeding ponds, they inhabit the burrows of ground squirrels or other rodents; they may be difficult to locate due to their cryptic appearance and behavior; the sub-adult and adult animals may be located a distance from the breeding ponds; the migrations occur on a limited period during rainy nights in the fall, winter, or spring; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Recent project monitoring suggests that California red-legged frogs are difficult to find during preconstruction clearance surveys that include excavation of potential upland salamander refugia in close proximity to breeding ponds and other aquatic habitat. Losses of California red-legged frogs may also be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Due to the difficulty in quantifying the number of California red-legged frogs that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as all of the California red-legged frogs inhabiting or utilizing the 11.89 acres associated with Arroyo Mocho, Arroyo del Valle and the action area south of Arroyo del Valle. The incidental take is expected to be in the form of harm, harassment, injury, and mortality to adult California red-legged frogs from habitat loss/degradation, construction-related disturbance, and capture and relocation.

Upon implementation of the following reasonable and prudent measures incidental take associated with the proposed action described above for the San Joaquin kit fox, California tiger salamander, and California re-legged frog will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take for the San Joaquin kit fox, California tiger salamander, and California red-legged frog is not likely to jeopardize the continued existence of these three species. Critical habitat for the San Joaquin kit fox has not been proposed or designated, therefore, none will be affected. Critical habitat for the California tiger salamander, and California red-legged frog have been designated, however none is located in the action area, and therefore none will be affected by the proposed project.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effect of the proposed action on the San Joaquin kit fox, California tiger salamander, and California red-legged frog:

1. Caltrans will implement the conservation measures in the project description as described in the June 2007 Biological Evaluation, the December 11, 2007 revised project description, and this biological opinion.

2. Reduce adverse effects to the San Joaquin kit fox, California tiger salamander, and California red-legged frog.

3. Caltrans shall ensure their compliance with this biological opinion.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, Caltrans shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The following Terms and Conditions implement Reasonable and Prudent Measure one (1):

   a. Caltrans shall minimize the potential for harm, harassment, or killing of federally listed wildlife species resulting from project related activities by implementation of the conservation measures as described in June 2007 Biological Evaluation, the December 11, 2007 revised project description, and appearing in the Project Description of this biological opinion.

   b. Caltrans shall include Special Provisions that include the Conservation Measures and the Terms and Conditions of this biological opinion in the solicitation for bid information. In addition, Caltrans shall educate and inform contractors involved in the project as to the requirements of the biological opinion.

   c. The applicant shall prepare a relocation plan for moving California red-legged frogs and California tiger salamanders at least 60 working days prior to the date of initial ground breaking.

2. The following Terms and Conditions implement Reasonable and Prudent Measure two (2):

   a. The Resident Engineer or their designee shall be responsible for implementing the conservation measures and Terms and Conditions of this biological opinion and shall be the point of contact for the project. The Resident Engineer or their designee shall maintain a copy of this biological opinion onsite whenever construction is taking place. Their name and telephone number shall be provided to the Service at least thirty (30) calendar days prior to groundbreaking at the project. Prior to ground breaking, the Resident Engineer must submit a letter to the Service verifying that they posses a copy of this biological opinion and have read the Terms and Conditions.

   b. The Caltrans biologist shall have oversight over implementation of all the Terms and Conditions in this biological opinion, and shall have the authority to stop project

activities, through communication with the Resident Engineer or their designee, if any of the requirements associated with these Terms and Conditions are not being fulfilled. If biologist/construction liaison has requested a stop work due to take of any of the listed species the Service and the California Department of Fish and Game will be notified within one (1) working day via email or telephone.

c. No more than thirty (30) calendar days prior to any ground disturbance, pre-construction surveys shall be conducted by a Service-approved biologist for the San Joaquin kit fox, California tiger salamander, and California red-legged frog for the road construction and restoration projects. These surveys shall consist of walking surveys of the project limits and adjacent areas accessible to the public to determine presence of the species. Biologist should investigate all potential California tiger salamander and California red-legged frog cover sites. This includes full investigation of mammal burrows. The entrances should be collapsed following investigation.

d. Nets or bare hands may be used to capture California red-legged frogs and California tiger salamanders. Service-approved biologists will not use soaps, oils, creams, lotions, repellents, or solvents of any sort on their hands within two hours before and during periods when they are capturing and relocating red-legged frogs or tiger salamanders. To avoid transferring disease or pathogens between aquatic habitats during the course of surveys or handling of red-legged frogs or tiger salamanders, Service-approved biologists will follow the Declining Amphibian Populations Task Force's "Code of Practice." Service-approved biologists will limit the duration of handling and captivity of red-legged frogs or tiger salamanders. While in captivity, individuals of these species shall be kept in a cool, moist, aerated environment, such as a bucket containing a damp sponge. Containers used for holding or transporting adults of these species shall not contain any standing water.

e. A biologist should be onsite to monitor the initial ground disturbance activities. The biologist should perform a clearance survey immediately prior to the initial ground disturbance. The biological monitor should also investigate areas of disturbed soil for signs of listed species within 30 minutes following the initial disturbance of that given area.

f. All California red-legged frogs and California tiger salamanders encountered in the action area should be relocated to a Service-approved location. The relocation site must be approved for the State Route 84 Expressway Widening Project prior to California red-legged frogs and California tiger salamanders preconstruction surveys.

g. Project-related vehicles shall observe a 20-mile (32-kilometer) per hour speed limit within construction areas, except on County roads, and State and Federal highways; this is particularly important at night when the San Joaquin kit fox, California tiger

salamander, and California red-legged frog are most active. To the maximum extent possible, night-time construction should be minimized. Off-road traffic outside of designated project areas shall be prohibited.

3. The following Terms and Conditions implement Reasonable and Prudent Measure three (3):

   a. Caltrans shall submit a post-construction compliance report prepared by the on-site biologist to the Sacramento Fish and Wildlife Office within 60 calendar days following project completion or within 60 calendar days of any break in construction activity lasting more than 60 calendar days. This report shall detail (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting compensation and other conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on the San Joaquin kit fox, California red-legged frog, and California tiger salamander, if any; (v) occurrences of incidental take of any of these three species; (vi) documentation of employee environmental education; and (vii) other pertinent information. The reports shall be addressed to the Deputy Assistant Field Supervisor of the Endangered Species Program, Sacramento Fish and Wildlife Office.

   b. Caltrans shall report to the Service any information about take or suspected take of listed wildlife species not authorized by this biological opinion. Caltrans must notify the Service via electronic mail and telephone within 24 hours of receiving such information. Notification must include the date, time, location of the incident or of the finding of a dead or injured animal, and photographs of the specific animal. The individual animal shall be preserved, as appropriate, and held in a secure location until instructions are received from the Service regarding the disposition of the specimen or the Service takes custody of the specimen. The Service contacts are Chris Nagano, Deputy Assistant Field Supervisor, Endangered Species Program, Sacramento Fish and Wildlife Office at (916) 414-6600, and Special Agent Scott Heard of the Service's Law Enforcement Division at (916) 414-6660.

Reporting Requirements

Injured San Joaquin kit foxes, California tiger salamanders, and/or California red-legged frogs must be cared for by a licensed veterinarian or other qualified person such as the on-site biologist; dead individuals of any of these three listed species should be placed in a sealed plastic bag with the date, time, location of discovery, and the name of the person who found the animal; the carcass should be kept in a freezer and held in a secure location. The Service and the California Department of Fish and Game must be notified within one (1) working day of the discovery of death or injury to a San Joaquin kit fox, California tiger salamander, and/or California red-legged frog that occurs due to project related activities or is observed at the project site. Notification must include the date, time, and location of the incident or of the finding of a

dead or injured animal clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. The Service contacts are Chris Nagano, Deputy Assistant Field Supervisor, Endangered Species Program at the Sacramento Fish and Wildlife Office (916/414-6600), and Scott Heard, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Mr. Scott Wilson at (707) 944-5584.

Sightings of any listed or sensitive animal species should be reported to the California Natural Diversity Database of the California Department of Fish and Game.

Caltrans shall submit a post-construction compliance report prepared by the on-site biologist to the Sacramento Fish and Wildlife Office within sixty (60) calendar days of the date of the completion of construction activity. This report shall detail (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting compensation and other conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on the San Joaquin kit fox, California tiger salamander, and California red-legged frog, if any; (v) occurrences of incidental take of any of these three listed species, if any; (vi) documentation of employee environmental education; and (vii) other pertinent information.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases.

The Service requests notification of the implementation of any conservation recommendations in order to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats. We propose the following conservation recommendations:

1. Caltrans should assist the Service in implementing recovery actions identified in the *Recovery Plan for the California Red-legged Frog* (Service 2002).

2. Caltrans should assist the Service in developing and implementing recovery actions identified in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (Service 1998).

3. Caltrans and ACTIA should consider participating in the planning for a regional habitat conservation plan for the San Joaquin kit fox, California tiger salamander, California red-legged frog, other listed species, and sensitive species.

4. Caltrans should consider establishing functioning preservation and creation conservation banking systems to further the conservation of the San Joaquin kit fox, California tiger salamander, California red-legged frog, and other appropriate species. Such banking systems also could possibly be utilized for other required mitigation (i.e., seasonal wetlands, riparian habitats, etc.) where appropriate.

5. Caltrans/ACTIA should incorporate culverts, tunnels, or bridges on highways and other roadways that allow safe passage by San Joaquin kit fox, California red-legged frog, California tiger salamander, other listed animals, and native wildlife. Caltrans/ACTIA should include photographs, plans, and other information in their biological assessments when they incorporate "wildlife friendly" crossings into their projects.

6. Caltrans/ ACTIA should continue to pursue multifaceted compensation packages such as the one developed for the proposed U.S. Interstate 580/Isabel Avenue Interchange Construction Project on future formal consultations with the Service.

7. Caltrans should continue to develop and implement their Early Statewide Biological Mitigation Planning Project that has been developed by the University of California at Davis, Road Ecology Center through Caltrans funding.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed and/or proposed species or their habitats, the Service requests notification of the implementation of these recommendations.

REINITIATION--CLOSING STATEMENT

This concludes formal consultation on the proposed State Route 84 Expressway Widening Project, Alameda County, California. As provided in 50 CFR §402.16 and in the terms and conditions of this biological opinion, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have questions concerning this opinion on the proposed State Route 84 Expressway Widening Project, Alameda County, California, you can contact John Cleckler or Chris Nagano at the letterhead address or at (916) 414-6600.

Sincerely,

for Cay C. Goude
Acting Field Supervisor

cc:
Scott Wilson, California Department of Fish and Game, Yountville, California
Janice Gan, California Department of Fish and Game, Tracy, California
Marcia Grefsrud, California Department of Fish and Game, Yountville, California
Eric Brown, City of Livermore, Livermore, California
Cheri Sheets, City of Livermore, Livermore, California
Michele Bellows, Alameda County Transportation Authority, Oakland, California
Arthur Dao, Alameda County Transportation Authority, Oakland, California
Margaret Gabil, California Department of Transportation, Oakland, California
Cheryl Davis, California Department of Transportation, Oakland, California
Dale Jones, California Department of Transportation, Sacramento, California
Brian Wines, State Water Resources Control Board, Oakland, California
William R. Gray, Gray-Bowen, Walnut Creek, California
Terry Bowen, Gray-Bowen, Walnut Creek, California
Casey Stewman, URS Corporation, San Jose, California
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FOR CONTRACT NO. 297614

MATERIALS INFORMATION

SOIL AND GROUNDWATER INVESTIGATION REPORT

DATED 4/2008

SOIL AND GROUNDWATER INVESTIGATION

APRIL 2008

SR 84 EXPRESSWAY WIDENING PROJECT
Ruby Hill Drive to Jack London Boulevard
Livermore, California

PM 22.5/27.3
EA 04-297600

For:

URS Corporation
San Jose, California

Y5302-01.00960

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EXECUTIVE SUMMARY
SOIL AND GROUNDWATER INVESTIGATION
SR 84 Expressway Widening Project
Livermore, California

BASELINE Environmental Consulting ("BASELINE") prepared this Soil and Groundwater Investigation report for the State Route ("SR") 84 Expressway Widening Project ("project") in Livermore, California. The project area is located along SR 84 from just south of Ruby Hill Drive to Jack London Boulevard. This investigation report was prepared for URS Corporation.

The purpose of this investigation was to determine whether shallow soils affected by the proposed project has been impacted by aerially-deposited lead ("ADL") and agricultural chemical residues, the potential contaminants of concern identified in an Initial Site Assessment prepared by BASELINE in December 2005. In addition, the investigation involved the collection of groundwater quality information at locations within the project area where dewatering might be required during project development. The scope of work for this investigation included: sampling and analysis of 64 soil samples collected in unpaved areas adjacent to the roadway shoulder at ground surface and at approximately 1.5 feet below ground surface; sampling and analysis of groundwater samples collected at locations within the project area where dewatering might be required during construction; evaluation of soil analytical results against federal and state hazardous waste thresholds, the ADL variance granted by the Department of Toxic Substances Control ("DTSC") to the California Department of Transportation, and environmental screening levels ("ESLs") for construction worker exposure scenario developed by the California Regional Water Quality Control Board, San Francisco Bay Region; and evaluation of groundwater data against the City of Livermore's ("City") discharge criteria for discharge of dewatered groundwater into the sanitary sewer.

- The reported concentrations for total and soluble lead in all soil samples were below the Total Threshold Limit Concentration ("TTLC") and the Soluble Threshold Limit Concentration for lead. Arsenic, copper, and mercury reported in composite samples were at concentrations below the respective TTLCs. The pH values for five discrete samples did not exceed hazardous waste threshold for corrosive wastes. Based on the soil analytical results, shallow soils adjacent to the roadway shoulder that would be affected by the project would be considered a non-hazardous waste, once excavated. Soils that cannot be reused within the project area could be disposed of at a Class II or Class III designated facility.

- The 64 soil samples were composited into eight samples and analyzed for organochlorine pesticides. None of the composite samples contained organochlorine pesticides above laboratory reporting limits. Based on the pesticide results, the soils adjacent to SR 84 do not appear to have been impacted by agricultural chemical residues.

- Since the soils affected by the project would be considered a non-hazardous waste, once excavated, the reuse of excavated soils within the project area would not require invoking the ADL variance issued by the DTSC.

- The soil analytical results for lead, arsenic, copper, and mercury did not exceed the ESL values for construction/trench worker exposure scenario. Based on the soil data, exposure of construction workers to project site soils during development would not be expected to present a significant health and safety risk.

- The analytical results of three out of four groundwater samples exceeded the City's discharge criteria for arsenic, chromium, copper, lead, mercury, nickel, and zinc. The three groundwater samples were collected near Arroyo del Valle bridge, Stanley Boulevard overcrossing, and Arroyo Mocho bridge. Groundwater extracted from the vicinity of these locations would require treatment prior to discharge into the City's sanitary sewer.

Based on the findings of the investigation, BASELINE recommends:

- Prior to project development, the soil analytical results should be provided to prospective Class II and Class III landfills in the event that surplus soils are generated during construction. This report may serve to fulfill a landfill's waste profiling requirements. However, waste acceptance is determined on a case-by-case basis and varies from one landfill to another. The prospective landfill may request additional sampling and testing to satisfy waste profile requirements.

- Prior to construction, a Soil Management Plan ("SMP") should be prepared to address the presence of metals in soils that will be affected by the project. The SMP should include a project-specific health and safety plan ("HSP") prepared by a qualified health and safety professional. The HSP should include measures to protect construction worker health and safety in accordance with federal and state regulations including the preparation of a written Lead Compliance Plan, as prescribed in 8 CCR section 1532.1.

- Prior to construction, a Groundwater Dewatering Plan ("GDP") should be prepared to address issues related to the discharge of dewatered groundwater into the sanitary sewer. The GDP should include extraction methodologies, estimated volume to be extracted, treatment methods, storage, frequency of sampling and analysis (if necessary), and periods of operation.

- The findings of this investigation should be provided to construction contractors, so that the information can be incorporated into their employee health and safety and hazard communication programs.

SOIL AND GROUNDWATER INVESTIGATION
SR 84 Expressway Widening Project
Ruby Hill Drive to Jack London Boulevard
Livermore, California

1. INTRODUCTION

This report presents the findings of a soil and groundwater investigation for the State Route ("SR") 84 Widening Project ("project") in Livermore, California (Figure 1). The project area is located along SR 84 from just south of Ruby Hill Drive to Jack London Boulevard. The project proposes to widen and upgrade SR 84 to expressway standards for the purposes of reducing congestion along SR 84 and improving local traffic circulation, reducing impacts of regional traffic diverting to local streets, and improving safety and operations on SR 84. The investigation was undertaken by BASELINE Environmental Consulting ("BASELINE") for URS Corporation ("URS").

An Initial Site Assessment ("ISA"), prepared by BASELINE in December 2005, identified aerially-deposited lead ("ADL") from vehicle exhausts and agricultural chemical residues as potential contaminants of concern along the project alignment. Although the ISA did not identify groundwater contamination issues, BASELINE collected a limited number of groundwater samples to provide groundwater quality information in the event that a permit for discharge of dewatered groundwater into the City of Livermore's ("City") sanitary sewer system is required during project development.

The purpose of this investigation was to determine whether shallow soils affected by the proposed project has been impacted by ADL and agricultural chemical residues and to obtain groundwater quality information at locations within the project area where dewatering might be required during project development. The scope of work for this investigation included: sampling and analysis of 64 soil samples collected in unpaved areas adjacent to the roadway shoulder at ground surface and at approximately 1.5 feet below ground surface ("bgs"); sampling and analysis of groundwater samples collected at locations within the project area where dewatering might be required during construction; screening of soil analytical results against federal and state hazardous waste thresholds, the ADL variance granted by the Department of Toxic Substances Control ("DTSC") to the California Department of Transportation ("Caltrans"), and environmental screening levels ("ESLs") for construction worker exposure scenario developed by the California Regional Water Quality Control Board, San Francisco Bay Region ("Water Board"); and screening of groundwater data against the City's sanitary sewer discharge criteria.

2. BACKGROUND/REGULATORY FRAMEWORK

This section presents the regulatory framework for management of soils impacted by ADL and agricultural chemical residues, discharge of dewatered groundwater into the City's sanitary

sewer system, and protection of construction worker's health and safety.

2.1 Hazardous Waste Framework

A soil, once excavated, may be classified as a federal hazardous waste, a California hazardous waste, or a non-hazardous waste depending on its characteristics. A soil is considered a federal hazardous waste if it contains soluble chemicals, determined by Toxicity Characteristic Leaching Procedure ("TCLP"), equal to or greater than the regulatory thresholds established in Title 40 of the Code of Federal Regulations ("40 CFR"). The TCLP method uses a dilution ratio of 20:1; therefore, a waste with a total concentration equal to or greater than 20 times the federal hazardous waste threshold could potentially be a federal hazardous waste, depending on the amount of total concentration that is soluble. The federal hazardous waste thresholds for metals and organochlorine pesticides are contained in 40 CFR. No hazardous waste threshold for total concentrations is specified at the federal level.

In California, a waste is considered hazardous if the total concentration of a chemical is at or above the Total Threshold Limit Concentration ("TTLC") or if the soluble concentration of a chemical, determined by the Waste Extraction Test method ("WET"), is at or above the Soluble Threshold Limit Concentration ("STLC"). The WET method uses a dilution ratio of 10:1; therefore, a waste with a total concentration equal to or greater than ten times the STLC value could potentially be a California hazardous waste, depending on the amount of total chemicals that are soluble. The TTLC and STLC values for metals and organochlorine pesticides are defined in Title 22 of the California Code of Regulations ("CCR").

A soil can also be considered a hazardous waste if it exhibits corrosive characteristics. A waste with corrosive properties is defined at the federal and state level as a liquid (or leachate) with a pH less than or equal to two or greater than or equal to 12.5.

A soil that is below the California hazardous waste criteria is considered unlikely to exceed the federal hazardous waste criteria due to a greater dilution ratio used in the TCLP method relative to the WET method. In addition to a greater dilution ratio, the TCLP method uses a weaker acid to leach the waste compared to the extractant used by the WET method. A waste that does not meet the federal and the California hazardous waste criteria is considered non-hazardous. In California, federal and California hazardous wastes are acceptable for disposal at a Class I designated landfill. Non-hazardous wastes are generally accepted at Class II and Class III designated landfills, depending on their permit-to-operate requirements.

2.2 ADL Variance

On 22 September 2000, DTSC issued a variance to Caltrans, allowing the reuse of some lead-affected soils on roadway construction projects that would otherwise be considered a California hazardous waste due to total or soluble lead concentration. Some of the terms contained in the September 2000 variance were modified by DTSC in a letter to Caltrans, dated 13 December 2002 (first modification) and 12 September 2003 (second modification). Under the terms of the variance, Caltrans can reuse soils that meet the established criterion for lead concentration and managed in accordance with handling procedures specified in the variance. Soils containing total lead at concentrations up to 3,397 milligrams per kilogram ("mg/kg") or soluble lead at

concentrations up to 50 milligrams per liter ("mg/L") (by modified WET method ["DI WET"], using deionized water as extractant) can be reused within Caltrans right-of-way provided that it is placed at least five feet above maximum groundwater level and covered with a minimum one foot of non-hazardous soil or a pavement structure maintained by Caltrans, among other conditions. In addition, soils with a pH value of less than five can only be reused under an impervious pavement for protection from water infiltration. Soils that meet the federal hazardous waste criteria cannot be reused within Caltrans right-of-way under the variance.

The September 2000 variance expired on 22 September 2005. Since then, the variance has been renewed on an annual basis with the existing variance valid until 30 June 2008. If the existing variance expired or not renewed prior to project development, reuse of lead-affected soils that meet that California hazardous waste criteria could not be reused within the project area. The lead-affected soils must be disposed of to an appropriate landfill permitted to accept such waste.

A copy of the September 2000 variance, the September 2003 variance (second modification), and the 2008 time extension on the existing variance is included in Appendix A.

2.3 Groundwater Discharge

The City of Livermore Public Works Department, Water Resources Division regulates discharges of stormwater, surface water, groundwater, and other non-polluted water into the City's sanitary sewer system. Discharges of stormwater, surface water, groundwater, and other non-polluted water are only authorized by permit and are subject to quantity and quality limitations. Standards regulating direct and indirect discharges of wastewater to the sanitary sewer and treatment system are contained in chapter 13.32 of the Livermore Municipal Code.

2.4 Worker Health and Safety

The U.S. Department of Labor, Occupational Safety and Health Administration is responsible for enforcement and implementation of regulations related to worker health and safety at the federal level. Under its jurisdiction, workers at hazardous waste sites must receive specialized training and medical supervision in accordance with the Hazardous Waste Operations and Emergency Response ("HAZWOPER") regulations contained in 29 CFR 1910.120.

In California, the California Department of Industrial Relations, Division of Occupational Safety and Health is responsible for protecting worker health and safety. Standards for protecting workers from health and safety hazards, including working in hazardous waste environments, are contained in Title 8 CCR. Title 8 CCR, Section 1532.1 provides for protection of workers exposed to lead during construction activities.

The Water Board has developed ESLs for a variety of chemical compounds commonly found on contaminated sites. The ESLs are chemical-specific concentrations that, if not exceeded, would not be expected to present a significant threat to human health and/or the environment. The screening values were developed using conservative (worst-case) assumptions for the San Francisco Bay Area.

3. FIELD ACTIVITIES

Prior to field activities, BASELINE procured a well permit from the Zone 7 Water Agency and cleared proposed boring locations with Underground Service Alert. BASELINE also contacted owners of properties affected by proposed borings to coordinate access to their properties. All field activities were performed in accordance with the well permit, a Caltrans encroachment permit secured by the Alameda County Transportation Improvement Authority, a site safety plan ("SSP") prepared by BASELINE, BASELINE's Quality Assurance Program Plan ("QAPP"), and *The Revised Soil and Groundwater Investigation Workplan* ("*Revised Workplan*") prepared by BASELINE, dated 19 March 2008. The *Revised Workplan* was prepared in coordination with Caltrans and URS. The well permit, encroachment permit, SSP, and QAPP are included in Appendices B through E, respectively.

On 20 and 21 March 2008, BASELINE collected 64 soil samples from 16 boring locations (SS-1 through SS-16) shown on Figures 2A and 2B. At each of the 16 boring locations, BASELINE collected one set of samples from immediately adjacent to the roadway shoulder pavement and one set from approximately ten feet away from the edge of the pavement. Each set of samples consisted of a sample collected at ground surface and approximately 1.5 feet bgs. Each soil sample was collected by driving a 3-inch sampler, fitted with a new 2-inch by 3-inch stainless steel tube, into the ground using a slide hammer. Prior to collection of the deeper samples, BASELINE installed a boring to an approximate depth of 1.5 feet bgs using hand tools such as a digging bar and a post-hole digger. Immediately following retrieval of the sampler, BASELINE sealed the ends of the tubes with Teflon sheets, plastic end caps, and silicon tape. The hand sampling tools were decontaminated between sampling locations by washing in Alconox solution followed by rinsing with deionized water. The decontamination rinsate was allowed to evaporate naturally. The open borings were backfilled with the same material excavated from each borehole.

On 24 through 26 March 2008, Precision Sampling, Incorporated – a California licensed driller – advanced five borings (GW-1 through GW-5) using a hollow-stem auger under the supervision of a BASELINE professional geologist (Figures 3A and 3B). The borings were advanced to a depth of a few feet below groundwater level except for one boring (GW-4), which did not encounter groundwater at 72 feet bgs, the maximum depth explored. Groundwater levels were measured at 45 feet bgs in GW-1, 40 feet bgs in GW-2, 35 feet bgs in GW-3, and 55 feet bgs in GW-5 (Figures 3A and 3B). BASELINE collected grab groundwater samples from the open boreholes by decanting groundwater into appropriate bottleware supplied by an analytical laboratory using a disposable bailer. The hollow-stem auger was steam cleaned on-site in between boring installations. Decontamination rinsate water generated during the investigation was placed in a properly labeled 55-gallon drum stored on a pump station parking lot off Stanley Boulevard. The borings were backfilled with compacted soil cuttings excavated from the same borehole.

The soil and groundwater samples were labeled with the sample's date and time, samplers' initials, and unique sample identification and placed in a cooler containing ice. The soil samples were transported to Curtis and Tompkins, Ltd. – a California certified analytical laboratory – on 21 March 2008 under proper chain-of-custody procedures. The groundwater samples were

transported to Curtis and Tompkins, Ltd at the end of each sampling day under proper chain-of-custody procedures.

Each soil sample was analyzed for total lead in accordance with U.S. Environmental Protection Agency ("EPA") Method 6010B and soluble lead by WET method. The 32 near-surface samples were composited into eight samples by the analytical laboratory and analyzed for total arsenic, copper, and mercury in accordance with EPA Method 6010B and 7470A and organochlorine pesticides in accordance with EPA Method 8081A. Five near-surface samples collected from immediately adjacent to the roadway shoulder (SS-2A;0-0.5, SS-11A;0-0.5, SS-12A;0-0.5, SS-13A;0-0.5, and SS-15A;0-0.5) were analyzed for pH in accordance with EPA Method 9045C.

Each groundwater sample was analyzed for: pH in accordance with EPA Method 9040B; cyanide in accordance with Standard Method 4500CN-E, Title 22[1] metals in accordance with EPA Method 6010B/7470A; and Total Toxics Organics ("TTO") in accordance with EPA Method 624.

4. ANALYTICAL RESULTS

The soil and groundwater analytical results are summarized in Tables 1 through 4. Soil sampling locations are depicted on Figures 2A and 2B, while groundwater sampling locations are shown on Figures 3A and 3B. Laboratory reports are included in Appendix F.

4.1 Soil – Lead

Total lead was reported in all 64 soil samples, ranging from 2.8 through 52 mg/kg (Figures 2A and 2B and Table 1). Out of the 64 soil samples analyzed for total lead, only one sample (SS-8B;1.5-2.0) contained total lead concentration that could potentially exceed the STLC for soluble lead of five mg/L (Figure 2A and Table 1). The laboratory reported WET lead for sample SS-8B;1.5-2.0 at 1.1 mg/L (Figure 2A and Table 1). In addition to SS-8B;1.5-2.0, 14 other samples contained WET lead above the laboratory reporting limit of 0.15 mg/L (Figures 2A and 2B and Table 1). The soluble lead concentrations of the 14 soil samples ranged from 0.19 through 1.5 mg/L (Figures 2A and 2B and Table 1).

4.2 Soil – pH

The laboratory reported pH for the five near-surface soil samples (SS-2A;0-0.5, SS-11A;0-0.5, SS-12A;0-0.5, SS-13A;0-0.5, and SS-15A;0-0.5) between 7.1 and 8.6 (Figures 2A and 2B and Table 1).

4.3 Soil – Arsenic, Copper, and Mercury

Arsenic and copper was reported above laboratory reporting limits in each of the eight composite samples (Table 2). Mercury was detected above the laboratory reporting limit of 0.02 mg/kg in five (SS-7/8-COMP, SS-9/10-COMP, SS-11/12-COMP, SS-13/14-COMP, and SS-15/16-

[1] The seventeen inorganic metals listed on Title 22 of the California Code of Regulations. The seventeen metals are antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. This group of metals may also be referred to as Title 26 Metals.

COMP) out of the eight composite samples (Table 2). The concentrations of arsenic in the composite samples ranged from 2.7 to 4.2 mg/kg, while copper ranged between 13 and 36 mg/kg (Table 2). Mercury in the five composite samples was reported between 0.023 and 0.064 mg/kg (Table 2).

4.4 Soil – Organochlorine Pesticides

The laboratory did not detect pesticide compounds in any of the composite samples above laboratory reporting limits.

4.5 Groundwater – pH and Cyanide

The laboratory reported pH at 7.4 for groundwater samples collected from GW-2 and GW-5 and 7.5 for water samples collected from GW-1 and GW-3 (Figures 3A and 3B and Table 3). Cyanide was not detected in all groundwater samples above the laboratory reporting limit of 0.01 mg/L (Figures 3A and 3B and Table 3).

4.6 Groundwater – Title 22 Metals

Concentrations of arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, vanadium, and zinc were reported in all or some of the groundwater samples (Figures 3A and3B and Table 4).

4.7 Groundwater – Total Toxics Organics

None of the organic compounds listed under the analytical method was reported above laboratory reporting limits. TTO is determined by summing the concentrations of each compound analyzed for.

5. EVALUATION OF RESULTS

This section presents an evaluation of soil quality data against federal and state hazardous waste thresholds, the ADL variance issued by the DTSC to Caltrans, and ESLs for construction worker exposure scenario and groundwater quality information against the City's discharge criteria for discharge of dewatered groundwater into the sanitary sewer.

5.1 Hazardous Waste Criteria

Out of the 64 soil samples analyzed for total and soluble lead, none exceeded the TTLC and STLC for lead of 1,000 mg/kg and 5 mg/L, respectively (Figures 2A and 2B and Table 1). In addition, the reported concentrations of arsenic, copper, and mercury in composite samples were below the TTLC values of 500, 2,500, and 20 mg/kg, respectively (Table 2). The reported pH values of five soil samples did not exceed the hazardous waste criteria for corrosive characteristics (Figures 2A and 2B and Table 1). Based on the soil analytical results, shallow soils adjacent to the roadway would be considered a non-hazardous waste, once excavated. Surplus soils from the project could be disposed of at a Class II or Class III designated facility permitted to accept non-hazardous waste.

The *Revised Workplan* proposed to analyze five soil samples with the highest WET lead concentrations for soluble lead by TCLP and DI WET methods. Further analysis for TCLP lead and DI WET lead in soil samples was not performed since the total lead and WET lead concentrations indicated that the soils would be a non-hazardous waste.

5.2 Aerially-Deposited Lead Variance

The variance for reuse of lead-contaminated soil within Caltrans right-of-way is only required for soil that meets the California hazardous waste criteria. Since the soil analytical data indicated that shallow soil adjacent to the roadway shoulder would be considered a non-hazardous waste, invoking the ADL variance for reuse of soils within Caltrans right-of-way would not be required. In addition, the pH results of five soil samples were greater than five, indicating that soils could be reused without the placement of an overlying pavement structure.

5.3 Groundwater Discharge Criteria

The groundwater analytical results were screened against specific pollutants specified in chapter 13.32 of the City's municipal code (Tables 3 and 4). The groundwater analytical results for pH, cyanide, and TTO did not exceed the City's discharge criteria (Tables 3 and 4). However, the discharge criteria for arsenic, chromium, copper, lead, mercury, nickel, and zinc were exceeded in one or more groundwater samples (Table 4). The groundwater sample collected from GW-5 contained six inorganic compounds (arsenic, chromium, copper, lead, nickel, and zinc) at concentrations that exceeded the City's discharge criteria (Figure 3B and Table 4). Groundwater samples from GW-1 and GW-2 exceeded the discharge criteria for mercury of 0.01 mg/L and nickel of 0.61 mg/L, respectively (Figures 3A and 3B and Table 4). The groundwater sample from GW-3 did not contain any compound at or above the City's discharge criteria (Figure 3B and Table 4).

The groundwater samples were collected and preserved without filtration. Without filtration, the reported metals concentration would be expected to be higher compared to a water sample that was filtered of sediments prior to analysis, since the acidic preservative would dissolve metal solids that are sorbed to the sediments. Based on the groundwater analytical results, groundwater extracted from the vicinity of GW-1 (Arroyo del Valle bridge), GW-2 (Stanley Boulevard overcrossing), and GW-5 (Arroyo Mocho bridge) would require treatment prior to discharge into the City's sanitary sewer. At a minimum, extracted groundwater should be contained in holding tanks to allow for settlement of sediments. Depending on the quality of groundwater, additional treatment or filtration may be required.

5.4 Health Screening

The soil analytical results were screened against the ESL values for construction/trench worker exposure scenario[2] (Tables 1 and 2). The reported concentrations of lead, arsenic, copper, and mercury were all below the ESL values of 750, 14, 280,000, and 33 mg/kg, respectively (Tables 1 and 2).

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[2] California Regional Water Quality Control Board, San Francisco Bay Region, 2007, Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Interim Final, November, Table K-3, Direct Exposure Soil Screening Levels, Construction/Trench Worker Exposure Scenario.

6. CONCLUSIONS

- The reported concentrations for total and soluble lead in all soil samples were below the TTLC and STLC for lead. Arsenic, copper, and mercury reported in composite samples were at concentrations below the respective TTLCs. The pH values for five discrete samples did not exceed hazardous waste threshold for corrosive wastes. Based on the soil analytical results, shallow soils adjacent to the roadway shoulder that would be affected by the project would be considered a non-hazardous waste, once excavated. Soils that cannot be reused within the project area could be disposed of at a Class II or Class III designated facility.

- The 64 soil samples were composited into eight samples and analyzed for organochlorine pesticides. None of the composite samples contained organochlorine pesticides above laboratory reporting limits. Based on the pesticide results, the soils adjacent to SR 84 do not appear to have been impacted by agricultural chemical residues.

- Since the soils affected by the project would be considered a non-hazardous waste, once excavated, the reuse of excavated soils within the project area would not require invoking the ADL variance issued by the DTSC.

- The soil analytical results for lead, arsenic, copper, and mercury did not exceed the ESL values for construction/trench worker exposure scenario. Based on the soil data, exposure of construction workers to project site soils during development would not be expected to present a significant health and safety risk.

- The analytical results of three out of four groundwater samples exceeded the City's discharge criteria for arsenic, chromium, copper, lead, mercury, nickel, and zinc. The three groundwater samples were collected near Arroyo del Valle bridge, Stanley Boulevard overcrossing, and Arroyo Mocho bridge. Groundwater extracted from the vicinity of these locations would require treatment prior to discharge into the City's sanitary sewer.

7. RECOMMENDATIONS

- Prior to project development, the soil analytical results should be provided to prospective Class II and Class III landfills in the event that surplus soils are generated during construction. This report may serve to fulfill a landfill's waste profiling requirements. However, waste acceptance is determined on a case-by-case basis and varies from one landfill to another. The prospective landfill may request additional sampling and testing to satisfy waste profile requirements.

- Prior to construction, a Soil Management Plan ("SMP") should be prepared to address the presence of metals in soils that will be affected by the project. The SMP should include a project-specific health and safety plan ("HSP") prepared by a qualified health and safety professional. The HSP should include measures to protect construction worker health

and safety in accordance with federal and state regulations, including the preparation of a written Lead Compliance Plan, as prescribed in Title 8 CCR, Section 1532.1.

- Prior to construction, a Groundwater Dewatering Plan ("GDP") should be prepared to address issues related to the discharge of dewatered groundwater into the sanitary sewer. The GDP should include extraction methodologies, estimated volume to be extracted, treatment methods, storage, frequency of sampling and analysis (if necessary), and periods of operation.

- The findings of this investigation should be provided to construction contractors, so that the information can be incorporated into their employee health and safety and hazard communication programs.

8. LIMITATIONS

This soil and groundwater investigation has been conducted for URS Corporation in support of the SR 84 Expressway Widening Project. BASELINE's interpretations and conclusions regarding this information and presented in this report are based on the expertise and experience of BASELINE in conducting similar assessments and current federal, state, and local regulations and standards.

BASELINE's objective is to perform our work with care, exercising the customary thoroughness and competence of earth science, environmental, and engineering consulting professionals, in accordance with the standard for professional services for a consulting firm at the time these services were provided. It is important to recognize that even the most comprehensive scope of services may fail to detect environmental conditions and potential liability at a particular site. Therefore, BASELINE cannot act as insurers and cannot "certify or underwrite" that a site is free of environmental contamination, and no expressed or implied representation or warranty is included or intended in this report except that the work was performed within the limits prescribed with the customary thoroughness and competence of our profession.

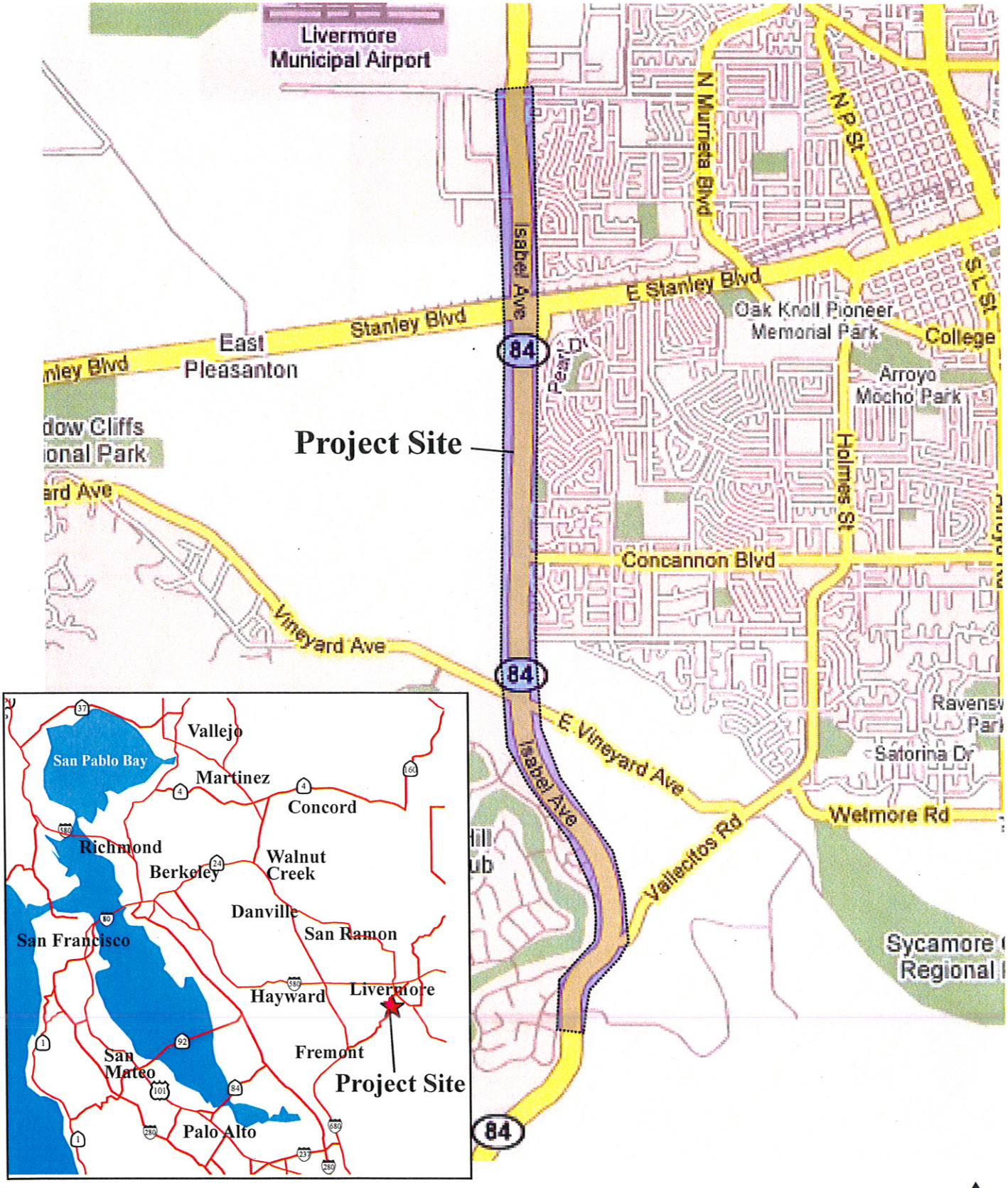
The passage of time, manifestation of latent conditions, or occurrence of future events may require further exploration at the project site, analysis of the data, and re-evaluation of the findings, observations, conclusions, and recommendations expressed in the report.

The findings, observations, conclusions, and recommendations expressed by BASELINE in this report are limited by the scope of services and should not be considered an opinion concerning the compliance of any past or current owner or operator of the site with any federal, state, or local law or regulation. No warranty or guarantee, whether express or implied is made with respect to the data reported or findings, observations, conclusions, and recommendations expressed in this report.

FIGURES

REGIONAL LOCATION

Figure 1



SR 84 Expressway Widening Project
Livermore, California

0 3000 Feet

BASELINE

Y5302.01.00960.Fig1.cdr 04/30/09

SOIL SAMPLING LOCATIONS

Figure 2A

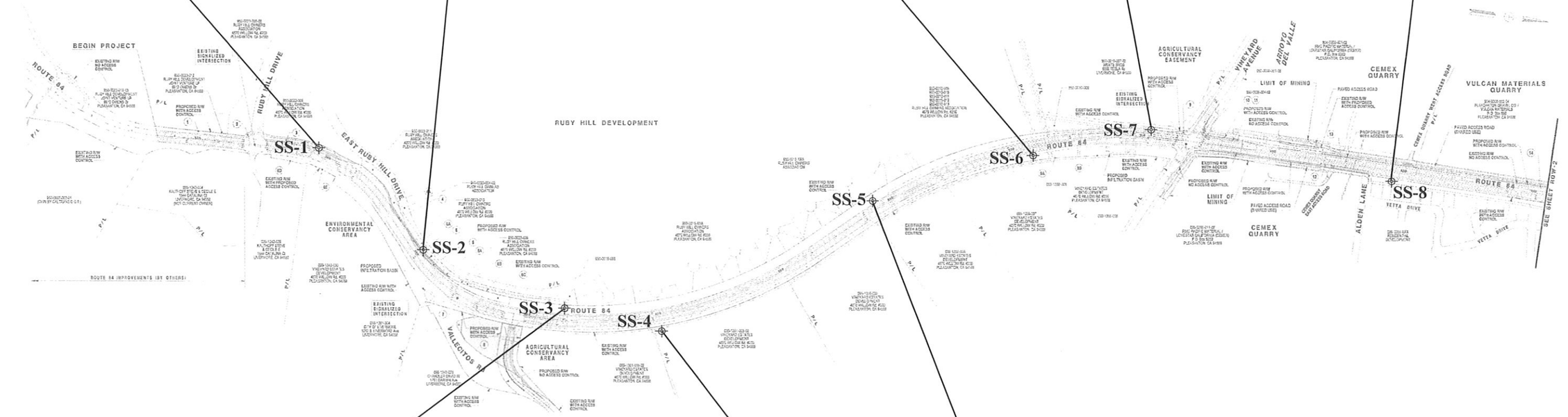
SS-1		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	4.8	<0.15
	1.5	8.3	<0.15
B	0.0	6.4	<0.15
	1.5	9.3	0.27

SS-2		3/21/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	6.8	<0.15
	1.5	10	0.22
B	0.0	5.8	<0.15
	1.5	7.0	<0.15

SS-6		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	5.7	<0.15
	1.5	6.1	<0.15
B	0.0	4.0	<0.15
	1.5	7.6	<0.15

SS-7		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	5.3	<0.15
	1.5	11	<0.15
B	0.0	7.0	<0.15
	1.5	6.8	<0.15

SS-8		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	13	0.22
	1.5	41	1.1
B	0.0	8.5	<0.15
	1.5	52	1.1



SS-3		3/21/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	4.1	<0.15
	1.5	6.7	<0.15
B	0.0	4.9	<0.15
	1.5	5.8	<0.15

SS-4		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	4.6	<0.15
	1.5	5.0	<0.15
B	0.0	4.7	<0.15
	1.5	5.8	<0.15

SS-5		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	9.1	<0.15
	1.5	8.7	<0.15
B	0.0	9.4	<0.15
	1.5	7.8	<0.15

Legend

⊕ Soil Sampling Location

Notes: Type A soil samples were collected from immediatedly adjacent to the roadway pavement, while type B samples were collected from approximately ten feet away from the edge of the pavement.

ft bgs = feet below ground surface. Pb = lead. mg/kg = milligrams per kilogram. mg/L = milligrams per liter.

Source: URS, April 2007, Right-of-Way Requirements Map

SR 84 Expressway Widening Project
Livermore, California

Approximate
0 800 Feet

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Y5302.01.00960.Fig2A.cdr 04/30/09

SOIL SAMPLING LOCATIONS

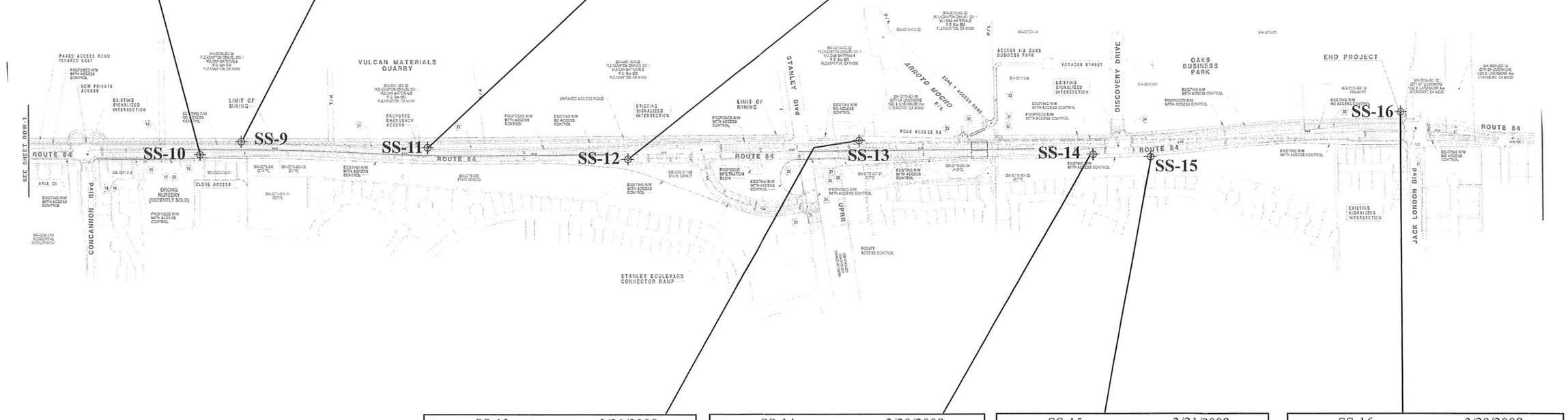
Figure 2B

SS-10		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	7.2	<0.15
	1.5	4.2	<0.15
B	0.0	15	0.53
	1.5	8.3	0.20

SS-9		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	13	<0.15
	1.5	4.7	<0.15
B	0.0	45	0.32
	1.5	6.5	<0.15

SS-11		3/21/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	13	0.22
	1.5	21	0.24
B	0.0	28	1.5
	1.5	5.4	<0.15

SS-12		3/21/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	44	1.0
	1.5	8.0	<0.15
B	0.0	30	0.46
	1.5	7.4	<0.15



SS-13		3/21/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	11	<0.15
	1.5	6.9	0.19
B	0.0	7.9	<0.15
	1.5	2.8	<0.15

SS-14		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	16	0.38
	1.5	4.0	<0.15
B	0.0	7.8	<0.15
	1.5	5.5	<0.15

SS-15		3/21/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	9.5	<0.15
	1.5	4.2	<0.17
B	0.0	5.9	<0.15
	1.5	5.9	<0.17

SS-16		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	8.6	<0.15
	1.5	5.6	<0.17
B	0.0	9.4	<0.15
	1.5	2.8	<0.17

Legend

⊕ Soil Sampling Location

Notes: Type A soil samples were collected from immediatedly adjacent to the roadway pavement, while type B samples were collected from approximately ten feet away from the edge of the pavement.

ft bgs = feet below ground surface. Pb = lead. mg/kg = milligrams per kilogram. mg/L = milligrams per liter.

Source: URS, April 2007, Right-of-Way Requirements Map

Approximate
0 800 Feet

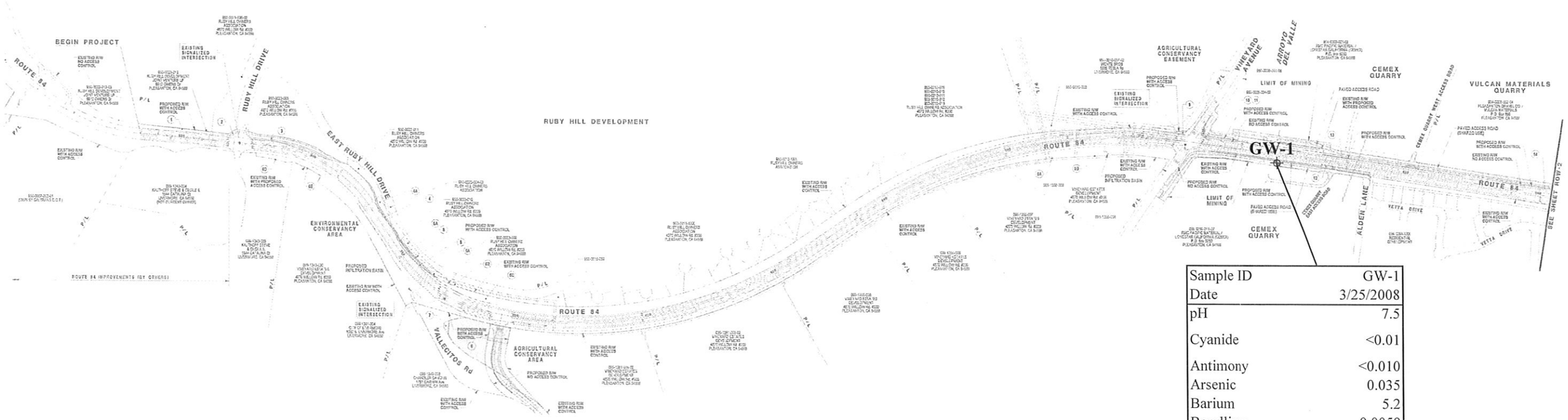
SR 84 Expressway Widening Project
Livermore, California

BASELINE

Y5302.01.00960.Fig2B.cdr 04/30/09

GROUNDWATER SAMPLING LOCATIONS

Figure 3A



Sample ID	GW-1
Date	3/25/2008
pH	7.5
Cyanide	<0.01
Antimony	<0.010
Arsenic	0.035
Barium	5.2
Beryllium	0.0059
Cadmium	<0.005
Chromium	0.19
Cobalt	0.28
Copper	0.22
Lead	0.025
Mercury	0.012
Molybdenum	<0.005
Nickel	0.54
Selenium	<0.010
Silver	<0.005
Thallium	<0.010
Vanadium	0.14
Zinc	0.35
Total Toxics Organics	ND

Legend

⊕ Groundwater Sampling Location

Notes: All reported concentrations are in milligrams per liter, except for pH.
ND= None of the compounds analyzed for was reported above laboratory reporting limits.

Source: URS, April 2007, Right-of-Way Requirements Map

Approximate
0 800 Feet

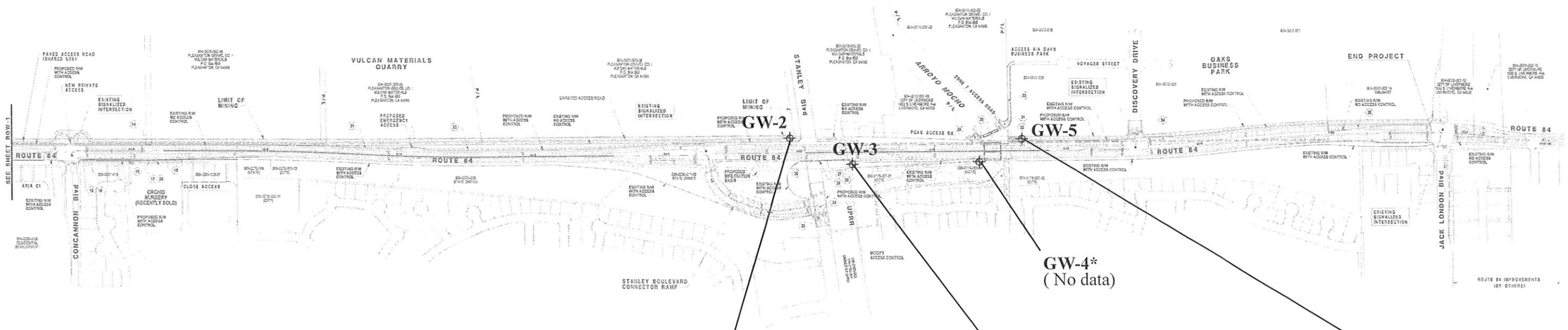
SR 84 Expressway Widening Project
Livermore, California

Y5302.01.00960.Fig3A.cdr 04/30/09

BASELINE

GROUNDWATER SAMPLING LOCATIONS

Figure 3B



Sample ID	GW-2
Date	3/24/2008
pH	7.4
Cyanide	<0.01
Antimony	<0.010
Arsenic	0.027
Barium	0.82
Beryllium	<0.002
Cadmium	<0.005
Chromium	0.26
Cobalt	0.066
Copper	0.12
Lead	0.034
Mercury	<0.0002
Molybdenum	0.0082
Nickel	0.61
Selenium	<0.010
Silver	<0.005
Thallium	<0.010
Vanadium	0.12
Zinc	0.22
Total Toxics Organics	ND

Sample ID	GW-3
Date	3/25/2008
pH	7.5
Cyanide	<0.01
Antimony	<0.010
Arsenic	0.01
Barium	1.8
Beryllium	<0.002
Cadmium	<0.005
Chromium	0.081
Cobalt	0.14
Copper	0.077
Lead	0.031
Mercury	0.0019
Molybdenum	0.0057
Nickel	0.43
Selenium	<0.010
Silver	<0.005
Thallium	<0.010
Vanadium	0.056
Zinc	0.16
Total Toxics Organics	ND

Sample ID	GW-5
Date	3/24/2008
pH	7.4
Cyanide	<0.01
Antimony	<0.010
Arsenic	0.49
Barium	14
Beryllium	0.022
Cadmium	0.0061
Chromium	5.7
Cobalt	1.6
Copper	2.7
Lead	0.67
Mercury	0.0095
Molybdenum	0.13
Nickel	20
Selenium	0.081
Silver	0.0065
Thallium	<0.010
Vanadium	2.2
Zinc	3.8
Total Toxics Organics	ND

Legend

⊕ Groundwater Sampling Location

Note: *The boring advanced at GW-4 did not encounter groundwater at 72 feet below ground surface, the maximum depth explored.
All reported concentrations are in milligrams per liter, except for pH.
ND= None of the compounds analyzed for was reported above laboratory reporting limits.

Source: URS, April 2007, Right-of-Way Requirements Map

Approximate
0 800 Feet

BASELINE

SR 84 Expressway Widening Project
Livermore, California

Y5302.01.00960.Fig3B.cdr 04/30/08

TABLES

Table 1: **Soil Analytical Results - pH and Lead**
SR 84 Expressway Widening Project
Livermore, California

Location	Type[1]	Depth[2] (ft bgs)	Sample ID	Date	Total Lead (mg/kg)	Soluble Lead (mg/L)	pH (S.U.)
SS-1	A	0.0	SS-1A;0-0.5	3/20/2008	**4.8**	<0.15	--
		1.5	SS-1A;1.5-2.0	3/20/2008	**8.3**	<0.15	--
	B	0.0	SS-1B;0-0.5	3/20/2008	**6.4**	<0.15	--
		1.5	SS-1B;1.5-2.0	3/20/2008	**9.3**	**0.27**	--
SS-2	A	0.0	SS-2A;0-0.5	3/21/2008	**6.8**	<0.15	7.1
		1.5	SS-2A;1.5-2.0	3/21/2008	**10**	**0.22**	--
	B	0.0	SS-2B;0-0.5	3/21/2008	**5.8**	<0.15	--
		1.5	SS-2B;1.5-2.0	3/21/2008	**7.0**	<0.15	--
SS-3	A	0.0	SS-3A;0-0.5	3/21/2008	**4.1**	<0.15	--
		1.5	SS-3A;1.5-2.0	3/21/2008	**6.7**	<0.15	--
	B	0.0	SS-3B;0-0.5	3/21/2008	**4.9**	<0.15	--
		1.5	SS-3B;1.5-2.0	3/21/2008	**5.8**	<0.15	--
SS-4	A	0.0	SS-4A;0-0.5	3/20/2008	**4.6**	<0.15	--
		1.5	SS-4A;1.5-2.0	3/20/2008	**5.0**	<0.15	--
	B	0.0	SS-4B;0-0.5	3/20/2008	**4.7**	<0.15	--
		1.5	SS-4B;1.5-2.0	3/20/2008	**5.8**	<0.15	--
SS-5	A	0.0	SS-5A;0-0.5	3/20/2008	**9.1**	<0.15	--
		1.5	SS-5A;1.5-2.0	3/20/2008	**8.7**	<0.15	--
	B	0.0	SS-5B;0-0.5	3/20/2008	**9.4**	<0.15	--
		1.5	SS-5B;1.5-2.0	3/20/2008	**7.8**	<0.15	--
SS-6	A	0.0	SS-6A;0-0.5	3/20/2008	**5.7**	<0.15	--
		1.5	SS-6A;1.5-2.0	3/20/2008	**6.1**	<0.15	--
	B	0.0	SS-6B;0-0.5	3/20/2008	**4.0**	<0.15	--
		1.5	SS-6B;1.5-2.0	3/20/2008	**7.6**	<0.15	--
SS-7	A	0.0	SS-7A;0-0.5	3/20/2008	**5.3**	<0.15	--
		1.5	SS-7A;1.5-2.0	3/20/2008	**11**	<0.15	--
	B	0.0	SS-7B;0-0.5	3/20/2008	**7.0**	<0.15	--
		1.5	SS-7B;1.5-2.0	3/20/2008	**6.8**	<0.15	--
SS-8	A	0.0	SS-8A;0-0.5	3/20/2008	**13**	**0.22**	--
		1.5	SS-8A;1.5-2.0	3/20/2008	**41**	**1.1**	--
	B	0.0	SS-8B;0-0.5	3/20/2008	**8.5**	<0.15	--
		1.5	SS-8B;1.5-2.0	3/20/2008	**52**	**1.1**	--
SS-9	A	0.0	SS-9A;0-0.5	3/20/2008	**13**	<0.15	--
		1.5	SS-9A;1.5-2.0	3/20/2008	**4.7**	<0.15	--
	B	0.0	SS-9B;0-0.5	3/20/2008	**45**	**0.32**	--
		1.5	SS-9B;1.5-2.0	3/20/2008	**6.5**	<0.15	--
SS-10	A	0.0	SS-10A;0-0.5	3/20/2008	**7.2**	<0.15	--
		1.5	SS-10A;1.5-2.0	3/20/2008	**4.2**	<0.15	--
	B	0.0	SS-10B;0-0.5	3/20/2008	**15**	**0.53**	--
		1.5	SS-10B;1.5-2.0	3/20/2008	**8.3**	**0.20**	--
SS-11	A	0.0	SS-11A;0-0.5	3/21/2008	**13**	**0.22**	8.6
		1.5	SS-11A;1.5-2.0	3/21/2008	**21**	**0.24**	--
	B	0.0	SS-11B;0-0.5	3/21/2008	**28**	**1.5**	--
		1.5	SS-11B;1.5-2.0	3/21/2008	**5.4**	<0.15	--
SS-12	A	0.0	SS-12A;0-0.5	3/21/2008	**44**	**1.0**	7.5
		1.5	SS-12A;1.5-2.0	3/21/2008	**8.0**	<0.15	--
	B	0.0	SS-12B;0-0.5	3/21/2008	**30**	**0.46**	--
		1.5	SS-12B;1.5-2.0	3/21/2008	**7.4**	<0.15	--

Table 1: **Soil Analytical Results - pH and Lead**
SR 84 Expressway Widening Project
Livermore, California

Location	Type[1]	Depth[2] (ft bgs)	Sample ID	Date	Total Lead (mg/kg)	Soluble Lead (mg/L)	pH (S.U.)
SS-13	A	0.0	SS-13A;0-0.5	3/21/2008	**11**	<0.15	8.3
		1.5	SS-13A;1.5-2.0	3/21/2008	**6.9**	**0.19**	--
	B	0.0	SS-13B;0-0.5	3/21/2008	**7.9**	<0.15	--
		1.5	SS-13B;1.5-2.0	3/21/2008	**2.8**	<0.15	--
SS-14	A	0.0	SS-14A;0-0.5	3/20/2008	**16**	**0.38**	--
		1.5	SS-14A;1.5-2.0	3/20/2008	**4.0**	<0.15	--
	B	0.0	SS-14B;0-0.5	3/20/2008	**7.8**	<0.15	--
		1.5	SS-14B;1.5-2.0	3/20/2008	**5.5**	<0.15	--
SS-15	A	0.0	SS-15A;0-0.5	3/21/2008	**9.5**	<0.15	7.5
		1.5	SS-15A;1.5-2.0	3/21/2008	**4.2**	<0.17	--
	B	0.0	SS-15B;0-0.5	3/21/2008	**5.9**	<0.15	--
		1.5	SS-15B;1.5-2.0	3/21/2008	**5.9**	<0.17	--
SS-16	A	0.0	SS-16A;0-0.5	3/20/2008	**8.6**	<0.15	--
		1.5	SS-16A;1.5-2.0	3/20/2008	**5.6**	<0.17	--
	B	0.0	SS-16B;0-0.5	3/20/2008	**9.4**	<0.15	--
		1.5	SS-16B;1.5-2.0	3/20/2008	**2.8**	<0.17	--
California Hazardous Waste Threshold					1,000	5.0	≤2 or ≥12.5
ESL for Construction/Trench Worker Exposure Scenario[3]					750	NE	NE

Notes:

See Figures 2A and 2B for sampling locations.

Samples were analyzed for pH (U.S. Environmental Protection Agency [EPA] Method 9045C), total lead (EPA Method 6010B), and soluble lead (Waste Extraction Test method).

Laboratory reports are provided in Attachment F.

Bold values indicate concentration was reported above the laboratory reporting limit.

The shaded cell indicates that the total concentration could potentially exceed the lead Soluble Threshold Limit Concentration of 5 mg/L, defined in Title 22 of the California Code of Regulations.

mg/kg = milligrams per kilogram.

mg/L = milligrams per liter.

S.U. = standard unit.

ft bgs = feet below ground surface.

<xx = indicates compound was not identified at or above the laboratory reporting limit of xx.

-- = not analyzed.

ESL = environmental screening level.

NE = not established.

[1]Type "A" refers to soil samples collected from immediately adjacent to the roadway pavement, while type "B" samples were collected from approximately ten feet away from the edge of the pavement.

[2]Depth of sample is reported to the nearest one-half foot.

[3]California Regional Water Quality Control Board, San Francisco Bay Region, 2007, *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*, Interim Final, November, Table K-3, Direct Exposure Soil Screening Levels, Construction/Trench Worker Exposure Scenario.

Table 2: **Soil Analytical Results - Arsenic, Copper, and Mercury (mg/kg)**
SR 84 Expressway Widening Project
Livermore, California

Sample ID	Date	Arsenic	Copper	Mercury
SS-1/2-COMP	3/21/2008	**3.5**	**20**	<0.02
SS-3/4-COMP	3/21/2008	**3.3**	**18**	<0.02
SS-5/6-COMP	3/20/2008	**3.0**	**16**	<0.02
SS-7/8-COMP	3/20/2008	**3.8**	**13**	**0.023**
SS-9/10-COMP	3/20/2008	**4.2**	**26**	**0.028**
SS-11/12-COMP	3/21/2008	**2.9**	**36**	**0.064**
SS-13/14-COMP	3/21/2008	**2.7**	**28**	**0.036**
SS-15/16-COMP	3/21/2008	**3.5**	**27**	**0.053**
California Hazardous Waste Threshold		500	2,500	20
ESL for Construction/Trench Worker Exposure Scenario[1]		14	280,000	33

Notes:
See Figures 2A and 2B for sampling locations.
Samples were analyzed by U.S. Environmental Protection Agency Method 6010B/7470A.
Laboratory reports are provided in Attachment F.
Bold values indicate concentration was reported above the laboratory reporting limit.

mg/kg = milligrams per kilogram.
<xx = indicates compound was not identified at or above the laboratory reporting limit of xx.
COMP = composite sample of shallow samples collected from locations x and y indicated in the sample ID (SS-x/y).
ESL = environmental screening level.

[1]California Regional Water Quality Control Board, San Francisco Bay Region, 2007, *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*, Interim Final, November, Table K-3, Direct Exposure Soil Screening Levels, Construction/Trench Worker Exposure Scenario.

Table 3: **Groundwater Analytical Results - pH and Cyanide**
SR 84 Expressway Widening Project
Livermore, California

Sample ID	GW-1	GW-2	GW-3	GW-5	
Date	3/25/2008	3/24/2008	3/25/2008	3/24/2008	Livermore Discharge Criteria[1]
pH	7.5	7.4	7.5	7.4	6.0 - 9.0 S.U.
Cyanide	<0.01	<0.01	<0.01	<0.01	0.04 mg/L

Notes:
See Figures 3A and 3B for sampling locations.
Samples were analyzed by U.S. Environmental Protection Agency Method 9040B and Standard Method 4500CN-E.
Laboratory reports are provided in Attachment F.
Boring GW-4 did not encounter groundwater at 72 feet below ground surface, the maximum depth explored.
pH results are reported in standard units (S.U.), while cyanide results are reported in milligrams per liter (mg/L).

<xx = indicates compound was not identified at or above the laboratory reporting limit of xx.

[1]City of Livermore Municipal Code sections 13.32.060 (General discharge prohibitions) and 13.32.110 (Specific pollutant limitations) for discharges of wastewater into the sanitary sewer.

Table 4: **Groundwater Analytical Results - Title 22 Metals (mg/L)**
SR 84 Expressway Widening Project
Livermore, California

Sample ID	GW-1	GW-2	GW-3	GW-5	Livermore Discharge
Date	3/25/2008	3/24/2008	3/25/2008	3/24/2008	Criteria[1]
Antimony	<0.010	<0.010	<0.010	<0.010	--
Arsenic	**0.035**	**0.027**	**0.01**	**0.49**	0.06
Barium	**5.2**	**0.82**	**1.8**	**14**	--
Beryllium	**0.0059**	<0.002	<0.002	**0.022**	--
Cadmium	<0.005	<0.005	<0.005	**0.0061**	0.14
Chromium	**0.19**	**0.26**	**0.081**	**5.7**	0.62
Cobalt	**0.28**	**0.066**	**0.14**	**1.6**	--
Copper	**0.22**	**0.12**	**0.077**	**2.7**	1.0
Lead	**0.025**	**0.034**	**0.031**	**0.67**	0.20
Mercury	**0.012**	<0.0002	**0.0019**	**0.0095**	0.01
Molybdenum	<0.005	**0.0082**	**0.0057**	**0.13**	--
Nickel	**0.54**	**0.61**	**0.43**	**20**	0.61
Selenium	<0.010	<0.010	<0.010	**0.081**	--
Silver	<0.005	<0.005	<0.005	**0.0065**	0.20
Thallium	<0.010	<0.010	<0.010	<0.010	--
Vanadium	**0.14**	**0.12**	**0.056**	**2.2**	--
Zinc	**0.35**	**0.22**	**0.16**	**3.8**	3.0

Notes:
See Figures 3A and 3B for sampling locations.
Samples were analyzed by U.S. Environmental Protection Agency Method 6010B/7470A.
Laboratory reports are provided in Attachment F.
Bold values indicate concentration was reported above the laboratory reporting limit
Boring GW-4 did not encounter groundwater at 72 feet below ground surface, the maximum depth explored.
Shaded cells indiate reported concentration is equal to or greater than City of Livermore discharge criteria.

<xx = indicates compound was not identified at or above the laboratory reporting limit of xx.
mg/L = milligrams per liter.
-- = compound does not have a discharge criteria.
Title 22 Metals = seventeen inorganic compounds listed on Title 22 of the California Code of Regulations.

[1]City of Livermore Municipal Code section 13.32.110, specific pollutant limitation for discharge of wastewater into the sanitary sewer.

APPENDICES

(*Portable Document Format on CD ROM*)

A: **September 2003 Aerially-Deposited Lead Variance and 2008 Time Extension**

B: **Zone 7 Water Agency Well Permit**

C: **Caltrans Encroachment Permit**

D: **Site Safety Plan**

E: **Quality Assurance Program Plan**

F: **Laboratory Reports and Chain-of-Custody Forms**

APPENDIX A

SEPTEMBER 2003 AERIALLY-DEPOSITED LEAD VARIANCE AND 2008 TIME EXTENSION

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: DEPUTY DISTRICT DIRECTORS, Construction
DEPUTY DIVISION CHIEF, Structure Construction
CONSTRUCTION MANAGERS
SENIOR CONSTRUCTION ENGINEERS
RESIDENT ENGINEERS

Date: August 20, 2007

File: Division of Construction
CPD 07-4

From: MARK LEJA
Chief
Division of Construction

Subject: 2008 Time Extension on Existing Variance for Aerially Deposited Lead

The Department of Toxic Substances Control (DTSC) issued a letter on January 31, 2007, to all districts currently holding an aerially deposited lead (ADL) variance and planning to renew it. The letter states that the existing variance for ADL is extended until June 30, 2008. The Department of Transportation is continuing to work with DTSC to renew the variance.

The Division of Environmental Analysis' internet and intranet web sites have additional information regarding the ADL variance:

http://www.dot.ca.gov/hq/env/haz/index.htm

http://pd.dot.ca.gov/env/haz/html/adl.htm

This Construction Procedures Directive (CPD) supersedes CPD 06-6.

If you have any questions or comments regarding this CPD, please contact Chuck Suszko, Chief, Office of Construction Engineering, at (916) 227-7314.

Margie Kough

Department of Toxic Substances Control

Edwin F. Lowry, Director
1001 "I" Street, 25th Floor
P.O. Box 806
Sacramento, California 95812-0806

Winston H. Hickox
Agency Secretary
California Environmental
Protection Agency

Gray Davis
Governor

September 12, 2003

CERTIFIED MAIL – 7001-0320-0000-9689-1178

Ms. Cindy Quon, District Director
California Department of Transportation, District 12
3347 Michelson Drive, Suite 100
Irvine, California 92612

LEAD CONTAMINATED SOIL VARIANCE, CALTRANS DISTRICT 12; SECOND MODIFICATION

Dear Ms. Quon:

This modification letter concerns the lead contaminated soil variance the Department of Toxic Substances Control (DTSC) issued to Caltrans, District 12 (the District) on September 22, 2000, which was first modified on December 13, 2002 (the First Modification). This modification (the Second Modification) replaces and supercedes the previous modification. The purpose of this Second Modification is to provide more clarity concerning new recommended lead levels.

The following paragraphs shall replace the corresponding sections in the variance issued on September 22, 2000 and the First Modification:

9.a.1. Lead contaminated soil containing 500 ug/l extractible lead or less (based on a modified waste extraction test using deionized water as the extractant) and 1411 mg/kg or less total lead may be used as fill provided that this soil is placed a minimum of five (5) feet above the maximum water table elevation and covered with at least one (1) foot of nonhazardous soil.

Soil that exceeds the allowed lead concentrations in this Condition 9.a.1. may still be used as fill if it meets the concentration levels described in Condition 9.a.2. below and the other requirements of Condition 9.a.2. are met.

9.a.2. Lead contaminated soil containing less than 50 mg/l extractible lead (based on a modified waste extraction test using deionized water as the extractant) and 3397 mg/kg or less total lead may be used as fill provided that this soil is placed a minimum of five (5) feet above the maximum water table elevation and protected from infiltration by a pavement structure which will be maintained by Caltrans.

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web-site at www.dtsc.ca.gov.

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Effective upon receipt of this Second Modification, all new projects conducted pursuant to the District's variance shall be required to use the modified lead levels and meet the other requirements specified above. This letter will formally modify the variance issued to the District and shall be attached as addendum to the existing variance. This letter also replaces and supersedes the First Modification.

If you have any questions or comments, please contact Michael Choe of my staff at (916) 322-5308.

Sincerely,

Peggy Harris, P.E., Chief
Regulatory and Program Development Division
Hazardous Waste Management Program

cc: Ms. Marge Rouch, Chief
Office of Noise, Vibration, and Hazardous Waste Management
Department of Transportation
1120 N Street, MS 27
Sacramento, California 95814

Ms. Marilee Hanson
Office of Legal Counsel and Investigations
Department of Toxic Substances Control
1001 "I" Street, P.O. Box 806
Sacramento, California 95812-0806

Mr. Jan Radimsky, P.E., Chief
Permitting Program Development Branch
Department of Toxic Substances Control
1001 "I" Street, P.O. Box 806
Sacramento, California 95812-0806

Mr. David Wright, P.E., Chief
Permit Program Development Section
Department of Toxic Substances Control
1001 "I" Street, P.O. Box 806
Sacramento, California 95812-0806

California Environmental Protection Agency
Department of Toxic Substances Control

VARIANCE

Applicant Names:

Mr. Harry Yahata, District Director
State of California
Department of Transportation, District 4
(Caltrans)
111 West Grand Avenue
P.O. Box 23660
Oakland, California 94623-0660

Variance No. 00-H-VAR-01

Effective Date: September 22, 2000

Expiration Date: September 22, 2005

Modification History:

Pursuant to Section 25143 of the California Health and Safety Code, the Department of Toxic Substances Control hereby issues the attached Variance consisting of 8 pages to Department of Transportation District 04.

Frederick S. Moss
Chief, Permitting Division
Department of Toxic Substances Control

Date: 9/22/00

VARIANCE

1. INTRODUCTION.

1.1 Pursuant to Section 25143, Chapter 6.5, Division 20 of the Health and Safety Code (HSC), the California Department of Toxic Substances Control (DTSC) grants a variance to the applicant below for waste considered hazardous solely because of its contaminant concentrations and as further specified herein.

1.2 DTSC hereby grants a variance only from the requirements specified herein and only in accordance with all terms and conditions specified herein.

2. IDENTIFYING INFORMATION.

APPLICANT/OWNER/OPERATOR

Mr. Harry Yahata, District Director
State of California
Department of Transportation, District 4 (Caltrans)
111 West Grand Avenue
P.O. Box 23660
Oakland, California 94623-0660

3. TYPE OF VARIANCE.

Generation, Manifest, Transportation, Storage and Disposal

4. ISSUANCE AND EXPIRATION DATES.

DATE ISSUED: September 22, 2000 EXPIRATION DATE: September 22, 2005.

5. APPLICABLE STATUTES AND REGULATIONS. The hazardous waste that is the subject of this variance is fully regulated under HSC, Section 25100, et seq. and Title 22 of the California Code of Regulations (CCR) Division 4.5 except as specifically identified in Section 8 of this variance.

6. DEFINITION. For the purposes of this variance, waste that meets the criteria in paragraphs a) and b) of section 9 below, shall be referred to as "lead-contaminated soil(s)".

7. FINDINGS/DETERMINATIONS. DTSC has determined that the variance applicant meets the requirements set forth in HSC Section 25143 for a variance from specific regulatory requirements as outlined in Section 8 of this variance. The specific determinations and findings made by DTSC are as follows:

a) Caltrans intends to excavate, stockpile, transport, bury and cover large volumes of soil associated with highway construction projects throughout the State. In the

more urbanized highway corridors this soil is contaminated with lead, primarily due to historic emissions from automobile exhausts. In situ testing has shown the uppermost two feet of soil have been found to contain concentrations of lead in excess of regulatory thresholds. However, DTSC has prepared a risk assessment that shows that soil contaminated with low concentrations of lead can be managed in a way that presents no significant risk to human health and the environment.

b) The lead-contaminated soil will be placed only in Caltrans rights of way. Based on concentration levels, the wastes will be covered with a minimum thickness of one (1) foot of non-hazardous soil or asphalt cover and will always be five (5) feet above the highest groundwater elevation. Caltrans will assure that proper health and safety procedures will be followed for workers. This includes any persons engaged in maintenance work in areas where the waste has been buried and covered.

c) DTSC finds and requires that the lead contaminated soil excavated, stockpiled, transported, buried and covered is a non-RCRA hazardous waste, and that the hazardous waste management activity is insignificant as a potential hazard to human health and safety and the environment, when managed in accordance with the conditions, limitations and other requirements specified in this variance.

8. PROVISIONS SUBJECT TO VARIANCE.

DTSC, subject to all terms and conditions herein, waives the hazardous waste management requirements of Title 22,CCR, sections 66264.250 through 66264.259, 22 CCR 66268.1 through 66268.9, 22 CCR 66262.10, 22 CCR 66262.12, 22 CCR 66262.20, 22 CCR 66262.30 through 66262.34, 22 CCR 66262.40 through 66262.42, 22 CCR 66263.10 through 66263.18 and 22 CCR 66263.20 through 66263.23 for the generation, transportation, manifesting, storage and land disposal of hazardous waste. These management requirements are only waived provided all other requirements of this variance are complied with at Caltrans construction projects in the Caltrans District specified in section 2 above.

9. SPECIFICATIONS OF THE CONDITIONS, LIMITATIONS, OR OTHER REQUIREMENTS. The owner/operator shall be subject to the following conditions:

a) Caltrans shall manage all soil contaminated with lead at concentrations such that it is considered a hazardous waste pursuant to HSC 25117 and 22 CCR, Div 4.5, Chapter 11, unless the contaminant concentrations and management practices meet the following conditions:

1. Soil containing 500 ug/l extractible lead or less (based on a modified waste extraction test using deionized water as the extractant) and 350 ppm or less total lead may be used as fill provided that the lead-contaminated soil is placed a minimum of five (5) feet above the maximum water table elevation and covered with at least one (1) foot of nonhazardous soil. The limit on total lead within shall be the following: Total parts per million (ppm) lead shall be at or below the statutory limits in effect when the soil is used as fill or the risk based limit of 1496mg/kg, whichever is less. On the effective date of this variance, HSC section 25157.8 limits total lead

concentrations to 350 ppm. That section may be amended and/or expire in the future. Additionally, other parts of relevant statutes may be added or amended in the future to include lead limits applicable to this variance.

2. Soil containing more than 500 ug/l and less than 50 mg/l extractible lead (based on a modified waste extraction test using deionized water as the extractant) and 350 or less ppm total lead may be used as fill provided that the lead-contaminated soils are placed a minimum of five (5) feet above the maximum water table elevation and protected from infiltration by a pavement structure which will be maintained by Caltrans. Caltrans shall comply with the lead limits discussed in paragraph a) 1 above.

3. Contaminated soil with a pH < 5.0 shall be used as fill material only under the paved portion of the roadway.

b) Caltrans will implement appropriate health and safety procedures to protect its employees and the public, and to prevent or minimize exposure to potentially hazardous substances. A project-specific health and safety plan must be prepared and implemented. The monitoring and exposure standards shall be based on Construction Standards in Title 22, CCR section 1532.1.

c) All lead-contaminated soil that cannot be buried and covered within the same Caltrans corridor from where it originated shall be managed as a hazardous waste.

d) Lead-contaminated soil will not be moved outside the designated corridor boundaries (see paragraph q) below).

e) Lead-contaminated soil shall not be buried in areas where it will be in contact with groundwater or surface water.

f) Lead-contaminated soil shall be buried and covered only in locations that are protected from erosion resulting from storm water run-on and run-off.

g) The lead-contaminated soil shall be buried and covered in a manner that will prevent accidental or deliberate breach of the asphalt, concrete, and/or cover soil.

h) The presence of lead-contaminated soil will be incorporated into the projects' as-built drawings. The as-built drawings shall be annotated with the location, representative analytical data, and volume of lead-contaminated soil. The as-built drawings shall also state the depth of the cover. These as-built drawings shall be retained by Caltrans until its rights-of-way or property ownership are relinquished.

I) Caltrans shall ensure that no other hazardous wastes, other than the lead-contaminated soil, are placed in the burial areas.

j) Lead-contaminated soil shall not be buried within ten (10) feet of culverts or locations subject to frequent worker exposure.

k) Excavated lead-contaminated soil not placed into the designated area (fill area, roadbed area) by the end of the working day shall be stockpiled and covered with sheets of polyethylene or at least one foot of non-hazardous soil. The lead contaminated soil, while stockpiled or under transport, shall be protected from contacting surface water and being dislodged or transported by wind or storm water. The stockpile covers shall be inspected at least once a week and within 24 hours after rainstorms.

l) Caltrans shall ensure that all stockpiling of lead contaminated soil remains within the specified corridor. Stockpiling of lead-contaminated soil outside the area of contamination is in direct violation of land disposal restrictions and is prohibited.

m) Caltrans shall conduct confirmatory sampling, if appropriate, of any stockpile area after removal of the lead- contaminated soil to ensure that contamination has not been left behind or has not migrated from the stockpiled material to the surrounding soils. Caltrans shall ensure that test results are kept with Caltrans project records located at the District office or a subsequent permanent location and are available to DTSC upon request.

n) Caltrans shall stockpile lead-contaminated soil only on high ground (i.e. no sump areas or low points) which will not be affected by surface water run-on or run-off.

o) Caltrans shall not stockpile soil in an environmentally sensitive area.

p) Caltrans shall ensure that run-off which has come into contact with stockpiled lead-contaminated soil will not flow to storm drains, inlets, or waters of the state.

q) Caltrans may move lead-contaminated soil from one Caltrans project to another Caltrans project so long as the lead-contaminated soil remains within the same designated Caltrans corridor. Caltrans shall record this movement of lead- contaminated soil by using a bill of lading. The bill of lading must contain: 1) US DOT description including shipping name, hazard class and ID number; 2) handling codes; 3) quantity of material; 4) volume of material; and 5) any specific handling instructions. The bill of lading shall be referenced in and kept on file with the project's as-built drawings. Lead-contaminated soil must be kept covered during transportation.

r) For each specific corridor where this variance is to be implemented, all of the following information will be submitted in writing to DTSC at least five (5) days before construction of any project begins:

1. a plan drawing designating the boundaries of the corridor where lead-contaminated soils will be excavated, stockpiled, buried and covered;

2. a list of the Caltrans projects that the corridor encompasses;

3. a list of Caltrans contractors that will be conducting any phase of work on any project affected by this variance;

4. duration of corridor construction;

5. location where sampling and analytical data used to make lead concentration level determinations are kept (e.g. a particular Caltrans project file);

6. name and phone number (please include area code) of project resident engineer and project manager;

7. location where Caltrans and contractor health and safety records are kept;

8. location of project special provisions (including page or section number) for soil excavation, transportation, stockpile, burial and placement of cover material;

9. location of project drawings (including drawing page number) for soil excavation, burial and placement of cover in plan and cross section (For example, "The project plans are located at the resident engineer's office located at 5th and Main Streets, City of Fresno,. See pages xxxxx of contract xxxx");

10. If a Caltrans project within the corridor is added, changed or deleted, Caltrans must update the information provided to DTSC five (5) days before construction begins; and

11. The type of environmental document for each project, date of adoption, document title, Clearing House number and where the document is available for review. A copy of the Notice of Exemption for any project shall be submitted to the DTSC Headquarters Project Manager within five (5) days of signing.

s) Changes in location of lead-contaminated soil placement, quantities or protection measures (field changes) will be noted in the resident engineer's project log within five (5) days of the field change.

t) Caltrans shall ensure that field changes are in compliance with the requirements of this variance.

u) If areas subject to the terms of this variance are sold, relinquished or abandoned (including roadways), all future property owners shall be notified in writing in advance by Caltrans of the requirements of this variance, and Caltrans shall provide the owner with a copy of the variance. A copy of such a notice shall be sent to and contain the corridor location and project. Caltrans shall also disclose to the new owner the location of areas where lead contaminated soil has been buried. Future property owners will be subject to the same requirements as Caltrans retains the right to modify or revoke this variance pursuant to HSC 25143 upon a change of ownership or at any other time.

v) For the purposes of informing the public about instances where the variance is implemented, Caltrans shall:

1. Maintain current fact sheets at all Caltrans resident engineer offices and the Caltrans District office. Caltrans shall make the fact sheets available to anyone expressing an interest in variance-related work.

2. Maintain a binder(s) containing copies of all reports submitted to DTSC at the District office. Caltrans shall ensure that the binders are readily accessible to the public.

3. Carry out the following actions when it identifies additional projects:

(A) Notify the public via a display advertisement in a newspaper of general circulation in that area.

(B) Update and distribute the fact sheet to the mailing list and repository locations.

w) Caltrans implementation of this variance shall comply with all applicable state policies for water quality control, water quality control plans, waste discharge requirements (including storm water permits), and others issued by the State Water Resources Control Board or a California Regional Water Quality Control Board.

x) This variance is applicable only to soil considered hazardous because of aerially-deposited lead contamination. The variance is not applicable to any other hazardous waste.

y) Lead-contaminated soil may be buried only in areas where access is limited or where lead-contaminated soil is covered and contained by a pavement structure.

1) Dust containing lead-contaminated soil must be controlled. Water or dust palliative may be applied to control dust. If visible dust migration occurs, all excavation, stockpiling and truck loading and burying must be stopped. The granting of this variance confers no relief on Caltrans from compliance with the laws, regulations and requirements enforced by any local air district or the California Air Resources Board.

2) Sampling and analysis is required to show the lead contaminated soil meets the variance criteria specified in a). All sampling and analysis must be done according to U.S. EPA subsection SW-846.

z) All correspondence shall be directed to the following office:

Frederick S. Moss, Chief
Permitting Division
Department of Toxic Substances Control
400 P Street, 4th Floor
P.O. Box 806
Sacramento, CA 95812-0806

Attn: Caltrans Lead Variance Notification Unit

10. DISCLAIMER.

10.1 The issuance of this variance does not relieve Caltrans of the responsibility for compliance with Division 20, Chapter 6.5, HSC, or the regulations adopted thereunder, and any other laws and regulations other than those specifically identified in Section 8 of this variance. Caltrans is subject to all terms and conditions herein. The granting of this variance confers no relief from compliance with any federal, state or local requirements other than those specifically provided herein.

10.2 The issuance of this variance does not release Caltrans from any liability associated with the handling of hazardous waste, except as specifically provided herein and subject to all terms and conditions of this variance.

11. VARIANCE MODIFICATION OR REVOCATION. This variance is subject to review at the discretion of DTSC and may be modified or revoked at any time pursuant to Health and Safety Code section 25143.

12. CEQA DETERMINATION. DTSC adopted a Negative Declaration on September 22, 2000.

Approved:

9/22/00
Date

Frederick S. Moss, Chief
Permitting Division
Hazardous Waste Management Program
Department of Toxic Substances Control

APPENDIX B

ZONE 7 WATER AGENCY WELL PERMIT

ZONE 7 WATER AGENCY

100 NORTH CANYONS PARKWAY, LIVERMORE, CALIFORNIA 94551 VOICE (925) 454-5000 FAX (925) 245-9306
E-MAIL whong@zone7water.com

DRILLING PERMIT APPLICATION

FOR APPLICANT TO COMPLETE

FOR OFFICE USE

LOCATION OF PROJECT near Stanley Blvd and Isabel Avenue intersection in Livermore

California Coordinates Source _____ ft. Accuracy _____ ft.
CCN _____ ft. CCE _____ ft.
APN _____

CLIENT
Name URS - Edujie Imonitie
Address 55 S. Market St. Phone (408) 297-9585
City San Jose Ste. 1500 Zip 95113

APPLICANT
Name BASELINE Environmental Consulting
Email redgy@baseline-env.com Fax (510) 420-1707
Address 5900 Hollis St. Suite D Phone (510) 420-8686
City Emeryville Zip 94608

TYPE OF PROJECT:
Well Construction ·· Geotechnical Investigation ··
Well Destruction ·· Contamination Investigation ··
Cathodic Protection ·· Other Groundwater Investigation ··

PROPOSED WELL USE:
Domestic ·· Irrigation ··
Municipal ·· Remediation ··
Industrial ·· Groundwater Monitoring ··
Dewatering ·· Other Not Applicable ··

DRILLING METHOD:
Mud Rotary ·· Air Rotary ·· (Hollow Stem Auger) ··
Cable Tool ·· Direct Push ·· Other _____ ··

DRILLING COMPANY Precision Sampling Inc.
DRILLER'S LICENSE NO. C57 636387

WELL SPECIFICATIONS:
Drill Hole Diameter _____ in. Maximum
Casing Diameter _____ in. Depth _____ ft.
Surface Seal Depth _____ ft. Number _____

SOIL BORINGS:
Number of Borings 5 Maximum
Hole Diameter 4 in. Depth 60 ft.

ESTIMATED STARTING DATE March 24, 2008
ESTIMATED COMPLETION DATE March 26, 2008

I hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE Reginald Ramirez Date 3/10/2008
Reginald Ramirez
ATTACH SITE PLAN OR SKETCH

PERMIT NUMBER 28032
WELL NUMBER _____
APN _____

PERMIT CONDITIONS
(Circled Permit Requirements Apply)

A. GENERAL
(1.) A permit application should be submitted so as to arrive at the Zone 7 office five days prior to proposed starting date.
2. Submit to Zone 7 within 60 days after completion of permitted work the original Department of Water Resources Water Well Drillers Report or equivalent for well projects, or drilling logs and location sketch for geotechnical projects.
(3.) Permit is void if project not begun within 90 days of approval date.

B. WATER SUPPLY WELLS
1. Minimum surface seal diameter is four inches greater than the well casing diameter.
2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic and irrigation wells unless a lesser depth is specially approved.
3. Grout placed by tremie.
4. An access port at least 0.5 inches in diameter is required on the wellhead for water level measurements.
5. A sample port is required on the discharge pipe near the wellhead.

C. GROUNDWATER MONITORING WELLS INCLUDING PIEZOMETERS
1. Minimum surface seal diameter is four inches greater than the well or piezometer casing diameter.
2. Minimum seal depth for monitoring wells is the maximum depth practicable or 20 feet.
3. Grout placed by tremie.

(D.) GEOTECHNICAL. Backfill bore hole with compacted cuttings or heavy bentonite and upper two feet with compacted material. In areas of known or suspected contamination, tremied cement grout shall be used in place of compacted cuttings.

E. CATHODIC. Fill hole above anode zone with concrete placed by tremie.

F. WELL DESTRUCTION. See attached.

G. SPECIAL CONDITIONS. Submit to Zone 7 within 60 days after completion of permitted work the well installation report **including all soil and water laboratory analysis results**.

Approved Wyman Hong Date 3/18/08
Wyman Hong

APPENDIX C

CALTRANS ENCROACHMENT PERMIT

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

ENCROACHMENT PERMIT

TR-0120

Permit No.	
0407-NSV1503	
Dist/Co/Rte/PM 04-Ala-84	RECEIVED 22.5/27.3 SEP 14 2007
Date September 10, 2007	ACTIA
Fee Paid	Deposit
Performance Bond Amount (1)	Payment Bond Amount (2)
Bond Company	
Bond Number (1)	Bond Number (2)

( ) compliance with (*Check one*):

☒ Your application of August 23, 2007

☐ Utility Notice No. _____ of _____

☐ Agreement No. _____ of _____

☐ R/W Contract No. _____ of _____

TO: ☐ Alameda County Transportation Improvement Authority
1333 Broadway, Suite 300
Oakland, CA 94612
Attn: Mr. Art Dao
Phone: (510) 267-6104 ☐, **PERMITTEE**

And subject to the following, **PERMISSION IS HEREBY GRANTED** to:

Perform site survey, soil sampling and geotechnical field investigations, on State Highway 04-Ala-84, Post Miles 22.5/27.3, in the City of Livermore, in conjunction with Caltrans Project E.A. Number 04-297600.

( ) minimum of one week prior to start of work under this permit, notice shall be given to, and approval of construction details, operations, public safety, and traffic control shall be obtained from State Representative Hamid Karami, ~~4585 Pacheco Boulevard, Suite 200~~, Martinez, CA 94553, ~~925-313-8846~~, weekdays, between 7:30 AM and 4:00 PM. 7B MOCO Co Rd. office: 925-957-2035 Fax: 925-957-2040

All permitted work requires the Permittee to apply for and obtain a work authorization number prior to start of work. See the attached "Encroachment Permit Project Work Scheduling Procedures" and the attached "Permit Project Work Scheduling Request Form". Additional time beyond the minimum seven-day advanced notice required in the above paragraph may be required for obtaining the traffic control approval.

The following attachments are also included as part of this permit (*Check applicable*):

☒ Yes	☐ No	General Provisions
☐ Yes	☒ No	Utility Maintenance Provisions
☐ Yes	☒ No	Special Previsions
☐ Yes	☒ No	A Cal-OSHA permit required prior to beginning work: # _____

In addition to fee, the permittee will be billed actual costs for:

☐ Yes	☒ No	Review
☐ Yes	☒ No	Inspection
☐ Yes		---------Field Work

(If any Caltrans effort expended)

☐ Yes ☒ No The information in the environmental documentation has been reviewed and considered prior to approval of this permit.

This permit is void unless the work is completed before March 31, 2008.

This permit is to be strictly construed and no other work other than specifically mentioned is hereby authorized.
No project work shall be commenced until all other necessary permits and environmental clearances have been obtained.

Date Rec'd 9-25-07
Log No _____ Main File # 274.01
Routed to 1 1
Copies to 1 1
From CT To URS
Description ACCESS ENCROACHMENT PERMIT

APPROVED:

BIJAN SARTIPI, District Director

BY:

Acting for

MICHAEL D. CONDIE, District Permit Engineer

The site of the work shall be enclosed by suitable barricades, signs and lights, as approved by State's representative, to warn and protect traffic effectively.

When survey operations are being conducted, the Permittee shall furnish, place and maintain signs and safety equipment in accordance with the latest edition of the "Manual of Traffic Controls for Construction and Maintenance Work Zones".

When the work area encroaches upon a sidewalk, walkway, or crosswalk area, special consideration must be given to pedestrian safety. Protective barricades, fencing, handrails and bridges, together with warning and guidance devices and signs must be utilized so that the passageway for pedestrians, especially blind and other physically handicapped, is safe and well defined.

All of Permittee's personnel shall wear appropriate personal protective equipment, including hard hats and bright-colored vests, shirts or jackets with retro-reflective material while on State highway right-of-way.

All survey operations shall be conducted off the traveled way except where necessary to traverse pavements and medians on conventional highways. No surveying is allowed on traveled ways of freeways or expressways.

No surveying or other work is authorized at locations accessible only from through traffic lanes of freeways or expressways without separate written permission.

Before any work is begun which will interrupt the normal flow of public traffic, approval shall be obtained from State's representative, and closures will be as shown on the attached copy of Standard Plan Sheet T-10.

Any damage to existing state facilities shall be repaired or replaced in kind by the Permittee immediately.

Traffic control is restricted to closure of one lane and/or shoulder, authorized only between 9:00 A.M. and 3:00 P.M., Monday through Friday, holidays excluded.

Immediately following completion of the work permitted herein, the Permittee shall fill out and mail the "Notice of Completion" attached to this permit.

RECEIVED
SEP 1 4 2007
ACTIA

STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION
ENCROACHMENT PERMIT GENERAL PROVISIONS
TR-0045 (REV. 05/2007)

1. **AUTHORITY:** The Department's authority to issue encroachment permits is provided under, Div. 1, Chpt. 3, Art. 1, Sect. 660 to 734 of the Streets and Highways Code.

2. **REVOCATION:** Encroachment permits are revocable on five days notice unless otherwise stated on the permit and except as provided by law for public corporations, franchise holders, and utilities. These General Provisions and the Encroachment Permit Utility Provisions are subject to modification or abrogation at any time. Permittees' joint use agreements, franchise rights, reserved rights or any other agreements for operating purposes in State highway right of way are exceptions to this revocation.

3. **DENIAL FOR NONPAYMENT OF FEES:** Failure to pay permit fees when due can result in rejection of future applications and denial of permits.

4. **ASSIGNMENT:** No party other than the permittee or permittee's authorized agent is allowed to work under this permit.

5. **ACCEPTANCE OF PROVISIONS:** Permittee understands and agrees to accept these General Provisions and all attachments to this permit, for any work to be performed under this permit.

6. **BEGINNING OF WORK:** When traffic is not impacted (see Number 35), the permittee shall notify the Department's representative, two (2) days before the intent to start permitted work. Permittee shall notify the Department's Representative if the work is to be interrupted for a period of five (5) days or more, unless otherwise agreed upon. All work shall be performed on weekdays during regular work hours, excluding holidays, unless otherwise specified in this permit.

7. **STANDARDS OF CONSTRUCTION:** All work performed within highway right of way shall conform to recognized construction standards and current Department Standard Specifications, Department Standard Plans High and Low Risk Facility Specifications, and Utility Special Provisions. Where reference is made to "Contractor and Engineer," these are amended to be read as "Permittee and Department representative."

8. **PLAN CHANGES:** Changes to plans, specifications, and permit provisions are not allowed without prior approval from the State representative.

9. **INSPECTION AND APPROVAL:** All work is subject to monitoring and inspection. Upon completion of work, permittee shall request a final inspection for acceptance and approval by the Department. The local agency permittee shall not give final construction approval to its contractor until final acceptance and approval by the Department is obtained.

10. **PERMIT AT WORKSITE:** Permittee shall keep the permit package or a copy thereof, at the work site and show it upon request to any Department representative or law enforcement officer. If the permit package is not kept and made available at the work site, the work shall be suspended.

11. **CONFLICTING ENCROACHMENTS:** Permittee shall yield start of work to ongoing, prior authorized, work adjacent to or within the limits of the project site. When existing encroachments conflict with new work, the permittee shall bear all cost for rearrangements, (e.g., relocation, alteration, removal, etc.).

12. **PERMITS FROM OTHER AGENCIES:** This permit is invalidated if the permittee has not obtained all permits necessary and required by law, from the Public Utilities Commission of the State of California (PUC), California Occupational Safety and Health Administration (Cal-OSHA), or any other public agency having jurisdiction.

13. **PEDESTRIAN AND BICYCLIST SAFETY:** A safe minimum passageway of 4' shall be maintained through the work area at existing pedestrian or bicycle facilities. At no time shall pedestrians be diverted onto a portion of the street used for vehicular traffic. At locations where safe alternate passageways cannot be provided, appropriate signs and barricades shall be installed at the limits of construction and in advance of the limits of construction at the nearest crosswalk or intersection to detour pedestrians to facilities across the street. Attention is directed to Section 7-1.09 Public Safety of the Department Standard Specifications.

14. **PUBLIC TRAFFIC CONTROL:** As required by law, the permittee shall provide traffic control protection warning signs, lights, safety devices, etc., and take all other measures necessary for traveling public's safety. While providing traffic control, the needs and control of all road users [motorists, bicyclists and pedestrians, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA)] shall be an essential part of the work activity.

    Day and night time lane closures shall comply with the California Manual on Uniform Traffic Control Devices (Part 6, Temporary Traffic Control), Standard Plans, and Standard Specifications for traffic control systems. These General Provisions are not intended to impose upon the permittee, by third parties, any duty or standard of care, greater than or different from, as required by law.

15. **MINIMUM INTERFERENCE WITH TRAFFIC:** Permittee shall plan and conduct work so as to create the least possible inconvenience to the traveling public; traffic shall not be unreasonably delayed. On conventional highways, permittee shall place properly attired flagger(s) to stop or warn the traveling public in compliance with the California Manual on Uniform Traffic Control Devices (Chapter 6E, Flagger Control).

16. **STORAGE OF EQUIPMENT AND MATERIALS:** The storage of equipment or materials <u>is not</u> allowed within State highway right-of-way, <u>unless specified</u> within the Special Provisions of this specific encroachment permit. If Encroachment Permit Special Provisions allow for the storage of equipment or materials within the State right of way, the equipment and material storage shall comply with Standard Specifications, Standard Plans, Special Provisions, and the Highway Design Manual. The clear recovery zone widths must be followed and are the minimum desirable for the type of facility indicated below: freeways and expressways - 30', conventional highways (no curbs) - 20', conventional highways (with curbs) – 1.5'. If a fixed object cannot be eliminated, moved outside the clear recovery zone, or modified to be made yielding, it should be shielded by a guardrail or a crash cushion.

17. **CARE OF DRAINAGE:** Permittee shall provide alternate drainage for any work interfering with an existing drainage facility in compliance with the Standard Specifications, Standard Plans and/or as directed by the Department's representative.

18. **RESTORATION AND REPAIRS IN RIGHT OF WAY:** Permittee is responsible for restoration and repair of State highway right of way resulting from permitted work (State Streets and Highways Code, Sections 670 et. seq.).

The duty of the permittee to indemnify and save harmless includes the duties to defend as set forth in Section 2778 of the Civil Code. The permittee waives any and all rights to any type of expressed or implied indemnity against the State, its officers, employees, and State contractors. It is the intent of the parties that the permittee will indemnify and hold harmless the State, its officers, employees, and State's contractors, from any and all claims, suits or actions as set forth above regardless of the existence or degree of fault or negligence, whether active or passive, primary or secondary, on the part of the State, the permittee, persons employed by the permittee, or acting on behalf of the permittee.

For the purpose of this section, "State's contractors" shall include contractors and their subcontractors under contract to the State of California performing work within the limits of this permit.

29. **NO PRECEDENT ESTABLISHED:** This permit is issued with the understanding that it does not establish a precedent.

30. **FEDERAL CIVIL RIGHTS REQUIREMENTS FOR PUBLIC ACCOMMODATION:**
A. The permittee, for himself, his personal representative, successors in interest, and assigns as part of the consideration hereof, does hereby covenant and agree that:
1. No person on the grounds of race, color, or national origin shall be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities.
2. That in connection with the construction of any improvements on said lands and the furnishings of services thereon, no discrimination shall be practiced in the selection and retention of first-tier subcontractors in the selection of second-tier subcontractors.
3. That such discrimination shall not be practiced against the public in their access to and use of the facilities and services provided for public accommodations (such as eating, sleeping, rest, recreation), and operation on, over, or under the space of the right of way.
4. That the permittee shall use the premises in compliance with all other requirements imposed pursuant to Title 15, Code of Federal Regulations, Commerce and Foreign Trade, Subtitle A, Office of the Secretary of Commerce, Part 8 (15 C.F.R. Part 8) and as said Regulations may be amended.
5. That in the event of breach of any of the above nondiscrimination covenants, the State shall have the right to terminate the permit and to re-enter and repossess said land and the land and the facilities thereon, and hold the same as if said permit had never been made or issued.

31. **MAINTENANCE OF HIGHWAYS:** The permittee agrees, by acceptance of a permit, to properly maintain any encroachment. This assurance requires the permittee to provide inspection and repair any damage, at permittee's expense, to State facilities resulting from the encroachment.

32. **SPECIAL EVENTS:** In accordance with subdivision (a) of Streets and Highways Code Section 682.5, the Department of Transportation shall not be responsible for the conduct or operation of the permitted activity, and the applicant agrees to defend, indemnify, and hold harmless the State and the city or county against any and all claims arising out of any activity for which the permit is issued.

Permittee understands and agrees that it will comply with the obligations of Titles II and III of the Americans with Disabilities Act of 1990 in the conduct of the event, and further agrees to indemnify and save harmless the State of California, all officers and employees thereof, including but not limited to the Director of Transportation, from any claims or liability arising out of or by virtue of said Act.

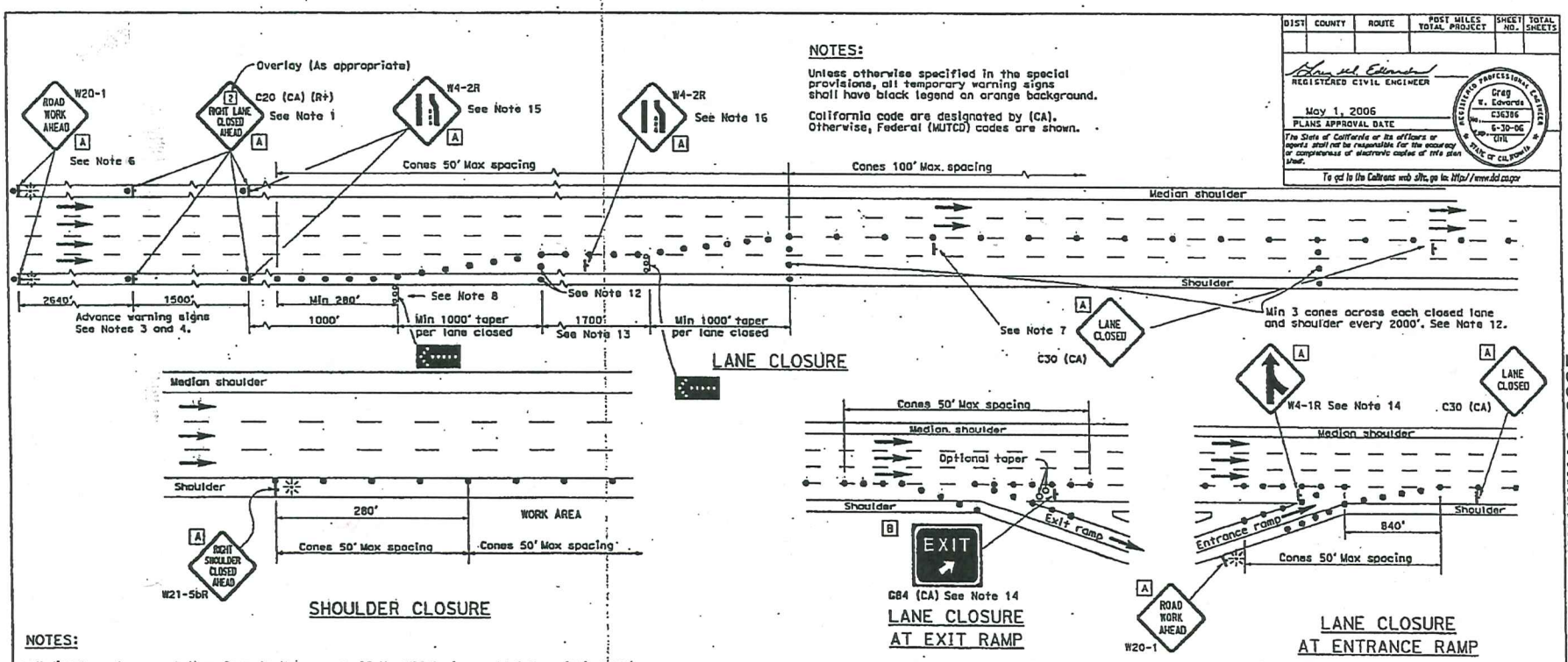
33. **PRIVATE USE OF RIGHT OF WAY:** Highway right of way shall not be used for private purposes without compensation to the State. The gifting of public property use and therefore public funds is prohibited under the California Constitution, Article 16.

34. **FIELD WORK REIMBURSEMENT:** Permittee shall reimburse State for field work performed on permittee's behalf to correct or remedy hazards or damaged facilities, or clear debris not attended to by the permittee.

35. **NOTIFICATION OF DEPARTMENT AND TMC:** The permittee shall notify the Department's representative and the Transportation Management Center (TMC) at least 7 days before initiating a lane closure or conducting an activity that may cause a traffic impact. A confirmation notification should occur 3 days before closure or other potential traffic impacts. In emergency situations when the corrective work or the emergency itself may affect traffic, TMC and the Department's representative shall be notified as soon as possible.

36. **SUSPENSION OF TRAFFIC CONTROL OPERATION:** The permittee, upon notification by the Department's representative, shall immediately suspend all lane closure operations and any operation that impedes the flow of traffic. All costs associated with this suspension shall be borne by the permittee.

37. **UNDERGROUND SERVICE ALERT (USA) NOTIFICATION:** Any excavation requires compliance with the provisions of Government Code Section 4216 et. seq., including, but not limited to notice to a regional notification center, such as Underground Service Alert (USA). The permittee shall provide notification at least 48 hours before performing any excavation work within the right of way.



DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

To get to the Caltrans web site, go to: http://www.dot.ca.gov

REGISTERED PROFESSIONAL ENGINEER Greg W. Edwards C36386 Exp. 6-30-06 Civil STATE OF CALIFORNIA

NOTES:

Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on orange background.

California code are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.

NOTES:

1. Median lane closures shall conform to the details for outside lane closures except that C20 (CA) (Lt) signs shall be used.
2. At least one person shall be assigned to provide full time maintenance of traffic control devices for lane closures.
3. Duplicate sign installations are not required:
   a) On opposite shoulder if at least one-half of the available lanes remain open to traffic.
   b) In the median if the width of the median shoulder is less than 8' and the outside lanes are to be closed.
4. Each advance warning sign on each side of the roadway shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color. Flashing beacons shall be placed at the locations indicated for lane closure during hours of darkness.
5. A C14 (CA) "END ROAD WORK" sign, as appropriate, shall be placed at the end of the lane closure unless the end of work area is obvious or ends within a larger project's limits.
6. If the W20-1 sign would follow within 2000' of a stationary W20-1 or C11 (CA) "ROAD WORK NEXT ___ MILES", use a C20 (CA) sign for the first advance warning sign.
7. Place a C30 (CA) sign every 2000' throughout length of lane closure.
8. One flashing arrow sign for each lane closed. The first flashing arrow sign shall be Type I. All others may be either Type I or Type II.
9. A minimum 1500' of sight distance shall be provided where possible for vehicles approaching the first flashing arrow sign. Lane closures shall not begin at top of crest vertical curve or on a horizontal curve.
10. All cones used for lane closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
11. Portable delineators, placed at one-half the spacing indicated for traffic cones may be used instead of cones for daytime closures only.
12. Unless otherwise specified in the special provisions, a minimum of 3 cones shall be placed transversely across each closed lane and shoulder at each location where a taper across a traffic lane ends and every 2000' as shown on the "Lane Closure" detail. Two Type II barricades may be used instead of the 3 cones. The transverse alignment of the cones or barricades on the closed shoulder may be shifted from the transverse alignment to provide access to the work.
13. Unless otherwise specified in the special provisions, the 1700' tangent shown along lane lines shall be used between the 1000' tapers required for each closed traffic lane.
14. Unless otherwise specified in the special provisions, the G84 (CA) and W4-1 signs shall be used as shown.
15. When specified in the special provisions, a W4-2 "LANE ENDS" symbol sign is to be used in place of the C20 (CA) "RIGHT LANE CLOSED AHEAD" sign.
16. The W4-2 "LANE ENDS" symbol sign shown at this location is to be used where the W4-2 sign is used as advance warning as described in Note 15.

SIGN PANEL SIZE (Min)

- A 48" x 48"
- B 54" x 48"

LEGEND

- Traffic Cone
- Traffic Cone (optional taper)
- Temporary Sign
- Flashing Arrow Sign (FAS)
- FAS Support or Trailer
- Direction of Travel
- Portable Flashing Beacon

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE ON FREEWAYS AND EXPRESSWAYS

NO SCALE

T10

Encroachment Permit Work Scheduling Request Form

Caltrans

Submit request to schedule traffic control weekly, 7 days in advance, using this form. Submit to Permit Duty Station by FAX, 510-286-3960, or E-mail: *Permit_Duty_Engineer@dot.ca.gov*. ***Reminder!*** - Notify Inspector listed on page 1 or 2 of your Permit. Check Permit Special Provisions for authorized **work hours**. Any deviation from the Permit must be requested in writing.

INSTRUCTIONS AND ABBREVIATIONS: See Procedures on reverse of this form (page 2).

1. Permit No.: 0407-NSV1503 2.Expiration Date: 3/31/08 3. Request Date: 3/25/08
4. Caltrans Inspector: Hamid Karami 5. Requested Work Week: 3/24 to 3/28
6. Route: 84 7. County: Alameda 8. City or township: Livermore
9. ☐PostMiles or ☐Kilopost: From: ____ To: ____ 10. Existing Lanes (in each Dir): Dir S Lns ____ / Dir ____ Lns ____
11. Describe Location (use landmark if necessary): From: Vineyard To: Jacklondon
12 Name of Conventional Highway or Surface St: Commercial Highway
13. (a through k) Fill in or 'x' if applicable: (a) ☐ Divided Hwy *or* ☐ Undivided Hwy (b) ☐ Full-Closure ☐ 1 dir or ☐ both dir
(c) ☐One-way Traffic Control: Only on "Undivided" Hwy (*Alternate use of same lane for both directions--hold trfc 5 -10 min w/flaggers*)
(d) ☐Connector Ramp: (*State Highway #*) _____ to (*State Highway #*) _____ Closed ☐ *or* Lane # _____
(e) ☐Off/ramp: (*Freeway to City St*) Ramp Name: _____ Off/ramp Closed ☐ *or* Lane#: _____
(f) ☐On/ramp: (*City St to Freeway*) Ramp Name: _____ On/ramp Closed ☐ *or* Lane#: _____
(g) ☐Divert Trfc or Contra Flow: Reconfigure lanes/divert trfc to Lane# ___ in the ___ Direction; ___ Lane(s) open ea direction.
(h) ☐Intermittent Traffic Control (i) ☐Various Locations (j) ☐Long-Term (24± hours continuous) ETO _____

(k) Year:			Time		Dir		* * * * * * Restricted Lanes * * * * * *														Brks		Closure ID#
From DATE	To DATE	DAY(S) SU-M-T-W-TH-F-SA	24-HR CLOCK Start (10-97)	Finish (10-98)	NB BB	SB WB	Full Closure See Detour	SHLDR L	SHLDR R	1	2	3	4	5	6	V L	Aux or Coll	CD or Med	TURN PCKT(S) L	TURN PCKT(S) R	Park Strip	5 to 15 Min	Roll -ing	*Caltrans will complete & return*
3/25	3/26	T-W	9:00	3:00					X															

14. Description of work/comments: Vertical borings to collect groundwater

15. Detour (*Required for full closure*): clean up debris, Remove vehicles, leave site when done

16. Contingency Plan: _____

17. On-site during work (*circle if applicable*) CHP / PD / Other: _____

18. Name:	Permittee: Alameda Co Trans Improvement		Contractor (if different than permittee):
Address:	1333 Broadway, Suit 300, Oakland CA		5900 Hollis ST Suit D Emeryville CA
On-site Personnel Contact Name(s) & Phone No.	Name: Bill Scott	Name:	BASELINE Environmental
	Office: 510 420-8686	Office:	510 420 8686
	Cell: 510 612 7153	Cell:	510 612-7153
	FAX: 510 420 1707	FAX:	510 420 1707

19. **"REAL-TIME" STATUS INSTRUCTIONS – PLEASE MAKE YOUR FIELD PERSONNEL AWARE & RESPONSIBLE!**
Permittee shall **STATUS** scheduled work **DAILY** via Caltrans 24-Hour Communication Center at **510-286-6359.** Status using Closure ID No(s) at the start of work, **(10-97)**, and again when work is finished for the day, **(10-98)**. To cancel **(10-22)**, phone **510-286-6359** or fax to **510-286-6358** before the scheduled 10-97 time, but no later than 1 hour prior to the scheduled 10-98 time. Any **delay** in picking up your closure must be reported immediately to **510-286-6359** or Permit Inspector. **See item 9** on reverse/page 2.

TATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

USTOMER SERVICE QUESTIONNAIRE

I-0164 (REV 2/2001)

PERMIT NUMBER 0401-NSV1503

ear Customer,

Our goal is to provide the best service possible to our customers. Please take a few minutes to complete this uestionnaire. Your comments will enable us to see how we are doing overall and any areas which may need nprovement.

PLEASE TELL US HOW WE'RE DOING

	EXCELLENT	VERY GOOD	GOOD	POOR
SIDE THE OFFICE				
taff courteous and helpful				
taff quick and efficient				
xplanations and instructions clear				
LEPHONE ANSWERING				
imely response				
eceiving information or answers				
NSPECTION				
nspector courteous and helpful				
re-construction meeting set and held in a timely manner				
nspector at job site frequently				
Inspector able to answer questions and deal with problems				
VERALL PERFORMANCE				
What would you say is our overall performance?				
Is there a staff person you would like to commend?	STAFF'S NAME:			

OMMENTS:

NAME *(Optional)*	BUSINESS PHONE NUMBER	DATE

ADA Notice For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

NOTICE OF COMPLETION

Permit No.: 0407-1503 Alg-84 ~~22.5~~ 27.3

Inspector: M Movassat

All work authorized by the above-numbered permit was completed on _____.

_____

Permittee Signature

APPENDIX D

SITE SAFETY PLAN

SITE HEALTH AND SAFETY PLAN

PROJECT/CLIENT INFORMATION

Project No:	Project Manager:	Site Health and Safety Manager:	Field Activities Date:
Y5302-01	Todd Taylor	Bill Scott	October-December 2007

Client: URS Corporation 55 South Market Street, Suite 1500 San Jose, CA 95113	Contact Person: Tim Lee Phone: (408) 297-9585	Site Address: SR-84, between Ruby Hill Drive and Jack London Blvd., Livermore, California Subcontractor: Precision Sampling, Incorporated

PROJECT DESCRIPTION: The project includes collection of 64 shallow soil samples (0 to 2 feet bgs) from 16 sampling locations and five grab groundwater samples from as many sampling locations near a proposed roadway improvement project. Soil samples will be collected with hand sampling equipment, while grab groundwater samples will be collected from a temporary well point installed by a hydraulic sampling rig or a hollow-stem auger drill rig. A Zone 7 Water District drilling permit will be obtained by BASELINE for the temporary well points. A Caltrans Encroachment Permit will be obtained by the Client for the field work.

All samples will be submitted for laboratory analysis, under chain-of-custody procedures. All soil samples will be analyzed for total lead (EPA Method 6010B) and soluble lead (WET method). Other analyses will be performed based on the initial total and soluble lead results. The 32 near-surface samples will be composited into eight samples at the laboratory and analyzed for total arsenic, copper, and mercury (EPA Methods 6010B & 7470A), and organochlorine pesticides (EPA 8081A). Groundwater samples will be analyzed for TPH-g (EPA Method 8015M), TPH-d, mo (EPA Method 8015M), VOCs (EPA Method 8260), SVOCs (EPA Method 8270), and Title 22 metals (EPA Method 6010B & 7470A).

No confined space entry or site excavation activities requiring a permit are included in the scope of work. The project area is accessible via several surface streets. The topography of the project area is relatively flat. Field activities will require approximately five days to complete.

SITE HISTORY: Agricultural chemical residues, aerially-deposited lead, and release of petroleum from an underground storage tank may have affected shallow soils and groundwater in the vicinity of the project area. Depending on the concentration of contaminants present in soil and groundwater, special soil and groundwater management and/or construction health and safety measures may be required during project construction.

TRAINING REQUIREMENTS: Yane Nordhav, R.G., is the Principal-in-charge. Todd Taylor, REA is the Project Manager. Other BASELINE personnel include: Bill Scott, Field Geologist, and Redgy Ramirez, Environmental Engineer. Samples will be submitted to a California-certified laboratory for analysis.

Responsibilities of BASELINE personnel include the following: The project manager or principal-in-charge shall: 1) be available by telephone at all times during on-site work; 2) have overall responsibility for preparation, implementation, and modifications to this Plan; and 3) designate a BASELINE Site Health and Safety Officer to carry out the requirements of this Plan during all sampling activities. The responsibilities of Bill Scott, the designated BASELINE Site Health and Safety Officer/Project Supervisor, include: 1) being present at all times during on-site work; 2) enforcing this Site Health and Safety Plan (including the Emergency Response Plan, below); 3) stopping field operation if personnel safety and health may be jeopardized; 4) requesting Site evacuation, if necessary; 5) conducting and evaluating or supervising the collection/evaluation of air monitoring data, if necessary, for the purpose of making decisions regarding the safety of on-site personnel; 6) designating other qualified personnel to work under the direction of Site Health and Safety Officer, as necessary, for purposes of implementing this Plan; and 6) overseeing completion of the sampling activities as described above. No subcontractors will be involved in the sampling event.

All on-site workers, including subcontractors and regulatory agency personnel, entering the contamination reduction (warm), exclusion (hot), or any other areas of the Site with potential or suspected contamination must be 40-hour trained in accordance with the Federal and State OSHA HAZWOPER standard (including 3 days of supervised field experience and annual refresher training), and must be medically surveilled and have received annual respirator training and fit testing in accordance with this Standard and the requirements of their company's health and safety plan. All visitors entering the contamination reduction or exclusion area or other areas of the Site with potential or suspected contamination must also be 40-hour trained. The Site Health and Safety Manager will inquire whether each visitor is trained.

A copy of this site-specific Health and Safety Plan will be provided at the Site and will be reviewed by the Site Health and Safety Manager prior to the start of work at the Site, as part of a tailgate safety meeting. This site-specific Plan applies to all BASELINE employees engaged in hazardous materials activities on-site. This Plan, or an equally protective Plan, shall be adopted by the subcontractors as a supplement to their existing health and safety programs. All on-site personnel will be asked to sign a consent form included in this Plan, prior to each day of field activities, indicating that they have read the Plan, have participated in the tailgate safety meeting, meet the training requirements, and agree to all Plan conditions. Should other employers elect to adopt this Plan, BASELINE shall be held harmless and indemnified against any claims associated with this Plan. If a separate Plan is developed, it must be submitted for review by BASELINE prior to the commencement of field activities, and the Subcontractor must designate a Site Safety Officer to monitor Plan implementation. The Subcontractors' Site Safety Officer will be subordinate to the designated BASELINE Site Health and Safety Manager.

This Site Health and Safety Plan is intended to act as an extension of BASELINE's in-house Health and Safety Program, including a Medical Surveillance Program, Hazard Communication Program, Hearing Conservation Program, Respiratory Protection Program, Personal Protective Equipment Program, Injury and Illness Program, Emergency Action Plan, and Fire Prevention Plan. BASELINE employees receive initial and annual training in these programs.

CHEMICAL HAZARDS

The following known/suspected chemical hazards identified below may be encountered by site personnel during sampling or other on-site activities.

Chemical	Description	Health and Safety Standards/Odor Threshold (OT)	Persons Exposed** and Potential Exposure Routes	Target Organs	Symptoms of Acute Exposure
Lead	Carcinogen[1,2], reproductive toxin LEL=NA UEL=NA	PEL=0.05 mg/m^3 REL/TLV=0.1 mg/m^3 STEL=-- IDLH=100 mg/m^3 OT=--	Inhalation, eyes, ingestion	Eyes, GI tract, CNS, kidneys, blood, gingival tissue	Weakness, lassitude, insomnia, abdominal pain, constipation, anemia, tremor, eye irritation
Arsenic	Silver-gray or white metal, brittle, odorless solid, carcinogen LEL=NA UEL=NA	PEL=0.01 mg/m^3 REL=[1] C=0.002 mg/m^3 (15 minute) STEL=-- IDLH=5 mg/m^3 OT=NA	Inhalation, ingestion, skin, eyes	Liver, kidney, skin, lungs, lymphatic system	Dermititis, stomach problems, peripheral neuropathy, respiratory irritation, darkening of skin, nose problems
Copper	Reddish, lustrous. Malleable, odorless solid LEL=NA UEL=NA	PEL= 1 mg/m^3 IDLH=100 mg/m^3	Inhalation, ingestion	Eyes, skin, respiratory system, liver, kidney	Irritated eyes, nose, pharynx; metallic taste
Mercury	Silver-white metal, heavy, odorless liquid LEL=NA UEL=NA	REL=0.05 mg/m^3 PEL=0.05 mg/m^3 C=0.1 mg/m^3 IDLH=10 mg/m^3 OT=NA	Eyes, skin, inhalation, ingestion	Eyes, skins, respiratory system	Eyes, skin and respiratory irritation, chest pain, difficulty breathing, tremor, insomia, irritability, headache, fatigue, among other effects
Organochlorine pesticides	Noncombustible liquid. Suspected carcinogen.	Varies depending on compound.	Dermal, ingestion	Varies depending on chemical	Minor eye skin irritation

Notes:
IDLH = Immediately dangerous to life and health; a condition from which one cannot escape within 30 minutes without permanent damage or death.
LEL = Lower explosive limit.
NA = Not available or not applicable.
OSHA = California Department of Industrial Relations, which enforces the Occupational and Safety Health Act.
PEL = Permissible exposure limit. Time-weighted average concentrations for a normal 8-hour work period for a 40-hour work week; PELs are enforced by OSHA.
REL = Recommended exposure limit. Time-weighted average concentrations for up to a 10-hour day during a 40-hour work week. RELs are recommended by NIOSH, but are not regulatorily enforceable.

STEL = Short term exposure limit. A 15-minute time weighted average exposure which is not to be exceeded at any time during a workday even if the 8-hr time-weighted average is below the PEL; regulated by OSHA. Up to 4 exposures at the STEL with one hour of no exposure between each exposure event may be experienced in an 8-hour working day.
UEL = Upper explosive limit.
-- = None.
CNS = Central nervous system.

Hazardous materials identified above as "carcinogens" or "reproductive toxins" are recognized as such under California's Proposition 65.* Chemical may be absorbed into the blood stream through the skin, mucous membranes, and/or the eye, and contribute to overall exposure.
** BASELINE, drillers, and regulatory agency personnel.
[1] NIOSH recommends that occupational exposure to carcinogens should be limited to the lowest feasible concentration.
[2] Lowest feasible recommended.

PHYSICAL HAZARDS

Fire and explosion, heavy equipment, traffic, heat or cold stress, noise, over and underground utilities, and tripping and falling hazards. Traffic control will be provided by BASELINE personnel. BASELINE employees will follow standard operating procedures (SOPs) for sampling and quality assurance/control, as found in BASELINE's *Quality Assurance Program Plan.*

Drill rig safety requirements are the responsibility of the operator. The drilling contractor shall be responsible for complying with all OSHA requirements and accepted industry practices for protection of employee health and safety. The drilling contractor shall ensure that all equipments are in good working order prior to starting work and shall ensure that proper housekeeping is maintained around the work area at all times. Drillers shall inform sampling personnel of safety features of the rig.

BASELINE employees, subcontractors, and other personnel shall observe the following precautions:
1) Watch for slippery ground;
2) All unattended boreholes must be adequately covered;
3) Wear required personal protective equipment (PPE) at all times (see below);
4) Prevent strain injuries by using small sampling shipping containers and/or material handling aids.
5) Avoid heat/cold stress by taking regular work breaks, liquids intake, and appropriate attire, as needed; and
6) Watch for traffic and heavy equipment while sampling.
7) Wear traffic safety vests at all times and implement a traffic control plan, including use of traffic cones and signs as necessary.
8) Maximize distance from the rig and do not take readings at the rig during drive sampling.

PERSONAL PROTECTIVE EQUIPMENT REQUIRED: SOPs shall be implemented to minimize exposure to hazardous materials potentially occurring at the Site. However, it is anticipated that SOPs cannot completely prevent exposure to all hazardous materials at the Site. Potential hazards include inhalation and dermal contact with contaminated materials during sampling events. Ingestion of hazardous materials is assumed to be negligible if personal hygiene measures discussed below are implemented. Hard hats, respirators equipped with high efficiency particulate filters (HEPA) (use to be designated by Site Health and Safety Manager), nitrile gloves, safety goggles (use to be designated by Site Health and Safety Manager), steel toed boots, water supply for washing, decontamination, and for drinking, disposable Tyvek overalls, first aid-kit, noise protection (ear plugs), traffic safety vests, and fire extinguisher (to be provided by drilling contractors). Note that Tyveks do not provide protection against solvents or fuels. They are only for protection against dust and dirt (including lead). Avoid contact with on-site soils on disposable Tyvkes to the extent possible. If you (or one of the driller's) Tyvek suits becomes heavily soiled, the Tyvek should be removed and exchanged for a new one. The nitrile gloves provide protection against volatile organics, chlorinated organics, and polynuclear aromatic hydrocarbons (PNAs) (unless saturated in soil; if saturated, double up gloves and exchange gloves frequently). Decontaminate gloves between each sample collected and sample location.

The rationale for selection of the PPE is based on the known and/or suspected hazardous materials at the Site, the anticipated amount of contact with potentially contaminated materials as part of site-specific tasks, and PPE performance characteristics. The need for respiratory protection shall be selected based on the results of the air monitoring (see Air Monitoring Strategy below). On-site personnel shall be required to don respiratory protection (Level C) if deemed necessary by the designated Site Health and Safety Manager. All respiratory protection must be NIOSH approved. On-site workers must be trained, as provided by their employer, in PPE use, care, proper fitting (including respirator fit-testing), donning and doffing, and limitations on at least an annual basis. All PPE must be properly maintained and stored to ensure it is in good working condition at the time of use. All PPE must be inspected before and after use. (BASELINE's PPE program is included in BASELINE's *Health and Safety Program Plan.*)

The need for Level B PPE (respiratory protection) is not anticipated at the Site. In the event Level B respiratory protection is warranted, on-site personnel will be asked to leave the area immediately by the Site Health and Safety Manager and the manager will notify the BASELINE Project Manager(s) immediately to determine future site actions. If PPE is deemed to be ineffective by the designated Site Health and Safety Manager, the Manager or his designee shall take immediate action to mitigate the problem(s).

AIR MONITORING STRATEGY (INCLUDING ACTION LEVELS): Volatile organic compounds and combustible gases will be monitored during drilling activities. IF PID readings greater than 1 ppm in breathing zone or LEL greater than 10 percent is measured, work will stop for 15 minutes; if readings are still higher than the action levels after 15 minutes, personnel will evacuate the site. Expected concentrations of contaminants in shallow soils are not anticipated to create conditions where PELs or Action Levels are exceeded. Conditions will be visually monitored for particulate matter by the Site Health and Safety Manager, and personnel will be asked to don respirators with HEPA filters and goggles if dusty conditions are encountered.

No IDLH or oxygen deficient conditions are expected at the site.

SITE CONTROL MEASURES: Sampling personnel will define and demarcate exclusion, decontamination, and clean zones for each boring location; the need for multiple exclusion/decontamination zones will be determined in the field. No eating or drinking shall be permitted in the exclusion zone; workers may go through partial decontamination (wash gloves, hands, and arms) to consume fluids in the warm zone. Avoid skin and eye contact with soil to the maximum extent possible. Personal hygiene is imperative to prevent prolonged contact with site soils and dusts. No utility clearance will be required for the sampling event.

In the event of a minor (incidental) release of a hazardous material, the spill will be immediately cleaned up by on-site BASELINE personnel, and spill cleanup materials placed in labeled containers. In the event of a larger than incidental (major) spill of hazardous materials, follow emergency procedures below.

Place all cuttings and rinsate/purge water and used PPE in drums, secure, and label. The location for temporary storage of drummed material generated during field activities is to be determined; the Site Health and Safety Manager will consult with the Project Manager and the client about where to securely store these drums.

DECONTAMINATION PROCEDURES (PERSONAL AND EQUIPMENT): All personal and equipment decontamination procedures shall be implemented prior to leaving the site. A decontamination area will be established from the work area (hot zone) to the control (cold) zone for soil sampling activities. The location of the decontamination area, and the need for multiple decontamination areas shall be determined by the Field Geologist/Project Supervisor and documented in the field after selection. Decontaminate sampling equipment, boots, and PPE according to the decontamination procedures below, and remove. Decontaminate boots, non-disposable PPE and sampling equipment on-site using trisodium phosphate (or Alcanox) and water, then rinse with water followed by a deionized water rinse. The equipment to be used for decontamination of sampling equipment, boots, and PPE will include three 5-gallon buckets (TSP or Alcanox/tap water, tap water rinse, and deionized water rinse, to be completed in that order) and brushes (for TSP or Alcanox bucket). Antiseptic towelettes will be used for cleaning respirators and washing hands and arms. Decontamination of sampling and drilling equipment will also be required prior to sampling and between sampling locations to avoid cross-contamination, as will decontamination or replacement of gloves at a new sampling location. All personnel should shower as soon as possible after leaving the Site. Contain all decontamination rinsate in labeled containers.

Decontamination procedures shall be monitored by the Site Health and Safety Manager to determine their effectiveness. If decontamination measures are found to be ineffective, the Site Health and Safety Manager or his designee shall take appropriate action to immediately correct any deficiencies.

OTHER: Illumination is not expected to be required as all work will be performed during daylight hours. The location of the nearest restroom will be identified by the Site Health and Safety Manager prior to sampling. Drinking water and antiseptic towelettes will be provided by BASELINE for personal hygiene.

Post-exposure medical screening is not deemed to be required for on-site personnel based on the hazardous materials known and/or suspected to be encountered during field operations. An employee heat and cold stress monitoring program is also not deemed to be required for Site operations based on the limited number of days of Site work and California's mild climate. However, on-site personnel shall avoid heat/cold stress by taking regular work breaks, monitoring sufficient liquids intake, and wearing appropriate attire, if needed.

All drums used at the site for the sampling activities described above must meet DOT, OSHA, and U.S. EPA regulations for the wastes they contain. Site operations shall be organized to minimize the amount of drum movement. Before moving drums, inform all immediate workers of the potential hazards associated with the contents of the drums and containers being moved or handled. Inspect the integrity of drums and containers prior to moving them. Immediately label all drums used to contain waste materials. Unlabeled drums shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled. Drums that cannot be moved without rupture, leaking, or spillage shall be emptied into a sound container (supplied by the drilling contractors). Workers not involved in opening drums or containers shall remain at a safe distance from drums and containers being opened. If flammable atmospheres are possible, non-sparking tools shall be used to open drums and containers. In addition, handling equipment used to transfer drums and containers shall be selected, positioned, and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers. Standing on drums or containers shall not be permitted at any time.

Any deficiencies in this Site Health and Safety Plan, identified by the Site Health and Safety Manager, shall be immediately corrected. On-site workers, identifying any deficiencies in this Plan, shall immediately notify the Site Health and Safety Manager of such deficiencies.

EMERGENCY PROCEDURES: A cellular phone is carried by BASELINE personnel. In the event of a major emergency (e.g., fire, major spill, medical, explosion), the Site Health and Safety Manager or his designee shall use the cellular phone to contact "911,"Yane Nordhav (510-420-8686), the client (phone number listed above), and other emergency numbers listed below, as applicable. The designated BASELINE Site Health and Safety Manager shall verbally request evacuation of Site personnel (personnel must first go through decontamination prior to evacuation).

Evacuation shall be requested by repeatedly honking the horn of a vehicle for personnel who are not within voice range. The honking will continue until personnel can be verbally notified of the emergency and the need for evacuation. Personnel shall evacuate the Site to the reassembly area. The Site Health and Safety officer will be responsible for notifying personnel and any visitors of an appropriate evacuation route and reassembly area prior to the field work during the tailgate safety meeting. The notification of the evacuation route and reassembly area may be made during the daily tailgate safety meeting and should be documented in the field log. An evacuation route and reassembly area are therefore not included herein. Any injured personnel shall be brought to the decontamination area prior to evacuation, and shall be assisted in decontamination, according to the procedures above, unless the transport or decontamination may potentially cause further injury, where transport and decontamination shall be requested by the paramedics. The designated Site Health and Safety Manager shall account for all on-site personnel following evacuation.

Rescue and medical duties (other than first aid/CPR by trained personnel), as required, shall be provided by off-site emergency responders (e.g., paramedics, fire fighters). Injured personnel may only be transported to the Hospital Emergency Room if the injury is non-threatening and does not require immediate attention (e.g., scrapes, minor cuts). (The hospital emergency route is on the last page of this Site Safety Plan.)

Following evacuation, the designated BASELINE Health and Safety Manager shall request on-site personnel to maintain security of the Site (by preventing unauthorized entry) until the Site has been released to off-Site emergency responders (fire fighters, police, etc.). Evacuated personnel will direct emergency responders to the emergency and inform them of Site hazards and the emergency. Other emergency notifications may be required, for example, the Emergency Management System (911), the Office of Emergency Services (800 852-7550), Oakland Fire Department, Hazardous Materials Management Program (510 238-3938), State Department of Fish and Game (707 944-5512), and U.S. Environmental Protection Agency, Region IX (415 744-2000). The need for emergency notifications will be determined by the designated BASELINE Health and Safety Manager and Project Manager(s), based on the emergency at hand. All notifications will be documented.

Following the emergency, the designated Site Health and Safety Officer shall be responsible for preparing a post-incident critique, for the purpose of identifying the cause of the emergency, response initiated, and need for additional training, procedures, or equipment. The designated Site Health and Safety Manager and Project Manager(s) shall take corrective action to prevent reoccurrence of the emergency. At any time if any deficiencies in these Emergency Procedures are identified, they shall be immediately corrected by the Site Health and Safety Manager. On-site workers identifying any deficiencies in the emergency procedures shall immediately notify the Site Health and Safety Manager of such deficiencies.

Prepared by:	Date:	Reviewed/Approved by:	Date:
Reginald Ramirez	17 October 2007	Todd Taylor	18 October 2007

Read by/Date:

William K Scott	3-24-08
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Salvador Rojo Peredo	3-24-08
Cornelio Mendoza	3-24-08
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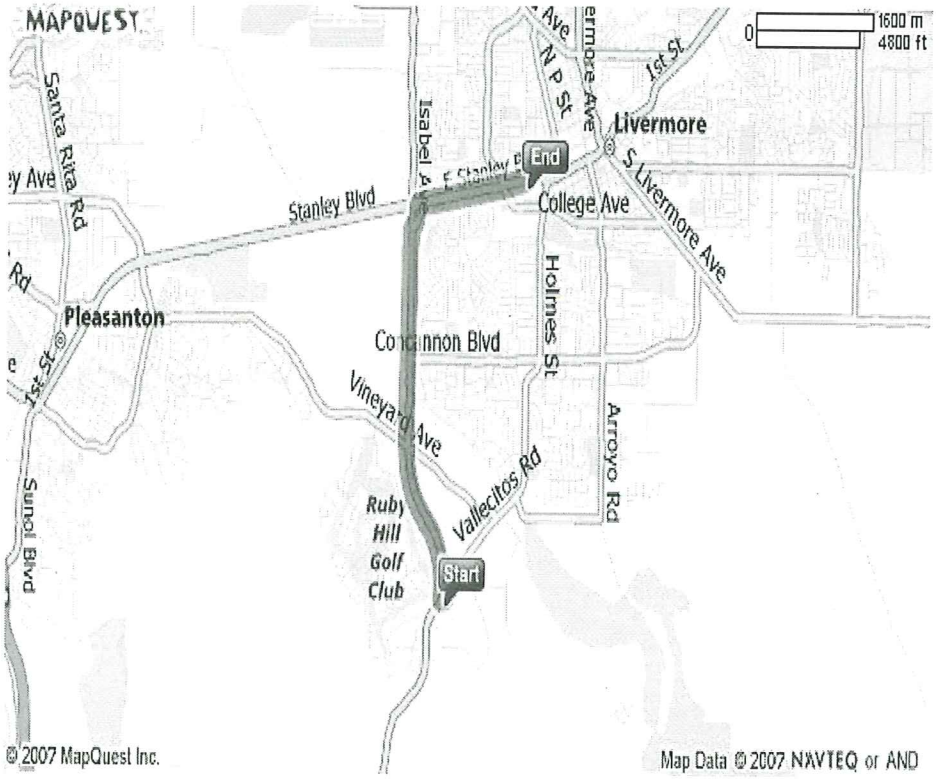
	/

HOSPITAL MAP



Hospital/Clinic Name and Address:	**Hospital Phone:**	**Paramedic/Fire & Police Dept. Phone:**
Valley Care Medical Center 1133 E. Stanley Blvd Pleasanton, CA	(925) 373-4018	911
Directions: From SR-84 (Isabel Avenue), take eastbound Stanley Blvd. The hospital is at 1133 E Stanley Blvd.		

APPENDIX E

QUALITY ASSURANCE PROGRAM PLAN

QUALITY ASSURANCE PROGRAM PLAN

MARCH 2004
(Revised)

5900 Hollis St., Suite D
Emeryville, CA 94608
(510) 420-8686

● 21 Columbus Ave., Suite 225
San Francisco, CA 94111
(415) 986-2871

● 101 H St., Suite C
Petaluma, CA 94952
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QUALITY ASSURANCE PROGRAM PLAN

MARCH 2004
(Revised)

BASELINE ENVIRONMENTAL CONSULTING

5900 Hollis St., Suite D
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QUALITY ASSURANCE PROGRAM PLAN
BASELINE ENVIRONMENTAL CONSULTING

1.0 INTRODUCTION

The purpose of the Quality Assurance Program Plan (QAPP) is to provide guidelines and procedures to ensure that the quality of work performed by BASELINE Environmental Consulting meets or exceeds industry standards. The QAPP describes a systematic plan used to collect, interpret, and report data from environmental investigations. This document defines the criteria used in establishing quality assurance objectives and describes the implementation of controls to ensure the collection of representative samples, the appropriate review of technical data, and the preparation of accurate documentation. This document has been prepared using the EPA Guidance for Quality Assurance Project Plans (1998).

2.0 ORGANIZATION AND RESPONSIBILITIES

Responsibility for implementing and ensuring compliance with this QAPP lies with the principal, the project managers, and the individual employees of BASELINE. The principal, Yane Nordhav, is responsible for ensuring that this document is available to all employees and that appropriate procedures are implemented. Project managers are responsible for ensuring that project team members (including BASELINE subcontractors) working on the project implement the appropriate procedures outlined in this document. It is the responsibility of each BASELINE employee to perform job tasks in compliance with this QAPP.

The principal is responsible for ensuring that project and technical personnel are qualified to perform their assigned job functions. Each staff member shall have the education, training, technical knowledge, and experience required to perform their assigned tasks.

3.0 QUALITY ASSURANCE OBJECTIVES

The overall quality assurance objective is to ensure that all technical data generated during BASELINE investigations are accurate, representative, technically and legally defensible, and appropriate for project objectives.

The criteria commonly used to specify quality assurance (QA) goals are precision, accuracy, representativeness, completeness, and comparability. These terms are briefly described below.

- Precision is a measure of the reproducibility of data when multiple samples are collected and analyzed under the same set of conditions.

- Accuracy is the difference between a measured value and an accepted reference or true value. The difference is usually expressed as a percentage.

- Representativeness is the degree to which data accurately and precisely represent an environmental condition.

Completeness is a measure of the amount of valid data collected from a location compared to the amount that was expected to be obtained under normal conditions.

- Comparability is a measure of the confidence with which one data set can be compared to another.

4.0 FIELD PROCEDURES

The sample types, quantity, locations, sampling techniques, and analytical test methods to be used during project investigations will conform to applicable regulations and/or guidance documents relevant to the project investigation. A written sampling plan or work plan will be developed for each field investigation. The sampling plan will describe the sampling criteria and provide justification for any sampling procedures that deviate from established guidance documents.

Quality assurance during field operations will be implemented by conducting all field work in accordance with BASELINE's Standard Operating Procedures (SOPs; Appendix A). The project manager is responsible for ensuring that all field personnel have access to, and have read the SOPs relevant to the activities they are to perform prior to the start of activities, and that the SOPs are followed in the field.

Field personnel are responsible for recording any deviations from the SOPs on a field log sheet or in a field notebook and reporting the deviations to the project manager. The project manager should ensure that all such deviations are documented and a copy placed in the project file. Any permanent changes or modifications to the SOPs must be made in writing, reviewed and signed by the principal, and included as a supplement to the QAPP until the SOPs are revised to reflect new procedures.

After field sampling activities, field documents are checked by field personnel and then reviewed by the project manager to confirm that correct sampling procedures were adhered to and that field data are coherent.

4.1 Field Measurements

Field measurements include water levels, conductivity, pH, temperature, DO, turbidity, organic vapor concentrations, and combustible gas concentrations. These activities are described in the SOPs (Appendix A). Calibration procedures for the field equipment are discussed in Section 7.0. Field measurements are maintained in permanent project files.

4.2 Sample Collection

Sample collection methods are described in the SOPs (Appendix A). It is the responsibility of the project manager to ensure that the appropriate sampling techniques and sample containers are used.

5.0 QUALITY CONTROL SAMPLING

Additional samples are collected for quality control (QC) purposes. The type of sample and frequency of collection are based on the individual requirements of each project investigation determined by the project manager. Field QC samples for soil and/or groundwater investigations include blank and duplicate samples. A brief description of the types of field QC samples is presented below. A minimum of one duplicate groundwater sample should be collected for every ten field samples or as directed by the project manager.

5.1 Blank Water Samples

- **Field blanks** are samples of distilled water that are collected and handled using the same techniques as the other samples. They are used to demonstrate that the sampling procedure has not contaminated the sample.

- **Trip blanks** are samples of distilled water placed in an appropriate sample container by the analytical laboratory. These samples are transported with the field samples without any manipulation. The trip blank provides data regarding potential contamination introduced to the sample during sample preservation, transportation, storage, and analysis.

5.2 Duplicate Soil and Water Samples

- Field duplicates consist of two independent samples collected at a sampling location during a single sampling event. If soil duplicates are collected, the duplicate soil sample will be obtained by the laboratory from the same sample collection tube, if possible. If insufficient sample volume is present in the sample tube, the duplicate sample will be collected from the adjacent sampling tube (i.e., the adjacent six-inch interval). They are used to evaluate the precision of the analytical data and sampling technique.

- Field splits consist of one sample divided into two portions and submitted and analyzed by two individual laboratories. They are used to evaluate the comparability and precision of two different laboratories.

6.0 SAMPLE CUSTODY

Sample custody must be documented and maintained from the time of sample collection through completion of laboratory analyses. A chain-of-custody record will be prepared following sample collection and must accompany the sample at all times. The sampler and each responsible individual (BASELINE employee, sample courier, laboratory) must sign the chain-of-custody at the time of release of the samples to another responsible individual. A copy of the chain-of-custody form must be maintained at the BASELINE office until the laboratory report is returned from the laboratory with the analytical results. Samples of all field forms are included in Appendix B.

7.0 CALIBRATION PROCEDURE AND FREQUENCY

All equipment and instruments used during a project investigation will be maintained and calibrated to operate within manufacturer's specifications, so that the required sensitivity and QA/QC parameters are upheld. A copy of the available operating manuals for the field instruments will be kept with those instruments. The field equipment maintenance supervisor, designated by the principal, is responsible for instructing field personnel in proper maintenance and calibration procedures for field equipment. Field personnel are responsible for maintaining field equipment in proper operating condition.

Modifications, adjustments, or repairs of each field instrument will be kept in a log book at the office. The equipment will be recalibrated and tested following any modifications prior to continued use, if required. Commonly used field equipment and minimum maintenance schedules are summarized in Table 1. Certified solutions will be purchased to serve as calibration standards. Calibration SOPs are included in Appendix A.

TABLE 1: **FIELD INSTRUMENT MAINTENANCE AND CALIBRATION SCHEDULE**

Instrument	Measurement	Calibration Procedure	Calibration Schedule	Inspection of Probes, Cables, Meters	Clean Instru-ment	Check Battery or Charger	Instru-ment Sensitivity
Dual Interface Probe	Depth to water and/or product	To known thickness; vegetable oil okay	Annually[1]	Daily when in the field	After use	Have replacement battery on hand (two 9-volt batteries)	0.01 foot
Gastech No. 1238	Combustible gas indicator	Refer to manual	Annually and before field use	Daily when in the field	After use	Recharge only when battery runs out. Use 12-volt car adapter (in case battery runs out)	Variable
Photovac PID	Identifies select volatile organic compounds	To standard isobutylene	Annually and twice daily: before field use and mid-work in the field	Daily when in the field	After use	Continually charging when not in use	Variable
Multi-RAE Plus (4-gas meter)	Oxygen (%), hydrogen sulfide (ppm), carbon dioxide (ppm), and combustible gases (% LEL)	To fresh air and 25 ppm hydrogen sulfide, 50 ppm carbon monoxide, and 2.5% (50% LEL) methane standard	Annually and daily before use	Daily when in field	After use	Continually charge when not in use; use 12-volt auto adapter or alkaline batteries (if battery runs out)	Variable, depending on sensor
NTU Lamott	Turbidity of water	Calibrate to 0 + 100 NTU	Annually and before and after use	Daily when in the field	After use	Before use (9-volt battery)	0 - 1,100 NTU

Table 1 - *continued*

Instrument	Measurement	Calibration Procedure	Calibration Schedule	Inspection of Probes, Cables, Meters	Clean Instru-ment	Check Battery or Charger	Instru-ment Sensitivity
Drager Accuro Pump & direct reading colorimetric tubes	Quantify specific chemical compounds	Perform a leak test; end of stroke indicator should not appear after 15 minutes	Calibration is not required	Daily when in the field	After use	Not required	Variable
Conductivity, temperature, salinity meter YSI No. 33	Electrical conductivity/ temperature	Reference to chemical standard	Annually and before and after field use	Before field use	After use	Before use (six AA batteries)	Variable
pH meter Orion Research No. SA 210	pH	Reference to chemical standard	Annually and before and after field use	Before field use	After use	Before use (one 9-volt battery)	0.01 pH
Conductivity, temperature, salinity, DO meter YSI No. 85	Electrical conductivity, temperature/ dissolved oxygen in water, salinity	To reference standard and to calibration table	Annually and before field use	Before field use	Before and after each use	Before use (six AA batteries)	Variable

[1] Annual maintenance calibration will be performed in addition to field use calibration, as indicated in this table. The results of the annual equipment calibration will be indicated in BASELINE's Equipment Calibration Log. The results of the field use calibration will be recorded on the Field Log and/or the Drilling Log.

8.0 LABORATORY QUALITY CONTROL

All analytical laboratories employed by BASELINE for sample analyses will be California certified for the analyses they are requested to perform. The laboratories must maintain an internal QA/QC program as required by their certification to ensure that their results are accurate, precise, and repeatable as defined by the EPA (SW-846) standards.

The laboratory's quality assurance plan (QAP) should be signed by the laboratory director and principal laboratory quality assurance manager, and key quality assurance personnel and their responsibilities must be identified in the QAP. In addition, the laboratory must maintain current certification by the California Department of Health Services for all analytical methods for which samples would be submitted for analyses.

The laboratory's QAP must describe the following topics:

- Data quality objectives
- Laboratory sample custody and sample control
- Calibration procedures and frequency

- Reagent and standard control
- Analytical standard operating procedures
- Data reduction, validation, and reporting
- Internal quality control checks
- Performance and systems audits
- Preventive maintenance
- Assessment of precision and accuracy
- Corrective actions
- Quality assurance reports
- Record keeping
- Internal auditing program

9.0 SUBCONTRACTORS

All field subcontractors must be qualified and maintain the appropriate licenses and/or certifications for their professions. The project manager must notify and ensure that all work performed by subcontractors is in compliance with the goals and procedures specified in this QAPP. Subcontractors are responsible for maintaining their equipment in good operating condition and providing appropriate equipment for the job.

10.0 DATA VALIDATION AND REPORTING

The original records from field activities and laboratory reports will be kept in the permanent project file. All data will include the date, initials of the sampler/analyst, and relevant information. The acceptability of the data is determined by the precision, accuracy, and completeness criteria stated in Section 3.0. The results of this evaluation will be documented by the project manager as part of the Quality Control Checklist for Review of Laboratory Reports (Appendix C) and placed in the permanent project file with the original laboratory reports. If the evaluation indicated noncompliance with an established procedure or requirement, a recommendation for corrective action will be documented on the checklist.

10.1 Analytical Results

The project manager must check analytical results against historical data, and review both field quality control data and laboratory internal quality control data to assess whether the results are within acceptable ranges established by the laboratory. This shall be done by completion of a Quality Control Checklist for Review of Laboratory Report (Appendix C) for all analytical results. Quality control limits established by the laboratory typically meet or exceed control limits established by the EPA. If data vary by an order of magnitude from historical data, or if data are outside laboratory control limits, the project manager must contact the analytical laboratory to investigate the validity of the results. If no reason for the discrepancy can be determined, the project manager may request that the sample analyses be reviewed and/or repeated. If the analytical results remain suspect, a new sample may be collected at the direction of the project manager. Suspect data included in a report will be flagged to indicate the suspect status.

10.2 Field Data

Validation of field data is performed by the project manager by checking field data collection procedures and comparing all data to previous results from the site. Field measurements that depart from historical trends will be re-checked when possible, at the direction of the project manager.

11.0 TECHNICAL REVIEW

The project manager will monitor the data, calculations, and figures needed for reports. The project manager will assign qualified geologists or engineers to review geologic analyses, calculations, computer models, and analytical data for completeness, accuracy, and precision. All reports, including tables, figures, conclusions, and recommendations, will be reviewed by a peer to ensure that the document is accurate, representative, able to withstand scientific scrutiny, legally defensible, and appropriate for the project objectives. Following review by the project manager, peer reviewer, and proofreader, the principal will review the report and data.

12.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits are performed to assure that technical procedures are in compliance with the QAPP. The purpose of the audits is to verify that field and laboratory QA procedures are followed, check that appropriate documents are being prepared and maintained, ensure that the SOPs are followed and are accurate, and identify deficiencies and initiate necessary corrective action.

Field audits and technical audits will be performed by the quality control officer, designated by the principal on an as-needed basis. All findings will be documented at the completion of the audit. The audits will include observation of field procedures, review of field documentation and data, and review of laboratory reports and quality control data.

13.0 CORRECTIVE ACTION

Data that are determined to be invalid or that show a significant departure from a historically established trend, or show disagreement with duplicated measurements beyond guidelines specified in EPA SW-846 or other similar document, are followed up with one or more of the following corrective actions:

- Suspect data are annotated.
- Documentation is reviewed for adherence to QA/QC procedures.
- Measurement is repeated to check for error.
- Duplicate sample is analyzed.
- Calibrations are checked and/or repeated.
- Measuring device is repaired or replaced.
- Sample is recollected.
- Analytical laboratory or subcontractor is changed.

The identification, documentation, and correction of nonconformances will be reported. For field data, the project manager is responsible for initiating and approving the appropriate corrective actions.

14.0 QUALITY ASSURANCE REPORTING AND RECORD KEEPING

Quality assurance reports will be prepared in conjunction with the auditing program described in Section 12.0. These reports would include the results of performance and system audits, an assessment of the precision, accuracy, and completeness of data, and a summary of quality assurance problems and proposed solutions. All quality assurance reports will be maintained in a permanent file in BASELINE's main office.

15.0 REFERENCES

EPA, 1998 EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, EPA/600/R-98/018.

APPENDIX A

STANDARD OPERATING PROCEDURES

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APPENDIX A
STANDARD OPERATING PROCEDURES
BASELINE ENVIRONMENTAL CONSULTING

1.0 INTRODUCTION

The purpose of this document is to present standard procedures to be employed by BASELINE staff during field activities and soil and groundwater investigations. The procedures contained in this document are to be used and implemented in conjunction with BASELINE's Quality Assurance Program Plan (QAPP) and Health and Safety Program. The objective of this document is to achieve quality assurance goals established in the QAPP, including maintaining high standards of quality, maintaining consistency, and implementing procedures for generating technically and legally defensible data.

Guidelines and procedures are presented for field documentation, soil and groundwater sampling, monitoring well installation and development, water level measurement, air monitoring, and other procedures.

2.0 RESPONSIBILITIES

All project and field personnel are responsible for being familiar with the contents of this document and adhering to the guidelines presented herein. It is the responsibility of the principal and project manager to ensure that all field personnel are qualified to perform the assigned field tasks. It is the responsibility of field personnel to document any deviations from the Standard Operating Procedures (SOPs), and to notify and assist the Quality Control Officer in the revision of outdated procedures.

2.1 Field Equipment

Several types of equipment are available for use during field investigations. Each field personnel who uses BASELINE equipment is responsible for understanding the proper operation, care, calibration, storage, and transport requirements of the equipment. It is the responsibility of field personnel to obtain any needed instruction from the equipment supervisor. If equipment malfunctions or becomes inoperable, it is the responsibility of field personnel to notify the equipment supervisor and make arrangements for replacement and repair.

BASELINE vehicles are maintained according to the manufacturer's specifications and are serviced according to the manufacturer's suggested maintenance interval. A designated employee at each BASELINE office is responsible for ensuring that maintenance and repairs are performed.

2.2 Regulations

It is the responsibility of the project manager to determine the appropriate regulations, guidelines, permits, and notification requirements for the project investigation. If site conditions indicate that

it is not practical or possible to follow established procedures, it is the project manager's responsibility to determine alternative procedures and notify the appropriate agencies.

2.3 Permitting

All pertinent permits needed for field activities will be acquired from appropriate agency(s) before field activities are initiated. All work will be conducted in accordance with permit requirements unless otherwise agreed to be waived by the permitting agency. Copies of permits must be kept on-site during field operations.

If required, an underground utility check will be performed before any field activities are initiated. BASELINE (or its subconsultants/subcontractors) will contact Underground Service Alert (USA) and the current land owner to verify that field activities will not cause damage to underground activities.

The project manager is responsible for obtaining all permits and utility clearances; the field geologist is responsible for assuring all permits and utility clearances are obtained and copies on-site prior to commencing field activities.

2.4 Licensing

Those activities conducted in the field by BASELINE that require specific licensing will be performed by the individual with the license or under the direct supervision of licensed personnel.

BASELINE will ensure that all contractors they retain will have the appropriate current contractors license applicable to the specific field activities that they will be performing.

2.5 Health and Safety

All BASELINE employees performing field activities will have met OSHA (29 CFR 1910.120) training requirements for performing various hazardous materials-related field activities. They will have completed 40-hour initial training, three days of supervised field work, and have had annual 8-hour refresher training. Each employee working in the field will have current respirator fit test. Current training and medical surveillance documentation for each BASELINE employee will be included in a binder on-site. Prior to any BASELINE employee entering a hazardous waste site, the employee will have been informed by the Project Manager and/or Site Health and Safety Manager (senior field person) about the potential hazards that may be associated with the site, and will have reviewed and signed the site-specific site safety plan. A copy of the Site Safety Plan and training certifications must be on-site whenever a BASELINE employee is on-site.

Any subcontractor employees entering the site must meet OSHA (29 CFR 1910.120) training requirements for work on hazardous waste sites prior to entering the site. The BASELINE project manager or site health and safety manager will inquire about this training at the time the subconsultant's services are requested, and will request written documentation of this training for the subconsultants' employees who will be present at BASELINE jobs, as needed. When BASELINE is primary site manager (e.g., at a soil investigation site), a site safety plan, written by

BASELINE, will be provided to the contractor prior to entering the site for informational purposes. At a site where BASELINE is not the primary site manager (e.g., an underground tank removal), the BASELINE Site Safety Plan will be reviewed by BASELINE personnel only.

2.6 Site Safety Plan

Upon arrival of a consultant/contractor to the site and when appropriate, a health and safety tailgate meeting will be performed by BASELINE Site Health and Safety Manager to discuss the site safety plan. The site safety plan will be signed and dated by BASELINE and contractor employees prior to initiation of work. A copy of the plan must be kept on-site at all times while BASELINE personnel are present. The site safety plan will include the following items pursuant to Title 8, California Code of Regulations, Section 5192:

- Client name
- Client contact person
- Project description
- Site history
- Potential chemical hazards, description, health and safety standards, potential routes of exposure, symptoms of acute exposure
- Physical hazards
- Personal protective equipment required
- Air monitoring strategy
- Site control measures
- Decontamination procedures
- Emergency procedures and route to the nearest hospital, including map

3.0 FIELD INVESTIGATIONS

Field activities are performed in accordance with applicable regulations and guidelines, and within established industry standards. All field tasks are to be conducted in accordance with BASELINE's Code of Safe Practices outlined in BASELINE's Health and Safety Program, and in accordance with an approved Site Safety Plan.

3.1 Documentation

All field work must be documented completely and correctly. Documentation should be concise and factual. All field forms must be checked for completeness and accuracy in the field. A daily field log is prepared for each day that field activity occurs at a project site. The field log should include the day's events, subcontractors, site visitors, field conditions, documentation of any deviations from established procedures or written sampling plans, and any other pertinent data. The scope of work and/or proposal should be reviewed by the field technician to ensure all elements of field activities are completed and documented. Copies of the field forms used by BASELINE are included in Appendix B of BASELINE's Quality Assurance Program Plan.

3.2 Site Reconnaissance

The purpose of a site reconnaissance is to obtain information regarding site conditions prior to performing a field investigation. Prior to the site reconnaissance, the following information should be obtained:

- Site location
- Site history
- Potential contaminants
- Land use in the vicinity of the site
- Site accessibility

During the site reconnaissance, the following should be noted (See Appendix B for the Site Reconnaissance Checklist):

General/Exterior Observations:

- Topography
- General description of site improvements (i.e., buildings, roadways, etc.) and current site uses
- General description of adjoining parcels, land uses, and evidence of hazardous material use/release (if apparent)
- Evidence of past uses at site (i.e., building foundations, abandoned equipment)
- Inventory of hazardous substances at site, including approximate quantities, types of containers, and storage conditions
- Aboveground storage tanks and evidence of underground storage tanks (vent pipes, fill tubes, pumps)
- Unusual or noxious odors (identify source, if possible)
- Pools of liquid, including standing surface water
- Drums/Hazardous Substance Containers/Unlabeled or unidentified containers
- Electrical equipment (i.e. transformers) known or likely to contain PCBs (excluding fluorescent lighting)
- Stained or disturbed soil or pavement
- Stressed vegetation
- Solid waste (dumping, etc.)
- Wastewater and storm/surface drainage
- Wells
- Septic Systems
- Public utilities (power, water, sewage, solid waste)

Interior Observations

- Heating and cooling
- Stains or corrosion
- Floor drains and sumps
- Typical interior finish materials (i.e., drywall, textured ceiling material, vinyl flooring, etc.)

Employees should bring the following items, as needed, to perform the site reconnaissance:

- Evacuation route (establish route and procedures upon arriving at site and inform other site workers of the evacuation route and procedures)
- Route to the nearest hospital
- Site entry permit/client contact information
- Cellular phone (or pay phone close-by)
- Hard hat
- Steel-toed boots
- Tyvek coveralls
- Respiratory protection
- Goggles or other eye protection
- Gloves (leather and/or chemical-type)
- Sunscreen
- "Walker" or tape measure
- Camera, film, and extra batteries
- Scale/ruler
- Clipboard
- Site map, if available, or graph paper to map site during reconnaissance
- Flashlight
- First aid kit
- Drinking water (if not provided on-site)
- Other items relevant to the site reconnaissance location (e.g., personal flotation devices, hip waders, etc.)

As no heavy equipment is used and site conditions are typically unknown, Site Safety Plans are generally not prepared for a site reconnaissance. However, BASELINE employees shall follow the Code of Safe Practices for Site Reconnaissance as indicated in BASELINE's Health and Safety Plan.

If any sampling activities are to be conducted, a Site Safety Plan must be prepared and standard operating procedures followed for soil borings, soil sampling and other sampling procedures, as needed.

3.3 Soil Borings

This protocol describes the procedures BASELINE will follow during drilling and abandonment of soil borings. The soil borings will provide subsurface information regarding geologic conditions, physical soil properties, and chemical quality in the soil. Typically, the target sampling depths for sites potentially contaminated with light, non-aqueous phase liquids (LNAPLs) will be five foot intervals starting at the ground surface and terminating at the groundwater interface. For sites potentially contaminated with dense, non-aqueous phase liquids (DNAPLs), the target sample depths will be at five foot intervals starting at the ground surface and terminated after penetrating the first fine-grained (silt or clay) layer below the groundwater interface. Sites potentially contaminated with metals will typically be sampled a few feet below the ground surface and at five-foot intervals to depth of boring and/or sampled in zone(s) which potentially may be associated with high metal content. Borings are installed with the use of hollow-stem auger, direct push technology (DPT),

hand auger, or slide hammer, as described below. Almost all locations within the Bay Area require a local permit for drilling (including DPT). A copy of the permit must be kept on-site during drilling operations.

Drilling, Hollow-Stem Auger

Only after obtaining a permit will drilling proceed. Drilling a boring with the use of a hollow-stem auger requires a drill rig with a licensed C-57 drilling contractor. The BASELINE Project Manager will confirm that the driller maintains a valid C-57 license. The hollow-stem auger typically has an outside diameter of 4, 8.25, or 11.75 inches. The boring is advanced until the proposed or targeted depth has been achieved. The target depth(s) should be determined previously by the project manager as the depth(s) that best represent the sampling goal and/or the depth(s) determined in the field by BASELINE field geologist. The targeted depth(s) will be sampled in accordance with the protocol for Soil Sampling. Prior to, during, and after sampling, air monitoring will be conducted in accordance with the protocol for Air Monitoring. All drill rods, augers, hoses, bits, and sampling equipment will be decontaminated and the soil and water generated during the coring process will be handled in accordance with the protocol for Decontamination and Disposal.

Direct Push Technology (DPT)

Installation of a boring using DPT requires a specialized coring rig. The rig pushes a coring barrel with an outside diameter of 2.5 or 4.0 inches to the target sampling depth(s). The targeted sampling depth(s) will be determined previously by the project manager as the depth(s) which best represents the sampling goal and/or the depth(s) controlled by site conditions as determined by the BASELINE field geologist. Collection of soil samples at the target sample depth(s) will be in accordance with the Soil Sampling protocol. Air monitoring will be conducted prior to, during, and after sample collection in accordance with the protocol for Air Monitoring. All coring rods, core barrels, sampling equipment will be decontaminated and the soil and water generated during the coring process will be handled in accordance with the protocol for Decontamination and Disposal.

Hand Augering

A hand auger is manually advanced by BASELINE field personnel or subcontractor and is typically used where site conditions are favorable for hand augering (relatively soft, cohesive soil and shallow target depth). The hand auger has an outside diameter of 3.75 inches. The target sampling depth(s) will be determined previously by the project manager as the depths(s) which best represents the sampling goal and/or the depth controlled by the site conditions, as determined by BASELINE field geologist. Collection of the soil sample at the target depth(s) will be in accordance with the protocol for Soil Sampling. Air screening and air monitoring may be performed and would follow the protocol for Air Monitoring. The hand auger bit and sampling equipment will be decontaminated and the soil and water generated during the coring process will be handled in accordance with the Decontamination and Disposal protocol.

Logging of Borings, Drill Logs, and Well Construction Summary

The BASELINE field geologist will record observations made at the time of drilling on a Drilling Log. The site location, driller, method of drilling, logger, bore size, boring number, datum (if known), date, and casing size (if applicable) will be completed for each boring. The BASELINE

geologist will be in direct communication with the drill rig operator to discuss and note any significant change in drilling speed, ease of drilling, drilling action, or absence of drill cutting returns.

A description of sampled soils and drill cuttings will be recorded along with their corresponding depth using the Unified Soil Classification System (USCS), soil type, grain size and gradation, moisture content, consistency, plasticity, and color based on the Munsell color charts. Other descriptive characteristics such as formation (if known), Bay Mud, fill, and presence of fossils, wood, concrete, bricks, and other foreign debris will be recorded. Readings obtained from air monitoring instruments will be recorded with its associated depth. A graphic depiction of lithologies encountered and the depth at which samples were collected will be included.

Soil Boring Abandonment

Soil borings that will not be used for monitoring wells will be abandoned in accordance with local permitting and regulatory agency requirements. The abandonment of the borings will typically require grout seals of the borehole with a neat cement/bentonite mixture (typically a ratio of five gallons of water to one bag of cement) and may be capped with concrete or asphalt or soil (if required). Most jurisdictions require an inspector to be present during abandonment. Unless otherwise allowed by the local inspecting agency, all boreholes will be sealed by pumping the neat cement/bentonite mixtures to the bottom of the hole with use of tremie pipe. When hollow-stem augers are used, the tremie pipe will be placed inside the auger and raised along with the auger as grouting proceeds, to ensure against borehole collapse. Shallow borings (generally less than 20 feet) that do not encounter groundwater may be abandoned by placing neat cement/bentonite seal from the surface, if otherwise not prohibited. If the local inspecting agency requires a signature from the on-site geologist/engineer that the information requested, such as depth of boring, water level, contamination, grout mixture is correct, the BASELINE field geologist will ensure that the information is correct and sign the form.

3.4 Soil Sampling

This protocol describes the procedures that BASELINE will follow for collecting soil samples during, drilling, coring, augering, excavations, and stockpile characterization. All the soil samples collected for chemical analysis will be brought to a California-certified laboratory, certified to perform that analysis.

Soil Samples Collected during Hollow Stem Drilling

Soil samples collected from a drill rig are collected using a California Modified sampler. The California Modified sampler has an inside diameter of two inches and is primarily used when colleting samples for chemical analysis. The sampler is typically 1.5 or two feet in length and will be fitted with three or four six-inch long and two-inch diameter pre-cleaned stainless steel or brass sleeves. The sampler is lowered into the boring to the target depth and driven into the ground by a 140-pound hammer falling 30 inches. The number of blow counts required to push the sample in increments of six inches will be recorded on the Drilling Log along with the depth (bgs) at which the sample was colleted. The sampler will be brought to the surface and the sleeves removed from the sampler; the sleeve nearest the tip of the sampler will be used for submittal to the laboratory

(unless field conditions dictate otherwise). The sample will be handled and preserved in accordance to the Soil Sample Handling and Preservation protocol, described below. All the sample equipment will be cleaned according to the protocol for Decontamination and Disposal.

Soil Samples Collected during DPT Borings

Soil samples from a DPT are collected from the coring barrel. The barrel has a length of two or three feet and is typically fitted with stainless steel sleeves, six inches in length and 1.5 inches in diameter. A continuous sample along the entire bore depth is achieved and upon retrieval of the core, a target sample is obtained. The soil sample will be handled and preserved accordingly to the protocol for Soil Sample Handling and Preservation, described below. All the sample equipment will be cleaned according to the protocol for Decontamination and Disposal.

Soil Samples Collected during Hand Augering

The samples will be collected with either a 2-inch by 12-inch or 2-inch by 6-inch stainless steel corer, fitted with one or two pre-cleaned stainless steel sample tubes, respectively. The cover will be driven into the ground using a slide hammer to the target depth(s). The sample will be handled and preserved in accordance with the protocol under Soil Sample Handling and Preservation. All the sample equipment will be cleaned in accordance with the protocol for Decontamination and Disposal.

Soil Samples Collected with Slide Hammer

The samples will be collected with either a 2-inch by 12-inch or 2-inch by 6-inch stainless steel corer, fitted with one or two pre-cleaned stainless steel sample tubes, respectively. The sampler is driven to the target depths(s) using a slide hammer. The sample will be handled and preserved in accordance with the protocol under Soil Sample Handling and Preservation. All the sample equipment will be cleaned in accordance with the protocol under Decontamination and Disposal.

Soil Samples Collected from Excavations

The locations of the sample will be determined using appropriate agency guidelines, if applicable. The location of each sample collected will be mapped along with the horizontal and vertical dimensions of the excavation. The samples will be collected with the use of an excavator, backhoe or hand auger from the desired sidewall and bottom location(s) without entering the excavation. If entering the excavation is required, the samples may be collected by entering the excavation provided only that Occupational Safety and Health Administration (OSHA) regulations are followed.

Soil Samples Collected Manually (Grab Sample)

Soil samples are collected manually when shallow samples are required, typically immediately below the surface. The soil may be exposed by scraping the top portion of soil to the target depth and inserting a pre-cleaned 2-inch by 6-inch stainless steel sleeve manually into the soil. The soil sample will be handled and preserved in accordance with the protocol under Sample Handling and Preservation.

Soil Samples Collected from Stockpiles

Soil samples collected from stockpiles will be collected in accordance with regulatory and/or landfill requirement guidelines. The number of samples to be collected will be determined after the stockpile has been measured and volume calculated (including a 30 percent fluff factor). The location of the samples will be chosen using guidelines in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846* (SW-846), Third Edition, EPA. The sample will be collected by following the protocol of Soil Samples Collected Manually and/or Soil Samples Collected with Slide hammer. All sampling equipment will be decontaminated in accordance with the Decontamination and Disposal protocol.

Soil Samples Collected Using EnCore® Sampler

The EnCore® Sampler is used when requested by the project manager or required by the lead agency to collect the portion of a soil sample for analysis of volatile organic compounds(VOC) and/or total petroleum hydrocarbons as gasoline,(TPHg). The EnCore® sample is collected by removing the EnCore vial from its individually sealed bag and attaching the vial to the end of the EnCore's T -handle. By holding the T-handle, the vial is manually pushed into the soil sample that was previously collected, as described in Section 3.4 above. The vial is then removed from the soil sample and examined to ensure that it does not contain any void spaces prior to being capped. The cap, included in same sealed bag that contained the vial, is inserted over the end of the vial until the tabs on the cap clip onto the vial, thus ensuring a proper fit and seal. Typically, three vials will be filled per analysis, three for VOC and three for TPHg. The sealed vials will be handled and preserved in accordance with the protocol described under Soil Sample Handling and Preservation in Section 3.4. All sample equipment will be cleaned in accordance with the protocol under Decontamination and Disposal described in Section 3.8.

Soil Sample Handling and Preservation

BASELINE will handle the soil samples using the following guidelines:

- The sample preparation area will be kept clean by placing clean visquene or cleaning a stainless steel surface before each sample preparation event.

- The person(s) handling the sampler and sample will don clean protective gloves, appropriate for the chemicals of concern, prior to contact with the sample.

- A visual inspection of both ends of the target sample tube will be conducted which will include observations of soil type, color, and presence of contamination. An air monitoring/screening will be performed, if warranted, prior to the sample being capped with teflon film, plastic cap, and sealed with silicone tape.

- A sample label will be filled out immediately after the sample has been capped. The label should have the following information:

    - BASELINE's phone number and address
    - Project number

- Project location
- Sample identification number including depth if appropriate.
- Sampler(s) initials
- Time and Date of sample collection
- Analytical work (optional)
- Any special request or information for the laboratory (optional)

- Once the sample has been labeled it will be sealed into a zip-lock bag and placed into a cooled ice chest.

3.5 Installation and Destruction of Wells

This protocol describes the procedures BASELINE will follow during the installation and destruction of monitoring/extraction wells. The protocol may be adjusted to accommodate a specific work plan, be superceded by applicable regulatory requirements, or be revised by the project manager. The wells will be installed in accordance with *California Well Standards Bulletin 74-90,* California Department of Water Resources (DWR) and local enforcement agency guidelines.

Monitoring/Extraction Well Installation

The well(s) will be designed to obtain groundwater samples which most represents the impacts to the groundwater quality of a particular site. The screened interval will be designed and selected according to the lithologic log. Each well will be designed to enable measurement of the potentiometric surface and to allow water sampling of a specific water-bearing zone. The BASELINE field geologist will design the screen and casing interval, filter material, and surface completion.

Monitoring/Extraction Well Screen and Casing

The well casing and screen will consist of threaded schedule 40 polyvinyl chloride (PVC), with an inside diameter of two or four inches, depending on the intended use of well. Typically, two-inch diameter wells will be installed for monitoring wells and four-inch diameter wells for monitoring/extraction wells. The well screen will consist of a machine slotted PVC casing with slot diameter of 0.01- or 0.02-inch. The slot size will be determined based on formation grain size. The length of the screened interval will not exceed 15 feet unless approved by the project manager and local regulating agency.

Filter Material

The size of the filter pack selected will be reflective of grain size distribution of the water bearing zone and will be compatible with the slot size selected. Typically, the filter pack used will be well-graded, pre-washed sand with sizes of either 2/12, 2/16, or #3. Filter pack sizes 2/12 or 2/16 will be placed around the well screen where water-bearing zones consist of fine-grained sands to Bay Mud. A #3 filter pack will be used for coarse to fine-grained sands.

Placement of Well Screens and Casing

After completion of the boring, the total depth of the borehole will be sounded and verified. The well screen, casing, and locking cap will be assembled by threading together the sections without the use of glue. The entire length of the casing and length of the screened interval will be measured from the top of casing (TOC) to nearest tenth of a foot. The casing shall be steam cleaned or unwrapped of sterile cover prior to being lowered into the boring. The well assembly will be lowered into the borehole ensuring that the top of the screened interval is placed at the designated depth (bgs). The filter pack material will be placed through the hollow-stem auger. The filter pack will remain a few feet inside the bottom of the auger as the auger is raised during placement of the filter pack. A continual check of the depth to sand in the auger, with use of weighted tape measure, will be conducted to ensure proper placement of filter pack and to ensure against bridging of the filter pack. If bridging does occur, raising of the auger a few inches off the bottom of hole may be needed to free the obstruction. If this is unsuccessful, a small amount of drinking water may be poured into the hollow-stems to break the bridge; this must be noted on the well construction summary log. Upon reaching the desired thickness of the filter pack, typically two feet above the top of the screened interval, a bentonite seal of one to two feet will be placed on top of the filter pack. The seal will be slowly hydrated with the addition of potable water, if required. Once hydration has occurred, the remaining annular space will be tremied with a neat cement/bentonite mixture typically at a ratio of 5:1 (potable water to cement [Portland type I/II cement and 2 percent bentonite powder]). Placement of the well seal will typically need to be inspected by the local regulatory agency. Once the seal is placed to one to two feet bgs, the locking cap shall be removed and a TOC mark will be established by filing a notch into the north side of the top of casing. This will be followed by water level measurement collected in accordance with the protocol for Water Level, Well Depth, and Floating Product Measurements.

Well Head Protection

After the well seal has set, well head protection will be installed. The well head protector will consist of metal stovepipe cover or water tight, traffic-rated Christy box finished slightly above grade. Both covers will be installed into the concrete apron to ensure that surface water does not enter into the well. A lock will be affixed to the locking well cap or stovepipe and a well identification number stamped or printed in indelible ink onto lid or cap.

Development of Monitoring or Extraction Well

After the grout has cured a minimum of 48 hours (or as required by the local permitting agency), the well will be developed with the use of development tools and pump. The objective for developing the well is to: 1) remove the silt and clay that may have accumulated at the bottom of the well; 2) dislodge fine particles within the water bearing zone; and 3) compact and wash the fine-grained sediments out of filter pack that may have been introduced during drilling and construction of the well. Prior to well development, a water level measurement should be obtained by following the protocol for Water Level Measurements.

Typically, the well will be pumped by using a double diaphragm, 12-volt submersible pump, or peristaltic pump to initially remove accumulated sediment. A surge block will then be used to dislodge fine-grained sediments and bring them into suspension so they can be pumped out. A

recharge rate will be estimated by performing a quick drawdown of the water level by pumping at a rate higher than the infiltration rate and anticipated purge rate. Once drawdown is achieved, the pump will be turned off and estimated recharge rate obtained by measuring water level rise over time, if possible. Development will proceed at or near infiltration rate until the appearance of the water becomes clear. To ensure adequate development throughout the entire length of the screen, the pump inlet will be raised to check that water clarity is maintained. The time, gallons removed, appearance, and measured recharge rate will be recorded on the Well Development form. The purged water, obtained from well development and decontamination of development tools, will be stored in accordance with the protocols for Decontamination and Disposal procedures. Once the well has been developed, a Well Completion Report, Form 188, will be filed with DWR and a copy of the Report will be submitted to the local enforcing agency.

Well Destruction

Wells will be abandoned in accordance with State and local agency requirements. Arrangements will be made with the local agency inspector to observe the destruction process, if required. The well head protector will be removed by jack hammering or drilling, if possible. The well casing will then be removed either by pulling out the casing, for shallow wells, or by drilling out with hollow-stem augers piloted by a leading drill rod inside the casing. The hollow-stem auger bit should be the same diameter or slightly larger than the well boring diameter. The auger will be advanced to a depth that is one-foot past the well boring depth to ensure that the annular filter and seal are removed. After ensuring that the casing length and a reasonable amount of filter pack has been removed, the borehole will be sealed by pumping a neat cement mixture to the bottom of the hole with the use of a tremie pipe. A concrete or asphalt cap may be required on paved surfaces. A Well Completion Report, Form 188, will then be filed with DWR and a copy of the Report will be submitted to the local agency.

Pressure grouting is another method used for well abandonment if overdrilling and removal as described above is not feasible or desirable. Pressure grouting must be approved by the local agency. Pressure grouting is not effective if the subsurface materials are highly permeable. Pressure grouting consists of injecting into the well a grout slurry consisting of five parts potable water to one part neat cement/bentonite. A specialized grout pump with pressure gauges is used to inject the grout seal into the well and is designed to replace the void space in the well's filter pack and casing. The sealing process is considered accomplished when the well no longer accepts grout under constant pressure for ten minutes. Following grouting, the well head protector will be removed by jack hammering or drilling out and the top of casing removed to several feet below ground surface. The surface void will be filled with a concrete or asphalt cap to match the surface condition. A Well Completion Report, Form 188, will then be filed with DWR and copy of the Report will be submitted to the local agency.

Hydropunch

The hydropunch program will be designed to obtain water from a specific water-bearing zone by temporarily screening a one- to two-foot interval. The screen interval will be determined by either 1) drilling a pilot boring adjacent to the proposed hydropunch location to obtain a lithologic log and depth to groundwater, or 2) from previous investigations conducted on-site. The hydropunch

consists of a small-diameter stainless steel cover (typically two- to three-inch diameter) attached to a stainless steel core barrel. Inside the core barrel is a small-diameter PVC casing and screen. The hydropunch is advanced by either direct push techniques (DPT) or by a combined augering/direct push technique to the target depth. The core barrel is then retrieved, leaving the hydropunch tip and screen/casing set at the target depth. Upon infiltration of groundwater, a grab water sample is collected. All drilling and sampling equipment will be decontaminated prior to and after use in accordance with the protocol for Decontamination and Disposal. Once the groundwater sample is obtained, the hydropunch boring will be sealed in accordance with the Soil Boring Abandonment protocol.

3.6 Sampling of Monitoring Wells, Hydropunches, Surface Grab Water Samples

These standard operating procedures describe the procedures BASELINE will follow during field activities performed during surface and subsurface water sample collection. These procedures are intended to be typical protocols and may be modified to address a site-specific work plan and/or site safety plan. They may also be modified during work progress, if warranted by site conditions, and approved by the project manager. The procedures may be superseded by applicable regulatory requirements.

Non-Purge Method for Well Sampling

In certain jurisdictions in the State, a non-purge approach for sampling of monitoring wells has been approved. These sites are typically petroleum sites where no free-phased product is present in the well. Use of the non-purge method of well sampling at a specific site will be determined by the project manager after determining that all well and site conditions have been met, and the local agency approves.

Prior to sampling, water level measurements must be taken and a check for floating product shall be performed in accordance with the Water Level Measurement protocol. Sampling of wells at petroleum hydrocarbon sites where the non-purge method has been approved shall be performed with a bailer. The water sample shall be collected from the top of the water column by carefully lowering the bailer to just below the water surface. This can be done by measuring the length of the bailer cord to the depth of the water level, adding the length of the bailer, and tying a knot. The bailer must be lowered and raised to assure that no splashing occurs in the water column. The first bailer shall be checked for free product or product sheen. Samples will than be collected in accordance with the protocol presented in Sample Collection.

Purging of Monitoring Wells

Purging is performed on groundwater monitoring wells to ensure that a representative sample of the formation water is obtained by removing water that has been present in the well casing and filter pack. The project manager should determine the number of well casing volumes needed for purging at a site and be consistent in the volumes for subsequent sampling events.

Purging should be performed with the intake or bailer collecting water from the top of the water column. This ensures fresh water from the formation will move upward and uniformly from the screened interval. In low-yield formations, water should be purged from the bottom of the screened

interval to assure that all water is removed from the water column. In no instances of well purging should the well be purged at a rate which would allow the formation water to cascade down the sides of the screen and cause the loss of volatiles. This will generally not be a problem in very slow recharge wells (i.e. several hours to several days) but can be a potential problem in moderately permeable formations where the rate of purging can greatly exceeds the recharge rate. Purging shall also be performed in such a manner that does not cause the recharge water to be excessively agitated.

Prior to purging, water level measurements must be taken and the presence of floating product shall be checked in accordance with the Water Level Measurement protocol. Several methods for purging and sampling are described below, the specific method will depend on the site conditions and parameters being analyzed. Unless otherwise specified, the method of purging shall be the same method used for sample collection. Once a purging method has been established for a specific site or well, it should be followed for subsequent sampling events. If the method is changed, it should be continued for the remainder of the sampling program.

Peristaltic Pump. Typically a peristaltic pump will be used on wells with shallow ground water (less than 24 feet bgs). The pump may either be operated at 12 VDC or 120 VAC current. The pump will be fitted with medical-grade silicon pump head tubing and attached to clean disposable intake poly-tubing. The tubing will be transported in a clean container and the portion of the hose that will be used will be removed out of the case just prior to use . The hose will be lowered slowly into the well ensuring that the hose does not come in contact with the ground surface. The tubing will be handled with glove-protected hands. The purge rate will be adjusted to closely match the recharge rate of the well, if possible. Water within the well casing will be removed by placing the purge intake at the top of the water column. The intake will be moved down as necessary to stay below the top of the water table. Field measurements will be conducted during the purge process in accordance with the Field Measurement protocols to ensure that a representative groundwater sample will be obtained.

Submersible Pump. Typically, a submersible pump will be used if the groundwater depth is greater than 24 feet bgs or if the groundwater table will be drawn down below 24 feet bgs during purging. The pump head will be fitted with clean poly tubing that has been stored in a clean case and removed just prior to use. The tubing and decontaminated pump and cable will be slowly lowered into the well ensuring that the tubing, and cable does not come in contact with the ground surface. The tubing and cable will be handled with glove protected hands and the pump slowly lowered just below the top of the water column.

The purge rate will be adjusted to closely match the intake flow rate of the well. The pump should be moved down as necessary to stay below the top of the water table. Field measurements will be collected during the purge process in accordance with the Field Measurement protocol to ensure that a representative groundwater sample will be obtained.

Hydropunches. Purging of groundwater from hydropunches is typically not required because of the technology of hydropunching. If installed correctly, the hydropunch does not create significant disturbance within the water-bearing zone; therefore, water withdrawn is representative of the water

within the sampled zone. A small portion of water may be purged prior to sampling in order to remove some of the fine-grained sediments that may have become dislodged during installation. The groundwater sample may be collected with the use of either a peristaltic pump and tubing, or a bailer. Water Sample Collection and Sample Handling protocols will be followed but field measurements will not be performed.

Bailer. The bailing method of purging and sampling can be used in any size well and any depth. However, if either: 1) significantly large volumes of water are needed for purging and/or sampling, 2) the depth to the water column is great, 3) dense non-aqueous phase liquid compounds (DNAPLs) are being sampled from the bottom of the water column, or 4) field-filtered metals samples are required, alternative methods should be considered. When purging or sampling with a bailer, a new disposable bottom-filling bailer will be used. The bailer will be removed from its protective wrapping, attached to clean cord, and slowly lowered to just below the water interface with glove-protected hands. The bailer shall not cause any splashing or agitation when it either enters or is removed from the water column. When the bailer becomes full, it will be slowly raised, ensuring that the cord and bailer do not come into contact with the ground surface. The first bailer of water will be checked for free product or product sheen. Water Sample Collection and Sample Handling protocols will be followed.

Sample Collection

Samples shall be collected from monitoring wells from the top of the water column unless DNAPLs are being analyzed. When sampling for DNAPLs, a pumping method of sampling should be used in order to access the sampling port or tubing intake at the bottom of the water column. When sampling from the top of the water column with a pump, the sampling port or tubing intake may need to be lowered as necessary during sampling to keep the intake below the top of the water column. The discharge shall be monitored such that the rate does not cause the recharge water to cascade down the well screen. Samples will be collected in the following order: volatile, semi-volatile, metals, other analyses.

When sampling for volatile or semi-volatile analysis using a pump, the pump rate will be decreased to approximately 100 ml/minute to minimize agitation. The effluent end of the sampling tube shall be placed at the bottom of the bottle and raised slowly to create as little turbulence as possible upon filling. When sampling with a bailer, a bottom flow control device (supplied with all disposable bailers) shall be used and the bottle filled in a similar manner. The 40 ml VOA bottles will be capped immediately and checked for air bubbles. If bubbles are observed, the bottle shall be refilled and checked again.

The VOA bottles are typically already preserved by the laboratory with HCL. When sampling brackish or saline water, a reaction may occur with the preservative; this reaction may create a build-up of air space, possibly reducing the sample's volatile concentration. In these instances, non-preserved VOAs will be used and noted on the label as “not preserved.”

Samples requiring filtration, such as metals, shall be filtered by the laboratory and preserved after filtration. When in-field filtration is required by a regulatory agency, a 0.45 micron filter will be

affixed to the effluent end of the pump discharge tube and placed inside the appropriate sample bottle. Samples collected for metals analysis which are not filtered in the field must be filtered then preserved by the laboratory within 24 hours of collection. Therefore, if the samples cannot be delivered to the laboratory within 24 hours, in-field filtering and preservation will be required. Collected water samples will be handled in accordance with Water Sample Handling and Preservation protocols.

Field Measurement

During the purging of monitoring wells, field measurements will be taken by using pH/temperature, electrical conductivity, turbidity meters, and, in some cases, dissolved oxygen meter. The instruments will be calibrated prior to and at the end of each day's sampling event. The calibration details along with time, cumulative gallons removed, and appearance of the purge water will be recorded on the Groundwater Sampling form. Groundwater parameter stabilization will be confirmed by three successive casing volumes (if possible) readings within the tolerance listed below:

- Electrical conductivity +/- 3%
- pH +/- 0.1
- Turbidity +/- 3%

It should be noted that in areas of saltwater intrusion, near Bay margins, stable conditions will be measured by turbidity. Field measurements will be collected by placing the instrument probes in a container filled periodically with aliquots of purged water.

Temperature/pH Measurement. Prior to the use of the temperature/pH meter, the instrument will be calibrated by following the two buffer calibration procedure found in the instrument manual. The two buffers used, (either 4.01 and 7.00 or 7.00 and 10.01) will bracket the expected pH range of the groundwater. The instrument will automatically calibrate itself to the two buffers used. The meter calibration readings will be recorded under “Before Purging” on the Groundwater Sampling form. There is no calibration required for the temperature. Once calibration of the pH probe is complete, the probe will be placed in the container and pH measurements recorded in to the nearest one-hundredth, when the "ready" signal has indicated on the instrument panel. Readings will be continued throughout the purge process until stabilization has been achieved.

At the completion of each sampling event, the pH will be checked for daily drift by measuring the two buffer solutions and comparing the values recorded before purging. The values obtained will be recorded on the Groundwater Sampling form under “After Purging.” If a significant variance is observed, a more frequent calibration period may be required or the battery may need to be replaced. Also, if readings are taking more than a few minutes to “ready,” replacement of the battery or probe may be necessary. All calibration standards used will be fresh and used before the expiration date.

Electrical Conductivity Measurement. Prior to the use of the electrical conductivity (EC) meter, the instrument will be calibrated by following the calibration procedure in the instrument manual. If the sample is expected to be fresh water, the probe will be calibrated with 1,000 µmhos/cm standard solution. If brackish and/or saline water is expected, the 10,000 µmhos/cm standard solution will be used. The solution used will be recorded under "Calibration Standard Reading" under "Before Purging" on the Groundwater Sampling form. After calibration, the probe will be placed into a glass container filled with purge water, and the EC measurements recorded in µmhos/cm. EC readings will be continued throughout the purge process at periodic intervals until stabilization has been achieved. After completion of each sampling event, the EC meter will be checked for daily drift by measuring the standard solution used for calibration and comparing the values recorded before purging. The values obtained will be recorded on the Groundwater Sampling form under "After Purging." If a significant variance is observed, the EC probe may need replacement. All calibration standards used will be fresh and used before the expiration date.

Dissolved Oxygen Measurement. Prior to the use of the dissolved oxygen (DO) meter, the instrument will be calibrated by following the calibration procedure in the instrument manual. The tip will be checked to ensure the membrane and fluid around the probe is satisfactory (i.e., no air, clear fluid) then placed into air-saturated deionized water. The expected dissolved oxygen at a particular temperature is obtained from the calibration chart; the meter is then adjusted and calibrated to this value. The temperature and calibrated value will be recorded on the Groundwater Sampling form. After calibration, the probe will be placed into a glass container filled with purge water and DO measurements recorded in mg/L.

Turbidity. Prior to the use of the turbidity meter, the instrument will be calibrated by following the calibration procedure in the instrument manual. The sample vial and calibration vial will be checked to ensure that they are clean prior to their use. If dirty, they will be cleaned with soapy water and dried using a lint free cloth. The instrument will then be calibrated to 0 and 100 Nephelometric Turbidity Units (NTU) standards and will be recorded under "Before Purging" on the Groundwater Sampling form. After calibration, readings will be obtained throughout the purge process at periodic intervals until stabilization has been achieved. After completion of each event, the meter will be checked for daily drift by measuring the standard used before purging. The values will be recorded on the Groundwater Sampling form under "After Purging." Calibration standards will replaced annually with fresh standards.

Water Sample Handling and Preservation

All containers used for water samples will be of the appropriate, type, size, number, and preservative for the specific analysis. Sample containers will be prepared in advance by an analytical laboratory. A list of the most common analyses requested, with the corresponding container type size, number, and preservative is listed in Table A-1. If unfiltered samples are collected for metals analysis, the samples must arrive at the laboratory within 24 hours of filtering and preserving.

TABLE A-1: **Sample Containers for Typical Analyses**

Method	Type of Analysis	Containers (Number, size and preservative)
EPA 601	Chlorinated hydrocarbons	three 40-ml VOAs w/HCL
EPA 8015M	Diesel	1 L amber glass
EPA 8015M	Gasoline	three 40-ml VOAs w/ HCL
EPA 8015M/8020	Gas/BTXE	three 40-ml VOAs w/ HCL
EPA 8015M/8020	Gas/BTXE/MTBE	three 40-ml VOAs w/HCL
EPA 8021B	BTEX (volatile aromatics)	three 40-ml VOAs w/HCL
EPA 8081/8082	PCBs and/or pesticides	1 L Amber glass
EPA 8260B	VOCs (mass spectrometry)	three 40-ml VOAs w/HCL
EPA 8270C	SVOCs (mass spectrometry)	two 1-L amber glass
EPA 8310	PAHs (polynuclear aromatic hydrocarbons)	1 L amber glass
EPA 418.1	Total recoverable petroleum hydrocarbons	1 L glass w/HCL
Standard Method 5520	Oil & grease (gravimetric)	1 L glass w/HCL
160.1	Total dissolved solids	500 ml plastic
160.2	Total suspended solids	500 ml plastic
300.0	Anions by IC, nitrate, nitrite, sulfate, phosphate, bromide, fluoride, chloride	two 500-ml plastic, unpreserved
Metals by ICP (200.7/6010)	6010 series	250 ml plastic, filter before preserving w/HNO_3
Metals by GFAA (7000 Series)	Arsenic, selenium, lead, thallium	250 ml plastic, filter before preserving w/HNO_3
26 CCR Metals (CAM17) (6000-7000 Series)	17 metals	250 ml plastic, filter before preserving w/HNO_3
Priority Pollutants Metals (6000-7000 Series)	13 metals	250 ml plastic, filter before preserving w/HNO_3
RCRA Metals (6000-7000 Series)	8 metals	250 ml plastic, filter before preserving w/HNO_3

BASELINE will handle water samples using the following protocol:

- The sample preparation area will be kept clean.

- The person(s) handling the sampling equipment and samples will don clean protective gloves appropriate for the chemicals of concern.

- A sample label will be filled out with an indelible pen prior to collection of the sample. Following completion of the label and capping of the sample, the label will be affixed to the container. The label will have the following information:

    - Sample identification number including depth, if appropriate.
    - BASELINE's phone number and address
    - Project number
    - Project location
    - Sampler(s) initials
    - Time and date of sample collection
    - Any special request or information for the laboratory

- Once the sample has been labeled it will be placed into an ice chest with ice. VOA bottles will be sealed into zip-lock plastic bags.

- An inspection of the water sample will be performed and the observed appearance and odor will be noted and recorded on the Groundwater Sampling form.

- Chain-of Custody protocols will be followed.

3.7 Air Monitoring

These protocols describe the procedures BASELINE will follow during air monitoring that may be performed during drilling operations, soil and groundwater sampling, underground tank removals, and soil management projects. These procedures are intended to be typical protocols and may be modified to address a site-specific work plan and/or site safety plan. They may also be modified during work progress, if warranted by site conditions, and approved by the project manager. The procedures may be superseded by applicable regulatory requirements.

Calibration, PID Photovac Meter

The PID instruments will be calibrated prior to each day's use by following the calibration procedures found in instrument's operation manual. The meter will be calibrated to 100 ppm of isobutylene (isobutylene gas is used during calibration of Photovac meter because it has a response value comparable to chemicals typically encountered in the field). The calibration gas used, time, date, and instrument calibration will be recorded on either the Field Log or Drilling Log.

Calibration, Gastec Meter

The Gastec will be calibrated prior to each day's use by following the calibration procedures found in the instrument's operation manual. The meter will be calibrated with hexane at 40% LEL (lower explosive limit) and 100 mg/L (hexane gas is used during calibration of Gastec meter because it has

an average response value comparable to chemicals typically encountered in the field). The calibration gas used, time, date, and instrument calibration will be recorded on either the Field Log or Drilling Log.

Calibration, RAE Systems, Multi-RAE Plus (4-gas meter)

The 4-gas meter contains sensors for oxygen, hydrogen sulfide, carbon monoxide, and records the Lower Explosive Limit (LEL) for combustible gases. The 4-gas meter will be calibrated, as frequently as needed, by following the calibration procedures found in the instrument's operations manual. The oxygen sensor will be calibrated using fresh air (20.9% oxygen) from an uncontaminated source. The hydrogen sulfide, carbon monoxide, and LEL meter will be calibrated using 25 ppm hydrogen sulfide, 50 ppm carbon monoxide, and 2.5% (50% LEL) methane. The calibration gas used, time, date, and instrument calibration will be recorded on either the Field Log or the Drilling Log.

Calibration, Drager Accuro Pump and Colorimetric (direct-reading) Tubes

No calibration of the pump or tubes is required prior to use; the pump and tubes are pre-calibrated. Prior to use, perform a leak test by inserting an unopened tube into the socket. Squeeze the pump completely and release. The pump is leak-proof if the white end of stroke indicator has not appeared after 15 minutes. The results of the leak test will be recorded on either the Field Log or the Drilling Log. Observe the temperatures and humidity conditions under which the tubes may be used. If needed, the tube reading can be corrected to true atmospheric pressure by multiplying the reading by an "f-factor;" calculation of an appropriate "f-factor" is indicated on the colorimetric tube instruction sheets. Also observe cross-sensitivities that could give an incorrect/false reading; see the colorimetric tube instruction sheets for details. A complete pump check will be performed annually.

Instrument Semi-Annual Maintenance, Performance and Calibration.

All field instruments will be calibrated a minimum of semi-annually and recorded in BASELINE Instruments Calibration Manual. Prior to calibration, the instrument will be inspected and checked for performance. Any maintenance that may be required according to the instrument maintenance schedule will be performed.

Air Monitoring, Soil Excavation Activities

After instrument calibration, background sampling points will be established around the perimeter, upwind and downwind of the excavation (exclusion zone). The sample locations, date, time, and wind direction will be recorded on either a site map or a Field Log form. Once background levels are established, air monitoring within the excavation (exclusion zone) will be performed both in the breathing zone and near newly excavated soil. If air monitoring action levels described in the Site Safety Plan are reached, the appropriate action will be implemented. In some cases this may involve stopping work until the hazardous conditions have been abated. The instrument readings and any actions undertaken will be recorded in the Field Log.

Air Monitoring, Drilling/Coring

After instrument calibration, the air monitoring instrument(s) will be adjusted to nullify any background levels before drilling/coring proceeds. Air monitoring will be performed downwind of the drill cuttings, within the breathing zone, and inside the boring. A reading from the representative target soil sample will also be recorded. If air monitoring action levels, as described in Site Safety Plan, are exceeded, the appropriate action will be implemented. In some cases this may involve stopping work until the hazardous conditions have been abated. The instrument readings and any actions undertaken will be recorded in the Field Log and/or the Drilling Logs.

3.8 Decontamination and Disposal

These protocols describe the procedures BASELINE will follow for decontaminating sampling equipment and managing liquid and/or solid waste generated from field activities. These procedures are intended to be typical protocols and may be modified to address a site specific work plan and/or site safety plan. They may also be modified during work progress, if warranted by site conditions and approved by the project manager. The procedures may be superseded by applicable regulatory requirements.

Decontamination, Drilling Activities

All drilling equipment, augers, drill rods, drill bits (and cables and 140 lbs drive hammer if they could come into contact with the subsurface or soil samples) will be steam cleaned by the drilling contractor prior to being brought onto the site. Between borings, the preferred method for decontamination of drilling equipment is steam cleaning according to Decon-Method I below. All sampling equipment used during sample collection including split spoon samplers, stainless steel or brass liners, and core barrels, will be decontaminated prior to and between sampling points. The preferred method for decontamination of sampling equipment is by washing them using the triple rinse protocol according to Decon Method II, described below.

Decon-Method I, Steam-Cleaner

A decontamination area will be established in an area that is inaccessible to the general public, or cordoned off from the general public with the use of caution tape. A containment area consisting of either a wood frame basin covered with visquene or a portable steam cleaning tub is used. All drilling equipment used will be washed inside the basin or tub at high temperature and pressure produced with a steam cleaner, until decontamination is achieved. The steam cleaning rinsate is transferred into 55-gallon drums, sealed, labeled (indicating its contents), and stored on-site until disposal according to the protocol for Disposal, described below.

Decon-Method II, Triple Rinse

This method is preferred when decontaminating sampling equipment used during soil sampling. All sampling equipment used during sample collection (split spoon sampler, stainless steel or brass liners, core barrels) will be decontaminated by washing them using the triple rinse method. The equipment will be washed in a sequence starting with 1) a solution of either alconox or trisodium phosphate mixed with clean water, 2) clean water, and 3) final rinse in de-ionized water. Anytime the water becomes visibly dirty, it will be replaced.

The used water is transferred into 55-gallon drum(s), sealed, labeled (indicating its contents) and stored on-site until disposal according to the protocol for Disposal, described below.

DECON-Method III Hand Held Bottle Sprayers

This method is preferred when small portions of the sampling equipment (groundwater level probe, EnCore® T-handle, or slide hammer core barrel) come in contact with soil or groundwater. The equipment is decontaminated by first spraying it with an alconox water solution followed by spraying with DI rinse water. Typically this method does not accumulate enough rinsate to be placed into a drum, and usually evaporates.

Disposal

Solid waste generated from drilling activities or soil excavation will be temporarily stored on-site in either an HW-classified container, or placed on and covered with visquene. Soil generated for disposal will be sampled in accordance with SW-846 as described in Section 3.4. Soil samples will be analyzed for the parameters at the frequency specified in the profiling requirements for each landfill. These profiling requirements can very significantly for each landfill; therefore, preselecting the landfill(s) is recommended to ensure these requirements are met. Once classified, the soil will be transferred to the landfill by an appropriately licensed hauler. All associated manifests will be signed by the site property owner or representative.

Liquid waste generated from drilling, soil sampling, and water sampling activities will be temporarily stored on site in an HW classified container. The water will be sampled or the analytical results of well water will be submitted to a recycling facility in accordance with profiling requirements. Upon acceptance, the liquid will be hauled to the facility by an appropriately licensed hauler. All associated manifest will be signed by the site property owner or representative.

At those sites where small quantities of rinsate (less than five gallons) are generated during sampling of a soil stockpile, and HW classified containers are not maintained at the site, an alternative disposal method may be used. The field geologist, engineer, or technician may apply the accumulated rinsate water to the soil stockpile providing both of the following provisions are satisfied:

1) The soil stockpile is of adequate size and absorptive capacity to ensure that no discharge to the environment will take place, OR the stockpile is on an impermeable surface (i.e., pavement or plastic sheet); and

2) There is no measurable thickness of floating product on the rinsate in the container.

3.9 Water Level Measurements

Water levels are determined using a dual interface probe, and are measured to an accuracy of 0.01 foot. The dual-interface probe measures both the depth to water and the depth to floating product that may be present in the well. Depths to water are measured from the same location indicated at the top of the well casing by a small notch or other survey mark. The depth to water is measured twice to ensure that the water level readings are the same (i.e., the water level has stabilized). In

cases where the water level continues to rise or drop very slowly, this is noted along with water level reading on the appropriate forms. The depths to water and floating product are recorded on a Water Level Measurement form, Groundwater Sampling form, Well Development form, or Well Construction diagram, depending on the field activity (Appendix B of BASELINE's Quality Assurance Program Plan). The dual-interface probe is decontaminated immediately after use with a TSP or alconox and water solution, typically using Decon Method III.

3.10 Chain-of-Custody Procedures

Once samples have been collected and properly preserved, they will be maintained under chain-of-custody procedures. The Chain-of-Custody Record (Appendix B of BASELINE's Quality Assurance Program Plan) documents the transfer of custody of the samples from the time the samples are collected in the field by the BASELINE personnel to the time they are received by the laboratory. Each sample collected for analysis will be included on the Chain-of-Custody Record, which will provide the following information

- Project number
- Project name and location
- Sampler's signature
- Turn-around time
- Laboratory name
- Name of BASELINE project manager
- Sample ID, number station
- Date, time, media type (soil or water), depth, number of containers
- Analyses required
- Remarks including detection limits and composites
- Condition of samples upon arrival at the laboratory
- The time, date, and signature of any person relinquishing the custody of the samples
- The time, date, and signature of any person receiving the custody of the samples.
-

Blank spaces on the Chain-of-Custody Record will be crossed out between the last person to receive the samples prior to the signature of the person receiving the samples at the laboratory.

A copy of the Chain-of-Custody Record will be retained by BASELINE personnel after the laboratory has received the samples. A copy of the Chain-of-Custody Record will be given to the project manager and the original will remain at the laboratory with the samples.

3.11 Mapping Soil Borings, Well Locations, and Surveying

Surface elevations of boring locations should be determined, when possible, using topographic maps or by field surveying at the time of drilling. All monitoring wells will be surveyed for both vertical and horizontal control by a surveyor licenced in the State of California. The vertical and horizontal control is established to determine groundwater elevation within a well and determine the local groundwater gradient and flow direction at the site. The vertical control will be established to the north side of the top of casing (TOC) and ground surface elevation for each well . The elevation will be recorded relative to the appropriate datum (as determined by the surveyor or project manager)

to within 0.01 foot. The horizontal control of each well will be established by locating the wells relative to a known permanent structure on the site and/or within reference to one another.

Soil boring, surface water sample, and grab soil sample locations will mapped in the field by BASELINE field personnel. If requested by the client, a surveyor licenced in the State of California may survey soil boring locations. A site map will be provided by the client or constructed in the field by BASELINE. Each sample location will be plotted on the site map. A site map and associated sample locations will be constructed by using a Brunton or similar compass, measuring tape, and/or walker by plotting the bearing and distance from established reference points. The bearing and distances measured will be documented on the original site map and stored in the BASELINE project file under Field Notes/ Maps/Photos.

4.0 DOCUMENT PRODUCTION

The project manager is responsible for ensuring the quality of documents. The project manager should provide detailed instructions regarding document production, including deadlines, to the designated BASELINE clerical or administrative employee. The designated BASELINE employee is responsible for ensuring the following steps are completed:

- Obtaining instructions from the project manager regarding document type, distribution information, and special instructions.

- Ensuring that the document is complete and all figures have page numbers and titles prior to reproduction.

- Ensuring that the document has been proofread, and received peer and principal reviews.

- Ensuring that colored stock is used for lead sheets, cover stock is used for front and back report covers, and acetate front and back covers are included on documents (acetate covers are not used on proposals).

- If a document is reproduced by a copy service, providing a detailed instruction sheet and appropriate stock, and identifying lead and cover sheets.

- Reviewing every document, page by page, to ensure that the copy quality is adequate and that all pages, including figures and appendices, are included and properly oriented.

- Ensuring that a transmittal form is completed, in accordance with instructions from the project manager.

- Ensuring that documents and addressed envelopes, if requested, are distributed using an appropriate delivery service.

- Checking master documents to ensure that they are in order and complete prior to filing.

The project manager is responsible for inspecting each package after production, prior to mailing or delivery, to ensure that these steps have been completed.

APPENDIX B

FIELD FORMS

APPENDIX B
FIELD FORMS

Field Log
Site Reconnaissance Checklist
Chain of Custody Record
Drilling Log
Well Construction Summary and Development Log
Field Water Level Measurements
Soil Sample Field Screening
Groundwater Sampling
Sample Label
Drum Label

BASELINE

FIELD LOG Page ____ of ____

Project:	Job No:
Logger:	Date:
Weather Conditions:	
Site Personnel:	

Time	Field Activities
	Arrival Time
	Departure Time

BASELINE

SITE RECONNAISSANCE
FIELD CHECKLIST

Describe the following, in order to meet ASTM standards:

General/Exterior Observations

Topography _____

_____

Site improvements (i.e., buildings, roadways, etc.) and current site uses _____

_____

_____

Adjoining parcels, land uses, and evidence of hazardous material use/release (if apparent) _____

_____

_____

Evidence of past uses at site (i.e., building foundations, abandoned equipment) _____

_____

_____

Inventory of hazardous substances at site, including approximate quantities, types of containers, and storage conditions _____

_____

Check box if present, and describe:

☐ Aboveground storage tanks and evidence of underground storage tanks (vent pipes, fill tubes, pumps)

_____

_____

☐ Unusual or noxious odors (identify source, if possible) _____

_____

☐ Pools of liquid, including standing surface water _____

_____

☐ Drums/Hazardous Substance Containers/Unlabeled or unidentified containers _____

_____

(continued)

Site Reconnaissance Field Checklist - *continued*

☐ Electrical equipment (i.e. transformers) known or likely to contain PCBs (excluding fluorescent lighting)

☐ Stained or disturbed soil or pavement

☐ Stressed vegetation

☐ Solid waste (dumping, etc.)

☐ Wastewater and storm/surface drainage

☐ Wells

☐ Septic Systems

☐ Public utilities (power, water, sewage, solid waste)

Interior Observations

Heating and cooling systems

Stains or corrosion

Floor drains and sumps

Interior finish materials (i.e., drywall, textured ceiling material, vinyl flooring, etc.)

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CHAIN OF CUSTODY RECORD

Turn-around Time _____
Lab _____
BASELINE Contact Person _____

Project Number	Project Name and Location:
Samplers: (Signature)	

Sample ID No. Station	Date:	Time:	Media	Containers: No.	Type: SS	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly		Preservative (Ice and :): None	HCl	NO_3	SO_4										Remarks/ Composite

Relinquished by: (Signature)	Custody Seal Yes No	Date/Time	Received by: (Signature)	Custody Seal intact Yes No NA	Date/Time	Conditions of Samples Upon Arrival at Laboratory:
Relinquished by: (Signature)	Custody Seal Yes No	Date/Time	Received by: (Signature)	Custody Seal intact Yes No NA	Date/Time	Remarks: **If analyzing for MTBE, confirm any hits with EPA method 8260**
Relinquished by: (Signature)	Custody Seal Yes No	Date/Time	Received by: (Signature)	Custody Seal intact Yes No NA	Date/Time	

Received at laboratory with intact custody seal: (Signature)	Date/Time	Comments:

Bill's/C:/chain of Custody/MasterC-o-C-seal 5-02

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DRILL LOG NO.:

5900 Hollis Street, Suite D
Emeryville, California 94608
(510) 420-8686 voice
(510) 420-1707 fax

Location	:	Boring no.	:
Driller	:	Project no.	:
Method	: Hollow stem	Date	:
Logger	: WKS	Casing size	: 2 inch
Ground surface elev.	: feet	Bore size	: 8 inch

Water level during drilling

Depth in feet	Water Level	Sample	USCS	GRAPHIC	PID (ppm)	DESCRIPTION	REMARKS
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

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BASELINE

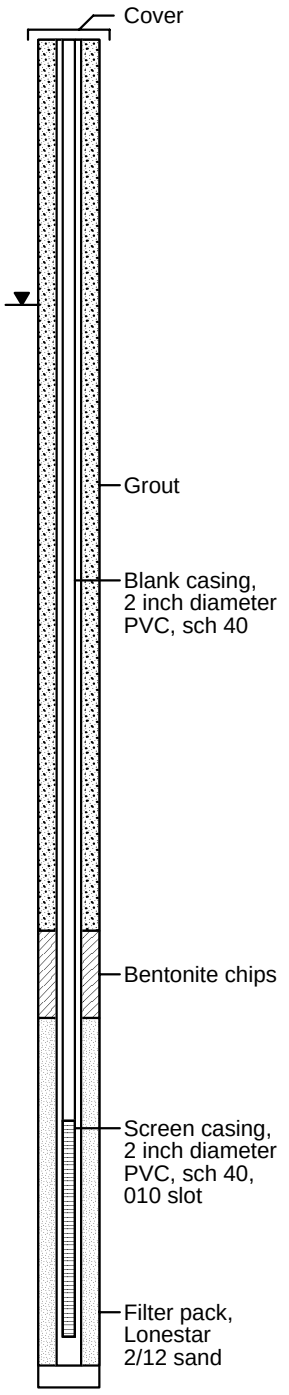
WELL LOG NO.:

5900 Hollis Street, Suite D
Emeryville, California 94608
(510) 420-8686 voice
(510) 420-1707 fax

Location	:	Boring no.	:
Driller	:	Project no.	:
Method	: Hollow stem	Date	:
Logger	: WKS	Casing size	:
Datum (TOC)	:	Bore size	:

Depth in feet | Graphic | USCS

Well:
NA



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Well Development Information

Well Construction :

Surface completion :
Neat cement (feet) :
Seal interval (feet) :
Filter pack (feet) :
Screen interval (feet) :

Initial depth to water (feet) :
Development method :
Product level from TOC :
Average recharge rate (gal/min):
Total gallons removed :

Well Development
Total depth from TOC: 29.12 feet

Notes

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FIELD WATER LEVEL MEASUREMENTS

Project Number:		Date:	
Project Name:		Logger:	
Project Location:		Measurement Method:	

Well	Date	Time	Depth from TOC to Product (feet)	Depth from TOC to Water (feet)	TOC Elevation (feet)	Product Thickness (feet)	Groundwater Elevation (feet)	Notes

BASELINE

SOIL SAMPLE FIELD SCREENING

Sample Location	Date	Depth	Material Type	Moisture Content	Visible Evidence of Contamination	Odor	HNu Reading	TLC

GROUNDWATER SAMPLING

Project no.:		Well no.:	Date:
Project name:		Depth of well from TOC (feet):	
Location:		Well diameter (inch):	
		Screened interval from TOC (feet):	
Recorded by:		TOC elevation (feet):	
Weather:		Water level from TOC (feet):	Time:
Precip in past 5 days (inch):		Product level from TOC (feet):	Time:
		Water level measurement device:	

CALCULATION OF WELL VOLUME:

[(ft) - (ft)] x (ft)^2 x 3.14 x 7.48 = _____ gallons in one well volume

well depth water level well radius _____ total gallons removed

CALIBRATION

	Time	Temp (° C)	pH	EC (µmho/cm)	NTU
Calibration Standard:	--				
Before Purging:					
After Purging:					

FIELD MEASUREMENTS:

Time	Temp (° C)	pH	EC (µmho/cm)	Cumulative Gallons Removed	Appearance	NTU

DO calibration: _____ DO results after purge: _____

Water level after purging prior to sampling (feet): _____ Time: _____

Appearance of sample: _____ Time: _____

Duplicate/blank number: _____ Time: _____

Purge method: _____

Sampling equipment: _____ VOC attachment: _____

Sample containers: _____

Sample analyses: _____ Laboratory: _____

Decontamination method: _____ Rinsate disposal: _____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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Project No:_____
SAMPLE ID:_____
Project Name:_____ Date:_____
Collected by:_____ Time:_____
Analyze for:_____

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NON-HAZARDOUS Waste

OPTIONAL INFORMATION

SHIPPER _____

ADDRESS _____

CITY, STATE, ZIP _____

CONTENTS _____

_____

NON-HAZARDOUS WASTE

APPENDIX C

LABORATORY QUALITY CONTROL

Quality Control Checklist
for Review of Laboratory Report

Job No.: _____ **Site:** _____

Laboratory: _____ **Laboratory Report No:** _____

Report Date: _____ **BASELINE Review By:** _____

	Yes	No	NA
GENERAL QUESTIONS **(Describe "no" responses below in "comments" section. Contact the laboratory, as required, for further explanation or action on "no" responses; document discussion in comments section.)**			
1a. Does the report include a case narrative? *(A case narrative MUST be prepared by the lab for all analytical work requested by BASELINE)*			
1b. Is the number of pages for the lab report as indicated on the case narrative/lab transmittal consistent with the number of pages that are included in report?			
1c. Does the case narrative indicate which samples were analyzed by a subcontractor and the subcontractor's name?			
1d. Does the case narrative summarize subsequent requests not shown on the chain-of-custody (e.g., additional analyses requested, release of "hold" samples)?			
1e. Does the case narrative explain why requested analyses could not be performed by laboratory (e.g., insufficient sample)?			
1f. Does the case narrative explain all problems with the QA/QC data as identified in the checklist (as applicable) ?			
2a. Is the laboratory report format consistent and legible throughout the report?			
2b. Are the sample and reported dates shown in the laboratory report correct?			
3a. Does the lab report include a copy of the chain-of-custody form?			
3b. Were all samples appropriately analyzed as requested on the chain-of-custody form?			
4. Was the lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel? (Some lab reports have signature spaces for each page). (This requirement also applies to any analyses subcontracted out by the laboratory)			
5a. Are preparation methods, cleanup methods (if applicable), and laboratory methods indicated for all analyses?			
5b. If additional analytes were requested as part of the reporting of the data for an analytical method, were these included in the lab report?			
6. Are the units in the lab report provided for each analysis consistent throughout the report?			
7. Are the detection limits (DL) appropriate based on the intended use of the data? (e.g., DL below applicable MCLs for water quality issues?)			
8a. Are detection limits appropriate based on the analysis performed? (i.e., not elevated due to dilution effects)			
8b. If no, is an explanation provided by the laboratory?			

	Yes	No	NA
9a. Were the samples analyzed within the appropriate holding time? (generally 2 weeks for volatiles, and up to 6 months for total metals)			
9b. If no, was it flagged in the report?			
10. If samples were composited prior to analysis, does the lab report indicate which samples were composited for each analysis?			
11a. Do the chromatograms confirm quantitative laboratory results? (petroleum hydrocarbons)			
11b. Is a standard chromatogram(s) included in the laboratory report?			
11c. Do the chromatograms confirm laboratory notes, if present (e.g., sample exhibits lighter hydrocarbon than standard)			
12. Are the results consistent with previous analytical results from the site? *(If no, contact the lab and request review/reanalysis of data, as appropriate)*			
13a. REVISED LAB REPORTS ONLY. Is the revised lab report or revised pages to a lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel?			
13b. REVISED LAB REPORTS ONLY. Does the case narrative indicate the date of revision and provide an explanation for the revision?			
13c. REVISED LAB REPORTS ONLY. Does the revised lab report adequately address the problem(s) which triggered the need for a revision?			
13d. REVISED LAB REPORTS ONLY. Are the data included in the revised report the same as data reported in the original report, except where the report was revised to correct incorrectly reported data?			
QA/QC Questions Field/Laboratory Quality Control - Groundwater Analyses			
14. Are field blanks reported as "ND"? (groundwater samples) *A field blank is a sample of DI water which is prepared in the field using the same collection and handling procedures as the other samples collected, and used to demonstrate that the sampling procedure has not contaminated the sample.*			
14a. Are rinsate blanks reported as "ND"? (Soil Sampling) *A rinsate blank is a sample of DI water which is prepared in the field by collecting DI rinse water after it has been poured over decontaminated sampling equipment. The rinsate blank is collected to demonstrate that the decontamination procedure has removed all the contaminants from the sampling equipment and that the sampling equipment has not contaminated the sample.*			
15. Are trip blanks reported as "ND"? (groundwater samples/volatile analyses) *A trip blank is a sample of contaminant-free matrix placed in an appropriate container by the lab and transported with the field samples collected. Provides information regarding positive interference introduced during sample transport, storage, preservation, and analysis. The sample is NOT opened in the field.*			

	Yes	No	NA
16. Are duplicate sample results consistent with the original sample? (groundwater samples) *Field duplicates consist of two independent samples collected at the same sampling location during a single sampling event. Used to evaluate precision of the analytical data and sampling technique. (Differences between the duplicate and sample results may also be attributed to environmental variability).*			
Batch Quality Control (Samples are batched together by matrix [soil, water] and analyses requested. A batch generally consists of 20 or fewer samples of the same matrix type, and is prepared using the same reagents, standards, procedures, and time frame as the samples. QC samples are run with each batch to assess performance of the entire measurement process.)			
17. Do the sample batch numbers and corresponding laboratory QA/QC batch numbers match?			
18a. Are method blanks (MB) for the analytical method(s) below the laboratory reporting limits? *Used to assess lab contamination and prevent false positive results. MBs should be "ND."*			
18b. If no, is an explanation provided in the case narrative to validate the data?			
18c. Are analytes which may be considered laboratory contaminants reported below the laboratory reporting limit? *Common lab contaminants include acetone, methylene chloride, diethylhexyl phthalate, and di-n-octyl phthalate.*			
18d. If no, was the laboratory contacted to determine whether reported analyte could be a potential laboratory contaminant and was an explanation included in the case narrative?			
19. Are laboratory control samples (LCS) and LCS duplicate (LCSD) [a.k.a., Blank Spike (BS) and BS duplicates (BSD)] within laboratory reporting limits? Limits should be provided on the report. *LCS is a reagent blank spike with a representative selection of target analyte(s) and prepared in the same manner as the samples analyzed. The LCS should be spiked with the same analytes as the matrix spike (below). The LCS is free from interferences from the sample matrix and demonstrates the ability of the lab instruments to recover the target analytes. Accuracy (recovery information) is generally reported as % spike recovery; precision (reproducibility of results) between the LCS and LCSD is generally reported as the relative percent difference (RPD). LCS/LCSD can be run in addition to or in lieu of, matrix QC data.*			
20a. Are the Matrix QC data (i.e., MS/MSD) within laboratory limits? Limits should be provided on the lab report. *The lab selects a sample from the batch and analyzes a spike and a spike duplicate of that sample. Matrix QC data is used to obtain precision and accuracy information and is reported in the same manner as LCS/LCSD. If the MS/MSD fails, the results may still be considered valid if the MB and either the LCS/LCSD or BS/BSD is within the lab's limits (failure is probably due to matrix interference).*			
20b. If no, is the MB and either LCS/LCSD or BS/BSD within lab limits to validate the data?			

	Yes	No	NA
Sample Quality Control			
21a. Are the surrogate spikes reported within the lab's acceptable recovery limits? *A surrogate is a non-target analyte, which is similar in chemical structure to the analyte(s) being analyzed for, and which is not commonly found in environmental samples. A known concentration of the surrogate is spike into the sample or QA "sample" prior to extraction or sample preparation. Results are usually reported as % recovery of the spike. Failure to meet lab's limits for primary and secondary surrogates results in rebatching and reanalysis of the sample; failure of only the primary or the secondary surrogate may be acceptable under certain circumstances. Failure generally is due to coelution with the sample matrix.*			
21b. If no, is an explanation given in the case narrative to validate the data?			

Comments:

APPENDIX F

LABORATORY REPORTS AND CHAIN-OF-CUSTODY FORMS

QUALITY CONTROL CHECKLIST
FOR REVIEW OF LABORATORY REPORT

Job No.	Y5302-01	**Site:**	SR 84 Expressway Widening Project
Laboratory:	Curtis and Tompkins, Ltd.	**Laboratory Report No.:**	202112
Report Date:	4 April 2008	**BASELINE Reviewer:**	RR

	Yes	No	NA
GENERAL QUESTIONS **(Describe "no" responses below in "comments" section. Contact the laboratory, as required, for further explanation or action on "no" responses; document discussion in comments section.)**			
1a. Does the report include a case narrative? *(A case narrative MUST be prepared by the lab for all analytical work requested by BASELINE)*	X		
1b. Is the number of pages for the lab report as indicated on the case narrative/lab transmittal consistent with the number of pages that are included in report?		X	
1c. Does the case narrative indicate which samples were analyzed by a subcontractor and the subcontractor's name?			X
1d. Does the case narrative summarize subsequent requests not shown on the chain-of-custody (e.g., additional analyses requested, release of "hold" samples)?	X		
1e. Does the case narrative explain why requested analyses could not be performed by laboratory (e.g., insufficient sample)?			X
1f. Does the case narrative explain all problems with the QA/QC data as identified in the checklist (as applicable)?	X		
2a. Is the laboratory report format consistent and legible throughout the report?	X		
2b. Are the sample and reported dates shown in the laboratory report correct?	X		
3a. Does the lab report include the original chain-of-custody form?	X		
3b. Were all samples appropriately analyzed as requested on the chain-of-custody form?	X		
4. Was the lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel? (Some lab reports have signature spaces for each page). (This requirement also applies to any analyses subcontracted out by the laboratory)	X		
5a. Are preparation methods, cleanup methods (if applicable), and laboratory methods indicated for all analyses?	X		
5b. If additional analytes were requested as part of the reporting of the data for an analytical method, were these included in the lab report?			X
6. Are the units in the lab report provided for each analysis consistent throughout the report?	X		

Quality Control Checklist *- continued*

	Yes	No	NA
7. Are the detection limits (DL) appropriate based on the intended use of the data (e.g., DL below applicable MCLs for water quality issues)?	X		
8a. Are detection limits appropriate based on the analysis performed (i.e., not elevated due to dilution effects)?	X		
8b. If no, is an explanation provided by the laboratory?			X
9a. Were the samples analyzed within the appropriate holding time (generally 2 weeks for volatiles, and up to 6 months for total metals)?	X		
9b. If no, was it flagged in the report?			X
10. If samples were composited prior to analysis, does the lab report indicate which samples were composited for each analysis?	X		
11a. Do the chromatograms confirm quantitative laboratory results (petroleum hydrocarbons)?			X
11b. Is a standard chromatogram(s) included in the laboratory report?			X
11c. Do the chromatograms confirm laboratory notes, if present (e.g., sample exhibits lighter hydrocarbon than standard)?			X
12. Are the results consistent with previous analytical results from the site? *(If no, contact the lab and request review/reanalysis of data, as appropriate.)*			X
13a. REVISED LAB REPORTS ONLY. Is the revised lab report or revised pages to a lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel?			X
13b. REVISED LAB REPORTS ONLY. Does the case narrative indicate the date of revision and provide an explanation for the revision?			X
13c. REVISED LAB REPORTS ONLY. Does the revised lab report adequately address the problem(s) that triggered the need for a revision?			X
13d. REVISED LAB REPORTS ONLY. Are the data included in the revised report the same as the data reported in the original report, except where the report was revised to correct incorrectly reported data?			X
QA/QC Questions Field/Laboratory Quality Control - Groundwater Analyses			
14. Are field blanks reported as "ND" (groundwater samples)? *A field blank is a sample of DI water that is prepared in the field using the same collection and handling procedures as the other samples collected, and used to demonstrate that the sampling procedure has not contaminated the sample.*			X
14a. Are rinsate blanks reported as "ND" (soil samples)? *A rinsate blank is a sample of DI water that is prepared in the field by collecting DI rinse water after it has been poured over decontaminated sampling equipment. The rinsate blank is collected to demonstrate that the decontamination procedure has removed all the contaminants from the sampling equipment and that the sampling equipment has not contaminated the sample.*			X

Quality Control Checklist *- continued*

	Yes	No	NA
15. Are trip blanks reported as "ND" (groundwater samples/volatile analyses)? *A trip blank is a sample of contaminant free matrix placed in an appropriate container by the lab and transported with the field samples collected. Provides information regarding positive interference introduced during sample transport, storage, preservation, and analysis. The sample is NOT opened in the field.*			X
16. Are duplicate sample results consistent with the original sample (groundwater samples)? *Field duplicates consist of two independent samples collected at the same sampling location during a single sampling event. Used to evaluate precision of the analytical data and sampling technique. (Differences between the duplicate and sample results may also be attributed to environmental variability.)*			X
Batch Quality Control (Samples are batched together by matrix [soil, water] and analyses requested. A batch generally consists of 20 or fewer samples of the same matrix type, and is prepared using the same reagents, standards, procedures, and time frame as the samples. QC samples are run with each batch to assess performance of the entire measurement process.)			
17. Do the sample batch numbers and corresponding laboratory QA/QC batch numbers match?	X		
18a. Are method blanks (MB) for the analytical method(s) below the laboratory reporting limits? *Used to assess lab contamination and prevent false positive results.*	X		
18b. If no, is an explanation provided in the case narrative to validate the data?			X
18c. Are analytes that may be considered laboratory contaminants reported below the laboratory reporting limit? *Common lab contaminants include acetone, methylene chloride, diethylhexyl phthalate, and di-n-octyl phthalate.*			X
18d. If no, was the laboratory contacted to determine whether the reported analyte could be a potential laboratory contaminant and was an explanation included in the case narrative?			X
19. Are laboratory control samples (LCS) and LCS duplicate (LCSD) [a.k.a., Blank Spike (BS) and BS duplicates (BSD)] within laboratory reporting limits? Limits should be provided on the report. *LCS is a reagent blank spike with a representative selection of target analyte(s) and prepared in the same manner as the samples analyzed. The LCS should be spiked with the same analytes as the matrix spike (below). The LCS is free from interferences from the sample matrix and demonstrates the ability of the lab instruments to recover the target analytes. Accuracy (recovery information) is generally reported as % spike recovery; precision (reproducibility of results) between the LCS and LCSD is generally reported as the relative percent difference (RPD). LCS/LCSD can be run in addition to or in lieu of matrix QC data.*	X		
20a. Are the Matrix QC data (i.e., MS/MSD) within laboratory limits? Limits should be provided on the lab report. *The lab selects a sample from the batch and analyzes a spike and a spike duplicate of that sample. Matrix QC data is used to obtain precision and accuracy information and is reported in the same manner as LCS/LCSD. If the MS/MSD fails, the results may still be considered valid if the MB and either the LCS/LCSD or BS/BSD is within the lab's limits (failure is probably due to matrix interference).*		X	

Quality Control Checklist *- continued*

	Yes	No	NA
20b. If no, is the MB and either LCS/LCSD or BS/BSD within lab limits to validate the data?	X		
Sample Quality Control			
21a. Are the surrogate spikes reported within the lab's acceptable recovery limits? *A surrogate is a non-target analyte, which is similar in chemical structure to the analyte(s) being analyzed for, and which is not commonly found in environmental samples. A known concentration of the surrogate is spiked into the sample or QA "sample" prior to extraction or sample preparation. Results are usually reported as % recovery of the spike. Failure to meet lab's limits for primary and secondary surrogates results in rebatching and reanalysis of the sample; failure of only the primary or the secondary surrogate may be acceptable under certain circumstances. Failure generally is due to coelution with the sample matrix.*	X		
21b. If no, is an explanation given in the case narrative to validate the data?			X

Comments:

The number of pages for the laboratory report was not indicated on the transmittal.

Low recovery for copper was observed in the Matrix spike of SS-13A;1.5-2.0. The recoveries for copper in the Blank spike and the Blank spike duplicate were within laboratory limits.

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

RECEIVED
APR 9 _ 2008
BASELINE

Laboratory Job Number 202112
ANALYTICAL REPORT

Baseline Environmental
5900 Hollis Street
Emeryville, CA 94608

Project : Y5302-01
Location : SR-84 Expressway Widening Project
Level : II

Sample ID	Lab ID
SS-1A;0-0.5	202112-001
SS-1B;0-0.5	202112-002
SS-2A;0-0.5	202112-003
SS-2B;0-0.5	202112-004
SS-3A;0-0.5	202112-005
SS-3B;0-0.5	202112-006
SS-4A;0-0.5	202112-007
SS-4B;0-0.5	202112-008
SS-5A;0-0.5	202112-009
SS-5B;0-0.5	202112-010
SS-6A;0-0.5	202112-011
SS-6B;0-0.5	202112-012
SS-7A;0-0.5	202112-013
SS-7B;0-0.5	202112-014
SS-8A;0-0.5	202112-015
SS-8B;0-0.5	202112-016
SS-9A;0-0.5	202112-017
SS-9B;0-0.5	202112-018
SS-10A;0-0.5	202112-019
SS-10B;0-0.5	202112-020
SS-11A;0-0.5	202112-021
SS-11B;0-0.5	202112-022
SS-12A;0-0.5	202112-023
SS-12B;0-0.5	202112-024
SS-13A;0-0.5	202112-025
SS-13B;0-0.5	202112-026
SS-14A;0-0.5	202112-027
SS-14B;0-0.5	202112-028
SS-15A;0-0.5	202112-029
SS-15B;0-0.5	202112-030
SS-16A;0-0.5	202112-031
SS-16B;0-0.5	202112-032
SS-1A;1.5-2.0	202112-033
SS-1B;1.5-2.0	202112-034
SS-2A;1.5-2.0	202112-035
SS-2B;1.5-2.0	202112-036
SS-3A;1.5-2.0	202112-037
SS-3B;1.5-2.0	202112-038
SS-4A;1.5-2.0	202112-039
SS-4B;1.5-2.0	202112-040
SS-5A;1.5-2.0	202112-041
SS-5B;1.5-2.0	202112-042
SS-6A;1.5-2.0	202112-043
SS-6B;1.5-2.0	202112-044
SS-7A;1.5-2.0	202112-045
SS-7B;1.5-2.0	202112-046
SS-8A;1.5-2.0	202112-047
SS-8B;1.5-2.0	202112-048
SS-9A;1.5-2.0	202112-049
SS-9B;1.5-2.0	202112-050
SS-10A;1.5-2.0	202112-051
SS-10B;1.5-2.0	202112-052
SS-11A;1.5-2.0	202112-053
SS-11B;1.5-2.0	202112-054
SS-12A;1.5-2.0	202112-055
SS-12B;1.5-2.0	202112-056
SS-13A;1.5-2.0	202112-057
SS-13B;1.5-2.0	202112-058
SS-14A;1.5-2.0	202112-059
SS-14B;1.5-2.0	202112-060
SS-15A;1.5-2.0	202112-061
SS-15B;1.5-2.0	202112-062
SS-16A;1.5-2.0	202112-063
SS-16B;1.5-2.0	202112-064
SS-1/2-COMP	202112-065
SS-3/4-COMP	202112-066
SS-5/6-COMP	202112-067
SS-7/8-COMP	202112-068
SS-9/10-COMP	202112-069
SS-11/12-COMP	202112-070
SS-13/14-COMP	202112-071
SS-15/16-COMP	202112-072

NELAP # 01107CA

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 202112
ANALYTICAL REPORT

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signatures. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: _____ Date: 04/04/2008
Project Manager

Signature: _____ Date: 04/04/2008
Operations Manager

NELAP # 01107CA

Curtis & Tompkins, Ltd.

CASE NARRATIVE

Laboratory number:	202112
Client:	Baseline Environmental
Project:	Y5302-01
Location:	SR-84 Expressway Widening Project
Request Date:	03/21/08
Samples Received:	03/21/08

This hardcopy data package contains sample and QC results for sixty four soil samples and eight four-point soil composites, requested for the above referenced project on 03/21/08. The samples were received on ice and intact.

Pesticides (EPA 8081A):
All samples underwent sulfur cleanup using the copper option in EPA Method 3660B. SS-1/2-COMP (lab # 202112-065), SS-11/12-COMP (lab # 202112-070), SS-13/14-COMP (lab # 202112-071), SS-15/16-COMP (lab # 202112-072), SS-7/8-COMP (lab # 202112-068), and SS-9/10-COMP (lab # 202112-069) were diluted due to the dark, viscous nature of the sample extracts. No other analytical problems were encountered.

Metals (EPA 6010B and EPA 7471A) Soil:
Low recovery was observed for copper in the MS of SS-13A;1.5-2.0 (lab # 202112-057); the BS/BSD were within limits, and the associated RPD was within limits. No other analytical problems were encountered.

Metals (EPA 6010B) WET Leachate:
No analytical problems were encountered.

pH (EPA 9045C):
No analytical problems were encountered.

202112

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) [signature] / Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: No.	Type: Stainless Steel	Type: Encore	Type: L-AG	Type: 40-ml VOA	Type: L-Poly	Type: 250 ml Poly	Type: Glass Jar	Preservative: Ice	Preservative: HCL	Preservative: HNO_3	Preservative: SO_4	Preservative: NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)	Total As, Cu, Hg (EPA 6010B/7470)	Organochlorine Pesticides (EPA 8081A)	Remarks/ Composite	
SS-1A;0-0.5	-1	3/20/08	0723	S	1	X							X					X	X						composite	-65
SS-1B;0-0.5	-2	3/20/08	0743	S	1	X							X					X	X				X	X		
SS-2A;0-0.5	-3	3/20/08	0913	S	1	X							X					X	X							
SS-2B;0-0.5	-4	3/20/08	0916	S	1	X							X					X	X	X						
SS-3A;0-0.5	-5	3/20/08	0958	S	1	X							X					X	X							
SS-3B;0-0.5	-6	3/20/08	10:20	S	1	X							X					X	X							
SS-4A;0-0.5	-7	3/20/08	0805	S	1	X							X					X	X				X	X	composite	-66
SS-4B;0-0.5	-8	3/20/08	0808	S	1	X							X					X	X							
SS-5A;0-0.5	-9	3/20/08	1114	S	1	X							X					X	X							
SS-5B;0-0.5	-10	3/20/08	1117	S	1	X							X					X	X				X	X	composite	-67
SS-6A;0-0.5	-11	3/20/08	0829	S	1	X							X					X	X							
SS-6B;0-0.5	-12	3/20/08	0832	S	1	X							X					X	X							
SS-7A;0-0.5	-13	3/20/08	1045	S	1	X							X					X	X							
SS-7B;0-0.5	-14	3/20/08	1048	S	1	X							X					X	X				X	X	composite	-68
SS-8A;0-0.5	-15	3/20/08	0927	S	1	X							X					X	X							
SS-8B;0-0.5	-16	3/21/08	0931	S	1	X							X					X	X							
SS-9A;0-0.5	-17	3/20/08	1000	S	1	X							X					X	X							
SS-9B;0-0.5	-18	3/20/08	1003	S	1	X							X					X	X							
SS-10A;0-0.5	-19	3/20/08	1311	S	1	X							X					X	X				X	X	composite	-69
SS-10B;0-0.5	-20	3/20/08	1314	S	1	X							X					X	X							

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	
Reginald Ramirez	3/21/08 11:37	[signature]	3/21/08 11:37a	Arrival at Laboratory:
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Remarks:
				Email contact: redgy@baseline-env.com
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Please provide EDD

Received at laboratory with intact: YES NO Comments: on ice, intact

chain of custody

revised COC by client

202112

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) Mollie Scott / Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: Type: No.	Stainless Steel	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly	Glass Jar	Preservative: Ice	HCL	HNO_3	SO_4	NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)	Total As, Cu, Hg (EPA 6010B/7470)	Organochlorine Pesticides (EPA 8081A)	Remarks/ Composite
-21 SS-11A;0-0.5		3/21/08	0736	S	1	X							X					X	X	X					
-22 SS-11B;0-0.5		3/21/08	0738	S	1	X							X					X	X						
-23 SS-12A;0-0.5		3/21/08	0834	S	1	X							X					X	X				X	X	composite -70
-24 SS-12B;0-0.5		3/21/08	0837	S	1	X							X					X	X	X					
-25 SS-13A;0-0.5		3/21/08	0811	S	1	X							X					X	X						
-26 SS-13B;0-0.5		3/21/08	0814	S	1	X							X					X	X	X					
-27 SS-14A;0-0.5		3/20/08	1355	S	1	X							X					X	X				X	X	composite -71
-28 SS-14B;0-0.5		3/20/08	1358	S	1	X							X					X	X						
-29 SS-15A;0-0.5		3/21/08	0833	S	1	X							X					X	X						
-30 SS-15B;0-0.5		3/21/08	1034	S	1	X							X					X	X	X					
-31 SS-16A;0-0.5		3/20/08	1416	S	1	X							X					X	X				X	X	composite -72
-32 SS-16B;0-0.5		3/20/08	1421	S	1	X							X					X	X						
-33 SS-1A;1.5-2.0		3/20/08	0747	S	1	X							X					X	X						
-34 SS-1B;1.5-2.0		3/20/08	0749	S	1	X							X					X	X						
-35 SS-2A;1.5-2.0		3/21/08	Verizon	0933	S	1	X							X					X	X						
-36 SS-2B;1.5-2.0		3/21/08	Verizon	0940	S	1	X							X					X	X						
-37 SS-3A;1.5-2.0		3/21/08	NRG	1017	S	1	X							X					X	X						
-38 SS-3B;1.5-2.0		3/21/08	NRG	1023	S	1	X							X					X	X						
-39 SS-4A;1.5-2.0		3/20/08	0814	S	1	X							X					X	X						
-40 SS-4B;1.5-2.0		3/20/08	0820	S	1	X							X					X	X						

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	
Reginald Ramirez	3/21/08 11:23		3/21/08 1123a	Arrival at Laboratory:
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Remarks:
				Email contact: redgy@baseline-env.com
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Please provide EDD

Received at laboratory with intact: YES NO Comments: on ice, intact

chain of custody

revised COC

202112

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) [signature] / Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: Type: No.	Stainless Steel	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly	Glass Jar	Preservative: Ice	HCL	HNO_3	SO_4	NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)				Remarks/ Composite
SS-5A;1.5-2.0	-41	3/20/08	1123	S	1	X							X					X	X							
SS-5B;1.5-2.0	-42	3/20/08	1128	S	1	X							X					X	X							
SS-6A;1.5-2.0	-43	3/20/08	0844	S	1	X							X					X	X							
SS-6B;1.5-2.0	-44	3/20/08	0857	S	1	X							X					X	X							
SS-7A;1.5-2.0	-45	3/20/08	1054	S	1	X							X					X	X							
SS-7B;1.5-2.0	-46	3/20/08	1104	S	1	X							X					X	X							
SS-8A;1.5-2.0	-47	3/20/08	0937	S	1	X							X					X	X							
SS-8B;1.5-2.0	-48	3/20/08	0947	S	1	X							X					X	X							
SS-9A;1.5-2.0	-49	3/20/08	1017	S	1	X							X					X	X							
SS-9B;1.5-2.0	-50	3/20/08	1027	S	1	X							X					X	X							
SS-10A;1.5-2.0	-51	3/20/08	1320	S	1	X							X					X	X							
SS-10B;1.5-2.0	-52	3/20/08	1328	S	1	X							X					X	X							
SS-11A;1.5-2.0	-53	3/21/08	0748	S	1	X							X					X	X							
SS-11B;1.5-2.0	-54	3/21/08	0754	S	1	X							X					X	X							
SS-12A;1.5-2.0	-55	3/21/08	0841	S	1	X							X					X	X							
SS-12B;1.5-2.0	-56	3/21/08	0853	S	1	X							X					X	X							
SS-13A;1.5-2.0	-57	3/21/08	0819	S	1	X							X					X	X							
SS-13B;1.5-2.0	-58	3/21/08	0824	S	1	X							X					X	X							
SS-14A;1.5-2.0	-59	3/20/08	[illegible]	S	1	X							X					X	X							
SS-14B;1.5-2.0	-60	3/20/08	1404	S	1	X							X					X	X							
			1400																							

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	
Reginald Ramirez	3/21/08 11:23	[signature]	3/21/08 11:23 am	Arrival at Laboratory:
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Remarks:
				Email contact: redgy@baseline-env.com
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Please provide EDD

Received at laboratory with intact: YES NO Comments: on ice, intact

chain of custody

revised COC

202112

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: Type: No.	Stainless Steel	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly	Glass Jar	Preservative: Ice	HCL	HNO_3	SO_4	NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)			Remarks/ Composite
-61 SS-15A;1.5-2.0		3/21/08	1089	S	1	X							X					X	X						
-62 SS-15B;1.5-2.0		3/21/08	0942	S	1	X							X					X	X						
-63 SS-16A;1.5-2.0		3/20/08	1424	S	1	X							X					X	X						
-64 SS-16B;1.5-2.0		3/20/08	1426	S	1	X							X					X	X						

Relinquished by: (Signature) Reginald Ramirez	Date/Time 3/21/08 11:23	Received by: (Signature)	Date/Time 3/21/08 11:23
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Arrival at Laboratory:
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Remarks: Email contact: redgy@baseline-env.com Please provide EDD
Received at laboratory with intact: YES NO	Comments: on ice, intact		

chain of custody

revised COC

COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login # 202112 Date Received 3/21/08 Number of coolers 1
Client Baseline Project SR-84 Expressway Widening Project

Date Opened 3/21/08 By (print) K Wollbrock (sign) K Wollbrock
Date Logged in ↓ By (print) _____ (sign) _____

1. Did cooler come with a shipping slip (airbill, etc)?..... YES (NO)
Shipping info _____

2A. Were custody seals present? .... ☐ YES (circle) on cooler on samples ☒ NO
How many _____ Name _____ Date _____
2B. Were custody seals intact upon arrival? ..... YES NO (N/A)
3. Were custody papers dry and intact when received?..... (YES) NO
4. Were custody papers filled out properly (ink, signed, etc)?..... (YES) NO
5. Is the project identifiable from custody papers? (If so fill out top of form)..... (YES) NO
6. Indicate the packing in cooler: (if other, describe) _____

☐ Bubble Wrap ☐ Foam blocks ☐ Bags ☒ None
☐ Cloth material ☐ Cardboard ☐ Styrofoam ☐ Paper towels

7. If required, was sufficient ice used? Samples should be < or = 6°C .....YES NO N/A
Type of ice used: ☒ WET ☐ BLUE ☐ NONE Temp(°C) no temp Ø
☐ SAMPLES RECEIVED ON ICE DIRECTLY FROM FIELD. COOLING PROCESS HAD BEGUN.

8. Were soil Encore sampling devices present? .....YES (NO)
If YES, what time were they transferred to freezer? _____
9. Did all bottles arrive unbroken/unopened?..... (YES) NO
10. Are samples in the appropriate containers for indicated tests? ..... (YES) NO
*11. Are sample labels present, in good condition and complete? .....YES NO *
12. Do the sample labels agree with custody papers? .....YES NO *
13. Was sufficient amount of sample sent for tests requested? ..... (YES) NO
14. Are the samples appropriately preserved? .....YES NO (N/A)
15. Are bubbles absent in VOA samples?.....YES NO (N/A)
16. Was the client contacted concerning this sample delivery?.....YES NO
If YES, Who was called? _____ By _____ Date: _____

COMMENTS
*11: Sample SS-5A; 0-0.5 has "SS-5A; 1.5-2.0" written on cap
↳ logged in per sample label, not cap

03.08

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) [signature] / Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: Type: No.	Stainless Steel	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly	Glass Jar	Preservative: Ice	HCL	HNO_3	SO_4	NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)	Total As, Cu, Hg (EPA 6010B/7470)	Organochlorine Pesticides (EPA 8081A)	Remarks/ Composite
SS-1A;0-0.5		3/20/08	0723	S	1	X							X					X	X				X	X	composite
SS-1B;0-0.5		3/20/08	0743	S	1	X							X					X	X						
SS-2A;0-0.5		3/20/08	0913	S	1	X							X					X	X						
SS-2B;0-0.5		3/20/08	0916	S	1	X							X					X	X						
SS-3A;0-0.5		3/20/08	0958	S	1	X							X					X	X				X	X	composite
SS-3B;0-0.5		3/20/08	10:00	S	1	X							X					X	X						
SS-4A;0-0.5		3/20/08	0805	S	1	X							X					X	X						
SS-4B;0-0.5		3/20/08	0808	S	1	X							X					X	X						
SS-5A;0-0.5		3/20/08	1114	S	1	X							X					X	X				X	X	composite
SS-5B;0-0.5		3/20/08	1117	S	1	X							X					X	X						
SS-6A;0-0.5		3/20/08	0829	S	1	X							X					X	X						
SS-6B;0-0.5		3/20/08	0832	S	1	X							X					X	X						
SS-7A;0-0.5		3/20/08	1045	S	1	X							X					X	X				X	X	composite
SS-7B;0-0.5		3/20/08	1048	S	1	X							X					X	X						
SS-8A;0-0.5		3/20/08	0927	S	1	X							X					X	X						
SS-8B;0-0.5		3/20/08	0931	S	1	X							X					X	X						
SS-9A;0-0.5		3/20/08	1000	S	1	X							X					X	X				X	X	composite
SS-9B;0-0.5		3/20/08	1003	S	1	X							X					X	X						
SS-10A;0-0.5		3/20/08	1311	S	1	X							X					X	X						
SS-10B;0-0.5		3/20/08	1314	S	1	X							X					X	X						

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	
Reginald Ramirez	3/21/08 11:37	[signature]	3/21/08 11:37a	Arrival at Laboratory:
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Remarks:
				Email contact: redgy@baseline-env.com
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Please provide EDD

Received at laboratory with intact: YES NO Comments: on ice, intact

chain of custody

000009

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: Type: No.	Stainless Steel	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly	Glass Jar	Preservative: Ice	HCL	HNO_3	SO_4	NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)	Total As, Cu, Hg (EPA 6010B/7470)	Organochlorine Pesticides (EPA 8081A)	Remarks/ Composite
SS-11A;0-0.5		3/21/08	0736	S	1	X							X					X	X						
SS-11B;0-0.5		3/21/08	0738	S	1	X							X					X	X				X	X	composite
SS-12A;0-0.5		3/21/08	0834	S	1	X							X					X	X						
SS-12B;0-0.5		3/21/08	0837	S	1	X							X					X	X						
SS-13A;0-0.5		3/21/08	0811	S	1	X							X					X	X						
SS-13B;0-0.5		3/21/08	0814	S	1	X							X					X	X				X	X	composite
SS-14A;0-0.5		3/20/08	1355	S	1	X							X					X	X						
SS-14B;0-0.5		3/20/08	1358	S	1	X							X					X	X						
SS-15A;0-0.5		3/21/08	0833	S	1	X							X					X	X						
SS-15B;0-0.5		3/21/08	1036	S	1	X							X					X	X				X	X	composite
SS-16A;0-0.5		3/20/08	1416	S	1	X							X					X	X						
SS-16B;0-0.5		3/20/08	1421	S	1	X							X					X	X						
SS-1A;1.5-2.0		3/20/08	0747	S	1	X							X					X	X						
SS-1B;1.5-2.0		3/20/08	0749	S	1	X							X					X	X						
SS-2A;1.5-2.0		3/21/08	0933	S	1	X							X					X	X						
SS-2B;1.5-2.0		3/21/08	0940	S	1	X							X					X	X						
SS-3A;1.5-2.0		3/21/08	1017	S	1	X							X					X	X						
SS-3B;1.5-2.0		3/21/08	1023	S	1	X							X					X	X						
SS-4A;1.5-2.0		3/20/08	0814	S	1	X							X					X	X						
SS-4B;1.5-2.0		3/20/08	0820	S	1	X							X					X	X						

Relinquished by: (Signature)		Date/Time	Received by: (Signature)	Date/Time	
Reginald Ramirez		3/21/08 11:23		3/21/08 11:23a	Arrival at Laboratory:
Relinquished by: (Signature)		Date/Time	Received by: (Signature)		Remarks:
					Email contact: redgy@baseline-env.com
Relinquished by: (Signature)		Date/Time	Received by: (Signature)		Please provide EDD

Received at laboratory with intact: YES NO
Comments: on ice, intact

chain of custody

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) [signature] / Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: Type: No.	Stainless Steel	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly	Glass Jar	Preservative: Ice	HCL	HNO_3	SO_4	NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)			Remarks/ Composite
SS-5A;1.5-2.0		3/20/08	1123	S	1	X							X					X	X						
SS-5B;1.5-2.0		3/20/08	1128	S	1	X							X					X	X						
SS-6A;1.5-2.0		3/20/08	0844	S	1	X							X					X	X						
SS-6B;1.5-2.0		3/20/08	0857	S	1	X							X					X	X						
SS-7A;1.5-2.0		3/20/08	1057	S	1	X							X					X	X						
SS-7B;1.5-2.0		3/20/08	1104	S	1	X							X					X	X						
SS-8A;1.5-2.0		3/20/08	0937	S	1	X							X					X	X						
SS-8B;1.5-2.0		3/20/08	0947	S	1	X							X					X	X						
SS-9A;1.5-2.0		3/20/08	1017	S	1	X							X					X	X						
SS-9B;1.5-2.0		3/20/08	1037	S	1	X							X					X	X						
SS-10A;1.5-2.0		3/20/08	1320	S	1	X							X					X	X						
SS-10B;1.5-2.0		3/20/08	1328	S	1	X							X					X	X						
SS-11A;1.5-2.0		3/21/08	0748	S	1	X							X					X	X						
SS-11B;1.5-2.0		3/21/08	0754	S	1	X							X					X	X						
SS-12A;1.5-2.0		3/21/08	0841	S	1	X							X					X	X						
SS-12B;1.5-2.0		3/21/08	0853	S	1	X							X					X	X						
SS-13A;1.5-2.0		3/21/08	0819	S	1	X							X					X	X						
SS-13B;1.5-2.0		3/21/08	0829	S	1	X							X					X	X						
SS-14A;1.5-2.0		3/20/08	[illegible]	S	1	X							X					X	X						
SS-14B;1.5-2.0		3/20/08	1404	S	1	X							X					X	X						
			1400																						

Relinquished by: (Signature)		Date/Time	Received by: (Signature)	Date/Time	
Reginald Ramirez		3/21/08 11:23	[signature]	3/21/08 11:23 am	Arrival at Laboratory:
Relinquished by: (Signature)		Date/Time	Received by: (Signature)		Remarks:
					Email contact:
Relinquished by: (Signature)		Date/Time	Received by: (Signature)		redgy@baseline-env.com
					Please provide EDD

Received at laboratory with intact: YES NO
Comments: on ice, intact

chain of custody

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature) Reginald Ramirez

Sample ID / Station	No.	Date	Time	Media	Containers: Type: No.	Stainless Steel	Encore	L-AG	40-ml VOA	L-Poly	250 ml Poly	Glass Jar	Preservative: Ice	HCL	HNO_3	SO_4	NaOH	Total Lead (EPA 6010B)	Soluble Lead (WET method)	pH (SM 4500 H+B)	Soluble Lead (Modified WET method)	Soluble Lead (TCLP method)			Remarks/ Composite
SS-15A;1.5-2.0		3/21/08	1039	S	1	X							X					X	X						
SS-15B;1.5-2.0		3/21/08	0942	S	1	X							X					X	X						
SS-16A;1.5-2.0		3/20/08	1424	S	1	X							X					X	X						
SS-16B;1.5-2.0		3/20/08	1426	S	1	X							X					X	X						

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	
Reginald Ramirez	3/21/08 11:23		3/21/08 11:23 am	Arrival at Laboratory:
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		Remarks:
				Email contact:
Relinquished by: (Signature)	Date/Time	Received by: (Signature)		redgy@baseline-env.com
				Please provide EDD

Received at laboratory with intact: YES NO
Comments: on ice, intact

chain of custody

000012

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-1/2-COMP	Batch#:	136448
Lab ID:	202112-065	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	3.000		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	5.1
beta-BHC	ND	5.1
gamma-BHC	ND	5.1
delta-BHC	ND	5.1
Heptachlor	ND	5.1
Aldrin	ND	5.1
Heptachlor epoxide	ND	5.1
Endosulfan I	ND	5.1
Dieldrin	ND	9.9
4,4'-DDE	ND	9.9
Endrin	ND	9.9
Endosulfan II	ND	9.9
Endosulfan sulfate	ND	9.9
4,4'-DDD	ND	9.9
Endrin aldehyde	ND	9.9
4,4'-DDT	ND	9.9
alpha-Chlordane	ND	5.1
gamma-Chlordane	ND	5.1
Methoxychlor	ND	51
Toxaphene	ND	180

Surrogate	%REC	Limits
TCMX	89	40-120
Decachlorobiphenyl	93	43-142

ND= Not Detected
RL= Reporting Limit

14.0

00013

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-3/4-COMP	Batch#:	136448
Lab ID:	202112-066	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	1.000		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	1.7
beta-BHC	ND	1.7
gamma-BHC	ND	1.7
delta-BHC	ND	1.7
Heptachlor	ND	1.7
Aldrin	ND	1.7
Heptachlor epoxide	ND	1.7
Endosulfan I	ND	1.7
Dieldrin	ND	3.3
4,4'-DDE	ND	3.3
Endrin	ND	3.3
Endosulfan II	ND	3.3
Endosulfan sulfate	ND	3.3
4,4'-DDD	ND	3.3
Endrin aldehyde	ND	3.3
4,4'-DDT	ND	3.3
alpha-Chlordane	ND	1.7
gamma-Chlordane	ND	1.7
Methoxychlor	ND	17
Toxaphene	ND	60

Surrogate	%REC	Limits
TCMX	93	40-120
Decachlorobiphenyl	100	43-142

ND= Not Detected
RL= Reporting Limit

15.0

000014

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-5/6-COMP	Batch#:	136448
Lab ID:	202112-067	Sampled:	03/20/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	1.000		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	1.7
beta-BHC	ND	1.7
gamma-BHC	ND	1.7
delta-BHC	ND	1.7
Heptachlor	ND	1.7
Aldrin	ND	1.7
Heptachlor epoxide	ND	1.7
Endosulfan I	ND	1.7
Dieldrin	ND	3.3
4,4'-DDE	ND	3.3
Endrin	ND	3.3
Endosulfan II	ND	3.3
Endosulfan sulfate	ND	3.3
4,4'-DDD	ND	3.3
Endrin aldehyde	ND	3.3
4,4'-DDT	ND	3.3
alpha-Chlordane	ND	1.7
gamma-Chlordane	ND	1.7
Methoxychlor	ND	17
Toxaphene	ND	60

Surrogate	%REC	Limits
TCMX	86	40-120
Decachlorobiphenyl	86	43-142

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-7/8-COMP	Batch#:	136448
Lab ID:	202112-068	Sampled:	03/20/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	5.000		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	8.4
beta-BHC	ND	8.4
gamma-BHC	ND	8.4
delta-BHC	ND	8.4
Heptachlor	ND	8.4
Aldrin	ND	8.4
Heptachlor epoxide	ND	8.4
Endosulfan I	ND	8.4
Dieldrin	ND	16
4,4'-DDE	ND	16
Endrin	ND	16
Endosulfan II	ND	16
Endosulfan sulfate	ND	16
4,4'-DDD	ND	16
Endrin aldehyde	ND	16
4,4'-DDT	ND	16
alpha-Chlordane	ND	8.4
gamma-Chlordane	ND	8.4
Methoxychlor	ND	84
Toxaphene	ND	300

Surrogate	%REC	Limits
TCMX	98	40-120
Decachlorobiphenyl	103	43-142

ND= Not Detected
RL= Reporting Limit

17.0

060616

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-9/10-COMP	Batch#:	136448
Lab ID:	202112-069	Sampled:	03/20/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	20.00		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	34
beta-BHC	ND	34
gamma-BHC	ND	34
delta-BHC	ND	34
Heptachlor	ND	34
Aldrin	ND	34
Heptachlor epoxide	ND	34
Endosulfan I	ND	34
Dieldrin	ND	66
4,4'-DDE	ND	66
Endrin	ND	66
Endosulfan II	ND	66
Endosulfan sulfate	ND	66
4,4'-DDD	ND	66
Endrin aldehyde	ND	66
4,4'-DDT	ND	66
alpha-Chlordane	ND	34
gamma-Chlordane	ND	34
Methoxychlor	ND	340
Toxaphene	ND	1,200

Surrogate	%REC	Limits
TCMX	DO	40-120
Decachlorobiphenyl	DO	43-142

DO= Diluted Out
ND= Not Detected
RL= Reporting Limit

18.0

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-11/12-COMP	Batch#:	136448
Lab ID:	202112-070	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	20.00		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	34
beta-BHC	ND	34
gamma-BHC	ND	34
delta-BHC	ND	34
Heptachlor	ND	34
Aldrin	ND	34
Heptachlor epoxide	ND	34
Endosulfan I	ND	34
Dieldrin	ND	65
4,4'-DDE	ND	65
Endrin	ND	65
Endosulfan II	ND	65
Endosulfan sulfate	ND	65
4,4'-DDD	ND	65
Endrin aldehyde	ND	65
4,4'-DDT	ND	65
alpha-Chlordane	ND	34
gamma-Chlordane	ND	34
Methoxychlor	ND	340
Toxaphene	ND	1,200

Surrogate	%REC	Limits
TCMX	DO	40-120
Decachlorobiphenyl	DO	43-142

DO= Diluted Out
ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-13/14-COMP	Batch#:	136448
Lab ID:	202112-071	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	10.00		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	17
beta-BHC	ND	17
gamma-BHC	ND	17
delta-BHC	ND	17
Heptachlor	ND	17
Aldrin	ND	17
Heptachlor epoxide	ND	17
Endosulfan I	ND	17
Dieldrin	ND	33
4,4'-DDE	ND	33
Endrin	ND	33
Endosulfan II	ND	33
Endosulfan sulfate	ND	33
4,4'-DDD	ND	33
Endrin aldehyde	ND	33
4,4'-DDT	ND	33
alpha-Chlordane	ND	17
gamma-Chlordane	ND	17
Methoxychlor	ND	170
Toxaphene	ND	600

Surrogate	%REC	Limits
TCMX	DO	40-120
Decachlorobiphenyl	DO	43-142

DO= Diluted Out
ND= Not Detected
RL= Reporting Limit

20.0

Curtis & Tompkins, Ltd.

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	SS-15/16-COMP	Batch#:	136448
Lab ID:	202112-072	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	03/28/08
Diln Fac:	5.000		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	8.5
beta-BHC	ND	8.5
gamma-BHC	ND	8.5
delta-BHC	ND	8.5
Heptachlor	ND	8.5
Aldrin	ND	8.5
Heptachlor epoxide	ND	8.5
Endosulfan I	ND	8.5
Dieldrin	ND	16
4,4'-DDE	ND	16
Endrin	ND	16
Endosulfan II	ND	16
Endosulfan sulfate	ND	16
4,4'-DDD	ND	16
Endrin aldehyde	ND	16
4,4'-DDT	ND	16
alpha-Chlordane	ND	8.5
gamma-Chlordane	ND	8.5
Methoxychlor	ND	85
Toxaphene	ND	300

Surrogate	%REC	Limits
TCMX	67	40-120
Decachlorobiphenyl	58	43-142

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC434816	Batch#:	136448
Matrix:	Soil	Prepared:	03/27/08
Units:	ug/Kg	Analyzed:	04/02/08
Basis:	as received		

Cleanup Method: EPA 3620B

Analyte	Result	RL
alpha-BHC	ND	1.7
beta-BHC	ND	1.7
gamma-BHC	ND	1.7
delta-BHC	ND	1.7
Heptachlor	ND	1.7
Aldrin	ND	1.7
Heptachlor epoxide	ND	1.7
Endosulfan I	ND	1.7
Dieldrin	ND	3.3
4,4'-DDE	ND	3.3
Endrin	ND	3.3
Endosulfan II	ND	3.3
Endosulfan sulfate	ND	3.3
4,4'-DDD	ND	3.3
Endrin aldehyde	ND	3.3
4,4'-DDT	ND #	3.3
alpha-Chlordane	ND	1.7
gamma-Chlordane	ND	1.7
Methoxychlor	ND	17
Toxaphene	ND	60

Surrogate	%REC	Limits
TCMX	99	40-120
Decachlorobiphenyl	133	43-142

#= CCV drift outside limits; average CCV drift within limits per method requirements
ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC434817	Batch#:	136448
Matrix:	Soil	Prepared:	03/27/08
Units:	ug/Kg	Analyzed:	04/02/08
Basis:	as received		

Cleanup Method: EPA 3620B

Analyte	Spiked	Result	%REC	Limits
gamma-BHC	13.17	10.66	81	27-120
Heptachlor	13.17	10.52	80	25-123
Aldrin	13.17	10.33	78	29-120
Dieldrin	26.33	21.66	82	32-127
Endrin	26.33	23.52 #	89	30-140
4,4'-DDT	26.33	20.71 #	79	29-130

Surrogate	%REC	Limits
TCMX	90	40-120
Decachlorobiphenyl	96	43-142

#= CCV drift outside limits; average CCV drift within limits per method requirements

Curtis & Tompkins, Ltd.

Batch QC Report

Organochlorine Pesticides

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3550B
Project#:	Y5302-01	Analysis:	EPA 8081A
Field ID:	ZZZZZZZZZZ	Batch#:	136448
MSS Lab ID:	202129-003	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	ug/Kg	Prepared:	03/27/08
Basis:	as received	Analyzed:	04/02/08
Diln Fac:	3.000		

Type: MS
Lab ID: QC434818

Cleanup Method: EPA 3620B

Analyte	MSS Result	Spiked	Result	%REC	Limits
gamma-BHC	<1.663	13.30	12.43	93	41-120
Heptachlor	<1.861	13.30	11.94	90	40-126
Aldrin	<1.808	13.30	10.54	79	45-120
Dieldrin	<3.741	26.60	21.53	81	44-128
Endrin	<3.516	26.60	23.31 #	88	31-134
4,4'-DDT	<3.788	26.60	21.44 #	81	27-135

Surrogate	%REC	Limits
TCMX	89	40-120
Decachlorobiphenyl	110	43-142

Type: MSD
Lab ID: QC434819

Cleanup Method: EPA 3620B

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
gamma-BHC	13.29	12.63	95	41-120	2	46
Heptachlor	13.29	12.44	94	40-126	4	50
Aldrin	13.29	11.92	90	45-120	12	46
Dieldrin	26.58	25.76	97	44-128	18	41
Endrin	26.58	23.53 #	89	31-134	1	49
4,4'-DDT	26.58	23.19 #	87	27-135	8	51

Surrogate	%REC	Limits
TCMX	95	40-120
Decachlorobiphenyl	103	43-142

#= CCV drift outside limits; average CCV drift within limits per method requirements
RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Arsenic

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3050B
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Arsenic	Batch#:	136349
Matrix:	Soil	Received:	03/21/08
Units:	mg/Kg	Prepared:	03/25/08
Basis:	as received	Analyzed:	03/26/08
Diln Fac:	1.000		

Field ID	Type	Lab ID	Result	RL	Sampled
SS-1/2-COMP	SAMPLE	202112-065	3.5	0.28	03/21/08
SS-3/4-COMP	SAMPLE	202112-066	3.3	0.28	03/21/08
SS-5/6-COMP	SAMPLE	202112-067	3.0	0.25	03/20/08
SS-7/8-COMP	SAMPLE	202112-068	3.8	0.25	03/20/08
SS-9/10-COMP	SAMPLE	202112-069	4.2	0.25	03/20/08
SS-11/12-COMP	SAMPLE	202112-070	2.9	0.27	03/21/08
SS-13/14-COMP	SAMPLE	202112-071	2.7	0.27	03/21/08
SS-15/16-COMP	SAMPLE	202112-072	3.5	0.28	03/21/08
	BLANK	QC434414	ND	0.29	

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Arsenic

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3050B
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Arsenic	Diln Fac:	1.000
Field ID:	SS-13A;1.5-2.0	Batch#:	136349
MSS Lab ID:	202112-057	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	mg/Kg	Prepared:	03/25/08
Basis:	as received	Analyzed:	03/26/08

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC434415		50.00	45.33	91	80-120		
BSD	QC434416		50.00	42.75	86	80-120	6	20
MS	QC434417	3.571	47.62	41.32	79	71-120		
MSD	QC434418		48.54	44.01	83	71-120	5	20

RPD= Relative Percent Difference

5.0

066025

Curtis & Tompkins, Ltd.

Copper

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3050B
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Copper	Batch#:	136349
Matrix:	Soil	Received:	03/21/08
Units:	mg/Kg	Prepared:	03/25/08
Basis:	as received	Analyzed:	03/26/08
Diln Fac:	1.000		

Field ID	Type	Lab ID	Result	RL	Sampled
SS-1/2-COMP	SAMPLE	202112-065	20	0.28	03/21/08
SS-3/4-COMP	SAMPLE	202112-066	18	0.28	03/21/08
SS-5/6-COMP	SAMPLE	202112-067	16	0.25	03/20/08
SS-7/8-COMP	SAMPLE	202112-068	13	0.25	03/20/08
SS-9/10-COMP	SAMPLE	202112-069	26	0.29	03/20/08
SS-11/12-COMP	SAMPLE	202112-070	36	0.27	03/21/08
SS-13/14-COMP	SAMPLE	202112-071	28	0.27	03/21/08
SS-15/16-COMP	SAMPLE	202112-072	27	0.28	03/21/08
	BLANK	QC434414	ND	0.29	

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Copper

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3050B
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Copper	Diln Fac:	1.000
Field ID:	SS-13A;1.5-2.0	Batch#:	136349
MSS Lab ID:	202112-057	Sampled:	03/21/08
Matrix:	Soil	Received:	03/21/08
Units:	mg/Kg	Prepared:	03/25/08
Basis:	as received	Analyzed:	03/26/08

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC434415		12.50	11.31	90	80-120		
BSD	QC434416		12.50	10.77	86	80-120	5	20
MS	QC434417	26.43	11.90	29.11	23 *	42-152		
MSD	QC434418		12.14	33.07	55	42-152	12	23

*= Value outside of QC limits; see narrative
RPD= Relative Percent Difference

000027

Curtis & Tompkins, Ltd.

Mercury by Cold Vapor AA

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7471A
Analyte:	Mercury	Batch#:	136316
Matrix:	Soil	Received:	03/21/08
Units:	mg/Kg	Prepared:	03/24/08
Basis:	as received	Analyzed:	03/24/08
Diln Fac:	1.000		

Field ID	Type	Lab ID	Result	RL	Sampled
SS-1/2-COMP	SAMPLE	202112-065	ND	0.020	03/21/08
SS-3/4-COMP	SAMPLE	202112-066	ND	0.020	03/21/08
SS-5/6-COMP	SAMPLE	202112-067	ND	0.020	03/20/08
SS-7/8-COMP	SAMPLE	202112-068	0.023	0.020	03/20/08
SS-9/10-COMP	SAMPLE	202112-069	0.028	0.020	03/20/08
SS-11/12-COMP	SAMPLE	202112-070	0.064	0.020	03/21/08
SS-13/14-COMP	SAMPLE	202112-071	0.036	0.020	03/21/08
SS-15/16-COMP	SAMPLE	202112-072	0.053	0.020	03/21/08
	BLANK	QC434253	ND	0.020	

ND= Not Detected
RL= Reporting Limit

000028

Curtis & Tompkins, Ltd.

Batch QC Report

Mercury by Cold Vapor AA

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7471A
Analyte:	Mercury	Batch#:	136316
Field ID:	ZZZZZZZZZZ	Sampled:	03/19/08
Matrix:	Soil	Received:	03/20/08
Units:	mg/Kg	Prepared:	03/24/08
Basis:	as received	Analyzed:	03/24/08
Diln Fac:	1.000		

Type	MSS Lab ID	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
BS		QC434254		0.5000	0.5330	107	80-120		
BSD		QC434255		0.5000	0.5280	106	80-120	1	20
MS	202086-001	QC434257	0.01467	0.5319	0.6170	113	68-140		
MSD	202086-001	QC434258		0.4386	0.5018	111	68-140	2	24
MS	202086-002	QC434260	0.02564	0.4032	0.5048	119	68-140		
MSD	202086-002	QC434261		0.4545	0.5264	110	68-140	7	24

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Lead

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3050B
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Lead	Basis:	as received
Matrix:	Soil	Diln Fac:	1.000
Units:	mg/Kg	Received:	03/21/08

Field ID	Type	Lab ID	Result	RL	Batch#	Sampled	Prepared	Analyzed
SS-1A;0-0.5	SAMPLE	202112-001	4.8	0.25	136327	03/20/08	03/24/08	03/24/08
SS-1B;0-0.5	SAMPLE	202112-002	6.4	0.25	136327	03/20/08	03/24/08	03/24/08
SS-2A;0-0.5	SAMPLE	202112-003	6.8	0.25	136327	03/21/08	03/24/08	03/24/08
SS-2B;0-0.5	SAMPLE	202112-004	5.8	0.25	136327	03/21/08	03/24/08	03/24/08
SS-3A;0-0.5	SAMPLE	202112-005	4.1	0.25	136327	03/21/08	03/24/08	03/24/08
SS-3B;0-0.5	SAMPLE	202112-006	4.9	0.25	136327	03/21/08	03/24/08	03/24/08
SS-4A;0-0.5	SAMPLE	202112-007	4.6	0.25	136327	03/20/08	03/24/08	03/24/08
SS-4B;0-0.5	SAMPLE	202112-008	4.7	0.25	136327	03/20/08	03/24/08	03/24/08
SS-5A;0-0.5	SAMPLE	202112-009	9.1	0.25	136327	03/20/08	03/24/08	03/24/08
SS-5B;0-0.5	SAMPLE	202112-010	9.4	0.25	136327	03/20/08	03/24/08	03/24/08
SS-6A;0-0.5	SAMPLE	202112-011	5.7	0.25	136327	03/20/08	03/24/08	03/24/08
SS-6B;0-0.5	SAMPLE	202112-012	4.0	0.25	136327	03/20/08	03/24/08	03/24/08
SS-7A;0-0.5	SAMPLE	202112-013	5.3	0.25	136327	03/20/08	03/24/08	03/24/08
SS-7B;0-0.5	SAMPLE	202112-014	7.0	0.25	136327	03/20/08	03/24/08	03/24/08
SS-8A;0-0.5	SAMPLE	202112-015	13	0.25	136327	03/20/08	03/24/08	03/24/08
SS-8B;0-0.5	SAMPLE	202112-016	8.5	0.25	136327	03/20/08	03/24/08	03/24/08
SS-9A;0-0.5	SAMPLE	202112-017	13	0.25	136327	03/20/08	03/24/08	03/24/08
SS-9B;0-0.5	SAMPLE	202112-018	45	0.25	136327	03/20/08	03/24/08	03/24/08
SS-10A;0-0.5	SAMPLE	202112-019	7.2	0.25	136327	03/20/08	03/24/08	03/24/08
SS-10B;0-0.5	SAMPLE	202112-020	15	0.25	136328	03/20/08	03/24/08	03/24/08
SS-11A;0-0.5	SAMPLE	202112-021	13	0.25	136328	03/21/08	03/24/08	03/24/08
SS-11B;0-0.5	SAMPLE	202112-022	28	0.25	136328	03/21/08	03/24/08	03/24/08
SS-12A;0-0.5	SAMPLE	202112-023	44	0.25	136328	03/21/08	03/24/08	03/24/08
SS-12B;0-0.5	SAMPLE	202112-024	30	0.25	136328	03/21/08	03/24/08	03/24/08
SS-13A;0-0.5	SAMPLE	202112-025	11	0.25	136328	03/21/08	03/24/08	03/24/08
SS-13B;0-0.5	SAMPLE	202112-026	7.9	0.25	136328	03/21/08	03/24/08	03/24/08
SS-14A;0-0.5	SAMPLE	202112-027	16	0.25	136328	03/20/08	03/24/08	03/24/08
SS-14B;0-0.5	SAMPLE	202112-028	7.8	0.25	136328	03/20/08	03/24/08	03/24/08
SS-15A;0-0.5	SAMPLE	202112-029	9.5	0.25	136328	03/21/08	03/24/08	03/24/08
SS-15B;0-0.5	SAMPLE	202112-030	5.9	0.25	136328	03/21/08	03/24/08	03/24/08
SS-16A;0-0.5	SAMPLE	202112-031	8.6	0.25	136328	03/20/08	03/24/08	03/24/08
SS-16B;0-0.5	SAMPLE	202112-032	9.4	0.25	136328	03/20/08	03/24/08	03/24/08
SS-1A;1.5-2.0	SAMPLE	202112-033	8.3	0.25	136328	03/20/08	03/24/08	03/24/08
SS-1B;1.5-2.0	SAMPLE	202112-034	9.3	0.25	136328	03/20/08	03/24/08	03/24/08
SS-2A;1.5-2.0	SAMPLE	202112-035	10	0.25	136328	03/21/08	03/24/08	03/24/08
SS-2B;1.5-2.0	SAMPLE	202112-036	7.0	0.25	136328	03/21/08	03/24/08	03/24/08
SS-3A;1.5-2.0	SAMPLE	202112-037	6.7	0.25	136328	03/21/08	03/24/08	03/24/08
SS-3B;1.5-2.0	SAMPLE	202112-038	5.8	0.25	136347	03/21/08	03/25/08	03/26/08
SS-4A;1.5-2.0	SAMPLE	202112-039	5.0	0.25	136347	03/20/08	03/25/08	03/26/08

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Lead

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3050B
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Lead	Basis:	as received
Matrix:	Soil	Diln Fac:	1.000
Units:	mg/Kg	Received:	03/21/08

Field ID	Type	Lab ID	Result	RL	Batch#	Sampled	Prepared	Analyzed
SS-4B;1.5-2.0	SAMPLE	202112-040	5.8	0.25	136347	03/20/08	03/25/08	03/26/08
SS-5A;1.5-2.0	SAMPLE	202112-041	8.7	0.25	136347	03/20/08	03/25/08	03/26/08
SS-5B;1.5-2.0	SAMPLE	202112-042	7.8	0.25	136347	03/20/08	03/25/08	03/26/08
SS-6A;1.5-2.0	SAMPLE	202112-043	6.1	0.25	136347	03/20/08	03/25/08	03/26/08
SS-6B;1.5-2.0	SAMPLE	202112-044	7.6	0.25	136347	03/20/08	03/25/08	03/26/08
SS-7A;1.5-2.0	SAMPLE	202112-045	11	0.25	136347	03/20/08	03/25/08	03/26/08
SS-7B;1.5-2.0	SAMPLE	202112-046	6.8	0.25	136347	03/20/08	03/25/08	03/26/08
SS-8A;1.5-2.0	SAMPLE	202112-047	41	0.25	136347	03/20/08	03/25/08	03/26/08
SS-8B;1.5-2.0	SAMPLE	202112-048	52	0.25	136347	03/20/08	03/25/08	03/26/08
SS-9A;1.5-2.0	SAMPLE	202112-049	4.7	0.25	136347	03/20/08	03/25/08	03/26/08
SS-9B;1.5-2.0	SAMPLE	202112-050	6.5	0.25	136347	03/20/08	03/25/08	03/26/08
SS-10A;1.5-2.0	SAMPLE	202112-051	4.2	0.25	136347	03/20/08	03/25/08	03/26/08
SS-10B;1.5-2.0	SAMPLE	202112-052	8.3	0.25	136347	03/20/08	03/25/08	03/26/08
SS-11A;1.5-2.0	SAMPLE	202112-053	21	0.25	136347	03/21/08	03/25/08	03/26/08
SS-11B;1.5-2.0	SAMPLE	202112-054	5.4	0.25	136347	03/21/08	03/25/08	03/26/08
SS-12A;1.5-2.0	SAMPLE	202112-055	8.0	0.25	136347	03/21/08	03/25/08	03/26/08
SS-12B;1.5-2.0	SAMPLE	202112-056	7.4	0.25	136347	03/21/08	03/25/08	03/26/08
SS-13A;1.5-2.0	SAMPLE	202112-057	6.9	0.25	136349	03/21/08	03/25/08	03/26/08
SS-13B;1.5-2.0	SAMPLE	202112-058	2.8	0.25	136349	03/21/08	03/25/08	03/26/08
SS-14A;1.5-2.0	SAMPLE	202112-059	4.0	0.25	136349	03/21/08	03/25/08	03/26/08
SS-14B;1.5-2.0	SAMPLE	202112-060	5.5	0.25	136349	03/21/08	03/25/08	03/26/08
SS-15A;1.5-2.0	SAMPLE	202112-061	4.2	0.25	136349	03/21/08	03/25/08	03/26/08
SS-15B;1.5-2.0	SAMPLE	202112-062	5.9	0.25	136349	03/21/08	03/25/08	03/26/08
SS-16A;1.5-2.0	SAMPLE	202112-063	5.6	0.25	136349	03/20/08	03/25/08	03/26/08
SS-16B;1.5-2.0	SAMPLE	202112-064	2.8	0.25	136349	03/20/08	03/25/08	03/26/08
	BLANK	QC434302	ND	0.25	136327		03/24/08	03/24/08
	BLANK	QC434307	ND	0.25	136328		03/24/08	03/24/08
	BLANK	QC434406	ND	0.25	136347		03/25/08	03/26/08
	BLANK	QC434414	ND	0.25	136349		03/25/08	03/26/08

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Lead

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3050B
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Lead	Basis:	as received
Matrix:	Soil	Diln Fac:	1.000
Units:	mg/Kg	Received:	03/21/08

Field ID	Type	MSS Lab ID	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim	Batch#	Sampled	Prepared	Analyzed
	BS		QC434303		100.0	90.93	91	80-120			136327		03/24/08	03/24/08
	BSD		QC434304		100.0	90.75	91	80-120	0	20	136327		03/24/08	03/24/08
SS-1A;0-0.5	MS	202112-001	QC434305	4.816	97.09	83.94	81	53-124			136327	03/20/08	03/24/08	03/24/08
SS-1A;0-0.5	MSD	202112-001	QC434306		98.04	82.97	80	53-124	2	28	136327	03/20/08	03/24/08	03/24/08
	BS		QC434308		100.0	105.9	106	80-120			136328		03/24/08	03/24/08
	BSD		QC434309		100.0	108.1	108	80-120	2	20	136328		03/24/08	03/24/08
SS-10B;0-0.5	MS	202112-020	QC434310	14.77	90.91	99.85	94	53-124			136328	03/20/08	03/24/08	03/24/08
SS-10B;0-0.5	MSD	202112-020	QC434311		93.46	101.9	93	53-124	0	28	136328	03/20/08	03/24/08	03/24/08
	BS		QC434407		9.091	8.682	95	80-120			136347		03/25/08	03/26/08
	BSD		QC434408		9.091	8.046	89	80-120	8	20	136347		03/25/08	03/26/08
SS-3B;1.5-2.0	MS	202112-038	QC434409	5.767	99.01	86.52	82	53-124			136347	03/21/08	03/25/08	03/26/08
SS-3B;1.5-2.0	MSD	202112-038	QC434410		99.01	87.81	83	53-124	1	28	136347	03/21/08	03/25/08	03/26/08
	BS		QC434415		100.0	88.53	89	80-120			136349		03/25/08	03/26/08
	BSD		QC434416		100.0	83.86	84	80-120	5	20	136349		03/25/08	03/26/08
SS-13A;1.5-2.0	MS	202112-057	QC434417	6.941	95.24	77.14	74	53-124			136349	03/21/08	03/25/08	03/26/08
SS-13A;1.5-2.0	MSD	202112-057	QC434418		97.09	75.31	70	53-124	4	28	136349	03/21/08	03/25/08	03/26/08

RPD= Relative Percent Difference

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000832

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Lead

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	WET
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Lead	Diln Fac:	10.00
Matrix:	WET Leachate	Received:	03/21/08
Units:	ug/L		

Field ID	Type	Lab ID	Result	RL	Batch#	Sampled	Prepared	Analyzed
SS-1A;0-0.5	SAMPLE	202112-001	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-1B;0-0.5	SAMPLE	202112-002	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-2A;0-0.5	SAMPLE	202112-003	ND	150	136417	03/21/08	03/26/08	03/26/08
SS-2B;0-0.5	SAMPLE	202112-004	ND	150	136417	03/21/08	03/26/08	03/26/08
SS-3A;0-0.5	SAMPLE	202112-005	ND	150	136417	03/21/08	03/26/08	03/26/08
SS-3B;0-0.5	SAMPLE	202112-006	ND	150	136417	03/21/08	03/26/08	03/26/08
SS-4A;0-0.5	SAMPLE	202112-007	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-4B;0-0.5	SAMPLE	202112-008	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-5A;0-0.5	SAMPLE	202112-009	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-5B;0-0.5	SAMPLE	202112-010	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-6A;0-0.5	SAMPLE	202112-011	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-6B;0-0.5	SAMPLE	202112-012	ND	150	136417	03/20/08	03/26/08	03/26/08
SS-7A;0-0.5	SAMPLE	202112-013	ND	150	136417	03/20/08	03/26/08	03/27/08
SS-7B;0-0.5	SAMPLE	202112-014	ND	150	136417	03/20/08	03/26/08	03/27/08
SS-8A;0-0.5	SAMPLE	202112-015	220	150	136417	03/20/08	03/26/08	03/27/08
SS-8B;0-0.5	SAMPLE	202112-016	ND	150	136417	03/20/08	03/26/08	03/27/08
SS-9A;0-0.5	SAMPLE	202112-017	ND	150	136417	03/20/08	03/26/08	03/27/08
SS-9B;0-0.5	SAMPLE	202112-018	320	150	136417	03/20/08	03/26/08	03/27/08
SS-10A;0-0.5	SAMPLE	202112-019	ND	150	136417	03/20/08	03/26/08	03/27/08
SS-10B;0-0.5	SAMPLE	202112-020	530	150	136417	03/20/08	03/26/08	03/26/08
SS-11A;0-0.5	SAMPLE	202112-021	220	150	136442	03/21/08	03/26/08	03/27/08
SS-11B;0-0.5	SAMPLE	202112-022	1,500	150	136442	03/21/08	03/26/08	03/27/08
SS-12A;0-0.5	SAMPLE	202112-023	1,000	150	136442	03/21/08	03/26/08	03/27/08
SS-12B;0-0.5	SAMPLE	202112-024	460	150	136442	03/21/08	03/26/08	03/27/08
SS-13A;0-0.5	SAMPLE	202112-025	ND	150	136442	03/21/08	03/26/08	03/27/08
SS-13B;0-0.5	SAMPLE	202112-026	ND	150	136442	03/21/08	03/26/08	03/27/08
SS-14A;0-0.5	SAMPLE	202112-027	380	150	136442	03/20/08	03/26/08	03/27/08
SS-14B;0-0.5	SAMPLE	202112-028	ND	150	136442	03/20/08	03/26/08	03/27/08
SS-15A;0-0.5	SAMPLE	202112-029	ND	150	136442	03/21/08	03/26/08	03/27/08
SS-15B;0-0.5	SAMPLE	202112-030	ND	150	136442	03/21/08	03/26/08	03/27/08
SS-16A;0-0.5	SAMPLE	202112-031	ND	150	136442	03/20/08	03/26/08	03/27/08
SS-16B;0-0.5	SAMPLE	202112-032	ND	150	136442	03/20/08	03/26/08	03/27/08
SS-1A;1.5-2.0	SAMPLE	202112-033	ND	150	136442	03/20/08	03/26/08	03/27/08
SS-1B;1.5-2.0	SAMPLE	202112-034	270	150	136442	03/20/08	03/26/08	03/27/08
SS-2A;1.5-2.0	SAMPLE	202112-035	220	150	136442	03/21/08	03/26/08	03/27/08
SS-2B;1.5-2.0	SAMPLE	202112-036	ND	150	136442	03/21/08	03/26/08	03/27/08
SS-3A;1.5-2.0	SAMPLE	202112-037	ND	150	136442	03/21/08	03/26/08	03/27/08
SS-3B;1.5-2.0	SAMPLE	202112-038	ND	150	136442	03/21/08	03/26/08	03/27/08
SS-4A;1.5-2.0	SAMPLE	202112-039	ND	150	136442	03/20/08	03/26/08	03/27/08

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Lead

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	WET
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Lead	Diln Fac:	10.00
Matrix:	WET Leachate	Received:	03/21/08
Units:	ug/L		

Field ID	Type	Lab ID	Result	RL	Batch#	Sampled	Prepared	Analyzed
SS-4B;1.5-2.0	SAMPLE	202112-040	ND	150	136442	03/20/08	03/26/08	03/27/08
SS-5A;1.5-2.0	SAMPLE	202112-041	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-5B;1.5-2.0	SAMPLE	202112-042	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-6A;1.5-2.0	SAMPLE	202112-043	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-6B;1.5-2.0	SAMPLE	202112-044	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-7A;1.5-2.0	SAMPLE	202112-045	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-7B;1.5-2.0	SAMPLE	202112-046	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-8A;1.5-2.0	SAMPLE	202112-047	1,100	150	136490	03/20/08	03/27/08	03/27/08
SS-8B;1.5-2.0	SAMPLE	202112-048	1,100	150	136490	03/20/08	03/27/08	03/27/08
SS-9A;1.5-2.0	SAMPLE	202112-049	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-9B;1.5-2.0	SAMPLE	202112-050	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-10A;1.5-2.0	SAMPLE	202112-051	ND	150	136490	03/20/08	03/27/08	03/27/08
SS-10B;1.5-2.0	SAMPLE	202112-052	200	150	136490	03/20/08	03/27/08	03/27/08
SS-11A;1.5-2.0	SAMPLE	202112-053	240	150	136490	03/21/08	03/27/08	03/27/08
SS-11B;1.5-2.0	SAMPLE	202112-054	ND	150	136490	03/21/08	03/27/08	03/27/08
SS-12A;1.5-2.0	SAMPLE	202112-055	ND	150	136490	03/21/08	03/27/08	03/27/08
SS-12B;1.5-2.0	SAMPLE	202112-056	ND	150	136490	03/21/08	03/27/08	03/27/08
SS-13A;1.5-2.0	SAMPLE	202112-057	190	150	136490	03/21/08	03/27/08	03/27/08
SS-13B;1.5-2.0	SAMPLE	202112-058	ND	150	136490	03/21/08	03/27/08	03/27/08
SS-14A;1.5-2.0	SAMPLE	202112-059	ND	150	136490	03/21/08	03/27/08	03/27/08
SS-14B;1.5-2.0	SAMPLE	202112-060	ND	150	136490	03/21/08	03/27/08	03/27/08
SS-15A;1.5-2.0	SAMPLE	202112-061	ND	170	136473	03/21/08	03/27/08	03/27/08
SS-15B;1.5-2.0	SAMPLE	202112-062	ND	170	136473	03/21/08	03/27/08	03/27/08
SS-16A;1.5-2.0	SAMPLE	202112-063	ND	170	136473	03/20/08	03/27/08	03/27/08
SS-16B;1.5-2.0	SAMPLE	202112-064	ND	170	136473	03/20/08	03/27/08	03/27/08
	BLANK	QC434697	ND	150	136417		03/26/08	03/26/08
	BLANK	QC434792	ND	150	136442		03/26/08	03/27/08
	BLANK	QC434924	ND	170	136473		03/27/08	03/27/08
	BLANK	QC435011	ND	150	136490		03/27/08	03/27/08

ND= Not Detected
RL= Reporting Limit

12.0

000034

Batch QC Report

Lead

Lab #:	202112	Location:	SR-84 Expressway Widen
Client:	Baseline Environmental	Prep:	WET
Project#:	Y5302-01	Analysis:	EPA 6010B
Analyte:	Lead	Units:	ug/L
Matrix:	WET Leachate		

Field ID	Type	MSS Lab ID	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim	Diln Fac	Batch#	Sampled	Received	Prepared	Analyzed
	BS		QC434698		2,000	1,865	93	80-120			1.000	136417			03/26/08	03/26/08
	BSD		QC434699		2,000	1,757	88	80-120	6	20	1.000	136417			03/26/08	03/26/08
SS-10B;0-0.5	MS	202112-020	QC434700	529.1	10,000	10,370	98	77-120			10.00	136417	03/20/08	03/21/08	03/26/08	03/26/08
SS-10B;0-0.5	MSD	202112-020	QC434701		10,000	10,030	95	77-120	3	20	10.00	136417	03/20/08	03/21/08	03/26/08	03/26/08
	BS		QC434793		2,000	1,964	98	80-120			1.000	136442			03/26/08	03/27/08
	BSD		QC434794		2,000	1,988	99	80-120	1	20	1.000	136442			03/26/08	03/27/08
SS-11A;0-0.5	MS	202112-021	QC434795	216.6	10,000	9,952	97	77-120			10.00	136442	03/21/08	03/21/08	03/26/08	03/27/08
SS-11A;0-0.5	MSD	202112-021	QC434796		10,000	9,608	94	77-120	4	20	10.00	136442	03/21/08	03/21/08	03/26/08	03/27/08
	BS		QC434925		2,000	2,009	100	80-120			1.000	136473			03/27/08	03/27/08
	BSD		QC434926		2,000	1,997	100	80-120	1	20	1.000	136473			03/27/08	03/27/08
ZZZZZZZZZZ	MS	202153-001	QC434927	61.37	10,000	10,090	100	77-120			10.00	136473	03/19/08	03/20/08	03/27/08	03/27/08
ZZZZZZZZZZ	MSD	202153-001	QC434928		10,000	10,220	102	77-120	1	20	10.00	136473	03/19/08	03/20/08	03/27/08	03/27/08
	BS		QC435012		2,000	1,807	90	80-120			1.000	136490			03/27/08	03/27/08
	BSD		QC435013		2,000	1,723	86	80-120	5	20	1.000	136490			03/27/08	03/27/08
SS-5A;1.5-2.0	MS	202112-041	QC435014	134.7	10,000	9,482	93	77-120			10.00	136490	03/20/08	03/21/08	03/27/08	03/27/08
SS-5A;1.5-2.0	MSD	202112-041	QC435015		10,000	9,224	91	77-120	3	20	10.00	136490	03/20/08	03/21/08	03/27/08	03/27/08

RPD= Relative Percent Difference

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pH

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 9045C
Analyte:	pH	Batch#:	136298
Matrix:	Soil	Received:	03/21/08
Units:	SU	Prepared:	03/24/08 10:35
Diln Fac:	1.000	Analyzed:	03/24/08 11:35

Field ID	Lab ID	Result	RL	Sampled
SS-2A;0-0.5	202112-003	7.1	1.0	03/21/08 09:13
SS-11A;0-0.5	202112-021	8.6	1.0	03/21/08 07:36
SS-12A;0-0.5	202112-023	7.5	1.0	03/21/08 08:34
SS-13A;0-0.5	202112-025	8.3	1.0	03/21/08 08:11
SS-15A;0-0.5	202112-029	7.5	1.0	03/21/08 10:33

RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

pH

Lab #:	202112	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 9045C
Analyte:	pH	Diln Fac:	1.000
Field ID:	SS-15A;0-0.5	Batch#:	136298
Type:	SDUP	Sampled:	03/21/08 10:33
MSS Lab ID:	202112-029	Received:	03/21/08
Lab ID:	QC434184	Prepared:	03/24/08 10:35
Matrix:	Soil	Analyzed:	03/24/08 11:35
Units:	SU		

MSS Result	Result	RL	RPD	Lim
7.540	7.460	1.000	1	20

RL= Reporting Limit
RPD= Relative Percent Difference

QUALITY CONTROL CHECKLIST
FOR REVIEW OF LABORATORY REPORT

Job No.	Y5302-01	**Site:**	SR 84 Expressway Widening Project
Laboratory:	Curtis and Tompkins, Ltd.	**Laboratory Report No.:**	202147
Report Date:	2 April 2008	**BASELINE Reviewer:**	RR

	Yes	No	NA
GENERAL QUESTIONS **(Describe "no" responses below in "comments" section. Contact the laboratory, as required, for further explanation or action on "no" responses; document discussion in comments section.)**			
1a. Does the report include a case narrative? *(A case narrative MUST be prepared by the lab for all analytical work requested by BASELINE)*	X		
1b. Is the number of pages for the lab report as indicated on the case narrative/lab transmittal consistent with the number of pages that are included in report?		X	
1c. Does the case narrative indicate which samples were analyzed by a subcontractor and the subcontractor's name?			X
1d. Does the case narrative summarize subsequent requests not shown on the chain-of-custody (e.g., additional analyses requested, release of "hold" samples)?			X
1e. Does the case narrative explain why requested analyses could not be performed by laboratory (e.g., insufficient sample)?			X
1f. Does the case narrative explain all problems with the QA/QC data as identified in the checklist (as applicable)?	X		
2a. Is the laboratory report format consistent and legible throughout the report?	X		
2b. Are the sample and reported dates shown in the laboratory report correct?	X		
3a. Does the lab report include the original chain-of-custody form?	X		
3b. Were all samples appropriately analyzed as requested on the chain-of-custody form?	X		
4. Was the lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel? (Some lab reports have signature spaces for each page). (This requirement also applies to any analyses subcontracted out by the laboratory)	X		
5a. Are preparation methods, cleanup methods (if applicable), and laboratory methods indicated for all analyses?	X		
5b. If additional analytes were requested as part of the reporting of the data for an analytical method, were these included in the lab report?			X
6. Are the units in the lab report provided for each analysis consistent throughout the report?	X		

Quality Control Checklist *- continued*

	Yes	No	NA
7. Are the detection limits (DL) appropriate based on the intended use of the data (e.g., DL below applicable MCLs for water quality issues)?	X		
8a. Are detection limits appropriate based on the analysis performed (i.e., not elevated due to dilution effects)?	X		
8b. If no, is an explanation provided by the laboratory?			X
9a. Were the samples analyzed within the appropriate holding time (generally 2 weeks for volatiles, and up to 6 months for total metals)?	X		
9b. If no, was it flagged in the report?			X
10. If samples were composited prior to analysis, does the lab report indicate which samples were composited for each analysis?			X
11a. Do the chromatograms confirm quantitative laboratory results (petroleum hydrocarbons)?			X
11b. Is a standard chromatogram(s) included in the laboratory report?			X
11c. Do the chromatograms confirm laboratory notes, if present (e.g., sample exhibits lighter hydrocarbon than standard)?			X
12. Are the results consistent with previous analytical results from the site? *(If no, contact the lab and request review/reanalysis of data, as appropriate.)*			X
13a. REVISED LAB REPORTS ONLY. Is the revised lab report or revised pages to a lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel?			X
13b. REVISED LAB REPORTS ONLY. Does the case narrative indicate the date of revision and provide an explanation for the revision?			X
13c. REVISED LAB REPORTS ONLY. Does the revised lab report adequately address the problem(s) that triggered the need for a revision?			X
13d. REVISED LAB REPORTS ONLY. Are the data included in the revised report the same as the data reported in the original report, except where the report was revised to correct incorrectly reported data?			X
QA/QC Questions Field/Laboratory Quality Control - Groundwater Analyses			
14. Are field blanks reported as "ND" (groundwater samples)? *A field blank is a sample of DI water that is prepared in the field using the same collection and handling procedures as the other samples collected, and used to demonstrate that the sampling procedure has not contaminated the sample.*			X
14a. Are rinsate blanks reported as "ND" (soil samples)? *A rinsate blank is a sample of DI water that is prepared in the field by collecting DI rinse water after it has been poured over decontaminated sampling equipment. The rinsate blank is collected to demonstrate that the decontamination procedure has removed all the contaminants from the sampling equipment and that the sampling equipment has not contaminated the sample.*			X

Quality Control Checklist *- continued*

	Yes	No	NA
15. Are trip blanks reported as "ND" (groundwater samples/volatile analyses)? *A trip blank is a sample of contaminant free matrix placed in an appropriate container by the lab and transported with the field samples collected. Provides information regarding positive interference introduced during sample transport, storage, preservation, and analysis. The sample is NOT opened in the field.*			X
16. Are duplicate sample results consistent with the original sample (groundwater samples)? *Field duplicates consist of two independent samples collected at the same sampling location during a single sampling event. Used to evaluate precision of the analytical data and sampling technique. (Differences between the duplicate and sample results may also be attributed to environmental variability.)*			X
Batch Quality Control (Samples are batched together by matrix [soil, water] and analyses requested. A batch generally consists of 20 or fewer samples of the same matrix type, and is prepared using the same reagents, standards, procedures, and time frame as the samples. QC samples are run with each batch to assess performance of the entire measurement process.)			
17. Do the sample batch numbers and corresponding laboratory QA/QC batch numbers match?	X		
18a. Are method blanks (MB) for the analytical method(s) below the laboratory reporting limits? *Used to assess lab contamination and prevent false positive results.*	X		
18b. If no, is an explanation provided in the case narrative to validate the data?			X
18c. Are analytes that may be considered laboratory contaminants reported below the laboratory reporting limit? *Common lab contaminants include acetone, methylene chloride, diethylhexyl phthalate, and di-n-octyl phthalate.*			X
18d. If no, was the laboratory contacted to determine whether the reported analyte could be a potential laboratory contaminant and was an explanation included in the case narrative?			X
19. Are laboratory control samples (LCS) and LCS duplicate (LCSD) [a.k.a., Blank Spike (BS) and BS duplicates (BSD)] within laboratory reporting limits? Limits should be provided on the report. *LCS is a reagent blank spike with a representative selection of target analyte(s) and prepared in the same manner as the samples analyzed. The LCS should be spiked with the same analytes as the matrix spike (below). The LCS is free from interferences from the sample matrix and demonstrates the ability of the lab instruments to recover the target analytes. Accuracy (recovery information) is generally reported as % spike recovery; precision (reproducibility of results) between the LCS and LCSD is generally reported as the relative percent difference (RPD). LCS/LCSD can be run in addition to or in lieu of matrix QC data.*	X		
20a. Are the Matrix QC data (i.e., MS/MSD) within laboratory limits? Limits should be provided on the lab report. *The lab selects a sample from the batch and analyzes a spike and a spike duplicate of that sample. Matrix QC data is used to obtain precision and accuracy information and is reported in the same manner as LCS/LCSD. If the MS/MSD fails, the results may still be considered valid if the MB and either the LCS/LCSD or BS/BSD is within the lab's limits (failure is probably due to matrix interference).*		X	

Quality Control Checklist - *continued*

	Yes	No	NA
20b. If no, is the MB and either LCS/LCSD or BS/BSD within lab limits to validate the data?	X		
Sample Quality Control			
21a. Are the surrogate spikes reported within the lab's acceptable recovery limits? *A surrogate is a non-target analyte, which is similar in chemical structure to the analyte(s) being analyzed for, and which is not commonly found in environmental samples. A known concentration of the surrogate is spiked into the sample or QA "sample" prior to extraction or sample preparation. Results are usually reported as % recovery of the spike. Failure to meet lab's limits for primary and secondary surrogates results in rebatching and reanalysis of the sample; failure of only the primary or the secondary surrogate may be acceptable under certain circumstances. Failure generally is due to coelution with the sample matrix.*	X		
21b. If no, is an explanation given in the case narrative to validate the data?			X

Comments:

The number of pages for the laboratory report was not indicated on the transmittal.

Low recoveries for antimony were observed in the Matrix spike and the Matrix spike duplicate of GW-2. The recoveries for antimony in the Blank spike and the Blank spike duplicate were within laboratory limits.

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 202147
ANALYTICAL REPORT

Baseline Environmental	Project : Y5302-01
5900 Hollis Street	Location : SR-84 Expressway Widening Project
Emeryville, CA 94608	Level : II

Sample ID	Lab ID
GW-2	202147-001
GW-5	202147-002
TRIP BLANK	202147-003

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signatures. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: _____ Date: 04/02/2008
Project Manager

Signature: _____ Date: 04/02/2008
Quality Assurance Director

NELAP # 01107CA

Curtis & Tompkins, Ltd.

CASE NARRATIVE

Laboratory number:	**202147**
Client:	**Baseline Environmental**
Project:	**Y5302-01**
Location:	**SR-84 Expressway Widening Project**
Request Date:	**03/24/08**
Samples Received:	**03/24/08**

This hardcopy data package contains sample and QC results for two water samples, requested for the above referenced project on 03/24/08. The samples were received on ice and intact, directly from the field.

Volatile Organics by GC/MS (EPA 624):
No analytical problems were encountered.

Metals (EPA 6010B and EPA 7470A):
Low recoveries were observed for antimony in the MS/MSD of GW-2 (lab # 202147-001); the BS/BSD were within limits, and the associated RPD was within limits. No other analytical problems were encountered.

Total Cyanide (SM4500CN-E):
No analytical problems were encountered.

pH (EPA 9040B):
No analytical problems were encountered.

18.0

000002

202147

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature)

Sample ID No. Station	Date	Time	Media	Containers: No.	Type: Stainless Steel	Type: Encore	Type: 500 ml Poly	Type: 40-ml VOA	Type: L-Poly	Type: 250 ml Poly	Type: Glass Jar	Preservative: Ice	Preservative: HCL	Preservative: HNO_3	Preservative: SO_4	Preservative: NaOH	pH (SM 4500H+B)	cyanide (SM 4500Cn-E)	TTO (EPA Method 624)	Title 22 metals (EPA Method 6010B/7470)	Remarks/ Composite
GW-1			W	1						x		X					x				
			W	1			x					X				x		x			
			W	3				x				X	x						x		
			W	1			x					X		x						x	
GW-2	3-24-08	13:40	W	1						x		X					x				
			W	1			x					X				x		x			
			W	3				x				X	x						x		
			W	1			x					X		x						x	
GW-3			W	1						x		X					x				
			W	1			x					X				x		x			
			W	3				x				X	x						x		
			W	1			x					X		x						x	
GW-4			W	1						x		X					x				
			W	1			x					X				x		x			
			W	3				x				X	x						x		
			W	1			x					X		x						x	
GW-5	3-24-08	12:30	W	1						x		X					x				
			W	1			x					X				x		x			
			W	3				x				X	x						x		
			W	1			x					X		x						x	

Relinquished by: (Signature)		Date/Time	Received by: (Signature)	Date/Time	
		3-24-08 15:00		3/24/08 1500	Arrival at Laboratory:
Relinquished by: (Signature)		Date/Time	Received by: (Signature)		Remarks:
					Email contact:
Relinquished by: (Signature)		Date/Time	Received by: (Signature)		redgy@baseline-env.com
					Please provide EDD

Received at laboratory with intact: YES NO
Comments: intact on ice Cold pk

COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login # 202147 Date Received 3/24/08 Number of coolers 1
Client BASELINE Project SR-84 EXPRESSWAY WIDENING PROJECT

Date Opened 3/24/08 By (print) M. VILLANUEVA (sign)
Date Logged in ↓ By (print) ↓ (sign) ↓

1. Did cooler come with a shipping slip (airbill, etc)?..... YES NO
   Shipping info _____

2A. Were custody seals present? .... ☐ YES (circle) on cooler on samples ☐ NO
   How many _____ Name _____ Date _____
2B. Were custody seals intact upon arrival? ..... YES NO N/A
3. Were custody papers dry and intact when received?..... YES NO
4. Were custody papers filled out properly (ink, signed, etc)?..... YES NO
5. Is the project identifiable from custody papers? (If so fill out top of form)..... YES NO
6. Indicate the packing in cooler: (if other, describe) _____

☐ Bubble Wrap ☑ Foam blocks ☐ Bags ☐ None

☐ Cloth material ☐ Cardboard ☐ Styrofoam ☐ Paper towels

7. If required, was sufficient ice used? Samples should be < or = 6°C .....YES NO N/A

Type of ice used: ☑ WET ☐ BLUE ☐ NONE Temp(°C) 6.5

☐ SAMPLES RECEIVED ON ICE DIRECTLY FROM FIELD. COOLING PROCESS HAD BEGUN.

8. Were soil Encore sampling devices present? ..... YES NO
   If YES, what time were they transferred to freezer? _____
9. Did all bottles arrive unbroken/unopened?..... YES NO
10. Are samples in the appropriate containers for indicated tests? ..... YES NO
11. Are sample labels present, in good condition and complete? ..... YES NO MV 3/24/08
12. Do the sample labels agree with custody papers? ..... YES NO
13. Was sufficient amount of sample sent for tests requested? ..... YES NO
14. Are the samples appropriately preserved? ..... YES NO N/A
15. Are bubbles absent in VOA samples?..... YES NO N/A
16. Was the client contacted concerning this sample delivery?..... YES NO
   If YES, Who was called? _____ By _____ Date: _____

COMMENTS MV 3/24/08 MV 3/24/08
2 RECD TRIP BLANK NOT ON COC LOGGED ON HOLD.
1/2 VOA TRIP BLANK W/ BUBBLE

000004

Curtis & Tompkins, Ltd.

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Field ID:	GW-2	Batch#:	136362
Lab ID:	202147-001	Sampled:	03/24/08
Matrix:	Water	Received:	03/24/08
Units:	ug/L	Analyzed:	03/25/08
Diln Fac:	1.000		

Analyte	Result	RL
Chloromethane	ND	1.0
Vinyl Chloride	ND	0.5
Bromomethane	ND	1.0
Chloroethane	ND	1.0
Trichlorofluoromethane	ND	1.0
1,1-Dichloroethene	ND	0.5
Methylene Chloride	ND	10
trans-1,2-Dichloroethene	ND	0.5
1,1-Dichloroethane	ND	0.5
Chloroform	ND	0.5
1,1,1-Trichloroethane	ND	0.5
Carbon Tetrachloride	ND	0.5
1,2-Dichloroethane	ND	0.5
Benzene	ND	0.5
Trichloroethene	ND	0.5
1,2-Dichloropropane	ND	0.5
Bromodichloromethane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Toluene	ND	0.5
trans-1,3-Dichloropropene	ND	0.5
1,1,2-Trichloroethane	ND	0.5
Tetrachloroethene	ND	0.5
Dibromochloromethane	ND	0.5
Chlorobenzene	ND	0.5
Ethylbenzene	ND	0.5
Bromoform	ND	1.0
1,1,2,2-Tetrachloroethane	ND	0.5
1,3-Dichlorobenzene	ND	0.5
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.5

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	109	76-138
Toluene-d8	100	80-120
Bromofluorobenzene	101	80-120

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Field ID:	GW-5	Batch#:	136362
Lab ID:	202147-002	Sampled:	03/24/08
Matrix:	Water	Received:	03/24/08
Units:	ug/L	Analyzed:	03/25/08
Diln Fac:	1.000		

Analyte	Result	RL
Chloromethane	ND	1.0
Vinyl Chloride	ND	0.5
Bromomethane	ND	1.0
Chloroethane	ND	1.0
Trichlorofluoromethane	ND	1.0
1,1-Dichloroethene	ND	0.5
Methylene Chloride	ND	10
trans-1,2-Dichloroethene	ND	0.5
1,1-Dichloroethane	ND	0.5
Chloroform	ND	0.5
1,1,1-Trichloroethane	ND	0.5
Carbon Tetrachloride	ND	0.5
1,2-Dichloroethane	ND	0.5
Benzene	ND	0.5
Trichloroethene	ND	0.5
1,2-Dichloropropane	ND	0.5
Bromodichloromethane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Toluene	ND	0.5
trans-1,3-Dichloropropene	ND	0.5
1,1,2-Trichloroethane	ND	0.5
Tetrachloroethene	ND	0.5
Dibromochloromethane	ND	0.5
Chlorobenzene	ND	0.5
Ethylbenzene	ND	0.5
Bromoform	ND	1.0
1,1,2,2-Tetrachloroethane	ND	0.5
1,3-Dichlorobenzene	ND	0.5
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.5

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	110	76-138
Toluene-d8	100	80-120
Bromofluorobenzene	95	80-120

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC434475	Batch#:	136362
Matrix:	Water	Analyzed:	03/25/08
Units:	ug/L		

Analyte	Result	RL
Chloromethane	ND	1.0
Vinyl Chloride	ND	0.5
Bromomethane	ND	1.0
Chloroethane	ND	1.0
Trichlorofluoromethane	ND	1.0
1,1-Dichloroethene	ND	0.5
Methylene Chloride	ND	10
trans-1,2-Dichloroethene	ND	0.5
1,1-Dichloroethane	ND	0.5
Chloroform	ND	0.5
1,1,1-Trichloroethane	ND	0.5
Carbon Tetrachloride	ND	0.5
1,2-Dichloroethane	ND	0.5
Benzene	ND	0.5
Trichloroethene	ND	0.5
1,2-Dichloropropane	ND	0.5
Bromodichloromethane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Toluene	ND	0.5
trans-1,3-Dichloropropene	ND	0.5
1,1,2-Trichloroethane	ND	0.5
Tetrachloroethene	ND	0.5
Dibromochloromethane	ND	0.5
Chlorobenzene	ND	0.5
Ethylbenzene	ND	0.5
Bromoform	ND	1.0
1,1,2,2-Tetrachloroethane	ND	0.5
1,3-Dichlorobenzene	ND	0.5
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.5

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	109	76-138
Toluene-d8	98	80-120
Bromofluorobenzene	101	80-120

ND= Not Detected
RL= Reporting Limit

4.0

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Matrix:	Water	Batch#:	136362
Units:	ug/L	Analyzed:	03/25/08
Diln Fac:	1.000		

Type: BS Lab ID: QC434476

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	12.50	14.96	120	77-132
Benzene	12.50	12.38	99	80-120
Trichloroethene	12.50	12.63	101	80-120
Toluene	12.50	13.39	107	80-121
Chlorobenzene	12.50	12.82	103	80-120

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	106	76-138
Toluene-d8	99	80-120
Bromofluorobenzene	98	80-120

Type: BSD Lab ID: QC434477

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	12.50	15.65	125	77-132	5	20
Benzene	12.50	12.69	102	80-120	2	20
Trichloroethene	12.50	13.38	107	80-120	6	20
Toluene	12.50	13.83	111	80-121	3	20
Chlorobenzene	12.50	13.44	108	80-120	5	20

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	105	76-138
Toluene-d8	98	80-120
Bromofluorobenzene	100	80-120

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

California Title 26 Metals

Lab #:	202147	Project#:	Y5302-01
Client:	Baseline Environmental	Location:	SR-84 Expressway Widening Project
Field ID:	GW-2	Diln Fac:	1.000
Lab ID:	202147-001	Sampled:	03/24/08
Matrix:	Water	Received:	03/24/08
Units:	ug/L	Prepared:	03/25/08

Analyte	Result	RL	Batch#	Analyzed	Prep	Analysis
Antimony	ND	10	136365	03/26/08	EPA 3010A	EPA 6010B
Arsenic	27	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Barium	820	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Beryllium	ND	2.0	136365	03/26/08	EPA 3010A	EPA 6010B
Cadmium	ND	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Chromium	260	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Cobalt	66	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Copper	120	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Lead	34	3.4	136365	03/26/08	EPA 3010A	EPA 6010B
Mercury	ND	0.20	136360	03/25/08	METHOD	EPA 7470A
Molybdenum	8.2	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Nickel	610	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Selenium	ND	10	136365	03/26/08	EPA 3010A	EPA 6010B
Silver	ND	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Thallium	ND	10	136365	03/26/08	EPA 3010A	EPA 6010B
Vanadium	120	5.0	136365	03/26/08	EPA 3010A	EPA 6010B
Zinc	220	20	136365	03/26/08	EPA 3010A	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

California Title 26 Metals

Lab #:	202147	Project#:	Y5302-01
Client:	Baseline Environmental	Location:	SR-84 Expressway Widening Project
Field ID:	GW-5	Sampled:	03/24/08
Lab ID:	202147-002	Received:	03/24/08
Matrix:	Water	Prepared:	03/25/08
Units:	ug/L		

Analyte	Result	RL	Diln Fac	Batch#	Analyzed	Prep	Analysis
Antimony	ND	10	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Arsenic	490	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Barium	14,000	50	10.00	136365	03/26/08	EPA 3010A	EPA 6010B
Beryllium	22	2.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Cadmium	6.1	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Chromium	5,700	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Cobalt	1,600	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Copper	2,700	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Lead	670	3.4	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Mercury	9.5	0.20	1.000	136360	03/25/08	METHOD	EPA 7470A
Molybdenum	130	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Nickel	20,000	50	10.00	136365	03/26/08	EPA 3010A	EPA 6010B
Selenium	81	10	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Silver	6.5	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Thallium	ND	10	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Vanadium	2,200	5.0	1.000	136365	03/26/08	EPA 3010A	EPA 6010B
Zinc	3,800	20	1.000	136365	03/26/08	EPA 3010A	EPA 6010B

ND= Not Detected
RL= Reporting Limit

7.0

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7470A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	136360
Lab ID:	QC434465	Prepared:	03/25/08
Matrix:	Water	Analyzed:	03/25/08
Units:	ug/L		

Result	RL
ND	0.20

ND= Not Detected
RL= Reporting Limit

8.0

00011

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3010A
Project#:	Y5302-01	Analysis:	EPA 6010B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC434486	Batch#:	136365
Matrix:	Water	Prepared:	03/25/08
Units:	ug/L	Analyzed:	03/26/08

Analyte	Result	RL
Antimony	ND	10
Arsenic	ND	5.0
Barium	ND	5.0
Beryllium	ND	2.0
Cadmium	ND	5.0
Chromium	ND	5.0
Cobalt	ND	5.0
Copper	ND	5.0
Lead	ND	3.4
Molybdenum	ND	5.0
Nickel	ND	5.0
Selenium	ND	10
Silver	ND	5.0
Thallium	ND	10
Vanadium	ND	5.0
Zinc	ND	20

ND= Not Detected
RL= Reporting Limit

000012

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	136360
Matrix:	Water	Prepared:	03/25/08
Units:	ug/L	Analyzed:	03/25/08
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC434466	5.000	5.090	102	80-120		
BSD	QC434467	5.000	5.040	101	80-120	1	20

RPD= Relative Percent Difference

16.0

000013

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	136360
Field ID:	ZZZZZZZZZZ	Sampled:	03/20/08
MSS Lab ID:	202091-001	Received:	03/20/08
Matrix:	Water	Prepared:	03/25/08
Units:	ug/L	Analyzed:	03/25/08
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC434469	<0.04502	5.000	5.000	100	77-126		
MSD	QC434470		5.000	4.850	97	77-126	3	20

RPD= Relative Percent Difference

11.0

000014

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3010A
Project#:	Y5302-01	Analysis:	EPA 6010B
Matrix:	Water	Batch#:	136365
Units:	ug/L	Prepared:	03/25/08
Diln Fac:	1.000	Analyzed:	03/26/08

Type: BS Lab ID: QC434487

Analyte	Spiked	Result	%REC	Limits
Antimony	500.0	523.2	105	80-120
Arsenic	100.0	106.0	106	80-120
Barium	2,000	2,000	100	80-120
Beryllium	50.00	52.95	106	80-120
Cadmium	50.00	53.43	107	80-120
Chromium	200.0	194.9	97	80-120
Cobalt	500.0	484.6	97	80-120
Copper	250.0	241.3	97	80-120
Lead	100.0	100.4	100	80-120
Molybdenum	400.0	413.1	103	80-120
Nickel	500.0	497.3	99	80-120
Selenium	100.0	105.2	105	80-120
Silver	50.00	48.08	96	80-120
Thallium	100.0	101.0	101	80-120
Vanadium	500.0	493.7	99	80-120
Zinc	500.0	521.0	104	80-120

Type: BSD Lab ID: QC434488

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	500.0	519.1	104	80-120	1	20
Arsenic	100.0	105.3	105	80-120	1	20
Barium	2,000	1,997	100	80-120	0	20
Beryllium	50.00	52.81	106	80-120	0	20
Cadmium	50.00	53.15	106	80-120	1	20
Chromium	200.0	194.2	97	80-120	0	20
Cobalt	500.0	483.5	97	80-120	0	20
Copper	250.0	240.1	96	80-120	0	20
Lead	100.0	99.45	99	80-120	1	20
Molybdenum	400.0	410.1	103	80-120	1	20
Nickel	500.0	493.4	99	80-120	1	20
Selenium	100.0	102.9	103	80-120	2	20
Silver	50.00	48.14	96	80-120	0	20
Thallium	100.0	102.2	102	80-120	1	20
Vanadium	500.0	493.0	99	80-120	0	20
Zinc	500.0	521.2	104	80-120	0	20

RPD= Relative Percent Difference

12.0

000015

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3010A
Project#:	Y5302-01	Analysis:	EPA 6010B
Field ID:	GW-2	Batch#:	136365
MSS Lab ID:	202147-001	Sampled:	03/24/08
Matrix:	Water	Received:	03/24/08
Units:	ug/L	Prepared:	03/25/08
Diln Fac:	1.000	Analyzed:	03/26/08

Type: MS Lab ID: QC434489

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	<0.9637	500.0	269.2	54 *	78-120
Arsenic	26.99	100.0	136.0	109	80-126
Barium	816.6	2,000	2,771	98	80-120
Beryllium	1.533	50.00	53.75	104	80-120
Cadmium	0.3711	50.00	52.16	104	80-120
Chromium	256.6	200.0	493.2	118	80-120
Cobalt	65.69	500.0	543.6	96	80-120
Copper	119.1	250.0	380.8	105	80-120
Lead	34.17	100.0	132.3	98	77-120
Molybdenum	8.248	400.0	400.6	98	80-120
Nickel	609.9	500.0	1,185	115	79-120
Selenium	<1.986	100.0	96.83	97	80-125
Silver	1.127	50.00	48.57	95	72-120
Thallium	<1.131	100.0	94.86	95	77-120
Vanadium	123.3	500.0	630.4	101	80-120
Zinc	215.4	500.0	745.4	106	78-122

Type: MSD Lab ID: QC434490

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	500.0	285.3	57 *	78-120	6	20
Arsenic	100.0	132.0	105	80-126	3	20
Barium	2,000	2,810	100	80-120	1	20
Beryllium	50.00	53.68	104	80-120	0	20
Cadmium	50.00	52.77	105	80-120	1	20
Chromium	200.0	481.1	112	80-120	2	20
Cobalt	500.0	549.4	97	80-120	1	20
Copper	250.0	373.3	102	80-120	2	20
Lead	100.0	132.0	98	77-120	0	20
Molybdenum	400.0	412.8	101	80-120	3	20
Nickel	500.0	1,149	108	79-120	3	20
Selenium	100.0	118.3	118	80-125	20	20
Silver	50.00	48.93	96	72-120	1	20
Thallium	100.0	97.39	97	77-120	3	20
Vanadium	500.0	628.5	101	80-120	0	20
Zinc	500.0	726.9	102	78-122	3	20

*= Value outside of QC limits; see narrative
RPD= Relative Percent Difference

13.0

060616

Curtis & Tompkins, Ltd.

pH

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 9040B
Analyte:	pH	Batch#:	136330
Matrix:	Water	Received:	03/24/08
Units:	SU	Analyzed:	03/24/08 17:10
Diln Fac:	1.000		

Field ID	Lab ID	Result	RL	Sampled
GW-2	202147-001	7.4	1.0	03/24/08 13:40
GW-5	202147-002	7.4	1.0	03/24/08 12:30

RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

pH

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 9040B
Analyte:	pH	Units:	SU
Field ID:	GW-5	Diln Fac:	1.000
Type:	SDUP	Batch#:	136330
MSS Lab ID:	202147-002	Sampled:	03/24/08 12:30
Lab ID:	QC434318	Received:	03/24/08
Matrix:	Water	Analyzed:	03/24/08 17:10

MSS Result	Result	RL	RPD	Lim
7.350	7.380	1.000	0	20

RL= Reporting Limit
RPD= Relative Percent Difference

000018

Curtis & Tompkins, Ltd.

Total Cyanide

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	SM4500CN-E
Analyte:	Cyanide	Sampled:	03/24/08
Matrix:	Water	Received:	03/24/08
Units:	mg/L	Prepared:	03/27/08
Diln Fac:	1.000	Analyzed:	03/31/08
Batch#:	136462		

Field ID	Type	Lab ID	Result	RL
GW-2	SAMPLE	202147-001	ND	0.01
GW-5	SAMPLE	202147-002	ND	0.01
	BLANK	QC434873	ND	0.01

ND= Not Detected
RL= Reporting Limit

16.0

000019

Curtis & Tompkins, Ltd.

Batch QC Report

Total Cyanide

Lab #:	202147	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	SM4500CN-E
Analyte:	Cyanide	Batch#:	136462
Field ID:	GW-5	Sampled:	03/24/08
MSS Lab ID:	202147-002	Received:	03/24/08
Matrix:	Water	Prepared:	03/27/08
Units:	mg/L	Analyzed:	03/31/08
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
LCS	QC434874		0.2000	0.2191	110	78-120		
MS	QC434875	<0.01000	0.2000	0.2222	111	61-120		
MSD	QC434876		0.2000	0.2098	105	61-120	6	20

RPD= Relative Percent Difference

QUALITY CONTROL CHECKLIST
FOR REVIEW OF LABORATORY REPORT

Job No. Y5302-01 **Site:** SR 84 Expressway Widening Project

Laboratory: Curtis and Tompkins, Ltd. **Laboratory Report No.:** 202180

Report Date: 2 April 2008 **BASELINE Reviewer:** RR

	Yes	No	NA
GENERAL QUESTIONS **(Describe "no" responses below in "comments" section. Contact the laboratory, as required, for further explanation or action on "no" responses; document discussion in comments section.)**			
1a. Does the report include a case narrative? *(A case narrative MUST be prepared by the lab for all analytical work requested by BASELINE)*	X		
1b. Is the number of pages for the lab report as indicated on the case narrative/lab transmittal consistent with the number of pages that are included in report?		X	
1c. Does the case narrative indicate which samples were analyzed by a subcontractor and the subcontractor's name?			X
1d. Does the case narrative summarize subsequent requests not shown on the chain-of-custody (e.g., additional analyses requested, release of "hold" samples)?			X
1e. Does the case narrative explain why requested analyses could not be performed by laboratory (e.g., insufficient sample)?			X
1f. Does the case narrative explain all problems with the QA/QC data as identified in the checklist (as applicable)?			X
2a. Is the laboratory report format consistent and legible throughout the report?	X		
2b. Are the sample and reported dates shown in the laboratory report correct?	X		
3a. Does the lab report include the original chain-of-custody form?	X		
3b. Were all samples appropriately analyzed as requested on the chain-of-custody form?	X		
4. Was the lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel? (Some lab reports have signature spaces for each page). (This requirement also applies to any analyses subcontracted out by the laboratory)	X		
5a. Are preparation methods, cleanup methods (if applicable), and laboratory methods indicated for all analyses?	X		
5b. If additional analytes were requested as part of the reporting of the data for an analytical method, were these included in the lab report?			X
6. Are the units in the lab report provided for each analysis consistent throughout the report?	X		

Quality Control Checklist *- continued*

	Yes	No	NA
7. Are the detection limits (DL) appropriate based on the intended use of the data (e.g., DL below applicable MCLs for water quality issues)?	X		
8a. Are detection limits appropriate based on the analysis performed (i.e., not elevated due to dilution effects)?	X		
8b. If no, is an explanation provided by the laboratory?			X
9a. Were the samples analyzed within the appropriate holding time (generally 2 weeks for volatiles, and up to 6 months for total metals)?	X		
9b. If no, was it flagged in the report?			X
10. If samples were composited prior to analysis, does the lab report indicate which samples were composited for each analysis?			X
11a. Do the chromatograms confirm quantitative laboratory results (petroleum hydrocarbons)?			X
11b. Is a standard chromatogram(s) included in the laboratory report?			X
11c. Do the chromatograms confirm laboratory notes, if present (e.g., sample exhibits lighter hydrocarbon than standard)?			X
12. Are the results consistent with previous analytical results from the site? *(If no, contact the lab and request review/reanalysis of data, as appropriate.)*			X
13a. REVISED LAB REPORTS ONLY. Is the revised lab report or revised pages to a lab report signed and dated as being reviewed by the laboratory director, QA manager, or other appropriate personnel?			X
13b. REVISED LAB REPORTS ONLY. Does the case narrative indicate the date of revision and provide an explanation for the revision?			X
13c. REVISED LAB REPORTS ONLY. Does the revised lab report adequately address the problem(s) that triggered the need for a revision?			X
13d. REVISED LAB REPORTS ONLY. Are the data included in the revised report the same as the data reported in the original report, except where the report was revised to correct incorrectly reported data?			X
QA/QC Questions Field/Laboratory Quality Control - Groundwater Analyses			
14. Are field blanks reported as "ND" (groundwater samples)? *A field blank is a sample of DI water that is prepared in the field using the same collection and handling procedures as the other samples collected, and used to demonstrate that the sampling procedure has not contaminated the sample.*			X
14a. Are rinsate blanks reported as "ND" (soil samples)? *A rinsate blank is a sample of DI water that is prepared in the field by collecting DI rinse water after it has been poured over decontaminated sampling equipment. The rinsate blank is collected to demonstrate that the decontamination procedure has removed all the contaminants from the sampling equipment and that the sampling equipment has not contaminated the sample.*			X

Quality Control Checklist *- continued*

	Yes	No	NA
15. Are trip blanks reported as "ND" (groundwater samples/volatile analyses)? *A trip blank is a sample of contaminant free matrix placed in an appropriate container by the lab and transported with the field samples collected. Provides information regarding positive interference introduced during sample transport, storage, preservation, and analysis. The sample is NOT opened in the field.*			X
16. Are duplicate sample results consistent with the original sample (groundwater samples)? *Field duplicates consist of two independent samples collected at the same sampling location during a single sampling event. Used to evaluate precision of the analytical data and sampling technique. (Differences between the duplicate and sample results may also be attributed to environmental variability.)*			X
Batch Quality Control (Samples are batched together by matrix [soil, water] and analyses requested. A batch generally consists of 20 or fewer samples of the same matrix type, and is prepared using the same reagents, standards, procedures, and time frame as the samples. QC samples are run with each batch to assess performance of the entire measurement process.)			
17. Do the sample batch numbers and corresponding laboratory QA/QC batch numbers match?	X		
18a. Are method blanks (MB) for the analytical method(s) below the laboratory reporting limits? *Used to assess lab contamination and prevent false positive results.*	X		
18b. If no, is an explanation provided in the case narrative to validate the data?			X
18c. Are analytes that may be considered laboratory contaminants reported below the laboratory reporting limit? *Common lab contaminants include acetone, methylene chloride, diethylhexyl phthalate, and di-n-octyl phthalate.*			X
18d. If no, was the laboratory contacted to determine whether the reported analyte could be a potential laboratory contaminant and was an explanation included in the case narrative?			X
19. Are laboratory control samples (LCS) and LCS duplicate (LCSD) [a.k.a., Blank Spike (BS) and BS duplicates (BSD)] within laboratory reporting limits? Limits should be provided on the report. *LCS is a reagent blank spike with a representative selection of target analyte(s) and prepared in the same manner as the samples analyzed. The LCS should be spiked with the same analytes as the matrix spike (below). The LCS is free from interferences from the sample matrix and demonstrates the ability of the lab instruments to recover the target analytes. Accuracy (recovery information) is generally reported as % spike recovery; precision (reproducibility of results) between the LCS and LCSD is generally reported as the relative percent difference (RPD). LCS/LCSD can be run in addition to or in lieu of matrix QC data.*	X		
20a. Are the Matrix QC data (i.e., MS/MSD) within laboratory limits? Limits should be provided on the lab report. *The lab selects a sample from the batch and analyzes a spike and a spike duplicate of that sample. Matrix QC data is used to obtain precision and accuracy information and is reported in the same manner as LCS/LCSD. If the MS/MSD fails, the results may still be considered valid if the MB and either the LCS/LCSD or BS/BSD is within the lab's limits (failure is probably due to matrix interference).*	X		

Quality Control Checklist - *continued*

	Yes	No	NA
20b. If no, is the MB and either LCS/LCSD or BS/BSD within lab limits to validate the data?			X
Sample Quality Control			
21a. Are the surrogate spikes reported within the lab's acceptable recovery limits? *A surrogate is a non-target analyte, which is similar in chemical structure to the analyte(s) being analyzed for, and which is not commonly found in environmental samples. A known concentration of the surrogate is spiked into the sample or QA "sample" prior to extraction or sample preparation. Results are usually reported as % recovery of the spike. Failure to meet lab's limits for primary and secondary surrogates results in rebatching and reanalysis of the sample; failure of only the primary or the secondary surrogate may be acceptable under certain circumstances. Failure generally is due to coelution with the sample matrix.*	X		
21b. If no, is an explanation given in the case narrative to validate the data?			X

Comments:

The number of pages for the laboratory report was not indicated on the transmittal.

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 202180
ANALYTICAL REPORT

RECEIVED
APR 4 _ 2008
BASELINE

Baseline Environmental	Project : Y5302-01
5900 Hollis Street	Location : SR-84 Expressway Widening Project
Emeryville, CA 94608	Level : II

Sample ID	Lab ID
GW-1	202180-001
GW-3	202180-002

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signatures. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: _____ Date: 04/01/2008
Project Manager

Signature: _____ Date: 04/02/2008
Quality Assurance Director

NELAP # 01107CA

Curtis & Tompkins, Ltd.

CASE NARRATIVE

Laboratory number:	202180
Client:	Baseline Environmental
Project:	Y5302-01
Location:	SR-84 Expressway Widening Project
Request Date:	03/25/08
Samples Received:	03/25/08

This hardcopy data package contains sample and QC results for two water samples, requested for the above referenced project on 03/25/08. The samples were received cold and intact.

Volatile Organics by GC/MS (EPA 624):
No analytical problems were encountered.

Metals (EPA 6010B and EPA 7470A):
No analytical problems were encountered.

Total Cyanide (SM4500CN-E):
No analytical problems were encountered.

pH (EPA 9040B):
No analytical problems were encountered.

202180

CHAIN OF CUSTODY RECORD

5900 Hollis Street, Suite D
Emeryville, CA 94608
Tel: (510) 420-8686 Fax: (510) 420-1707

Turn-Around-Time Normal 5-Day
Laboratory Curtis and Tompkins, Ltd.
BASELINE Contact Person Redgy Ramirez/Bill Scott

Project Number Y5302-01
Project Name: SR-84 Expressway Widening Project
Samplers: (Signature)

Sample ID No. Station	Date	Time	Media	Containers: No.	Type: Stainless Steel	Type: Encore	Type: 500 ml Poly	Type: 40-ml VOA	Type: L-Poly	Type: 250 ml Poly	Type: Glass Jar	Preservative: Ice	Preservative: HCL	Preservative: HNO_3	Preservative: SO_4	Preservative: NaOH	pH (SM 4500H+B)	cyanide (SM 4500Cn-E)	TTO (EPA Method 624)	Title 22 metals (EPA Method 6010B/7470)				Remarks/ Composite
GW-1	3/25/08	10:30	W	1						x		X					x							
			W	1			x					X				x		x						
			W	3				x				X	x						x						
			W	1			x					X		x						x					
GW-2			W	1						x		X					x							
			W	1			x					X				x		x						
			W	3				x				X	x						x						
			W	1			x					X		x						x					
GW-3	3/25/08	13:00	W	1						x		X					x							
			W	1			x					X				x		x						
			W	3				x				X	x						x						
			W	1			x					X		x						x					
GW-4			W	1						x		X					x							
			W	1			x					X				x		x						
			W	3				x				X	x						x						
			W	1			x					X		x						x					
GW-5			W	1						x		X					x							
			W	1			x					X				x		x						
			W	3				x				X	x						x						
			W	1			x					X		x						x					

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
	3/25/08 14:20		3/25/08 1420
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	

Arrival at Laboratory:
Remarks:
Email contact:
redgy@baseline-env.com
Please provide EDD

Received at laboratory with intact: YES NO
Comments: intact on ice cold RC

Curtis & Tompkins, Ltd.

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Field ID:	GW-1	Batch#:	136412
Lab ID:	202180-001	Sampled:	03/25/08
Matrix:	Water	Received:	03/25/08
Units:	ug/L	Analyzed:	03/27/08
Diln Fac:	1.000		

Analyte	Result	RL
Chloromethane	ND	1.0
Vinyl Chloride	ND	0.5
Bromomethane	ND	1.0
Chloroethane	ND	1.0
Trichlorofluoromethane	ND	1.0
1,1-Dichloroethene	ND	0.5
Methylene Chloride	ND	10
trans-1,2-Dichloroethene	ND	0.5
1,1-Dichloroethane	ND	0.5
Chloroform	ND	0.5
1,1,1-Trichloroethane	ND	0.5
Carbon Tetrachloride	ND	0.5
1,2-Dichloroethane	ND	0.5
Benzene	ND	0.5
Trichloroethene	ND	0.5
1,2-Dichloropropane	ND	0.5
Bromodichloromethane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Toluene	ND	0.5
trans-1,3-Dichloropropene	ND	0.5
1,1,2-Trichloroethane	ND	0.5
Tetrachloroethene	ND	0.5
Dibromochloromethane	ND	0.5
Chlorobenzene	ND	0.5
Ethylbenzene	ND	0.5
Bromoform	ND	1.0
1,1,2,2-Tetrachloroethane	ND	0.5
1,3-Dichlorobenzene	ND	0.5
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.5

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	114	76-138
Toluene-d8	97	80-120
Bromofluorobenzene	96	80-120

ND= Not Detected
RL= Reporting Limit

4.0

3330 4

Curtis & Tompkins, Ltd.

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Field ID:	GW-3	Batch#:	136453
Lab ID:	202180-002	Sampled:	03/25/08
Matrix:	Water	Received:	03/25/08
Units:	ug/L	Analyzed:	03/27/08
Diln Fac:	1.000		

Analyte	Result	RL
Chloromethane	ND	1.0
Vinyl Chloride	ND	0.5
Bromomethane	ND	1.0
Chloroethane	ND	1.0
Trichlorofluoromethane	ND	1.0
1,1-Dichloroethene	ND	0.5
Methylene Chloride	ND	10
trans-1,2-Dichloroethene	ND	0.5
1,1-Dichloroethane	ND	0.5
Chloroform	ND	0.5
1,1,1-Trichloroethane	ND	0.5
Carbon Tetrachloride	ND	0.5
1,2-Dichloroethane	ND	0.5
Benzene	ND	0.5
Trichloroethene	ND	0.5
1,2-Dichloropropane	ND	0.5
Bromodichloromethane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Toluene	ND	0.5
trans-1,3-Dichloropropene	ND	0.5
1,1,2-Trichloroethane	ND	0.5
Tetrachloroethene	ND	0.5
Dibromochloromethane	ND	0.5
Chlorobenzene	ND	0.5
Ethylbenzene	ND	0.5
Bromoform	ND	1.0
1,1,2,2-Tetrachloroethane	ND	0.5
1,3-Dichlorobenzene	ND	0.5
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.5

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	113	76-138
Toluene-d8	97	80-120
Bromofluorobenzene	97	80-120

ND= Not Detected
RL= Reporting Limit

5.0

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Matrix:	Water	Batch#:	136412
Units:	ug/L	Analyzed:	03/26/08
Diln Fac:	1.000		

Type: BS Lab ID: QC434674

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	25.00	25.93	104	77-132
Benzene	25.00	25.35	101	80-120
Trichloroethene	25.00	27.50	110	80-120
Toluene	25.00	23.80	95	80-121
Chlorobenzene	25.00	24.73	99	80-120

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	111	76-138
Toluene-d8	97	80-120
Bromofluorobenzene	95	80-120

Type: BSD Lab ID: QC434675

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	25.00	25.72	103	77-132	1	20
Benzene	25.00	25.27	101	80-120	0	20
Trichloroethene	25.00	26.83	107	80-120	2	20
Toluene	25.00	23.30	93	80-121	2	20
Chlorobenzene	25.00	24.50	98	80-120	1	20

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	109	76-138
Toluene-d8	96	80-120
Bromofluorobenzene	94	80-120

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC434787	Batch#:	136412
Matrix:	Water	Analyzed:	03/26/08
Units:	ug/L		

Analyte	Result	RL
Chloromethane	ND	1.0
Vinyl Chloride	ND	0.5
Bromomethane	ND	1.0
Chloroethane	ND	1.0
Trichlorofluoromethane	ND	1.0
1,1-Dichloroethene	ND	0.5
Methylene Chloride	ND	10
trans-1,2-Dichloroethene	ND	0.5
1,1-Dichloroethane	ND	0.5
Chloroform	ND	0.5
1,1,1-Trichloroethane	ND	0.5
Carbon Tetrachloride	ND	0.5
1,2-Dichloroethane	ND	0.5
Benzene	ND	0.5
Trichloroethene	ND	0.5
1,2-Dichloropropane	ND	0.5
Bromodichloromethane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Toluene	ND	0.5
trans-1,3-Dichloropropene	ND	0.5
1,1,2-Trichloroethane	ND	0.5
Tetrachloroethene	ND	0.5
Dibromochloromethane	ND	0.5
Chlorobenzene	ND	0.5
Ethylbenzene	ND	0.5
Bromoform	ND	1.0
1,1,2,2-Tetrachloroethane	ND	0.5
1,3-Dichlorobenzene	ND	0.5
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.5

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	113	76-138
Toluene-d8	96	80-120
Bromofluorobenzene	95	80-120

ND= Not Detected
RL= Reporting Limit

8.0

0000 7

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Matrix:	Water	Batch#:	136453
Units:	ug/L	Analyzed:	03/27/08
Diln Fac:	1.000		

Type: BS Lab ID: QC434837

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	25.00	25.26	101	77-132
Benzene	25.00	24.27	97	80-120
Trichloroethene	25.00	25.93	104	80-120
Toluene	25.00	22.85	91	80-121
Chlorobenzene	25.00	23.73	95	80-120

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	107	76-138
Toluene-d8	96	80-120
Bromofluorobenzene	95	80-120

Type: BSD Lab ID: QC434838

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	25.00	24.23	97	77-132	4	20
Benzene	25.00	23.76	95	80-120	2	20
Trichloroethene	25.00	26.23	105	80-120	1	20
Toluene	25.00	22.19	89	80-121	3	20
Chlorobenzene	25.00	23.34	93	80-120	2	20

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	107	76-138
Toluene-d8	97	80-120
Bromofluorobenzene	95	80-120

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 624
Project#:	Y5302-01	Analysis:	EPA 624
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC434839	Batch#:	136453
Matrix:	Water	Analyzed:	03/27/08
Units:	ug/L		

Analyte	Result	RL
Chloromethane	ND	1.0
Vinyl Chloride	ND	0.5
Bromomethane	ND	1.0
Chloroethane	ND	1.0
Trichlorofluoromethane	ND	1.0
1,1-Dichloroethene	ND	0.5
Methylene Chloride	ND	10
trans-1,2-Dichloroethene	ND	0.5
1,1-Dichloroethane	ND	0.5
Chloroform	ND	0.5
1,1,1-Trichloroethane	ND	0.5
Carbon Tetrachloride	ND	0.5
1,2-Dichloroethane	ND	0.5
Benzene	ND	0.5
Trichloroethene	ND	0.5
1,2-Dichloropropane	ND	0.5
Bromodichloromethane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Toluene	ND	0.5
trans-1,3-Dichloropropene	ND	0.5
1,1,2-Trichloroethane	ND	0.5
Tetrachloroethene	ND	0.5
Dibromochloromethane	ND	0.5
Chlorobenzene	ND	0.5
Ethylbenzene	ND	0.5
Bromoform	ND	1.0
1,1,2,2-Tetrachloroethane	ND	0.5
1,3-Dichlorobenzene	ND	0.5
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.5

Surrogate	%REC	Limits
1,2-Dichloroethane-d4	114	76-138
Toluene-d8	96	80-120
Bromofluorobenzene	97	80-120

ND= Not Detected
RL= Reporting Limit

10.0

Curtis & Tompkins, Ltd.

California Title 26 Metals

Lab #:	202180	Project#:	Y5302-01
Client:	Baseline Environmental	Location:	SR-84 Expressway Widening Project
Field ID:	GW-1	Units:	ug/L
Lab ID:	202180-001	Sampled:	03/25/08
Matrix:	Water	Received:	03/25/08

Analyte	Result	RL	Diln Fac	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Arsenic	35	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Barium	5,200	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Beryllium	5.9	2.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Cadmium	ND	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Chromium	190	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Cobalt	280	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Copper	220	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Lead	25	3.4	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Mercury	12	0.40	2.000	136475	03/27/08	03/27/08	METHOD	EPA 7470A
Molybdenum	ND	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Nickel	540	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Selenium	ND	10	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Silver	ND	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Thallium	ND	10	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Vanadium	140	5.0	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Zinc	350	20	1.000	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

California Title 26 Metals

Lab #:	202180	Project#:	Y5302-01
Client:	Baseline Environmental	Location:	SR-84 Expressway Widening Project
Field ID:	GW-3	Diln Fac:	1.000
Lab ID:	202180-002	Sampled:	03/25/08
Matrix:	Water	Received:	03/25/08
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Arsenic	10	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Barium	1,800	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Beryllium	ND	2.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Cadmium	ND	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Chromium	81	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Cobalt	140	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Copper	77	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Lead	31	3.4	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Mercury	1.9	0.20	136475	03/27/08	03/27/08	METHOD	EPA 7470A
Molybdenum	5.7	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Nickel	430	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Selenium	ND	10	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Silver	ND	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Thallium	ND	10	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Vanadium	56	5.0	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B
Zinc	160	20	136416	03/26/08	03/28/08	EPA 3010A	EPA 6010B

ND= Not Detected
RL= Reporting Limit

000611

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3010A
Project#:	Y5302-01	Analysis:	EPA 6010B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC434690	Batch#:	136416
Matrix:	Water	Prepared:	03/26/08
Units:	ug/L	Analyzed:	03/28/08

Analyte	Result	RL
Antimony	ND	10
Arsenic	ND	5.0
Barium	ND	5.0
Beryllium	ND	2.0
Cadmium	ND	5.0
Chromium	ND	5.0
Cobalt	ND	5.0
Copper	ND	5.0
Lead	ND	3.4
Molybdenum	ND	5.0
Nickel	ND	5.0
Selenium	ND	10
Silver	ND	5.0
Thallium	ND	10
Vanadium	ND	5.0
Zinc	ND	20

ND= Not Detected
RL= Reporting Limit

000012

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7470A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	136475
Lab ID:	QC434935	Prepared:	03/27/08
Matrix:	Water	Analyzed:	03/27/08
Units:	ug/L		

Result	RL
ND	0.20

ND= Not Detected
RL= Reporting Limit

15.0

060613

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3010A
Project#:	Y5302-01	Analysis:	EPA 6010B
Matrix:	Water	Batch#:	136416
Units:	ug/L	Prepared:	03/26/08
Diln Fac:	1.000	Analyzed:	03/28/08

Type: BS Lab ID: QC434691

Analyte	Spiked	Result	%REC	Limits
Antimony	500.0	498.5	100	80-120
Arsenic	100.0	102.9	103	80-120
Barium	2,000	2,013	101	80-120
Beryllium	50.00	53.58	107	80-120
Cadmium	50.00	51.99	104	80-120
Chromium	200.0	195.3	98	80-120
Cobalt	500.0	472.5	94	80-120
Copper	250.0	241.7	97	80-120
Lead	100.0	96.51	97	80-120
Molybdenum	400.0	407.4	102	80-120
Nickel	500.0	484.7	97	80-120
Selenium	100.0	100.9	101	80-120
Silver	50.00	47.68	95	80-120
Thallium	100.0	101.2	101	80-120
Vanadium	500.0	492.2	98	80-120
Zinc	500.0	501.7	100	80-120

Type: BSD Lab ID: QC434692

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	500.0	510.4	102	80-120	2	20
Arsenic	100.0	105.6	106	80-120	3	20
Barium	2,000	2,021	101	80-120	0	20
Beryllium	50.00	54.09	108	80-120	1	20
Cadmium	50.00	53.36	107	80-120	3	20
Chromium	200.0	197.3	99	80-120	1	20
Cobalt	500.0	477.0	95	80-120	1	20
Copper	250.0	243.1	97	80-120	1	20
Lead	100.0	98.53	99	80-120	2	20
Molybdenum	400.0	414.6	104	80-120	2	20
Nickel	500.0	490.8	98	80-120	1	20
Selenium	100.0	101.5	101	80-120	1	20
Silver	50.00	47.80	96	80-120	0	20
Thallium	100.0	104.6	105	80-120	3	20
Vanadium	500.0	495.5	99	80-120	1	20
Zinc	500.0	507.2	101	80-120	1	20

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	EPA 3010A
Project#:	Y5302-01	Analysis:	EPA 6010B
Field ID:	ZZZZZZZZZZ	Batch#:	136416
MSS Lab ID:	202172-001	Sampled:	03/25/08
Matrix:	Water	Received:	03/25/08
Units:	ug/L	Prepared:	03/26/08
Diln Fac:	1.000	Analyzed:	03/28/08

Type: MS Lab ID: QC434693

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	8.637	500.0	522.1	103	78-120
Arsenic	<1.387	100.0	110.4	110	80-126
Barium	162.9	2,000	2,099	97	80-120
Beryllium	0.2990	50.00	53.27	106	80-120
Cadmium	<0.3555	50.00	52.30	105	80-120
Chromium	0.7562	200.0	188.7	94	80-120
Cobalt	0.3722	500.0	462.9	93	80-120
Copper	41.35	250.0	283.5	97	80-120
Lead	<1.150	100.0	89.67	90	77-120
Molybdenum	11.69	400.0	418.0	102	80-120
Nickel	1.920	500.0	473.6	94	79-120
Selenium	3.333	100.0	110.2	107	80-125
Silver	1.488	50.00	49.78	97	72-120
Thallium	<1.131	100.0	94.99	95	77-120
Vanadium	4.460	500.0	490.5	97	80-120
Zinc	302.9	500.0	797.8	99	78-122

Type: MSD Lab ID: QC434694

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	500.0	520.8	102	78-120	0	20
Arsenic	100.0	110.8	111	80-126	0	20
Barium	2,000	2,114	98	80-120	1	20
Beryllium	50.00	53.71	107	80-120	1	20
Cadmium	50.00	52.01	104	80-120	1	20
Chromium	200.0	190.1	95	80-120	1	20
Cobalt	500.0	464.9	93	80-120	0	20
Copper	250.0	287.2	98	80-120	1	20
Lead	100.0	89.18	89	77-120	1	20
Molybdenum	400.0	415.8	101	80-120	1	20
Nickel	500.0	472.2	94	79-120	0	20
Selenium	100.0	114.3	111	80-125	4	20
Silver	50.00	50.21	97	72-120	1	20
Thallium	100.0	95.18	95	77-120	0	20
Vanadium	500.0	491.0	97	80-120	0	20
Zinc	500.0	811.7	102	78-122	2	20

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	136475
Matrix:	Water	Prepared:	03/27/08
Units:	ug/L	Analyzed:	03/27/08
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC434936	5.000	5.110	102	80-120		
BSD	QC434937	5.000	5.150	103	80-120	1	20

RPD= Relative Percent Difference

18.0

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 26 Metals

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	136475
Field ID:	ZZZZZZZZZZ	Sampled:	03/25/08
MSS Lab ID:	202184-007	Received:	03/25/08
Matrix:	Water	Prepared:	03/27/08
Units:	ug/L	Analyzed:	03/27/08
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC434939	<0.04502	5.000	5.270	105	77-126		
MSD	QC434940		5.000	5.300	106	77-126	1	20

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

pH

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 9040B
Analyte:	pH	Batch#:	136361
Matrix:	Water	Received:	03/25/08
Units:	SU	Analyzed:	03/25/08 18:05
Diln Fac:	1.000		

Field ID	Lab ID	Result	RL	Sampled
GW-1	202180-001	7.5	1.0	03/25/08 10:30
GW-3	202180-002	7.5	1.0	03/25/08 13:00

RL= Reporting Limit

2.0

Curtis & Tompkins, Ltd.

Batch QC Report

pH

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	EPA 9040B
Analyte:	pH	Units:	SU
Field ID:	ZZZZZZZZZZ	Diln Fac:	1.000
Type:	SDUP	Batch#:	136361
MSS Lab ID:	202157-003	Sampled:	03/24/08 14:31
Lab ID:	QC434474	Received:	03/24/08
Matrix:	Water	Analyzed:	03/25/08 10:05

MSS Result	Result	RL	RPD	Lim
7.780	7.760	1.000	0	20

RL= Reporting Limit
RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Total Cyanide

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	SM4500CN-E
Analyte:	Cyanide	Sampled:	03/25/08
Matrix:	Water	Received:	03/25/08
Units:	mg/L	Prepared:	03/28/08
Diln Fac:	1.000	Analyzed:	03/31/08
Batch#:	136498		

Field ID	Type	Lab ID	Result	RL
GW-1	SAMPLE	202180-001	ND	0.01
GW-3	SAMPLE	202180-002	ND	0.01
	BLANK	QC435045	ND	0.01

ND= Not Detected
RL= Reporting Limit

20.0

Curtis & Tompkins, Ltd.

Batch QC Report

Total Cyanide

Lab #:	202180	Location:	SR-84 Expressway Widening Project
Client:	Baseline Environmental	Prep:	METHOD
Project#:	Y5302-01	Analysis:	SM4500CN-E
Analyte:	Cyanide	Batch#:	136498
Field ID:	ZZZZZZZZZZ	Sampled:	03/25/08
MSS Lab ID:	202169-007	Received:	03/25/08
Matrix:	Water	Prepared:	03/28/08
Units:	mg/L	Analyzed:	03/31/08
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
LCS	QC435046		0.2000	0.2134	107	78-120		
MS	QC435047	0.06110	0.2000	0.2790	109	61-120		
MSD	QC435048		0.2000	0.2842	112	61-120	2	20

RPD= Relative Percent Difference

FOR CONTRACT NO. 297614

MATERIALS INFORMATION

GEOTECHNICAL DESIGN REPORT AND MATERIALS REPORT

DATED 1/14/2011

04-ALA-84-PM22.9/27.1

EA297601
JANUARY 14, 2011

VOLUME I OF II
GEOTECHNICAL DESIGN REPORT AND MATERIALS REPORT

ROUTE 84 EXPRESSWAY WIDENING LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Improvement Authority
1333 Broadway, Suite 300
Oakland, CA 94612

URS

100 W. San Fernando Street, Suite 200
San Jose, California 95113

`

URS

January 14, 2011
Project 28649640

File No.04-ALA-84-PM 22.7/27.1
EA297601

Ms. Stefan Garcia
Project Coordinator
Alameda County Transportation Improvement Authority (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

Subject: **Geotechnical Design Report (GDR) and Materials Report**
Route 84 Expressway Widening
Livermore, California

Dear Ms. Garcia:

URS has completed a geotechnical investigation and the GDR/Materials Report for the proposed modifications to Route 84 in Livermore, California. The accompanying report has been prepared in accordance with Caltrans GDR Guidelines, dated December 2006 and Corrosion Guidelines, dated September 2003.

The report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed roadways and road signs. The opinions and recommendations have been based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Mr. Madhu Thummaluru, Staff Engineer, performed engineering calculations and assisted in preparation of this report. Mr. Mark Schmoll, Certified Engineering Geologist, contributed to the seismic source characterization and the evaluation of geologic conditions along the project alignment. Mr. Michael Larson, G.E. provided technical review and guidance to the URS project team over the course of the investigation. Mr. Paul Boddie, Principal Geotechnical Engineer, also provided overall peer review of this report in accordance with URS Corporation Quality Control Plan.

Since our 35, 65 and 95 percent reports dated April 28, 2008, September 17, 2008 and February 25, 2010 were issued, we received review comments from Caltrans dated June 2, 2008, June 23, 2008, October 23, 2009, and May 24, 2010, as well as a meeting on July 7, 2009. In addition, comments on the August 6, 2010 version of this report were provided verbally at a meeting by Caltrans reviewer on November 18, 2010. These comments have been incorporated into this report.

If any questions should arise, or if we can be of further service, please contact the undersigned at (408) 297-9585.

Sincerely,

S. Stephen Huang
Project Manager, G.E. 2150

URS Corporation
100 W. San Fernando Street, Suite 200
San Jose, CA 95113
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1.1 DESCRIPTION OF PROJECT

1.1.1 Location and Route Description

The project follows the existing alignment of State Route (SR) 84 (Isabel Avenue) from south of Ruby Hill Drive to Jack London Boulevard (PM 22.5/27.3) in the City of Livermore, near the eastern boundary of the City of Pleasanton. The project will conform to the Pigeon Pass Project (EA 172400) to the south and the I-580/Isabel Avenue Interchange Project (EA 171300) to the north.

SR 84 follows a discontinuous route consisting of two segments: an east-west segment running from Livermore to Fremont in Alameda County, crossing San Francisco Bay via the Dumbarton Bridge and continuing from Menlo Park to San Gregorio in San Mateo County. The other section is a north-west segment that begins in Rio Vista and ends at the Interstate 80 interchange in Sacramento. In eastern Alameda County, Route 84 provides local access for the cities of Pleasanton and Livermore, as well as an alternative east-west link between the Central Valley and the San Francisco Bay Area via the I-580 and I-680 corridors. Route 84 follows Isabel Avenue and Vallecitos Road between I-580 in Livermore and I-680 in Sunol (Figure 1-1). Isabel Avenue was designated as a substitute route for SR 84 in 2003, a shift from its original alignment through downtown Livermore. The station locations are shown in Key Map K-1 in Appendix A.

1.1.2 General

The project proposes to widen and upgrade SR 84 to expressway standards (55 mph) from Ruby Hill Drive to Jack London Boulevard for the purpose of reducing congestion along Route 84 and improving local traffic circulation; reducing impacts of regional traffic diverting to local streets; and improving safety and operations on SR 84.

SR 84 would be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment, with some potential changes in roadway curvature at the southern limit in the section between Ruby Hill Drive and Vallecitos Road (the proposed widening is described below by each roadway segment). As an expressway, access on to SR 84 would be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Discovery Drive (proposed) and Jack London Boulevard would be widened and upgraded to accommodate future traffic movements. At the intersection of SR 84/Stanley Boulevard the northbound ramp would be widened. A multi-use trail located on the east side of Route 84 between Jack London Boulevard and Concannon Boulevard would remain.

The roadway cross section would consist of 12-foot traveled lane and 10-foot shoulder widths separated by a concrete median barrier. Where practical, side slopes would be 4:1 (horizontal:vertical) or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes would be 2:1 or flatter. The approximate station limits of cut and fill are presented in Table 1-1. The roadway median at intersections would be locally widened up to 36 feet to accommodate left-turn lanes. No concrete barrier would be provided at the

intersection approaches; a crash cushion would protect the blunt end of the barriers where terminated.

1.1.3 Ruby Hill Drive to Vallecitos Road Improvements

The SR 84/Vallecitos Road intersection would be realigned and signalized by an interim project (City of Livermore Project No. 1999-13) to improve the continuity of SR 84 at this location. This alignment would widen and realign existing SR 84 from Ruby Hill Drive to just north of Vallecitos Road. The existing roadway pavement would be used where practical. A 4,000 foot retaining wall would be required on the east side of SR 84 to minimize impacts to an existing environmental conservation easement, and on the west side to retain cut adjacent to the Ruby Hill development. A maximum excavation for the retaining wall is expected to be 6 feet. Roadway widening section excavations are expected to be approximately 3 feet deep. Minor modifications to the Ruby Hill Drive and Vallecitos Road intersections would be required.

1.1.4 Vallecitos Road to Vineyard Avenue Improvements

SR 84 would generally be widened to the east along this segment and incorporate the existing roadway pavement. Roadway widening section excavations are expected to be approximately 3 feet deep. The signalized intersection at Vineyard Avenue would be widened and upgraded. Vineyard Avenue would also be widened on each approach to the intersection to accommodate extended turn lanes.

1.1.5 Vineyard Avenue to Stanley Boulevard Improvements

SR 84 would be widened to the east between Vineyard Avenue and Concannon Boulevard, and to the west for the remainder of this segment. Roadway widening section excavations are expected to be approximately 3 feet deep. The existing two-span bridge at Arroyo Del Valle would be widened by 55 feet to the east to accommodate the roadway widening. Excavations to the bottom of spread footings at the 2 abutments and center pier are expected to extend to a maximum depth of about 9 feet. The existing abutments, abutment slopes, and center bent would be extended to accommodate the widened structure. The flow channel passes on both sides of the center bent.

A separate new Trail Bridge, also supported on 2 abutments and one center bent on spread footings, is planned just east of the existing Arroyo Del Valle Bridge. About 2 feet of fill would be needed in order to raise the bridge soffit above the estimated 100-year flood water level. Excavations to the bottom of spread footings at the 2 abutments and center pier are expected to extend to a maximum depth of about 10 feet. The flow channel passes on both sides of the center bent.

Slope protection would be provided underneath the widened bridge and new Trail Bridge. Excavation to key in the rock slope protection is anticipated. An unpaved maintenance road crosses under the northern portion of the bridge. The signalized intersection at Concannon Boulevard would be widened and upgraded. Driveway access to the quarry, west of SR 84, would also be realigned to this intersection.

There are existing and planned expansions of current gravel mining operations on the west side of SR 84 within this segment, which are independent of this proposed SR 84 project. We understand gravel mining to depths as deep as 240 feet is planned on the west side of SR 84 between Vineyard Avenue and Stanley Boulevard, and also on the east side between Vineyard Avenue and Alden Lane. After mining is completed in approximately 25 years, the adopted Reclamation Plan requires the formation of basins to create groundwater storage, conveyance and recharge facilities collectively referred to as the Chain of Lakes. The Zone 7 Water Agency, which is the Tri-Valley water wholesaler serving Livermore, Pleasanton, and Dublin, would operate and maintain these reclamation facilities. When mining is completed, Arroyo Del Valle would be converted to basins on either side of SR84 and the crossing would become a concrete spillway between the two lakes. Therefore, the SR84 project roadway cross sections, driveway access, drainage systems, and utility relocations require coordination with both the mining operations and the Zone 7 Reclamation Plan.

1.1.6 Stanley Boulevard Interchange Improvements

Roadway widening section excavations are expected to be approximately 3 feet deep. Retaining walls would be required at both abutments of the undercrossing.

1.1.7 Stanley Boulevard to Jack London Boulevard Improvements

SR84 will be widened on both sides including retaining walls where it passes under the existing Stanley Boulevard bridges, then widened to the west for the remainder of this segment. Roadway widening section excavations are expected to be approximately 3 feet deep. A maximum excavation for the retaining wall is expected to be 7 feet. No modifications to the Stanley Boulevard bridge structures are proposed.

The existing three-span bridge at Arroyo Mocho would be widened by 65 feet to the west to accommodate the roadway widening. Excavations at the 2 abutments and piers are expected to a maximum depth of about 6 feet. Piling support is expected to be placed to a depth of 40 feet. The existing abutments, concrete abutment slopes, and bents would be extended to accommodate the widened structure.

In addition a new Access Bridge is planned west of the widened bridge, but supported on spread footings. Excavations at the 2 abutments and piers are expected to a maximum depth of about 6 feet. No changes to the channel are proposed.

The signalized intersections at Jack London Boulevard and at Discovery Drive would be widened and upgraded.

1.1.8 Other Features

Existing gas, sanitary sewer, storm drain, electrical, cable and telephone utilities lie within the proposed right-of-way for the project and would need to be relocated to meet expressway standards. The study area for this project includes provision of utility corridors outside of state right of way to accommodate relocation of private utilities. Roadway runoff would be conveyed by gutters to existing drainage systems. The outfalls for the drainage systems are at Arroyo Del

Valle, Arroyo Mocho, and Arroyo Las Positas. An existing storm water pump station is located between the Stanley Boulevard bridges. Minor modifications to the facility would be required to accommodate the roadway widening. Outfalls for the future Zone 7 basins would be addressed by the project.

Where necessary, retaining walls would be constructed to avoid or minimize impacts on adjacent properties and to reduce right-of-way take. However, the proposed project would require additional right-of-way at a number of locations.

Construction of the project is scheduled to begin in early 2009 and be completed by the end of 2010.

1.1.9 Other Projects in the Regional Area

There are other projects planned or proposed in the regional area, as described below in Table 1-2.

Table 1-2 Regional Project Summary

Project	Location	Description	Anticipated Schedule
I-580 Isabel Avenue Interchange Construction Project	At Isabel Avenue and I-580, between Jack London Boulevard and Portola Avenue, directly north of the SR 84 Expressway Widening Project	Constructing a new modified partial cloverleaf interchange, including a new bridge crossing I-580, roadway improvements on Isabel Avenue to Jack London Boulevard, and local street improvements	Begin Construction Summer 2007, Open to traffic Fall 2009
State Route 84 Realignment and Widening (Pigeon Pass "SHOPP Project")	On SR 84 between Ruby Hill Drive intersection and the Vallecitos Hills/Pigeon Pass area, directly south of the SR84 Expressway Widening Project	Upgrade SR 84 within the project limits to expressway design standards, involving realignment of horizontal and vertical curves, and addition of climbing lanes in the Pigeon Pass area.	Begin Construction Summer 2006, Open to traffic Summer 2008
I-580 Eastbound HOV Lane	Along eastbound I-580 between Santa Rita Road and Greenville Road	Create an eastbound High Occupancy Vehicle (HOV) lane from west of Santa Rita Road to east of Greenville Road; create eastbound auxiliary lanes between El Charro Road and Airway Boulevard, and between First Street and Vasco Road; make median barrier and drainage improvements.	Begin Construction Fall 2006, Open to traffic Fall 2008
Gravel Mining Operations (Vulcan Materials Quarry)	Adjacent to the west side of SR 84 Isabel Avenue, between approximately Stanley Boulevard and Arroyo Del Valle	Vulcan Materials have mining rights to extract gravel deposits up to 50 feet of existing right of way line	Ongoing for next 25 years

Table 1-2 Regional Project Summary

Project	Location	Description	Anticipated Schedule
Gravel Mining Operations (Cemex Quarry)	Both sides of Route 84 between Vineyard Avenue and Alden Lane	Cemex has mining rights to extract gravel deposits up to 50 feet of existing right of way line	Ongoing for next 25 years
Isabel Avenue/Vallecitos Road Intersection Project	Route 84 at Vallecitos Road	Realign Isabel Avenue at Vallecitos Road and relocate signalized intersection.	Begin Construction Summer 2006, Open to traffic Fall 2007
Oaks Business Park Development	West side of SR 84, between Jack London Boulevard and Arroyo Mocho	178-acre site is graded and undeveloped (in mid-2005). Subdivided into 35 parcels that are zoned for technical/light industrial development. New access on Discovery Drive will connect to SR 84 at a signalized intersection.	Construction begins late 2005.
Chevron Pipeline Relocation and Watershed Protection Project	Between Arroyo Road in Livermore and Calaveras Road near I-680. With respect to the ACTIA SR 84 project, it is in the uplands south of Vallecitos Road	Relocation of 7.5 miles of an existing petroleum products pipeline (neither the existing or proposed pipeline routes physically cross Route 84 in the project area).	Draft EIR completed in 2004.

Date of Latest Revision: September 7, 2005

1.1.10 Retaining Walls

A total of thirteen (13) retaining walls are planned, as shown on Figure 1-2 and as summarized in the following table.

Table 1-3 Planned Retaining Walls

Wall No.	Alignment	Direction	Begin Station (Approximately)	End Station (Approximately)	Length	Height
					(ft)	(ft)
236	Route 84	Lt (SB)	"A1" 235+60	"A1" 240+00	460	6 to 10
246	Route 84	Lt (SB)	"A1" 246+00	"A1" 257+54	1,154	5 to 28
245	Vallecitos Rd Connector	Rt (NB)	"A1" 245+00	"V" 106+60	1,505	3 to 24
109	Vallecitos Rd	Rt (SB)	"V" 109+05	"V" 113+02	396	3½ to 12½
110	Vallecitos Rd	Lt (SB)	"V" 110+30	"V" 115+64	546	5½ to 10½
314	Route 84	Rt (NB)	"A1" 314+40	"A1" 318+68	429	4 to 16½
317	Route 84	Lt (SB)	"A1" 316+66	"A1" 319+25	192	7 (max)

Table 1-3 Planned Retaining Walls

Wall No.	Alignment	Direction	Begin Station (Approximately)	End Station (Approximately)	Length (ft)	Height (ft)
320	Route 84	Rt (NB)	"A1" 320+36	321+98	161	11¼ (max)
391	Route 84	Lt (SB)	"A1" 391+05	"A1" 400+10	920	12 to 18
400N	Route 84	Rt (NB)	"A1" 400+00	"A1" 411+80	1,180	8 to 16
400S	Route 84	Lt (SB)	"A1" 400+10	"A1" 402+57	247	14 (max)
403	Route 84	Lt. (SB)	"A1" 402+98	"A1" 411+80	882	6 to 24
437	Route 84	Rt (NB)	"A2" 435+85	"A3" 447+08	1,120	10½ (max)

Walls RW 246, 391, 400N, 400S and 403 are considered to be special walls (non-standard). The geotechnical design parameters and aspects of these walls are presented in the Retaining Wall Foundation Report, under a separate cover.

Retaining Wall 246 is planned along the west side of SR84 Between Ruby Hill Drive and Vallecitos Road and is required to accommodate roadway widening between Stations 246+00 and 258+00. RW 246 is 1,154 feet long and in close proximity to East Ruby Hill Drive. If a conventional cantilever wall were used, it would require either (1) a cut into East Ruby Drive, which is infeasible, or (2) temporary shoring, which is cost prohibitive. Therefore, top-down construction techniques such as a soil nail wall are likely to be needed. The wall would be constructed with an initial shotcrete facing and a final cast-in-place reinforced concrete facing with architectural treatment. Maximum wall height would be about 28 feet.

1.1.11 Soundwalls

Soundwalls currently are not planned for this project.

1.2 EXISTING STRUCTURES

Figures 1-3 through 1-10 present the layout of the existing bridge structures. Based on as-built plans, the pile and spread footing foundation loadings are summarized as follows:

Table 1-4 Existing Structures

Bridge Number	Name	Abutment / Bent / Foundation Type	Pile [(1)] Loading (tons)	Allowable Bearing Pressure (pounds per square foot) [(2)]
-	Arroyo Del Valle Creek Bridge Structures (widen)	Abutments (spread footings)	-	8,000
		Bents (spread footings)	-	11,000

Table 1-4 Existing Structures

Bridge Number	Name	Abutment / Bent / Foundation Type	Pile (1) Loading (tons)	Allowable Bearing Pressure (pounds per square foot) (2)
33C-0405	Isabel Avenue Underpass (3)	Abutments (spread footings)	-	6,000
		Bents (spread footings)	-	6,000
33C-0406	Isabel Avenue Undercrossing (4)	Abutments (piles)	140	-
		Bents (piles)	140	-
33C-0407	Arroyo Mocho Creek Bridge (widen)	Abutments (piles)	80	-
		Bents (piles)	140	-

(1) All loads including wind and seismic
(2) Nominal resistance
(3) Union Pacific Railroad (UPRR)
(4) Stanley Boulevard

1.3 PHYSICAL SETTING

1.3.1 Climate

Climatologically, the area is classified as Mediterranean with dry summers and mild winters. The following discussion includes records at the Livermore weather station (Western Regional Climate Center, 2006). The mean annual temperature is 59.4° F. Extremes of temperatures expected range from an average daily maximum of 89.5° F in July to average daily lows of 36.4° F in January. The highest and lowest temperatures on record in Livermore are 115° F and 18° F. Freezing temperatures should only be expected to occur an average of 30.8 days per year, so freeze-thaw conditions should not be a factor.

Precipitation in Livermore averages 14.53 inches per year, primarily confined to the months of October through May. December, January, February and March usually have the most precipitation accumulation, averaging 2.63, 2.91, 2.57 and 2.12 inches per month, respectively. Thunderstorms are rare.

1.3.2 Terrain

The proposed improvements to SR84 between Jack London Boulevard on the north and Ruby Hill Drive on the south cross the relatively flat Livermore Valley. The topography along the existing roadway ranges in elevation from approximately 410 to 420 feet between Jack London Boulevard at Station 448+00 to the drainage crossing of Arroyo Del Valle at Station 320+00. The incised Arroyo Del Valle and Arroyo Mocho drainage crossings are at about Elevation 400 feet in the channel bottom. South of the Arroyo Del Valle crossing the road alignment gradually

climbs a gentle alluvial fan, rising to about elevation 590 feet south of Ruby Hill Drive at Station 227+00. South of the intersection with Vallecitos Road the road alignment is surrounded by low rolling hills as it enters the mouth of a canyon.

Development along the project is mixed, including agricultural, scattered commercial and industrial (mainly at the north end), planned residential communities and gravel quarries. The gravel quarries are extensive, as the majority of them are located along the west side of SR84, between about Station 314+00 north of Vineyard Avenue to Station 415+00 at the Arroyo Mocho bridge crossing.

1.3.3 Surface Drainage

Watershed

Major streams within or in the vicinity of the project include, from north to south (Wreco, 2006):

- Arroyo Las Positas (0.6 mile north of project)
- Arroyo Mocho (crossed by project)
- Arroyo Del Valle (crossed by project)

The two proposed bridges are located in the Arroyo del Valle and Arroyo Mocho watersheds (Wreco, 2008). Arroyo Del Valle begins approximately 29.5 miles upstream of the project site, at the confluence of Arroyo Bayo and San Antonio Creek in the County of Santa Clara, between the Burnt Hills and Seeboy Ridge. Lake Del Valle is located 6 miles upstream of the bridge site in the Del Valle Regional Park (State Recreation Area). The headwaters of Arroyo Mocho begin approximately 27.8 miles upstream of the project site, at the South Pocket of Mount Mocho (3,664 feet) in Santa Clara County.

Arroyo Del Valle and Arroyo Mocho are tributaries to Alamo Canal. The confluence of Arroyo de la Laguna and Alamo Canal is about 6.4 miles downstream of the project site. The confluence of Arroyo Mocho and Alamo Canal is approximately 6.8 miles downstream of the project site. Alamo Canal turns into Arroyo de la Laguna after it passes under I-680.

At the Arroyo Del Valle and Arroyo Mocho bridge sites, the areas consist of open space and gravel mining operations. In the project vicinity, the land use is residential with some commercial in the City of Livermore. In general, the Arroyo Mocho watershed in the City of Livermore is more developed than the Arroyo Del Valle, which is further south and more distant from the developed portions of the city. Outside of the city, the watersheds can be characterized as rural, undeveloped, and hilly to mountains. Lake Del Valle is a recreational area and park. Vegetation ranges from Valley Oak Woodland to Hardwood Rangeland.

Flood Sources

The drainage basin of this project is located in the upstream Alameda Creek Watershed of eastern Alameda County (Wreco, 2006). The Arroyo de la Laguna is the major tributary to Alameda Creek where all three major streams listed above are tributaries. According to Federal Emergency Management Agency's (FEMA) Flood Insurance Study (FIS) (1997, 2000), rainfall capable of producing floods in the project area only occurs during the winter months. Storm

runoff is concentrated rapidly by the network of tributaries from the eastern hills which discharge into the tributaries of Arroyo de la Laguna, including the three major streams: Arroyo Las Positas, Arroyo Mocho and Arroyo Del Valle. The tributaries have carved well-defined courses through the hills, but upon reaching the flat valley, the channels are shallow and inadequate for higher frequency flows. The main flooding problem is caused by low capacity of the lower reaches of Arroyo de la Laguna, downstream of the project, which causes backwater flooding in its tributary channels. This was the cause of relatively frequent and substantial flooding of the Amador and Livermore Valleys in the past. The Pacific Ocean storms, which bring the winter rains, are capricious, fluctuating in size from year to year and from storm to storm, occasionally bringing heavy rainfall in short periods of time. The flooding was mostly downstream of the project area. (Arroyo Mocho to Alamo Canal, I-580 to downtown Pleasanton which happened in 1955.)

When substantial rainfall does occur in this area, the runoff is rapid and heavy, causing stream flows to exceed the normal stream courses' capacities and inundate large areas of the valley floor. Flooding is not limited to occasions of intense precipitation. Flooding may occur following low-intensity precipitation spread over several days, as occurred in the storms of 1955 and 1958. Rapid runoff rates, inadequate channels and constricting structures combine with the development of some floodplain areas to make the Cities of Dublin, Pleasanton and Livermore susceptible to flood damage when large rainstorms occur.

Since the 1960s, flood channels have been constructed to convey runoff from Livermore Valley down toward Alameda Creek. In recent years (1980s to 1990s), Arroyo Mocho has been channelized along East Stanley Boulevard from Murrieta Boulevard to Isabel Avenue to accommodate the 100-year flood event. At the Isabel Avenue crossing, Arroyo Mocho has also been realigned and channelized as part of the Isabel Avenue Extension Project. As a consequence of these flood control measures, there is no 100-year flood risk to the project area.

In 1968, Del Valle Dam was built in the upstream Arroyo Del Valle, creating a reservoir of 77,100 acre-feet capacity. The reservoir has a drainage area of 149 square miles. Since then, the flood release has been regulated through the spillway and the downstream flooding along the Arroyo Del Valle has been reduced within the existing natural flood channel.

1.3.4 Regional Geology

The SR84 alignment lies within the Livermore Valley within the central portion of the Coast Ranges geomorphic province of California. Northwest-southeast-trending valleys and ridges characterize the regional morphology of the Coast Ranges province. These topographic features are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent predominantly strike-slip faulting along the San Andreas fault system between the Pacific and North American plates. Regional geologic mapping shows the project alignment to be underlain by Holocene alluvium and channel sand and gravel deposits along the active channel of Arroyo Del Valle (Dibblee, 1980; Gramer et al., 1996). More recent mapping by Witter and others (2006) subdivide the alluvium into latest Holocene alluvial fan deposits extending from about Jack London Boulevard south to Stanley Boulevard, Holocene alluvial fan deposits extending from about Stanley Boulevard to just north of Concannon Boulevard and historic stream channel deposits within the active channels of Arroyo Mocho and

Arroyo Del Valle. The geologic map (Figure 1-11) shows the areal extent of these various geologic units. Witter (2006) also maps a small area of stream terrace deposits and Pleistocene alluvial fan deposits, mostly east of SR84 and north of Arroyo Del Valle in the vicinity of Concannon Boulevard. South of Arroyo Del Valle the road alignment crosses through Holocene alluvian deposits and alluvial fan deposits as it enters the mouth of a canyon at the south end of the alignment. The surrounding low hills south of the intersection of Vallecitos Road are mapped as older alluvium deposits and the Pleistocene Livermore Gravels Formation. The project alignment does not cross into these older formations.

In this portion of southeastern Alameda County, the underlying "bedrock" is the nonmarine sedimentary Livermore Gravels Formation (Graymer, et al.1996; Dibblee, 1980). The Livermore Gravels Formation is up to about 4,000 feet thick and lies as much as 400 feet in depth below the alluvium in the central Livermore Valley (Hall, 1958). It contains poorly to moderately consolidated cobble conglomerate, conglomeratic sandstone, and coarse-grained sandstone with some siltstone and claystone (Graymer et al., 1996). The Livermore Gravels may have been encountered at depth in some of the deeper borings completed near the southern portion of the project alignment, however it is difficult to distinguish between the gravelly alluvium soils and the older Livermore Gravels Formation in the borings.

1.4 PREVIOUS INVESTIGATIONS NEAR SITE

The existing Foundation Investigation references provided by the City of Livermore include the following:

Table 1-5 Previous Investigations

Bridge Number	Name	Report Description	Date
-	Arroyo Del Valle Creek Bridge	Unavailable	-
33C-0406	Isabel Avenue Undercrossing (at Stanley Boulevard)	Foundation Recommendations (by Geotechnical Consultants, Inc.)	April 15, 1998
33C-0405	Isabel Avenue Underpass (UPRR adjacent to Stanley Boulevard)	Foundation Recommendations (by Geotechnical Consultants, Inc.)	April 15, 1998
33C-0407	Arroyo Mocho Bridge	Foundation Recommendations (by Geotechnical Consultants, Inc.)	April 15, 1998

1.5 REVIEW COMMENTS

URS submitted a Geotechnical Design and Materials Report dated April 28, 2008 for the proposed Route 84 Expressway Widening Project. Subsequently, Caltrans reviewed our report and provided their comments in correspondence dated June 2 and June 23, 2008. Subsequently the 65 percent report was issued on September 17, 2008 followed with review comments dated October 23, 2009. The 95 percent report dated February 25, 2010 was reviewed and comments were received on May 24, 2010. Copies of Caltrans' review comments are attached in Appendix N. We have incorporated these review comments in this report.

2.1 ORIGINAL CONSTRUCTION

Existing structural pavement sections are shown on six sets of As-built (exist) Typical Cross Section drawings in Appendix B. The six sets of plans include:

- Project Plans for Construction on State Highway in Alameda County near Livermore from 0.5 Km East of Route 680 to 1.1 Km East of Vallecitos Atomic Laboratory Road and from 0.5 Km West of Ruby Hills Drive to 0.2 Km East of Isabel Avenue, Contract No. 04-272614, dated August 13, 2004.
- Project Plans for Construction on Isabel Avenue / Vallecitos Road Intersection Realignment, Project No. 1999-13, City of Livermore, Alameda County, California, dated July 31, 2007.
- Improvement Plan, Isabel Avenue – Phase 1, City of Livermore, Alameda County, California, dated July 15, 1999. Project limits on Isabel Avenue from Station 2+60 to 21+80 (Metric Units) (approximate SR 84 Station "A1" 246+81 to 252+18).
- Isabel Avenue Extension-Phase 2, Project 1, City of Livermore Project No. 89-50, dated May 11, 1999. Project limits on SR84 extend from Station "I" 101+60 to 145+50.
- Isabel Avenue Extension-Phase 2, Project 2, City of Livermore Project No. 96-91, dated May 11, 1999. Project limits on SR84 extend from Station "RH" 4+60 to Station "I" 101+60.
- Oaks Business Park – Tract 7300, Construction Plans for Isabel Avenue (SR 84) Widening, in Alameda County, in Livermore, from Arroyo Mocho Bridge to 300M South of Jack London Boulevard and at Jack London Boulevard, dated January 25, 2008.

In addition, information from the following design drawings is also reviewed:

- Project Plans for Construction on Isabel Avenue – Phase 1, in Alameda County in Livermore, from 0.75 km South of Concannon Blvd to 0.1 km North of Airway Blvd, dated February 26, 1998.

Consistent with Caltrans terminology, for the remainder of this report, the following definitions, abbreviations, and acronyms are used:

- Asphalt concrete, Type A is AC(A)
- Asphalt treated permeable material is ATPB
- Asphalt concrete base, Type A is ACB(A)
- Cement treated base, Class A is Cl. A CTB
- Cement treated base, Class B is C1. B CTB
- Lean concrete base is LCB
- Class 3 aggregate base is Cl. 3 AB
- Cement treated subbase is CTS
- Class 4 aggregate subbase is Cl. 4 AS
- Open graded asphalt concrete is OGAC
- Portland cement concrete is PCC
- Selected material is SM
- Rubberized asphalt concrete, gap graded is RAC-G
- Pervious subbase material is PSM.
- Permeable material is Perm.
- Perforated metal pipe is PMP.

- Hot mix asphalt is HMA

2.2 ROUTE 84

According to Typical Cross Sections presented in the record drawings discussed in Section 2.1, the existing pavement sections for SR84 mainline and shoulders consist of the following structural elements.

Table 2-1 Existing Typical Structural Sections

Direction	Station	Traveled Way Section (feet)	Shoulder Section (feet)	Record Drawings
NB/SB	227+00 to 246+81	RAC (G) 0.15 AC (Type A) 0.45 CL 2 AB 0.65 CL 4 AS 0.75	RAC (G) 0.15 AC (Type A) 0.45 CL 2 AB 0.65 CL 4 AS 0.75	0.5 Km West of Ruby Hills Drive to 0.2 Km East of Isabel Avenue, 2004
See Station Column	246+81 to 248+77 NB / SB 252+18 to 258+01 SB 252+18 to 254+28 NB 257+19 to 258+01 NB	RAC (G) 0.15 AC (Type A) 0.49 CL 3 AB 0.94 CL 4 AS 1.38	RAC (G) 0.15 AC (Type A) 0.49 CL 3 AB 0.94 CL 4 AS 1.38	Isabel Avenue / Vallecitos Road Intersection Realignment, City of Livermore, 2007
NB	254+28 to 257+19	AC 0.54 ATPB 0.25 CL 3 AB 0.83 CL 4 AS 1.54	AC 0.54 ATPB 0.25 CL 3 AB 0.83 CL 4 AS 1.54	Isabel Avenue / Vallecitos Road Intersection Realignment, City of Livermore, 2007
NB/SB	248+77 to 252+18	RAC (G) 0.15 AC (Type A) 0.49 CL 3 AB 0.94 CL 4 AS 1.38	RAC (G) 0.15 AC (Type A) 0.49 CL 3 AB 0.94 CL 4 AS 1.38	Isabel Avenue / Vallecitos Road Intersection Realignment, City of Livermore, 2007
NB/SB	258+01 to 265+49	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.83 CL 2 AS 1.54	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.83 CL 2 AS 1.54	Improvement Plan, Isabel Avenue–Phase I, City of Livermore, 1999
NB/SB	265+49 to 275+33	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.83 CL 2 AS 1.25	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.83 CL 2 AS 1.25	Improvement Plan, Isabel Avenue–Phase I, City of Livermore, 1999
NB/SB	275+33 to 281+89	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.98	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.98	Improvement Plan, Isabel Avenue–Phase I, City of Livermore, 1999
NB/SB	281+89 to 302+56	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.83 CL 4 AS 1.29	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.83 CL 4 AS 1.29	Improvement Plan, Isabel Avenue–Phase I, City of Livermore, 1999

Table 2-1 Existing Typical Structural Sections

Direction	Station	Traveled Way Section (feet)	Shoulder Section (feet)	Record Drawings
NB/SB	302+56 to 319+25	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 0.54	AC (Type A) 0.54 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 0.54	Improvement Plan, Isabel Avenue–Phase I, City of Livermore, 1999
NB/SB	320+35 to 333+11 387+44 to 388+88 411+85 to 419+72	AC (Type A) 0.59 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 1.08	AC (Type A) 0.59 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 1.08	Isabel Avenue Extension –Phases 1 & 2, Project 1, 1999
NB/SB	333+11 to 387+44	AC (Type A) 0.74 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 1.08	AC (Type A) 0.74 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 1.08	Isabel Avenue Extension –Phases 1 & 2, Project 1, 1999
NB/SB	388+88 to 411+85	AC (Type A) 0.59 ATPB 0.25 CL 2 AB 1.08 CL 3 Perm 0.69	AC (Type A) 0.59 ATPB 0.25 CL 2 AB 1.08 CL 3 Perm 0.69	Isabel Avenue Extension – Phases 1 & 2, Project 1, 1999
NB/SB	419+18 to 447+08	AC (Type A) 0.74 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 1.08	AC (Type A) 0.74 ATPB 0.25 CL 2 AB 0.69 CL 4 AS 1.08	Isabel Avenue Extension –Phase 2, Project 1, 1999

Figure 2-1 presents a schematic profile of the existing structural pavement sections summarized in Table 2-1. The profile also includes approximate depths of the AC and AB components observed in the borings (summarized later in Section 2.4). In general, the depths of AC are consistent with record drawings information. Between approximate Station 333+11 and 387+44, the profile presents the thickness of AC that includes an overlay of 0.15 foot (45 mm) reportedly constructed in 1999 for the Isabel Avenue Extension Phases 1 and 2. The pavement components revealed from the shoulder explorations appear to be less than that shown on the record drawings. Therefore, it is conservative to consider the combined AC thickness between Stations 333+11 and 387+44 is 0.74 foot; the corresponding top of ATPB layer is about 0.74 foot below pavement surface.

2.3 ISABEL AVENUE CONNECTOR

According to Typical Cross Sections drawings X-6 and X-7 the 1999 pre-existing pavement structural sections are not shown. However, the plans indicate that pavement installed in 1999 at this ramp at Stanley Boulevard include Section Numbers 1 and 11 (As-Built Contract Number 04-233054). These two sections consist of the following structural elements.

- Section Number 1
  - 0.60 foot AC (A)
  - 0.25 foot ATPB
  - 0.67 foot Class 2 AB
  - 1.08 feet Class 4 AS
- Section Number 11

- 0.60 foot AC (A)
- 0.25 foot ATPB
- 1.08 feet Class 2 AB
- 0.67 foot Class 3 Perm

2.4 STRUCTURAL PAVEMENT SECTION

The existing pavement structural sections were measured where our boring locations coincided with the existing pavement. Approximate measurements of the existing section were made in exploratory boreholes at the time of drilling and are summarized in the following table.

Table 2-2 Borings in Shoulders/Median

Boring Number	Approximate Station	Offset (feet)*	AC Thickness		AB Thickness		Sample Location
			(inches)	(feet)	(inches)	(feet)	
NB05	A1 252+76	10	9	0.75	9	0.75	Travelled Lane
NB16	A1 348+18	52	7	0.58	17	1.42	Shoulder
NB17	A1 354+12	52	7	0.58	17	1.42	Shoulder
NB18	A1 359+40	51	8	0.67	16	1.33	Shoulder
NB25	A1 435+92	62	6	0.50	12	1.00	Shoulder
RB01	A1 230+68	-6	8	0.67	6.5	0.54	Travelled Lane
RB02	A1 238+10	76	8	0.67	9	0.75	Shoulder
RB04	A1 253+70	68	9	0.75	Not Encountered	Not Encountered	Shoulder
RB06	A1 264+70	5	5	0.42	4	0.33	Travelled Lane
RB07	A1 270+16	-8	6	0.50	4	0.33	Travelled Lane
RB08	A1 278+11	-33	5	0.42	4	0.33	Shoulder
RB09	A1 280+36	-33	5.5	0.46	6.5	0.54	Shoulder
RB10	A1 284+94	-3	5.5	0.46	5	0.42	Travelled Lane
RB11	A1 289+94	-6	6.5	0.54	2	0.17	Travelled Lane
RB12	A1 295+52	-33	7	0.58	10	0.83	Shoulder
RB13	A1 300+54	-10	6	0.50	4	0.33	Travelled Lane
RB14	A1 305+99	11	6	0.50	12	1.00	Travelled Lane
RB15	A1 312+66	-3	6	0.50	Not Encountered	Not Encountered	Median
RB16	A1 324+39	-30	6	0.50	Not Encountered	Not Encountered	Shoulder
RB18	A1 332+97	-31	5.5	0.46	6.5	0.54	Shoulder
RB19	A1 341+68	-11	8	0.67	10	0.83	Travelled

Table 2-2 Borings in Shoulders/Median

Boring Number	Approximate Station	Offset (feet)*	AC Thickness		AB Thickness		Sample Location
			(inches)	(feet)	(inches)	(feet)	
							Lane
RB20	A2 359+00	12	8	0.67	Not Encountered	Not Encountered	Travelled Lane
RB23	A2 364+95	50	7	0.58	26	2.17	Shoulder
RB27	A2 388+30	52	7.5	0.62	7.5	0.62	Shoulder
RB28	A2 393+06	125[1]	8	0.67	Not Encountered	Not Encountered	Shoulder
RB29	A3 395+80	423[1]	8	0.67	10	0.83	Shoulder
RB30	A3 396+95	58	7.5	0.62	8.5	0.71	Shoulder
RB31	A3 400+73	413[1]	8.5	0.71	6	0.50	Shoulder
RB32	A3 405+43	11	8	0.67	6	0.50	Travelled Lane
RB33	A3 408+67	37	6.5	0.54	11.5	0.96	Shoulder
RB34	A3 416+46	10	8	0.67	Not Encountered	Not Encountered	Travelled Lane
RB35A	A3 422+01	2	10	0.83	20	1.67	Median
RB36A	A3 427+03	22	9	0.75	29	2.42	Travelled Lane
RB37A	A3 432+85	4	10	0.83	18	1.50	Travelled Lane
RB38A	A3 437+66	14	8.5	0.71	21.5	1.79	Travelled Lane
RB39	A3 441+36	8	6	0.50	12	1.00	Travelled Lane
RB40	A3 447+24	-2	7.5	0.62	Not Encountered	Not Encountered	Median
RB41	A3 230+21	0	8.5	0.71	9.5	0.80	Median
RB42	A3 237+41	30	7	0.58	17	1.41	Shoulder
RB43	A3 247+57	30	4	0.33	>56	>4½	Shoulder

1. Cores retrieved on shoulder of Stanley Connector.

Borings RB41 and RB42, drilled in December 2009, were drilled to supplement missing as-built structural pavement data for the roadway section between "A1" Station 227+00 and 246+81.

3.1 FIELD EXPLORATION

The locations of all borings for the entire SR84 project are presented in Figures 3-1 through 3-17. The locations of selected borings used for this report are presented on Boring Records, in Appendix C.

The selected borings for this GDR/Materials Report include RB01 through RB35, RB37 through RB43 and RB35A through RB38A. These borings were drilled primarily for determination of the roadway structural pavement section and subgrade; depths were generally in the range of 9.5 to 15.0 feet, and typically about 10 feet. Several RB borings were shallower at a depth of 5 feet in Borings RB35A, RB36A, RB37A, RB38A, RB41 through RB43. RB is an abbreviation for roadway boring. These borings were drilled with a hollow stem auger.

Furthermore, the selected borings also include other new multipurpose borings (NB) drilled for future retaining walls, signs and bridges, as well as modifications to existing bridges. These deeper borings include NB01 through NB26, NB30 through NB36, NB05A, NB07A, NB22A and NB25A. Depths of these borings ranged from 14 to 101½ feet. These borings were drilled by either the rotary wash method or by the hollow stem auger method using a truck-mounted drill rig. Exceptions to this were Borings NB01, NB02 and NB05A, which were drilled using a solid-stem auger mounted on a steep hillside portable rig.

The field investigation was conducted during the period of November 19, 20 and 27, 2007 and December 3, 4, 5 and 10, 2007 for the initial RB borings. The first phase of NB borings were drilled during the period of November 20, 21, 26 and 27, 2007, December 4, 5, 7, 10, 13, 14, 17 through 21, 26 and 27, 2007, January 2, 3, 4 and 18, 2008 and March 4 through 7, 2008. A subsequent phase of field investigation was conducted during the period of December 9, 2008 through January 7, 2009. Additional borings included the following:

- NB30 to NB36 for the proposed retaining walls along the new Vallecitos Road alignment;
- NB37 and NB38 for the center pier at Arroyo Del Valle bridge and proposed trail bridge;
- RB41 to RB43 for the roadway section of Isabel Avenue between Ruby Hill and Vallecitos Road.

During drilling, visual classifications of the soils encountered were made from cuttings and soil samples. Typically, drive samples were collected just below the ground surface or under the pavement structural section to a depth of approximately 6 feet and at intervals thereafter of about 2 to 5 feet. Bulk samples of the subgrade materials were also collected for R-value testing.

After the borings were completed, the approximate horizontal location (latitude and longitude) and vertical location (ground surface elevation) were recorded using a GPS (global positioning system) unit. In addition, boring locations were also measured from known landmarks as field checked of the GPS positions.

A representative of URS supervised the drilling operations and soil sampling. The soil samples collected were labeled and sealed immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. Descriptions of individual laboratory tests and results are presented in Appendix D,

"Laboratory Tests," and on the Boring Records. A summary of laboratory test results is presented in Table 3-1.

Comprehensive descriptions of the soils encountered at each boring, together with field and laboratory test data are presented on the Boring Records.

3.2 SUBSURFACE CONDITIONS

3.2.1 General

All explorations (auger and rotary wash borings) were located in the paved shoulder, the paved mainline areas, in the future traveled way (ramps and median), within bridge areas (existing or replace), or near future retaining walls and soundwalls. The pavement sections encountered in our explorations are presented previously in Section 2 "Existing Structural Pavement Sections".

3.2.2 Subsurface Conditions

Based on a review of the borings completed along the project alignment, the soil profile along a portion of the alignment consists of a few feet of fill (Borings NB01 through NB05, NB12, NB13, NB22, NB25A, RB01, RB11, RB40 through RB43) overlying alluvium. The fill, where encountered, ranges from about 3 feet thick to as much as 12 feet in thickness in Boring NB13 on the north bridge abutment of Arroyo Del Valle, to 20 feet in Boring NB25A in a man-made ridge, to 25 feet in Boring NB02 on the hillside between SR84 and East Ruby Hill Drive. The fill consisted of locally derived silt, sand and clay with gravel and occasionally contained asphalt and concrete fragments. In addition, an existing pavement section typically consisting of asphalt concrete overlying aggregate base material was encountered in a number of borings; this information is summarized in Section 2.4 "Structural Pavement Section".

Alluvium was encountered in all of the borings either beginning at the ground surface or underlying the road base and fill materials. The alluvium consists of complexly interbedded sand, silt and clay with gravel and extensive channel deposits of silty gravel, clayey gravel and poorly graded sand/gravel mixtures.

In general the alluvium encountered south of Arroyo Del Valle, where the road alignment gradually climbs a gentle alluvial fan, is more dense/stiff compared with the alluvium north of the drainage. The uncorrected N-values in the borings south of the drainage are nearly all above 40 blows per foot and most were well above 50 blows per foot, even in the silts and clays. South of Arroyo Del Valle the fine grained soils (silts and clays) are generally medium stiff to hard in consistency, and occasionally soft; coarse grained soils (sands and gravels) are typically medium dense to very dense in relative density, and occasionally loose. Fat clays (CH) were revealed in Borings RB13, RB14 and NB13 and elastic silt (MH) in RB07. Cobbles were encountered in Borings NB03 (at 7 feet bgs) and NB06 (at 31 feet bgs).

North of Arroyo Del Valle the fine grained soils are generally medium stiff to hard, and occasionally soft. Coarse grained soils are typically medium dense to very dense in relative density. Cobbles and/or boulders were encountered in Borings NB13 (at 11½ to 15 feet bgs and 25 feet), NB23 (at 3 feet bgs) and NB24 (about 4 feet bgs). North of the drainage the alluvium is

less dense/stiff with N-values typically in the 10 to 30 blows per foot range in the upper 20 to 30 feet and increasing with depth.

3.2.3 Groundwater

None of the shallow "RB" borings completed for pavement design using hollow stem auger methods encountered groundwater. These borings were generally 10 to 15 feet in depth.

The groundwater depths encountered for the deeper NB series are summarized in the following table.

Table 3-2 Groundwater Measurements

Boring Number	Water Depth (feet)	Total Boring Depth (feet)	Drilling Method	Comments
NB01	20.0	25.0	Auger	Hillside boring
NB02	Dry	30.0	Auger	Hillside boring
NB03	Not Measured	80.0	Rotary Wash	Dry to 7 feet
NB04	Dry	25.0	Hollow Stem Auger	
NB05	Not Measured	56.5	Rotary Wash	Dry to 7 feet
NB05A	Dry	35.0		Hillside boring
NB06	Not Measured	80.0	Rotary Wash	Dry to 7 feet
NB07	Dry	20.0	Hollow Stem Auger	
NB07A	Dry	20.0	Hollow Stem Auger	
NB08	Dry	31.5	Hollow Stem Auger	
NB09	Dry	30.0	Hollow Stem Auger	
NB10	23.5	30.0	Hollow Stem Auger	
NB11	Not Measured	60.0	Rotary Wash	5 feet to drilling fluid upon completion of drilling
NB12	Not Measured	71.5	Rotary Wash	8 feet to drilling fluid level on 2nd day of drilling
NB13	Not Measured	80.0	Rotary Wash	14 feet to drilling fluid level on 2nd day of drilling
NB14	Not Measured	60.0	Rotary Wash	Dry to 11.5 feet
NB15	Dry	14.0	Hollow Stem Auger	
NB16	Dry	15.5	Hollow Stem Auger	
NB17	Dry	20.0	Hollow Stem Auger	
NB18	Dry	20.0	Hollow Stem Auger	
NB19	Dry	30.0	Hollow Stem Auger	
NB20	Dry	40.0	Hollow Stem Auger	
NB21	Dry	40.0	Hollow Stem Auger	
NB22	Dry	30.0	Hollow Stem Auger	
NB22A	24.7	30.0	Hollow Stem Auger	
NB23	Not Measured	101.5	Rotary Wash	42.5 feet to drilling fluid level after 6th day
NB24	Not Measured	101.5	Rotary Wash	26.5 feet to drilling fluid level on 2nd day of drilling

Table 3-2 Groundwater Measurements

Boring Number	Water Depth (feet)	Total Boring Depth (feet)	Drilling Method	Comments
NB25	Dry	22.0	Hollow Stem Auger	
NB25A	Dry	25.0	Hollow Stem Auger	
NB26	Dry	30.0	Hollow Stem Auger	
NB30	24	50.0	Hollow Stem Auger	
NB31	28	50.0	Hollow Stem Auger	
NB32	Dry	50.0	Hollow Stem Auger	
NB33	Dry	30.0	Hollow Stem Auger	
NB34	Dry	35.0	Hollow Stem Auger	
NB35	14.5	50.0	Hollow Stem Auger	
NB36	Dry	50.0	Hollow Stem Auger	
NB37	3.5	90.0	Rotary Wash	
NB38	3	90.0	Rotary Wash	

All of the deeper exploratory borings completed for the bridge foundations were drilled with rotary wash drilling methods and immediately backfilled with a mixture of soil, cement and bentonite grout at completion of drilling; therefore, groundwater depths could not be measured in these borings. However, many of the "NB" borings completed for the retaining wall structures were drilled using hollow stem auger drilling methods. These borings ranged from about 15 to 50 feet in depth and groundwater was encountered in some of the borings with depths ranging from 14½ to 28 feet bgs. In Boring NB22A, wet soils were noted at a depth of 24.7 feet; however, at the completion of drilling to a depth of 30 feet bgs, it was noted to be dry.

No groundwater springs or seeps were observed on or near the project alignment, and the stream channels crossed by the alignment flow only during the rainy season and shortly afterwards.

Groundwater levels may vary considerably in the area with seasonal rainfall or with fluctuations of water levels in Arroyo Mocho and Arroyo Del Valle.

4.1 REGIONAL TECTONIC SETTING AND SEISMICITY

The project alignment lies between known active and potentially active geologic faults. In general, earthquakes occur as a result of movement along active faults. For the purpose of activity classification, faults are generally grouped into the following categories by the California Division of Mines and Geology (since renamed the California Geological Survey, CGS) (Jennings, 1994):

- Holocene: displacement has occurred within the last 10,000 to 11,000 years.
- Late Quaternary: displacement has occurred within the last 700,000 years, but evidence of Holocene activity is lacking.
- Quaternary: evidence of displacement within the last 1.6 million years, but evidence of Holocene activity is lacking.
- Pre-quaternary: no recognized evidence of displacement in the last 1.6 million years.

Generally, faults with Holocene movement are considered to be "active" while faults with late Quaternary to Quaternary movement are considered to be "potentially active".

The closest active faults to the project alignment are the Greenville, Calaveras, and Verona Williams faults (Mualchin, 1996). The California Geological Survey (2000) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. All three of these faults are included as Alquist-Priolo (A-P) zoned faults. The Greenville fault is located about 5.2 miles (8.3 km) east of the project site. The Calaveras fault is located about 4.5 miles (7.3 km) west of the site and the Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. More distant active faults include the Hayward fault located 10.5 miles (16.9 km) southwest of the southern end of the project alignment, and the San Andreas fault located 29 miles (46.7 km) southwest of the southern end of the project alignment. Figure 4-1 shows active faults within the region relative to the project. The project alignment does not cross any mapped A-P zoned faults.

Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1 mile (1.6 km) southeast of the southern end of the project alignment, and the Livermore fault, located about 1,000 feet northeast of the intersection of SR84 and Jack London Boulevard. The geologic map (Figure 1-11) shows the location of the Livermore fault as mapped by Dibblee (1980) and Alamdea County Seismic Safety Element (1982). The California Geological Survey (2000) includes a portion of the Las Positas fault as an A-P zoned fault south of the Lawrence Livermore complex, but does not extend the A-P zone as far west as Dibblee (1980) and Wagner et al. (1990) map the fault. Both Dibblee and Wagner also map the Livermore fault as a concealed fault trending northwesterly. The Alameda County Seismic Safety Element (1982) also shows this fault on hazard maps, indicating its location is based on a groundwater barrier. They classify the fault as "potentially uncertain" meaning the activity of the fault has insufficient evidence to give it an activity classification. Wagner et al. (1990) maps the Livermore fault as an early Quaternary fault (2,000,000 to 700,000 years old). The project alignment does not cross either the Los Positas fault or the Livermore fault.

The following paragraphs are brief descriptions of the nearby active faults.

4.1.1 Calaveras Fault

The Calaveras fault is a dextral strike-slip fault that is part of the larger San Andreas fault system and is located along the eastern side of the East Bay Hills. The fault is located about 4.5 miles (7.3 km) west of the project alignment and is predominantly a vertical fault with a slip rate of 0.47 to 0.71 inch/year (12 to 18 mm/year) (WGCEP, 2003). Active seismicity, including a moderate magnitude earthquake in 1856, has been recorded along the Calaveras fault resulting in surface ruptures and large earthquakes (Kelson and others, 1996; Simpson and others, 1999). In addition to seismic events, fault creep continues to be present along the Calaveras fault as indicated by a seismic surficial fault rupture in numerous localities.

4.1.2 Greenville Fault

The Greenville fault lies 5.2 miles (8.3 km) east of the project alignment. Recent investigations of the Greenville fault and Mount Diablo thrust indicate that these two structures are geometrically linked, with the Mount Diablo thrust acting to transfer strain from the Greenville fault to the Concord-Green Valley fault (Unruh and Sawyer, 1997). This suggests that the Greenville fault does not continue to the north as previously mapped, but dies out near Morgan Territory Road. Two earthquakes during January 1980 on this fault measured Richter magnitudes of 5.9 and 5.8.

Available data on the late Quaternary slip rate of the Greenville fault are sparse and have significant uncertainties. The Working Group on California Earthquake Probabilities estimates the slip rate on the Greenville fault to be about 0.08 inch/year (2 mm/yr) (WGCEP, 2003). Based on correlation of terraces south of Livermore Valley offset by the Greenville fault, Wright et al. (1982) documented approximately 295 feet (90 m) of Pleistocene displacement. The deformed terraces were estimated to be 125,000 to 180,000 years old, based on soil profile development, thus implying a slip rate of 0.02 to 0.03 inch/year (0.5 to 0.7 mm/yr) (Wright et al., 1982). Paleoseismic trench investigations across one of the strands of the northern Greenville fault documented evidence for Holocene surface-rupturing events. Wright et al. (1982) estimated a horizontal slip rate of approximately 0.004 to 0.01 inch/year (0.1 to 0.3 mm/yr) with a recurrence interval estimated to be on the order of 550 years. Recent investigations by Unruh and Sawyer (1998) and Sawyer and Unruh (2002) indicate a 43.5-mile (70-km) length for the active Greenville fault. Preliminary Holocene slip rate estimates from a site at the northern end of the Livermore Valley are 0.16 ± 0.07 inch/year (4.1 ± 1.8 mm/yr) (Sawyer and Unruh, 2002). However, Unruh cites strong geomorphic and structural evidence to support a more limited rupture length for a Maximum Credible Earthquake (MCE) on the Greenville fault. Detailed geomorphic and preliminary paleoseismic investigations support a maximum rupture length of 26.7 miles (43 km) along the northern part of the Greenville fault; equivalent to rupture of the Livermore and Arroyo Mocho sections of Unruh and Sawyer (1998). A rupture of this length would generate a MCE of **M** 7.

4.1.3 Verona Williams Fault

The Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. This fault is shown as an uncertain trace over a curving length of about 4 miles (6½ km) along the base of the hills on the north side of the Vallecitos Valley (CGS, 2000).

Because the CGS believes that there is insufficient evidence to indicate that this fault is inactive and that there is sufficient evidence to indicate that this fault is potentially active, it is included within an Alquist-Priolo Earthquake Fault Zone (Hart, 1975; CDMG, 1982a).

4.1.4 Las Positas Fault

The Las Positas fault was originally mapped in 1975 and 1977 by Herd as a northeast-trending, 9.3-mile (15-km) long zone of left-lateral strike slip faults. Herd showed the southwest end of the fault (the end closest to the project alignment) covered by alluvium and landslides. Herd cites geomorphic features including scarps and several drainages that have been deflected as evidence for recent movement along the fault. Radiometric dating of buried charcoal from a faulted stream terrace indicated that faulting has occurred 17,400 ± 250 years ago (Carpenter et al., 1980). Bonilla et al. (1980) described several en echelon fractures that they attributed to tectonic movement along the Las Positas fault following the two1980 Livermore earthquakes on the Greenville fault. An analysis of seismicity in the Livermore Valley area following these two earthquakes showed that the movement along the Las Positas fault was left lateral and that this fault is "probably seismically active", although the analysis of the limited data set compiled for this study could not prove seismic activity (Ellsworth and Marks, 1980).

California Division of Mines and Geology Fault Evaluation Report 112 by Smith (1981) summarizes the exploratory work and mapping that were performed by numerous authors to evaluate the activity of the Las Positas fault and this document was used to justify the delineation of the Earthquake Fault Zone along a portion of this fault. The Alquist-Priolo Earthquake Fault Zone delineated along the Las Positas fault is located about 3.5 miles (5.6 km) northeast of the end of the project alignment (CGS, 2000).

4.2 PEAK BEDROCK ACCELERATION

The active faults close to the SR84 alignment between Ruby Hill Drive and Jack London Boulevard are the Greenville, Calaveras, and Verona Williams faults. The Greenville fault, Calaveras fault, and Verona Williams fault are designated with MCE magnitudes of 7.25, 7.5 and 6.0, respectively, by the California Seismic Hazard Map (Mualchin, 1996). The locations of these faults and associated peak bedrock acceleration (PBA) contours were obtained from the California Seismic Hazard Map and transferred to a topographical map showing the SR84 structure. Three faults contribute the same level of ground shaking at the site (0.5g) even though the Verona Williams fault is closest to the site. The MCE, nevertheless, is the earthquake on the Calaveras fault since it potentially releases the highest energy (M=7.5). The SR84 alignment is roughly parallel to the Calaveras fault, and the distance from the site to the Calaveras fault is approximately 4.5 miles (7.3 km).

Table 4-1 Seismic Source Parameters

Fault	Type	MCE	Distance		Near Field Effects?	Design PBA (g)
			(km)	(miles)		
Calaveras	strike-slip	7.5	7.3	4.5	Y	0.5
Greenville	strike-slip	7.25	8.3	5.2	Y	0.5
Verona Williams	Unknown	6	2.8	1.7	Y	0.5

4.3 POTENTIAL GEOLOGIC HAZARDS

4.3.1 Surface Fault Displacement and Ground Shaking

The project alignment does not cross any Alquist-Priolo Earthquake Fault Zones. Surface rupture due to faulting along the alignment, therefore, is not expected to occur. However, the short distance to the Earthquake Fault Zones along the Calaveras, Verona Williams, Greenville and Hayward faults, does create a high risk for ground shaking from fault movement. The intensity of the ground shaking is dependent upon the size of the earthquake, the distance of the epicenter from the site, the direction that the earthquake propagates along the fault, and the site geologic conditions. Section 4.2 "Peak Bedrock Acceleration" discusses the anticipated seismic shaking from these more distant faults.

4.3.2 Landslides

With the exception of the southern portion of the project alignment where it enters the mouth of a canyon, the roadway is on relatively flat ground and is not subject to landsliding. Our reconnaissance mapping along the alignment indicates that there are two small landslides that extend into the existing right-of-way. These landslides are both about 150 feet in width and 220 to 240 feet in length and occur on the slopes located east of SR84 (see Figure 1-11), opposite Station 247+00 and 250+00. These are both old rotational slump type landslides that are overgrown with trees and brush. Both of the landslides toe out in a small drainage channel that parallels the eastern edge of the roadway. Boring NB04 was drilled about 100 feet west and northwest of the toe of these landslides for a proposed retaining wall. Although the toes of these old landslides extend into the existing right-of-way, they should not impact the proposed improvements. Therefore, landslide mitigation is not anticipated. No other landslides were noted in the vicinity of the project alignment and a review of the U.S. Geological Survey landslide map for the Livermore quadrangle (Nilsen, 1975) does not show any other landslides.

4.3.3 Liquefaction

Liquefaction is a phenomenon whereby sediments temporarily lose shear strength and collapse. This condition is caused by cyclic loading during earthquake shaking that generates high pore water pressures within the sediments. The soil type most susceptible to liquefaction is loose, cohesionless, granular soil below the water table and within about 50 feet of the ground surface. Liquefaction can result in loss of foundation support and settlement of overlying structures, ground subsidence and translation due to lateral spreading, lurch cracking, and differential settlement of affected deposits. Lateral spreading occurs when a layer liquefies at depth and causes horizontal movement or displacement of the overburden mass towards a free face such as a stream bank or excavation, or towards an open body of water.

In a regional study of the nine-county San Francisco Bay region for the U.S. Geological Survey, Witter et al. (2006) mapped the liquefaction susceptibility of the site soils along the project alignment. The alluvium between Jack London Boulevard and Stanley Boulevard (Station 401+00) is mapped as having "high" liquefaction susceptibility. Between Stanley Boulevard and Arroyo Del Valle (Station 321+00) the alluvium is mapped as having "moderate" liquefaction susceptibility. From Arroyo Del Valle extending south about 1,500 feet to Station 304+00 the

alluvium is mapped as having "high" liquefaction susceptibility and south of this point to the southern end of the project alignment the soils have a "moderate" liquefaction susceptibility. The historic channel deposits in the active channel of both Arroyo Del Valle and Arroyo Mocho are mapped as having "very high" liquefaction susceptibility.

Based on a review of the borings completed along the alignment, a few thin layers of medium dense sand and silty sand were encountered in the upper 20 feet, primarily north of Arroyo Del Valle. These upper granular soils could be subject to liquefaction if saturated, however the depth to groundwater is at least 20 feet or greater based on the borings drilled in this area. More specifically, groundwater was observed in Borings NB01 (20 feet bgs), NB10 (23.5 feet bgs) and NB22A (24.7 feet bgs), as well as the December 2009 Borings NB30 (24 feet bgs), NB31 (28 feet bgs), and NB35 (14.5 feet bgs). At and below these depths the soils encountered were mostly dense to very dense sands and gravels, interbedded with medium stiff to hard clays; therefore, the potential for liquefaction of these materials to occur is also considered to be low. An approximately 5-foot-thick discontinuous pocket of medium dense sandy silt was encountered in Boring NB37 at a depth of about 43 feet below the channel bed (about Elevation 360 feet). This layer is considered potentially liquefiable based on driving resistance, and the likely consequence would be localized, liquefaction induced settlement of less than ½ inch.

4.3.4 Subsidence and Settlement

Subsidence typically occurs as a result of subsurface fluid extraction (e.g. groundwater, petroleum) or compression of soft, geologically young sediments. Groundwater extraction for high volume municipal and agricultural use has the potential to cause future ground subsidence in the region. However, we are not aware of subsidence in the area. No active petroleum wells are present within many miles of the site (California Division of Oil, Gas, and Geothermal Resources, 2001).

Settlement can occur quickly when soil is loaded by a structure or by the placement of fill on top of soil and it can also occur gradually when soil pore pressures, increased by vertical loading, gradually dissipate over time. This second type is termed consolidation settlement. It is unlikely that the load imposed by the proposed project improvements will cause settlement.

Compaction settlement, or seismic densification, occurs when loose granular soils above the water table increase in density as a result of earthquake shaking. The soil densification can result in differential settlement because of variations in soil composition, thickness, and initial density. For design, we estimated the potential post-earthquake settlement at a number of borings (NB03, NB06, NB17, NB20, B12 at Stanley Boulevard, and NB26) ranging in depth from 20 to 80 feet and using the computer program LIQUEFY PRO that is based on National Center for Earthquake Engineering (NCEE) procedures of liquefaction analysis. In our analyses we used a peak ground acceleration of 0.5 g and design earthquake moment magnitude of 7.5. The results of these studies are presented in Appendix E. As previously mentioned, occasional layers of medium dense granular soils were encountered in a few of the borings, mostly located north of Arroyo Del Valle. These granular layers may be subject to cyclic densification during strong ground shaking. Based on our analyses, we estimate compaction settlement of less than ½ inch.

4.3.5 Flooding

With the exception of the active channels of Arroyo Del Valle and Arroyo Mocho, the project alignment is located outside of the 100-year flood zone as shown on the FEMA flood hazard zone maps (ABAG, 2007).

4.4 SCOUR

The channel and side slopes beneath Arroyo Del Valle Bridge presumably are not lined with stone riprap or concrete. Based on a hydraulic analysis (Wreco - January 31, 2008), the estimated scour depth is up to about 22 feet, if the channel bottom and side slopes are left unprotected. In order to protect the new and existing foundations from scour, we understand rock slope protection options are being considered.

The channel and side slopes beneath existing Arroyo Mocho bridge are concrete lined; the new widened section will be concrete lined. For the proposed Access Bridge, estimated scour depth is about 1 foot (Wreco, 2008). Since new footing depth is at least 5 feet, we understand additional slope protection is not planned for the Access Bridge.

4.5 CORROSION

Results of a site specific study and recommendations regarding the corrostivity of soils and groundwater at these structures are presented in more detail in Section 7.

5.1 STRUCTURAL SECTION DESIGN PARAMETERS

Structural section designs described in the following paragraphs follow in general the Caltrans Highway Design Manual dated September 1, 2006, Chapters 600-670 "Pavement Engineering", and in particular Chapter 630 "Flexible Pavement".33

Acronyms used in this section are defined in Section 2.1 "Original Construction".

We also followed these guidelines in developing the new structural pavement sections:

- To provide continuity of pavement drainage layers, matching bottom of new ATPB layer with bottom of existing ATPB layer, where new pavement section is located on the down gradient direction of the existing pavement.
- Where no ATPB layer in existing pavement section or the new pavement section is to be on the up gradient direction of existing pavement, a new pavement section with no drainage layer will be specified. Thicken new HMA so top of existing ATPB layer matches top of new AB.
- Total overlay thicknesses are 0.15 or 0.25 foot, as discussed in Section 5.5 "Pavement Overlay."
- To minimize the number of grading planes for the various components of the structural section; i.e. HMA, AB or AS layers may be thicker than the calculated minimum thickness.
- To provide continuity of pavement underdrainage where permeable material (Perm) layer is required in cut, matching new Perm layer (top and bottom) with existing Perm layer (top and bottom).
- Where Perm layers are not required, both AB and AS are required; AB layer must be included.
- Where widening is required, saw cut line should be at least 1 foot from existing edge of travel way and be on the upslope side of existing edge drains.

5.1.1 Traffic Data

The projected traffic loading for the SR84 Expressway Widening design is given in terms of traffic indices (TI). The TI for a 20-year design life was determined by URS in agreement with Caltrans. Accordingly, a TI of 11.0 applies for all mainline lanes, as well as the ramp at Stanley Boulevard.

5.2 SUBGRADE CONDITIONS

The subgrade conditions beneath the areas of the proposed roadway and ramp modifications were revealed by the exploratory borings listed previously in section entitled "Roadway, Culvert and Embankment Foundations." Twenty three bulk samples were retrieved from the borings along SR84 and two from Vallecitos Road, and all were submitted to R-value testing; the test results are summarized in the table below and in Appendix F.

Table 5-1 R-Value Test Results

Boring	R-Value	Plasticity Index	Soil Description	Depth Interval (feet)	Control Line Designation	Stationing (feet)	Offset (feet) (2)
RB01	1 and 3 (1)	21	CL	1-5	ML	230+68	5½ Lt
RB41	5	15	CL	1-5	ML	230+17	7 Rt
RB42	7		CL	1-5	ML	237+88	30.5 Lt
RB03	65		CL	1-5	ML	243+42	27½ Rt
RB04	69		SP	1-5	ML	253+70	68 Rt
RB05	11	5	CL	1-5	ML	260+11	4 Rt
RB07	45		GP-GM	1-5	ML	270+16	7¾ Lt
RB10	12	15	CL	1-5	ML	284+94	3¼ Lt
RB11	31		SC	1-5	ML	289+94	6 Lt
RB12	31		CL-GM	1-5	ML	295+52	32¾ Lt
RB14	35		SM	1-5	ML	305+99	10¾ Rt
RB16	51		GW-GM	1-5	ML	324+39	30 Lt
RB18	59		SM	1-5	ML	332+97	31 Lt
RB21	29		GM	1-5	ML	356+49	11¾ Lt
RB24	25		ML	1-5	ML	369+58	49¼ Lt
RB25	54		SM	1-5	ML	374+38	9½ Rt
RB28	68		SM	1-5	ML	393+06	125¼ Rt
RB31	57		CL	1-5	ML	400+73	412¾ Rt
RB33	43		SM	1-5	ML	408+67	36¾ Rt
RB35	18		CL	1-5	ML	422+03	12½ Lt
RB37	7		CL	1-5	ML	432+76	5¾ Lt
RB40	72		SP-SM	1-5	ML	447+24	2½ Lt
NB30	15(3)		CL	1-5	VEX	51+26	34 Rt
NB36	58(3)		SP-SC	1-5	V1	116+11	25¼ Lt

1. Actual values are 1 and 3 on two different adjacent soil samples.
2. Lt = Left, Rt = Right
3. Along Vallecitos Road

Caltrans defines an “expansive subgrade” as soil with a plasticity index (PI) greater than 12 and California R-value less than 10. On this basis only the samples from RB01, RB10 and RB41 fall in this category or are close to this category.

R-value tests were performed on bulk samples obtained from the subgrade directly under the existing asphalt concrete and aggregate base structural pavement (shoulder) or on fill or native soil in the median at depths in the upper 1 to 5 feet. As shown in the above table, with the exception of RB01 the results of the tests range from an R-value of 5 to 72 for the twenty five soil samples. However, in order to assign design R-values we plotted the numerical distribution of R-values in Figure 5-1 and the distribution of R-values along the alignment in Figure 5-2. As shown on Figure 5-1, R-values fall in a wide range of 1 to 72. The geographical distribution of R-values is shown in Figure 5-2. We reviewed the Profile Grade sheets in Appendix B, which show minimal cut below present grade (generally 0 to 4 feet). Minor new fill (0 to 4 feet) is anticipated only in two areas, one near Ruby Hill Drive and the other at Arroyo Del Valle Bridge. On this basis, the selected R-values of the anticipated subgrade soils are summarized in the following table.

Table 5-2 Subgrade Design R-values

Segment Number	Approximate "A-1" Line Station Limits (feet)		Segment Length (feet)	Design R-value	Boring Number
	From	To			
1	227+00	246+80 (Ruby Hill Drive)	700	5	RB41, RB42
2	246+80	290+00	5,600	10	RB03, RB04, RB05, RB07, RB10
3	290+00	415+00 (Arroyo Mocho)	12,500	25	RB11, RB12, RB14, RB16, RB18, RB21, RB24, RB25, RB28, RB31, RB33
4	415+00	450+00	3,500	5	RB35, RB37, RB40
		Total	**22,300**		

We understand an R-value of 5 was used for original design in Segment 1. R-value tests at Boring RB41 and RB42 are 5 and 7, respectively; these results confirm the lean clay subgrade soils in this area. Although two soil samples at RB01 (about Station 230+68) revealed R-value test results lower than 5, the lack of pavement distress along this segment of Isabel Avenue indicates that the structural pavement section based on a design R-value of 5 appears appropriate. For these reasons, we recommend new pavement be designed with a minimum R-value of 5 for Segment 1. Alternatively, consideration was given to excavating the subgrade soil in Segment 1 to a depth of 4 feet and replacing it with imported fill that meets the requirement of R-value greater than 15 pursuant to the Standard Specifications. However, as shown on Sheet X-2, the existing shoulder (in Segment 1) will be partially removed, as well as soil outside the shoulder; this cut slot width will range from 4 to 6.9 feet (Station 226+97.10 to 234+50.00), 4 to 10 feet (Southbound Shoulder Details Station 226+97.10 to 232+40.00) and 2 to 20.9 feet (Southbound Shoulder Details Station 232+40.00 to 234+50.00). The lower bound widths (2 to 4 feet) in combination with a 4 foot subgrade cut would require removal of a portion of the shoulder pavement to allow compaction with a standard roller. For that reason, no further consideration was given to this alternative.

For the Route 84 portion of the project (excluding Vallecitos Road), the estimated cut quantities are very large when compared to the estimated fill quantities. Similarly, between Stations 290+00 and 415+00 (where high soil R-values of 25 are available), the estimated cut quantities are also very large when compared to the estimated fill quantities. Since there is excess high R-value cut available between Stations 290+00 and 415+00 (Segment 3), we recommend the Segment 3 cut material be placed within 4 feet of the grading plane in Segment 3.

For only the Vallecitos Road portion of the project (along "V" Line and "VEX" Line), the cut quantities are very small when compared to the estimated fill quantities. More than 40,000 cubic yards of cut will need to be transported from along Route 84 and be placed as fill along Vallecitos Road. A subgrade R-value of 15 was used for pavement structural design along Vallecitos Road. Since there is excess high R-value (of 25) cut available between Stations 290+00 and 415+00 (Segment 3), we recommend the Segment 3 cut material also be placed within 4 feet of the grading plane in fill areas along Vallecitos Road. There also is approximately 2,000 cubic yards of cut available (R-value of 15 or greater) along Vallecitos Road that can be reused as fill along Vallecitos Road and placed within 4 feet of the grading plane.

5.3 EXISTING STRUCTURAL PAVEMENT SECTIONS

The existing pavement structural sections for SR84 and adjacent ramps were discussed previously under the section entitled "Existing Structural Pavement Sections" and are presented in Appendix B.

5.4 NEW STRUCTURAL PAVEMENT SECTIONS

5.4.1 Background

As discussed in a later section entitled Section 6.3, "Storm Drainage System", all cuts for new pavement require an underdrain system consisting of a layer of permeable material with toe (underdrains) drains. The approximate Station limits of these cuts are summarized as follows:

- Between "A1" Line Stations 247+00 to 262+00
- Between "A1" Line Stations 388+90 to 411+85

In addition, existing underdrain systems should be extended under the widened roadway. As presented in Section 2.2, a blanket drain underdrain system is present between Stations 388+88 and 411+85

There is an existing drainage ditch on the west side of Route 84 beginning at "A1" Station 230+00 and terminating at "A1" Station 242+40. This drainage ditch is also shown on plan sheet X-3 cross section "A1" 240+00.07 to "A1" 246+00.00. Beginning at this latter location, a new culvert will be constructed under the highway terminating on the east side of Route 84. From the east side of Route 84, another drainage ditch continues northward. As shown on Sheet X-3, a new embankment is also planned on the west side of Route 84; the fill will be placed on the existing drainage ditch. We anticipate some overexcavation of unsuitable material (see Standard Specifications Section 19-2, Roadway Excavation) below the ditch bottom.

We recommend that a note be added to the Project Plans stating "The elevation of the ATPB layer may be adjusted during construction in order to match the elevation of the existing ATPB layer". Some funds should be included in the PS&E to allow the Resident Engineer to make this adjustment.

An edge drain is recommended at the edge of new shoulders where ATPB layers are included in the pavement structural section.

At locations where widening includes removing existing shoulder sections with edge drains, the saw cut line should be placed about 1 foot from the existing edge drains, on the upslope direction.

We have analyzed structural pavement design, numbered Structural Pavement Cross Sections (SPCS) 1 through 8 for the mainline and shoulder of SR 84. SPCS 10 through 13 are for Vallecitos Road, the trails and quarry access roads. The recommended sections were estimated using the Caltrans HDM method, and then, optimized to aim at reducing the total required number of sections following the guidelines presented in Section 5.1. Figures 5-3, 5-4 and 5-5 present schematically the beginning and end stations of each SPCS and corresponding design plan Typical Cross Section (TCS) numbers. Detailed descriptions of the SPCS and the corresponding TCS are presented in Section 5.4.3. For reference purposes, the South Segment limits are A1 Station 226+97 to A2 Station 364+00 (Figure 5-5), whereas the North Segment limits are A2 Station 364+00 to A3 Station 447+76 (Figures 5-3 and 5-4).

5.4.2 RHMA Considerations

Consideration was given to Rubberized Hot Mix Asphalt Concrete (RHMA) as a structural course. RHMA is formulated by mixing granulated (crumb) rubber with hot asphalt to form an elastic binder with less susceptibility to temperature changes. The rubberized asphalt is substituted for the regular asphalt as the binder for the flexible pavement. RHMA is generally specified to retard reflection cracking, resist thermal stresses created by wide temperature variations and add flexibility to a structural overlay. Caltrans uses gap-graded (RHMA-G) and open-graded (RHMA-O) rubberized asphalt. The difference between the two is in the gradation of the aggregate. RHMA-O is used only as a non-structural wearing course. RHMA-G can be used as either a surface course or a non-structural wearing course. The minimum thickness for RHMA (any type) should be 0.10 foot for new construction and rehabilitation. For pavement preservation, RHMA may be placed as thin as 0.08 foot provided compaction requirements can be met. The maximum thickness for RHMA-G is 0.20 foot. The maximum thickness for RHMA-O is 0.15 foot. It is undesirable to place RHMA-G or RHMA-O in areas that will not allow surface water to drain. As an example, a surface that is milled only on the traveled way and not on the shoulder forms a "bathtub" section that can trap water beneath the surface of the traveled way. To prevent this effect, RHMA-G should be placed over the whole cross section of the road (traveled way and shoulders). For this project RHMA-G is selected.

According to Section 39 of the 2006 Caltrans Standard Specifications, Hot Mix Asphalt (HMA) shall be placed only when the atmospheric temperature is above the following values:

Table 5-3 Hot Mix Asphalt Placement Temperatures

Type of Hot Mixed Asphalt	Specified Atmospheric Temperature ^{o}F
Type A and Type B	45 – 55
RHMA-G	55

We compared the specified placement temperatures to the recorded atmospheric temperatures at the Livermore weather station. The latter graph is presented in Figure 5-6 and shows the (1) average of all daily maximum temperatures recorded between 1961 and 1990, (2) average of all daily minimum (MINADT) temperatures recorded between 1961 and 1990, and (3) average of all daily average temperatures recorded between 1961 and 1990. We then superimposed the specific atmospheric temperatures for Type A and B ($50^{o}F$) on Figure 5-6. Assuming the average of all daily average temperatures is the appropriate temperature criteria, we offer the following conclusions based on Figure 5-6:

- For RHMA a minimum atmospheric temperature of $55^{o}F$ is required
  - At Livermore (Figure 5-6) the expected placement period is between about April 1 and November 1, which is a relatively large window of time.

In summary, the seasonal window of time for placement of Types A and B as well as RHMA is relatively large.

We also reviewed local availability of RHMA, which is summarized in Table 8-1 along with other materials. Teichert Aggregate (haul distance about 20½ miles) and Granite Rock (haul distance about 1 mile) indicated they can set up a mobile plant to manufacture RHMA-G.

In summary RHMA-G is locally available but will require setting up a temporary plant for this project.

5.4.3 Recommended SPCS

Table 5-4 presents the design plan Typical Cross Section (TCS) numbers corresponding to the SPCS numbers. As reference, the Typical Cross Sections for the north segment are presented in Appendix G.

Table 5-4 Structural Pavement Cross Section versus Design Plan Typical Cross Section

Structural Pavement Cross Section	Project Segment	Design Plan Typical Cross Section
SPCS 1	North	TCS 3
SPCS 2	North	TCS 3B
SPCS 3	North	TCS 4
SPCS 4	North	TCS 5
SPCS 5	North	TCS 6
SPCS 6	North	TCS 7
SPCS 7	South	To be determined
SPCS 8	South	To be determined
SPCS 9	South	To be determined
SPCS 10	North	TCS 8
	South	To be determined
SPCS 11	North	TCS 13
	South	To be determined
SPCS 11A	North	TCS 10
SPCS 12	South	To be determined
SPCS 13	South	To be determined for Vallecitos Road

Recommended SPCS 1

Design Factors for SPCS 1, TI_{20} = 11.0, R-value = 5, GE (required) = 3.34 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.60	1.44
Class 2 AB 1.25	1.38
Class 4 AS 0.75	0.75
Total	**3.57**

In addition to mainline and shoulder lanes, SPCS 1 could be specified for roadway where widening and/or improvements are located on the up gradient direction of existing pavement sections consisting of ATPB layers.

Recommended SPCS 2

Design Factors for SPCS 2, TI_{20} = 11.0, R-value = 5, GE (required) = 3.34 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.60	1.44
Class 2 AB 1.25	1.38
Class 3 Perm 0.75	0.75
Total	**3.57**

SPCS 2 should be specified for roadway where cuts are required to accommodate widening and/or improvements locating on the up gradient direction of existing pavement sections consisting of ATPB layers.

Recommended SPCS 3

Design Factors for SPCS 3, TI_{20} = 11.0, R-value = 25, GE (required) = 2.64 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.75	1.83
Class 2 AB 1.10	1.21
Class 4 AS 0.75	0.75
Total	**3.79**

Recommended SPCS 4

Design Factors for SPCS 4, TI_{20} = 11.0, R-value = 5, GE (required) = 3.34 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.60	1.44
ATPB 0.25	0.35
Class 2 AB 1.00	1.10
Class 4 AS 0.75	0.75
Total	**3.64**

Recommended SPCS 5

Design Factors for SPCS 5, TI_{20} = 11.0, R-value = 5, GE (required) = 3.34 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.75	1.83
ATPB 0.25	0.35
Class 2 AB 0.85	0.93
Class 4 AS 0.75	0.75
Total	**3.86**

Recommended SPCS 6

Design Factors for SPCS 6, TI_{20} = 11.0, R-value = 25, GE (required) = 2.64 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.60	1.44
ATPB 0.25	0.35
Class 2 AB 1.00	1.10
Class 3 Perm 0.75*	0.75
Total	**3.64**

*Includes underdrain (toe drain)

Recommended SPCS 7

Design Factors for SPCS 7, TI_{20} = 11.0, R-value = 10, GE (required) = 3.17 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.55	1.31
ATPB 0.25	0.35
Class 2 AB 0.60	0.66
Class 4 AS 1.00	1.00
Total	**3.32**

Recommended SPCS 8

Design Factors for SPCS 8, TI_{20} = 11.0, R-value = 10, GE (required) = 3.17 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.55	1.31
Class 2 AB 0.85	0.93
Class 4 AS 1.00	1.00
Total	**3.24**

Recommended SPCS 9

Design Factors for SPCS 9, TI_{20} = 11.0, R-value = 5, GE (required) = 3.34 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.55	1.31
Class 2 AB 1.00	1.10
Class 4 AS 1.00	1.00
Total	**3.41**

In addition to mainline and shoulder lanes, SPCS 9 could be specified for roadway where widening and/or improvements are located on the up gradient direction of existing pavement sections consisting of ATPB layers.

Recommended SPCS 10

This structural pavement section is recommended for trail pavement sections along lines TR2, TR3 and TR4.

Design Factors for SPCS 10, TI_{20} = 5.0, R-value = 15 (Fill), GE (required) = 1.46 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
HMA 0.60*	1.58
Total	**1.58**

*Full depth HMA

Recommended SPCS 11

This structural pavement section is recommended for Discovery Drive (D Station 38+34 to 39+29), access roads to quarry from "AC1" Line Station 120+20 to 164+23 and trail pavement "TR1" Line.

Design Factors for SPCS 11, TI_{20} = 10.0, R-value = 25, GE (required) = 2.40 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
HMA 0.50	0.90
Class 2 AB 1.40	1.54
Total	**2.44**

Quarry vehicles including hauling trucks are expected to utilize trail TR1; therefore, a section compatible to the quarry access road should be used. Alternatively, a full depth HMA section with a thickness of 1.1 feet can be specified; this alternative is numbered as SPCS 11A.

Recommended SPCS 12

This structural pavement section is recommended for Access Roads to Quarry Section from "AC2" Line Station 212+53 to 223+97, and it should use same structural section as SPCS 11.

Design Factors for this section are as follows:

TI_{20} = 8.0, R-value = 5, GE (required) = 2.43 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
HMA 0.50	1.00
Class 2 AB 1.40	1.54
Total	**2.54**

For the above table, we assumed (1) the same HMA thickness and the same Class 2 AB thickness as for SPCS 10 and (2) a reduced TI_{20} = 8.0. The latter value is not known, but is believed to be less than 10.0 and is consistent with the traffic volume at the quarry. Conservatively, we have also reduced the R-value = 5 from 25 for SPCS 11.

Recommended SPCS 13

This structural pavement section is recommended for Vallecitos Road from "V" Line Station 100+97 to 115+64.

Design Factors for SPCS 13, TI_{20} = 11.0, R-value = 15*, GE (required) = 2.99 feet.

Recommended Structural Section	
Structural Section (feet)	**Gravel Equivalent (feet)**
RHMA-G 0.15	
HMA 0.45	1.07
Class 2 AB 0.65	0.72
Class 4 AS 1.20	1.20
Total	**2.99**

*The proposed alignment of the new portion of Vallecitos Road is expected to be placed on imported fill. On that basis, a subgrade R-value of 15 is appropriate for the new structural pavement section. Furthermore, two subgrade R-value test results (NB30 and NB36) of 15 and 58 also are consistent with a design R-value of 15.

5.5 PAVEMENT OVERLAY

5.5.1 Background

CHEC Management Systems, Inc., under subcontract to URS, performed field deflection tests on March 11 and 12, 2008 on existing AC sections on both SR84 mainline and AC outside shoulders. Testing was performed by CHEC using the Dynaflect nondestructive pavement testing device in accordance with California Test Method (CTM) 356. This device places a 1,000 pound oscillatory load on the pavement surface. Motion sensing geophones (sensors) placed on the pavement surface read the pavement deflection resulting from the load. A strong pavement will deflect less than a weak pavement under the same loading.

The analysis and initial recommendations are presented in the CHEC report dated March 20, 2008 and their letter dated April 4, 2008 (see Appendix H) and were developed for a Design Traffic Index (TI) of 11.0.

5.5.2 Overlay Recommendations

The following table provides design recommendations for each of six pavement segments.

Table 5-5 Summary of AC Overlay Recommendations

Segment Number	From	To	CTM Structural Requirement	Overlay Design Recommendations
1	Jack London Blvd.	Stanley Blvd.	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(1)
2	Stanley Blvd.	Concannon Blvd.	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(1)
3	Concannon Blvd.	Vineyard Ave.	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(2)
4	Vineyard Ave.	Pavement Change North of Vallecitos Road	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(2)
5	Pavement Change North of Vallecitos Road	Pavement Change South of Vallecitos Road	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(2)
6	Pavement Change South of Vallecitos Road	Ruby Hill Road	0.25 ft HMA Overlay	0.15 ft. RHMA-G and 0.10 ft HMA Overlay (surface layer)(2)

(1) The HMA overlay (0.15 or 0.13 foot) was omitted in Segment Numbers 1 and 2 at the request of Caltrans; they stated "this proposed overlay is a very conservative design since the pavement was constructed in 2000±."

(2) As-built information in Table 2-1 (Existing Typical Structural Sections) reveals existing thickness of travelled way of HMA or HMA plus RHMA-G ranging from 0.54 to 0.64 foot. According to Caltrans Flexible Pavement Rehabilitation Design Manual (CFPRDM) dated 2001 (Chapter 4) and HDM Section 635, overlay thickness to retard reflective cracking should be at least one-half the thickness of the existing HMA pavement. Therefore, the overlay thickness should be in the range of 0.27 foot (½ x 0.54) to 0.32 foot (½ x 0.64). Since RHMA-G has a thickness equivalency of 1:2 (HDM Table 635.1D) compared to HMA, the RHMA-G required overlay should be in the range of 0.13 foot (½ x 0.27) to 0.16 foot (½ x 0.32). However, the 0.16 foot RHMA-G overlay applies to about 1,200 feet of roadway constructed in 2007. Therefore, it is our engineering opinion that a uniform overlay thickness of 0.15 foot meets the intent of both CFPRDM and HDM.

The above recommendations were made based on criteria and analyses in Caltrans Flexible Pavement Rehabilitation Design Manual (2001) and Highway Design Manual (HDM 2009). The purpose of the overlay is to extend the service life of the existing structural pavement by a minimum of 10 years. Each segment of road needs to satisfy both the structural and reflective requirements of the design procedure.

CHEC provided these additional guidelines:

- With asphalt overlays, wedge cutting is recommended at all conforms to provide a smooth taper and transition.
- Prior to an overlay, an application of a tack coat is required for a proper bond.
- According to Caltrans, all areas of moderate to severe alligator cracking and/or bleeding should be removed to the top of aggregate base or ATPB, not to exceed a depth 0.50 foot. The dig out should be replaced with HMA.
- According to Caltrans, all transverse and longitudinal cracks wider than ¼ inch should be sealed with a low modulus asphalt crack sealant or asphalt rubber (instead of emulsified

crack sealant). Emulsion needs time to break and its placement becomes a concern because of limited lane closure hours in District 4.

6.1 FOUNDATION TREATMENT

6.1.1 Clearing and Grubbing

Before any grading begins, all locations to be filled should be cleared of existing improvements (rails, posts, curbs, pavements, etc.), all debris, vegetation, and any soils containing roots or other vegetative matter in accordance with Section 16 of Caltrans Standard Specifications. A stripping depth of 4 to 6 inches is estimated. The entire root ball of large shrubs should be removed, including all roots greater than 1 inch in diameter.

6.1.2 Subgrade Preparation

Immediately after existing guardrail posts have been removed, the resulting voids should be backfilled with slurry cement up to present ground surface in accordance with Caltrans Standard Specifications Section 19-3.062 "Slurry Cement Backfill".

All subgrades should be prepared in accordance with Caltrans Standard Specifications Section 25-1.03 "Subgrade". After the areas to receive fill have been cleared and stripped, the exposed subgrade soil should be scarified, moisture conditioned to near the optimum moisture content, and compacted to the requirements of fill to a minimum depth of 6 inches. When the subgrade has been compacted and approved by the Engineer, fill can be placed to provide the desired finished grades.

6.1.3 Fill Material

In general, materials intended for use as fill materials should be a soil or soil/rock mixture that is free of organic matter and other deleterious substances in accordance with Section 19 of Caltrans Standard Specifications. In addition, these materials should have an R-value greater than 25 to be consistent with the design R-value used in pavement structural design. All import material should meet these requirements and should be approved by the Engineer prior to construction. Asphalt concrete and aggregate base that are pulverized to meet the size requirements for fill material detailed above, could be reused as fill.

6.1.4 Fill Placement

All fill should be constructed in accordance with Caltrans Standard Specifications Section 19, entitled "Earthwork." Relative compaction of not less than 90 percent should be achieved in all fill materials, except where 95 percent is required.

6.2 ESTIMATED SETTLEMENT

6.2.1 General

Based on the profile sheets (in Appendix I) along the SR84 "A-1", "A-2" and "A-3" lines, cuts and fills are generally less than 2 feet in height. Exceptions to this for cuts include: (1)

maximum cut of about 4 feet between approximately Stations 249+00 to 251+00, (2) maximum cut of about 28 feet at Station 256+00 for a tie-back retaining wall and (3) maximum cut of about 3 feet between about Stations 422+00 and 473+00. Exceptions to this for fill include: (1) maximum fill height of 3 feet between Stations 227+00 and 230+00, (2) maximum fill height of order 4 feet or more between Stations 241+00 and 245+00, and (3) maximum fill height of 2 feet at approach embankments at Arroyo Del Valle between Stations 317+00 and 322+00.

6.2.2 Most Fill Areas

Most new fill depths are less than 2 feet. In these areas, it is our opinion (1) that immediate settlement of well compacted fill should be less than ⅛ inch and (2) that long term settlement of these fill areas should be negligible.

6.2.3 Maximum Fill Area

As discussed above, maximum fill height is about 4 feet (or more) between Stations 241+00 and 245+00. We estimate immediate settlement at this location should be about ¼ inch and long term settlement should be negligible.

At the approach embankments for the Arroyo Del Valle bridge, we estimate immediate settlement should be less than ¼ inch and long term settlement should be negligible.

6.2.4 Surcharge and Monitoring

The immediate settlement estimated above is expected to occur during placement of fill, as a result of elastic compression of granular and cohesive soils. Long term consolidation settlement of clay soils is not anticipated (1) since groundwater is relatively deep and (2) clays below groundwater are generally hard and relatively incompressible. Considering that the estimated settlements are relatively small, we see no need for (1) surcharging the fills and (2) monitoring the settlement of fills with settlement monitoring devices.

6.3 STORM DRAINAGE SYSTEM

To intercept and transmit storm water, new and realigned storm drains, and raising of some existing drain inlets are planned as shown in Drainage Plan drawings D-1 through D-14 in Appendix J.

In general, the retaining wall drainage system probably should be separated from the underdrain system. However, retaining wall drainage requirements depend on the type of retaining walls. For example, Standard Type I walls include pervious backfill material about 12 inches thick immediately behind the wall. Whereas, it would be difficult to install a pervious backfill section behind other types of walls such as a soldier pile and lagging anchored wall.

6.4 UNDERDRAIN SYSTEM

New underdrains are planned as shown in Typical Underdrain Detail drawing X-1 and in Appendix G.

We recommend the following guidelines for design of underdrains to handle groundwater.

1. All cuts for new pavement should include an underdrain system consisting of a layer of permeable material with toe drains.
2. All existing underdrain systems should be extended under roadway widening. Please refer to drawing X-1 for typical detail in Appendix G.
   - Remove existing toe drains and extend permeable material layer under new pavement section.
   - Install new toe drains along edge of extended permeable material layer.
   - Extend drainage trench to accommodate the underdrain pipe plus a minimum of 12 inches below the bottom of the permeable blanket. The size of the underdrain pipes should have a minimum diameter of 8 inches.

6.5 UTILITY CROSSINGS

6.5.1 General

As shown on Utility Plan Sheets U-1 through U-23 (Appendix K) there are several existing and planned buried utilities that cross the roadway. In general, we estimate that buried utilities subject to loading from new fill will undergo settlement less than ⅛ inch, except in fill areas described in Section 6.2.3 "Maximum Fill Area" where we estimate settlement of about ¼ inch.

6.5.2 Gas Line Crossing at Station 323+80

6.5.2.1 Description

The location of the proposed 24 inch high pressure PG&E gas main is shown on Sheet U-10 in Appendix K, Utility Plan Drawings. As shown, it will cross under Route 84 and therefore could be installed by a trenchless construction method. It is located about 1,000 feet north of Vineyard Avenue and about 450 feet north of Arroyo Del Valle. According to Caltrans Encroachment Permits Manual, Chapter 600 Utility Permits, Table 6.8 (revised 07/09) and Appendix H, natural gas lines require a minimum 7.5 feet depth of cover (for bore and jack or directional drilling) and should be encased. On that basis, depth to pipe invert is at least 10 feet bgs.

6.5.2.2 Subsurface Conditions

In order to investigate the subsurface conditions at and in the vicinity of the crossing, four exploratory borings (RB16, RB17, NB13 and NB14) were drilled at the locations shown on Sheet X-10, Field Exploration Location Plan 3-10. Boring RB16 is located about 40 feet from the crossing, whereas the other three borings are located about 300 to 400 feet from the crossing. The borings extend to depths of 10 feet (RB16 and RB17), 60 feet (NB14) and 80 feet (NB13) below present ground surface (bgs). Logs of borings are presented in Appendix C Boring Records. Boring RB16 is positioned on the west shoulder, whereas Borings RB-17, NB13 and NB14 are positioned off the east shoulder of Route 84. In addition, Boring NB13 is positioned in the north approach embankment fill for Arroyo Del Valle Bridge. Based on the boring

records, ground surface at RB16 is about Elevation 424; assuming 10 feetto pipe invert; pipe invert is about Elevation 414. Ground surface at RB17 is about 1.7 feet above ground surface at RB16; ground surface at NB13 and NB14 is about 3.2 and 9.2 feet lower, respectively, than ground surface at RB16. Considering the large distance of NB13 and NB14 from the gas main crossing, as well as the lower ground surface, no further consideration was given to soil conditions at NB13 and NB14; only soil conditions at RB16 and RB17 are discussed.

At Boring RB16, an asphalt concrete pavement 6 inches thick was encountered. Underlying the pavement and extending to a depth of 5.5 feet bgs is a layer of dense to very dense well graded gravel. From a depth of 5.5 to 8.3 feet bgs, a deposit of very stiff sandy lean clay with gravel was encountered. Occurring directly below this deposit is medium dense well-graded gravel to the terminal depth of 10 feet.

At Boring RB17, silty gravel with sand occurred from ground surface to terminal depth of 10 feet bgs. In general, this layer is dense, except at 8.5 feet it becomes medium dense.

Both Borings RB16 and RB17 were dry to terminal depth of 10 feet bgs. Groundwater was encountered in distant Boring NB13 at a depth of 14 feet bgs (Elevation 407). This groundwater level is about 7 feet below assumed pipe invert Elevation 414 and may be related to water in Arroyo Del Valle.

6.5.2.3 Experience in Area

We have contacted several PG&E staff familiar with historical pipeline crossings in the Isabel Avenue Livermore area. Based on these conversations, we have summarized below their experience.

One crossing was partially constructed and then aborted more than 10 years ago; it was placed perpendicular to Isabel Avenue near Vineyard Avenue in Livermore. A 24-inch steel gas pipeline crossing was planned; 7.5 feet of cover was required, resulting in a 10 foot deep trench. Reportedly, sand and gravel were encountered using the conventional cut and cover technique and it was difficult to excavate sloping sides within the sand to depths greater than 8 feet or so; shoring was not used. The trench was dry and cobbles and boulders were not encountered. Traffic plates were temporarily placed across trench for night-time traffic. For reasons unknown to the PG&E's representatives, the City (Livermore) cancelled the project before the crossing was completed.

In another separate project, two 24-inch steel gas pipelines were jacked years ago under railroad tracks located near the Stanley Boulevard Underpass at Isabel Avenue. These pipelines were installed using a "pneumatic hammer bore." Reportedly, the pipe installation went well with no problems. In this method, a pneumatic hammer is attached to the inside of a sacrificial piece of carrier pipe; soil on the face is then dislodged with the hammer. The sacrificial pipe and subsequent sections welded on are pushed from a large jacking pit. Once the sacrificial pipe reaches the receiving pit, it is removed and soil is manually excavated for a short distance from inside the next pipe section. A special plug is then placed inside the excavated pipe face and induced water pressure pushes the plug and soil back to the jacking pit where they are removed. Then, this becomes an open pipe. This method requires excavation of a long jacking pit and

carefully setting the jacked pipe to proper grade and slope within the pit. Reportedly, material "nothing of significant size" was encountered, inferred to be boulders and/or cobbles.

6.5.2.4 Discussion

Since open cut trenching is not allowed at this crossing, the Contractor should submit a trenchless construction method based on soil and groundwater conditions, buried existing utilities and surface constraints at the pits and along the alignment. Potential trenchless construction methods considered include pipe ramming, pipe jacking, microtunneling, and horizontal directional drilling, as discussed below.

Such systems are available to install almost any size pipe from about 1 to 10 feet in diameter. It should be noted that in North America the definition of microtunneling has been expanded to include all remote-controlled pipe jacking operations, while in Europe, the definition of microtunneling is limited to non-person entry pipe sizes, which are typically less than about 3 feet in diameter, as discussed below.

Pipe Ramming

Pipe ramming is a trenchless construction method that uses pneumatic percussive blows to advance an open-ended pipe that allows the soil to enter the pipe interior as it advances through the ground. Spoil removal from inside the pipe may be performed by auger, compressed air, or water jetting, and may be done after the entire pipe length is in place, or it may be removed before installation is complete to reduce the ramming force required. Pipe ramming is not-steerable, meaning that subsurface obstruction (such as gravel encountered in Borings RB16 and RB17) or improperly aligned pipes may result in significant deviations from the desired line and grade.

Pipe Jacking

Pipe jacking involves installing a pipeline by pushing pipe sections through the ground with hydraulic jacks assembled in a jacking frame located in a shaft excavation called the jacking pit. This involves constructing the tunnel in a one-pass method by which the casing pipe is pushed directly behind the wheel cutter. The spoils fall into a drum located behind the cutter head and are transported from the tunnel via a conveyor system. These machines are steerable in any direction and use laser guided sights to maintain line and grade. If needed, following the installation of an initial casing for ground support, the final carrier pipe can be constructed safely within the casing. Pipe jacking is favorable at this site since groundwater is below pipe invert.

Microtunneling

Microtunneling is distinguished from pipe ramming and pipe jacking in several ways: 1) microtunneling utilizes remotely controlled equipment that does not require personnel to work underground, 2) microtunneling machines have sophisticated computer controlled guidance systems which are capable of more accurate control of line and grade, and 3) microtunneling machines have the capability to control groundwater inflows and minimize loss of ground

without the need for dewatering or ground improvement. The pipe is then installed using pipe jacking techniques similar to those described above.

Microtunneling machines can generally be divided into two categories: slurry machines and auger machines. In a slurry machine, soil excavated by the cutterhead of the machine passes through slots or ports where it is mixed with slurry in a chamber at the front of the machine. The spoil-slurry mixture is pumped to the jacking pit through slurry discharge pipes, installed inside the jacking pipe string and is discharged to a surface separation plant to remove spoil.

Conversely, an auger machine relies on a continuous flight auger to convey the excavated soil from the face to the jacking pit. The tunnel face is supported by an earth pressure that results from holding the excavated spoil under pressure in a chamber between the cutterhead and bulkhead. A plug is formed in the chamber by forcing the excavated spoil into the chamber and compacting it.

Since both Borings RB16 and RB17 were dry to 10 feet, control of groundwater is not required; therefore microtunnelling is not required to control groundwater.

Horizontal Directional Drilling

Another trenchless construction method that is commonly used is horizontal directional drilling (HDD). HDD methods utilize a guided drilling bit to drill a pilot hole which is subsequently enlarged with various reaming tools. After the hole has been enlarged to the required size, the pipeline is pulled back into the hole in a single operation. Both microtunneling and HDD methods have advantages and limitations that need to be recognized. For example, HDD methods are not generally feasible in soils having a gravel content more than about 50 percent, soils with cobbles and boulders, and in hard rock, stronger than about 12,000 psi. HDD is not advisable at this site due to gravel content exceeding 50 percent at pipe depth in Borings RB16 and RB17.

Geotechnical Engineering Considerations

Selection of the right equipment for the project depends on determining equipment requirements that are compatible with the subsurface conditions that will be encountered during construction. Because of this, it is extremely important to have a thorough understanding of the subsurface conditions and the physical properties of the soil/rock deposits that will be encountered. There are various types of cutterheads that can be used to adapt these machines to a wide range of ground conditions including sand and gravel, stiff clay, cobbles and boulders, and rock. For these reasons, we recommend that additional field exploration be performed near/on the proposed pipeline alignment. At present, Boring RB16 is located about 40 feet from the crossing, whereas other borings are 300 feet or more from the crossing. Therefore, we recommend that two additional borings, each 20 feet deep, be drilled on/near the outside edge of each shoulder. Continuous sampling is recommended.

One advantage to using microtunneling methods is the ability to complete successful pipeline installations where other methods might not be successful. In unstable soil conditions, such as saturated sand and gravel deposits, special microtunneling equipment can be used to safely

install the pipeline without the need for dewatering and without excessive loss of ground and surface settlement.

In general, slurry machines are more appropriate for clean, saturated sand and gravel deposits because they can handle higher groundwater pressures and also provide more precise pressure regulation at the cutterhead that is needed to control loss of ground in these deposits. Auger systems are used mainly for cohesive silts and clays because these materials are capable of forming an impervious plug in the chamber that can resist the hydrostatic pressure.

Mixed face conditions consist of soil and rock in the heading at the same time or, in some cases, two soils with extremely different physical properties in the heading at the same time. A mixed face of soil and rock can result in steering difficulties because the machine will tend to ride up the rock contact following the path of least resistance. The best approach to dealing with these potential problems is to avoid a mixed face of soil and rock if at all possible.

Evaluation of Trenchless Construction Methods

Key issues that should be considered when developing a preliminary construction cost estimate are as follows:

- Geotechnical and groundwater conditions.
- Potential for cobbles, rock, timber debris, tree roots, old foundations, or other obstructions.
- Potential for contaminated soils and/or groundwater.
- Casing requirements.
- Pipe/casing sizes and materials.
- Total length of project, number of drives, and maximum drive lengths.
- Line and grade tolerances.
- Required jacking loads.
- Shaft sizes, depths, and groundwater control requirements.
- Site layout, staging area, site access, and traffic control.
- Equipment requirements and production rates.
- Slurry separation requirements; spoil and slurry disposal sites.

In addition, the following items should be considered in the planning of the project in order to develop a realistic cost estimate:

- Project set up.
- Power supply.
- Water supply.
- Existing utilities.
- Staging areas.
- Traffic control and site access.

The pipeline invert will be positioned at a depth of about 10 feet bgs, or about Elevation 414. At these depths, highly variable deposits of medium dense to very dense well-graded gravel, silty gravel and very stiff sandy clay were encountered in Borings RB16 and RB17. Both borings were dry to the terminal depth of 10 feet bgs. Groundwater was encountered in only one Boring

NB13 located in the general area (at Elevation 407); this groundwater level is about 7 feet below assumed pipe invert Elevation 414.

Based on the site surface and subsurface conditions, we offer the following comments:

- Construction dewatering is not anticipated for invert depth of 10 feet bgs.
- Pipe ramming is not advisable for this site because significant deviations from desired line and grade may result. There is also a risk that the existing gas main could be damaged.
- HDD is not advisable for this site because of the high gravel content.
- Either pipe jacking or microtunneling are feasible methods from a geotechnical point of view; cost may then be a key consideration.

After the additional exploration is completed, the boring records should be included in this document and the discussion in Section 6.4 be modified to include our interpretation.

6.5.2.5 Jacking and Receiving Pits

This crossing will also require construction of two access shafts (jacking and receiving) or pits to provide an area to mobilize equipment for this trenchless operation, remove spoils and install the pipeline. These access shafts should be located in accordance with applicable right-of-way requirements.

The design of the shoring system at jacking and receiving pits, as well as design of the jacking system, should be performed by a California Registered Civil or Structural Engineer, retained by the Contractor, and submitted to the Engineer prior to its implementation. Furthermore, the Contractor should retain a California Registered Geotechnical Engineer to provide shoring design parameters.

Where shaft or pit excavations are supported with temporary shoring, some settlement of the adjacent ground surface should be anticipated. If these shored excavations are placed in a paved street or highway, cracking and settlement of the adjacent pavements should be anticipated. The project specifications should require restoration of these damaged pavements, curbs and gutters to their preconstruction condition.

At the base of the jacking and receiving pits, the Contractor should consider installing a working platform to stabilize the subgrade. Based on the logs of our two borings, the pit subgrade soils are anticipated to be medium dense gravel and very stiff lean clay. Although these soils are relatively strong, the exposed subgrade could become disturbed and weakened. Therefore, the subgrade should be stabilized by placement of a minimum thickness of 12 inches of ¾ inch drain rock encapsulated in a layer of high strength geofabric such as TC Mirafi 600X or equivalent. As an alternative, a lean concrete rat slab (seal course) could be placed on the subgrade.

6.5.2.6 Pipe Jacking Considerations

The pipe should be designed to accommodate the axial jacking stresses, as well as the earth loads imposed due to the full overburden pressure. The use of the full overburden pressure is recommended since the depth of the pipe is too shallow to result in a pressure reduction due to soil arching. The excavation method should be selected by the Contractor.

6.5.2.7 Settlement Monitoring

An independent Instrumentation Specialist must install and monitor settlement monitoring points. The survey accuracy of the settlement monitoring points must be within 0.01 foot (1/8 inch). Evaluate settlements using methods developed by Birger Schmidt and Peck (1969), Bennett (1998), or equivalent that are approved by the Engineer.

Subsurface monitoring points must be installed at 5 feet and 10 feet above the crown of the proposed tunnel near the jacking shaft, above utilities, and on shoulders of roadways, before proceeding under critical locations. Additional points at non-critical locations must be monitored to gain an early indication of workmanship. Additional surface settlement monitoring points may be used to supplement subsurface points. Surface settlement points must be checked hourly when heading is within 25 feet, otherwise daily. If ¼ to ½ inch settlement is detected, corrective action must be taken, including but not limited to: filling voids with grout, limiting the radial overcut or filling the annulus with bentonite lubricant during tunneling. Changes in means and methods may be appropriate and should be considered, such as position of cutting tools with respect to leading edge of casing and discontinuing use of high pressure cutting nozzles or jets etc.

Surface settlement points located in traffic lanes must be checked before and after tunneling. If ¼ inch settlement is detected, corrective action must be taken, including but not limited to: filling voids with grout. Monitoring points must be surveyed prior to tunneling to establish the baseline.

If settlement results in roadway distress, resurfacing by the Contractor could become necessary.

6.6 CUTS AND EXCAVATIONS

6.6.1 Along Mainline

The approximate station limits of cut and fill are presented in Table 1-1.

In most ramp and median areas, relatively shallow excavations (less than 4 feet) are currently planned for placement of new pavement sections, retaining wall foundations and bridge footings. A maximum cut depth (vertical height) of about 28 feet near Station 256+00 is anticipated for RW 246. A special overexcavation of unsuitable material in a drainage ditch is recommended between Station 240+00 and 246+00 on the west side of Route 84; refer to Section 5.4.1 "Background" for details.

Shallow excavations will be completed entirely in the existing pavement structural sections and into the embankment fill or native materials underlying the existing pavements. Cobbles and/or boulders were encountered at boring locations at depths ranging from 3 to 31 feet bgs, as discussed previously in Section 3.2.2 "Subsurface Conditions". In particular, cobbles and/or boulders were encountered at variable depths in the vicinity of Arroyo Mocho and Arroyo Del Valle.

In our opinion, materials excavated from the existing pavement structural sections can be reused as fill materials in the new or raised embankments provided the asphalt concrete is pulverized to

meet the size requirements for fill. However, the existing fill materials underlying the pavement structure should be reviewed by the Geotechnical Engineer at the time of construction to verify they meet the requirements for fill.

Based on the Boring Records, potentially expansive fat clay (CH) and elastic silt (MH) were encountered at shallow depths primarily in the following areas:

- At Boring RB13 at about Station 300+54 CH ranging in depth from 3 to terminal depth of 10 feet bgs.
- At Boring RB14 at approximate Station 305+99 CH ranging in depth from 2½ to 4½ feet bgs.
- At Boring NB13 at approximate Station 320+87 CH ranging in depth from 20 to 24½ feet bgs.
- At Boring RB07 at about Station 270+16 MH ranging in depth from 8½ to 12 feet bgs.

In our opinion the CH materials, if excavated at RB13, RB14 and NB13, should not be reused as engineered fill due to their expansive nature, i.e. potential to shrink and swell with moisture changes. This requirement is included in Section 9, Specifications, 9.2.1 Earthwork, Table 9-1; estimated station limits are also included in this table. If used in embankments, CH soils will slough where exposed. The insitu moisture content of these soils is about 12 percent and is close to optimum moisture content. At RB07, the MH material is below a depth of 8½ feet and will be left in place.

The explorations were completed during the months of November and December 2007, both of which were relatively dry, and January 2008, which was wet. No perched water was encountered in the semi-permeable aggregate base component of the pavements. However, it is conceivable that some free water could potentially be encountered in the aggregate base and subbase components of the existing pavements if construction occurs in the winter and spring months.

As stated above, cuts ranging from about 1 to 28 feet are anticipated along the median, shoulders, and into the hillsides. Based on the most recent water depths measured in the closest borings, it appears the 2007 and 2008 groundwater levels are below the bottom of most shallow excavations. However, some localized groundwater is anticipated in a few excavations, particularly for bridge foundations. If excavations extend below the groundwater level, the Contractor should be prepared to provide standard sumping during construction to remove accumulated seepage at the bottom of bridge foundation excavations.

6.6.2 Gravel Mining Excavations

As discussed previously in Section 1.1.5 “Vineyard Avenue to Stanley Boulevard Improvements”, significant gravel mining operations to depths of 240 feet are planned on portions of the west and east sides of SR84.

Two previous slope stability studies (Shannon & Wilson, 1978; Geomatrix, 2004) were performed for side slopes as a result of future mining operations planned just west of Isabel Avenue and south of Stanley Boulevard. Those studies were based on a maximum side slope

inclination of 1½ to 1 (horizontal to vertical) for both temporary and permanent slopes. Geomatrix concluded:

- The 1½ to 1 slope inclination was appropriate;
- The granular soils are not likely to liquefy during or after earthquake shaking; and
- The estimated deformations due to earthquake shaking are about 1 foot for the excavated slope during mining and reclamation and less than ¼ foot after reclamation.

The hinge point of these slopes is about 35 to more than 50 feet from Caltrans right-of-way. The previous slope stability studies by others indicate a 1½ to 1 slope inclination would meet County permit requirements. However, we understand the current quarry permit approved a 2 to 1 side slope inclination. Nevertheless, as discussed with and concurred with by Caltrans, we believe it would be prudent to monitor horizontal ground movements to maximum depths of order 240 feet. We recommend that five slope inclinometers be installed and periodically monitored, including before, during and after excavation (mining). The approximate recommended locations near the proposed new shoulders are as follows:

Table 6-1 Recommended Inclinometer Locations

Inclinometer Number	Approximate Station (feet)	Shoulder Location	Approximate Casing Depth (feet)
I-1	A1 322+00	NB	180
I-2	A1 323+20	SB	240
I-3	A2 347+00	SB	240
I-4	A2 371+00	SB	240
I-5	A3 395+00	SB	180

– Soil samples should be obtained at intervals of 10 feet; the installation and reading of inclinometers should be supervised by a Certified Engineering Geologist (CEG) or Registered Geotechnical Engineer (GE). The monitored ground movements should also be interpreted by a CEG or GE, to assess the structural integrity of SR 84.

6.7 EMBANKMENTS

Most embankment fills will be on the order of 4 feet or less in height.

The planned fills should be constructed in accordance with Caltrans Standard Specifications Section 19, entitled “Earthwork”. The undesirable materials should be removed in accordance with Caltrans Standard Specifications Section 16, “Clearing and Grubbing”.

Consistent with Caltrans standards, the proposed slope inclinations of new embankments throughout the project are 2H:1V and 1½H:1V under bridge abutments. In our opinion, the existing embankment soils and supporting soils are capable of being inclined at these proposed

slopes provided that the new embankment fills are constructed in accordance with the recommendations of this report and Caltrans Standard Specifications. For most engineered fill embankments constructed with the above slope inclinations, stability analyses generally are not required.

New embankment fill should be benched and keyed into existing slopes as specified in Caltrans Standard Specifications Section 19-6 "Embankment Construction".

6.8 EARTHWORK FACTORS

In general minor cuts and fills are anticipated. Some cut materials will be generated by removing the existing shoulder and median to allow for placement of the new traveled way pavement structural section.

In general, no apparent distress was observed in median shoulder pavements. Assuming that the existing pavement structural sections were constructed in accordance with Caltrans Standard Specifications, it is likely that the pavement structural sections were well compacted at the time they were constructed. Based on density tests performed in our laboratory on samples recovered from our borings, the subgrade materials appear to exhibit moderate to high in place density. Based on our field observations, laboratory testing, and our engineering judgment and experience, the following earthwork factors are recommended for the purpose of estimating the volume changes during construction.

1. For existing asphalt concrete and aggregate base materials used for fill material compacted to a relative compaction of 95 percent, use 1.0 for an earthwork factor.
2. For native subgrade materials underlying the existing pavements, used for fill material compacted to a relative compaction of 95 percent, use 0.94 for an earthwork factor (i.e., 6 percent volume decrease).
3. For existing fill materials used for new fill compacted to a relative compaction of 95 percent, use 1.0 for an earthwork factor.

6.9 RETAINING WALLS

As discussed previously in Section 1.1.10 "Retaining Walls", thirteen (13) retaining walls are planned. Foundation design concepts and preliminary geotechnical recommendations for five special walls (non-standard) including RW 246, 391, 400N, 400S and 403 are summarized in a separate Foundation Investigation Report. Drawings and details of the remaining eight (8) retaining walls are presented in Appendix M. Table 6-2 presents a summary of wall configurations of the eight proposed standard Type 1 walls.

Table 6-2 Summary of Wall Configurations

Wall	Length (feet)	Wall Height (feet)	Approximate Depth of Cut from Original Ground (feet)	Approximate Fill Height from Original Ground (feet)
236	460	8 to 12	9 to 13	
245	1,505	3 to 24		3 to 22
109	396	3½ to 12½		1½ to 9

110	546	5½ to 10½		1½ to 9
314	429	4 to 16½		0 to 12
317	192	7 maximum		0 to 5½
320	161	5½ to 11¼		2½ to 6
437	1,120	4 to 10½	4 to 12	

Based on the project quantity estimates, it is understood that there could be excess cut material need to be hauled offsite. Therefore, it is assumed that all embankment fill and wall backfill would be derived from onsite soils. Based on exploratory boring data at proposed cut slopes, we estimate the resulting fill material to be of clayey to silty sand and gravel, with an an average as compacted moist unit weight of 130 pcf. For a compacted clayey to silty sand and gravel fill material, we anticipate the friction angle, ϕ', to be greater than 34 degrees; thus, the resulting equivalent fluid pressure of the wall backfill should be equal to less than 36 psf per lineal foot. Therefore, the standard plan Type 1 wall soil design parameters are applicable.

Table 6-3 below presents a summary of the estimated base bearing pressures at the maximum wall height location of each of the eight standard Type 1 walls.

Table 6-3 Type I Wall Soil Parameters

Wall	Maximum Wall Height (feet)	Ultimate Bearing Pressure (psf)	Allowable Bearing Pressure (psf)	Equivalent Fluid Pressure (psf per lineal foot)
236	12	9,000	3,000	36
245 (LOL 5+00 to 10+00)	5	12,000	4,000	36
245 (LOL 10+00 to 20+00	24	18,000	6,000	36
109	12½	13,500	4,500	36
110	10½	10,500	3,500	36
314	16½	18,000	6,000	36
317	7	7,000	2,300	36
320	11¼	15,000	5,000	36
437	9½	10,500	3,500	36

6.10 SOUNDWALLS

Soundwalls currently are not planned for this project.

6.11 GEOTECHNICAL CALCULATIONS

A copy of our geotechnical engineering calculations are presented in Appendix L. These calculations include estimated settlement.

7.1 CORROSION INVESTIGATION SUMMARY

An assessment of the potential for corrosion of various buried foundation and pipe structures was performed by V&A Consulting Engineers (V&A). The results of their investigation are presented in Appendix O. The following paragraphs include their summary, conclusions, and recommendations.

V&A was retained by URS Corporation to perform a corrosion survey on SR 84, from Ruby Hill Drive to Jack London Boulevard, in Livermore, California. The objective of the investigation was to measure various soil parameters and evaluate the results with respect to possible levels of corrosion along the highway. The soil was tested at depths ranging from 0 to 62 feet below existing grade. This report recommends corrosion control for construction materials being considered for a proposed retaining wall along the Ruby Hill Drive/Vallecitos Road segment of SR 84, for retaining wall modifications at the Stanley Boulevard Underpass, for new and existing bridge structures at Arroyo del Valle and Arroyo Mocho stream crossings and for culverts and underdrain pipes along the roadway. The materials being considered as part of this investigation include buried reinforced concrete, prestressed concrete piles, steel pipe piles, metal culverts and metal or plastic drainage pipes.

This report gives recommendations for corrosion control of reinforced concrete foundations and soil nails for the Ruby Hill Drive/Vallecitos Road Retaining Wall from Station 245+50 to Station 258+00, and for reinforced concrete foundations and soil nails for two retaining walls at the Stanley Boulevard Underpass between Stations 391+00 and 412+00. Corrosion control recommendations are provided for reinforced concrete foundations, prestressed concrete piles, and steel pipe piles for existing highway bridge modifications and new public access bridges at the Arroyo del Valle crossing, Station 320+00 and at the Arroyo Mocho crossing, Station 415+00. Metal culvert and underdrain pipe material recommendations for 50 year maintenance-free service based on ambient soil conditions are also included.

The investigation was conducted in accordance with California Department of Transportation's Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch "Corrosion Guidelines" (Guidelines) dated September 2003. These Guidelines consider representative soil or water samples to be corrosive to structural elements if one or more of the following conditions exist:

1. The chloride concentration is 500 ppm or greater,
2. The sulfate concentration is 2,000 ppm or greater,
3. The pH is 5.5 or less.

Evaluation of the soil environment was made in terms of potential corrosion damage to concrete and metal structures. Soil resistivity measurements were conducted in the field during the intial stages of the work. In addition, 14 soil samples taken during a geotechnical investigation were provided to V&A for laboratory testing. The soil samples were analyzed for minimum (saturated) resistivity, as well as for pH, chloride and sulfate ion concentrations. All of these affect the corrosion rate of buried structures. Table 7-1 presents a summary of the sample locations in relation to existing and proposed buried utilities and pipelines, as well as test data results.

Table 7-1 Summary of Corrosion Test Locations, Nearby Buried Utilities and Test Data

Boring Number	Boring				Proposed Drainage System	Existing Drainage System	Proposed Utilities	Existing Utilities	Approximate Distance from Boring Location (feet)	Test Data			
	Line	Station	Offset (feet)	Depth (feet)						Minimum Soil Resistivity (ohm-cm)	Chemical Data		
											pH	Sulfate (mg/kg)	Chloride (mg/kg)
NB03 (5 to 6.5 feet)	A1	245+90.1	27.8 Lt	80.0	18" APC				18	3,302	7.5	<5	6
NB05 (5 to 6.5 feet)	A1	252+76.0	10.2 Rt	56.5	gutter/ditch flow line				50	7,312	8.4	<5	<2
					18" RCP				64				
NB07 (5 to 6.5 feet)	A1	293+10.8	53.8 Lt	20.0	gutter/ditch flow line				<5	1,510	7.1	<5	20
					18" APC				53				
NB11 (20 to 21.5 feet)	A1	318+45.8	111.8 Rt	60.0			Gas Line		44	7,255	7.4	<5	<2
					18" APC				70				
								12" Water Line	<5				
								TV Cable Line (AT&T)	25				
								Sewer	39				
						edge drain			24				
NB12 (5 to 6.5 feet)	A1	318+90.0	19.4 Rt	71.5	18" APC				24	10,028	8.6	<5	<2
							Gas Line		50				
					42" APC				87				
								12" Water Line	<5				
								TV Cable Line (AT&T)	29				
								Sewer	40				
NB13 (25 to 26.5 feet)	A1	320+87.3	15.7 Rt	80.0			Gas Line		50	7,992	8.3	<5	<2
					42" APC				38				
					drainage easement				32				
								12" Water Line	29				
								12" Water Line	<5				
NB14 (5 to 6.5 feet)	A1	320+72.1	65.7 Rt	60.0			Gas Line		<5	10,586	8.5	<5	<2
					42" APC				13				
					drainage easement				18				
								12" Water Line	48				
NB20 (3.5 to 5 feet)	A3	395+45.2	63.8 Lt	40.0	24" APC				46	5,340	8.2	7	<2
						edge drain			26				
						under drain			29				
					24" SD				52				
NB22A (3.5 to 5 feet)	A3	407+87.4	91.1 Rt	30.0				RCW	11	5,386	8.6	<5	9
					18" APC				34				
						under drain			55				
NB23 (5 to 6.5 feet, 60 to 61.5 feet)	A3	413+63.2	94.8 Lt	101.5				Gas Line	7	5,347	8.4	<5	2
										6,052	7.9	<5	3
NB24 (5 to 6.5 feet, 60 to 61.5 feet)	A3	415+18.7	155.2 Lt	101.5	24"RCP				39	14,478	9.1	<5	<2
								Gas Line	65	1,978	7.8	<5	7
NB25A (8.5 to 10 feet)	A3	435+92.0	92.4 Rt	25.0				RCW	12	23,278	8.3	<5	<2
					24" RCP				38				
								Sewer	60				
						edge drain			46				

Notes: APC = alternative pipe culvert, RCP = reinforced concrete pipe, RCW = reclaimed water

The minimum (saturated) resistivity of the 14 soil borings submitted for analysis ranged from 1,510 ohm-cm to 23,278 ohm-cm. The soil pH ranged from 7.1 to 9.1 and the water-soluble chloride concentrations ranged from below the detection limit of 2 mg/kg to 20 mg/kg. The water-soluble sulfate concentrations ranged from below the detection limit of 5 mg/kg to 7 mg/kg.

One water sample taken from the stream at the existing Arroyo del Valle Bridge site was also analyzed for resistivity, pH, soluble chloride and soluble sulfate. The water resistivity is 1,686 ohm-cm and its pH is 8.3. The soluble chloride is 63.7 mg/L and the soluble sulfate is 19.9 mg/L.

Culvert materials were selected using the Department of Transportation Alternative Pipe Culvert Selection Website (AltPipe Version 6.08) which calculates Maintenance-Free Service Design Estimates using California Department of Transportation (Caltrans) criteria. The latter are outlined in Caltrans California Test Method 643, in Caltrans Highway Design Manual, Section 850, Physical Standards, dated November 2, 2009 and in Design Information Bulletin 83-01 dated June 30, 2003. The results listed in V&A's Appendix 2 (Appendix O) used conditions from the analyzed soil bore samples taken closest to each drainage system. Where no bore samples were taken near a drainage system, the more corrosive of two samples taken closest to the ends of the drainage system was used. Drainage Systems 56 and 59 used the analytical results of soil bore samples NB24-2-X and NB23-2-4, respectively, which were in better agreement with the field resistivity measurements at 10 feet below grade. An intermittent flow velocity of less than 1.5 meters/second (5 feet/second) under non-abrasive conditions, and a maximum burial depth of 10 feet were used for the AltPipe calculations.

7.2 CONCLUSIONS

- The soil bore chemical analyses and the stream water analysis all gave pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg and soluble sulfate concentrations less than 2,000 mg/kg. According to the Guidelines, the soils and water are considered *non-corrosive*.
- No corrosion mitigation for steel piles is required by the Guidelines for non-corrosive soil conditions.
- None of the proposed bridge structures are within 1,000 feet of salt or brackish water.

7.3 RECOMMENDATIONS

Based on the test data and a review of the project requirements, recommendations for each material alternative are listed below.

7.3.1 Buried Reinforced Concrete Structures and Cast in Place Piles

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.

- A concrete cover of a minimum of 2 inches should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should also have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

7.3.2 Prestressed Concrete Piles

Prestressed concrete piles should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 2 inches should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should also have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

7.3.3 Drainage Culverts and Underdrain Pipes

Specific material selections for each of the 35 proposed new or modified drainage systems have been determined using the Caltrans AltPipe (Alternative Pipe) Version 6.08. The results are presented in V&A's Appendix 2 (Appendix O). Using soil bore sample data from sites in closest proximity to the new or modified drainage systems proposed along Highway 84, the following material recommendations are made for 50-year culvert service life:

Coated steel pipe can be used in all of the proposed drainage systems. The coating material, minimum metal thickness, and recommended corrugated or ribbed structural designs are dictated by the soil resistivity, soil pH, and pipe diameter in each drainage system.

Aluminum metal pipes are not recommended for sites where the soil pH is higher than 8.5.

Ribbed and corrugated PVC and HDPE plastic pipe can be used at all drainage sites.

Reinforced concrete pipes are acceptable for all of the proposed drainage systems. AltPipe recommends 0.75-inch concrete cover over steel reinforcement for 12 and 18-inch diameter pipe, and 1 inch of concrete cover for 24 to 42-inch diameter pipe.

7.3.4 Mechanically Stabilized Embankment and Metallic Soil Reinforcement Backfill

In accordance with the Guidelines, non-corrosive backfill for metallic soil reinforcement, such as tie-back anchors or soil nails and reinforced concrete structures shall meet the following requirements:

- Minimum resistivity greater than 1,500 ohm-cm.
- Water soluble chloride ion concentration less than 500 mg/kg
- Water soluble sulfate ion concentration less than 2,000 mg/kg

- A pH between 5.5 and 10.0
- Slag aggregate should not be used in backfill due to high sulfate concentrations

7.3.5 Soil Nails and Rock Anchors

Ruby Hill Drive/Vallecitos Road Retaining Wall and Stanley Boulevard Underpass Retaining Walls

All metallic soil reinforcement must be galvanized in accordance with requirements in California Department of Transportation Standard Specification 75-1.05.

Soil Borings NB03 at Station 246+00 and NB05 at Station 293+00 were used to evaluate site corrosivity at the Ruby Hill Drive/Vallecitos Road Retaining Wall:

- NB03 has a pH of 7.5 and a minimum resistivity of 3,302 ohm-cm
- NB05 has a pH of 8.4 and a minimum resistivity of 7,312 ohm-cm

Soil Borings NB20 at Station 395+50 and NB22A at Station 408+00 were used to evaluate site corrosivity:

- NB20 has a pH of 8.2 and a minimum resistivity of 5,340 ohm-cm
- NB22A has a pH of 8.6 and a minimum resistivity of 5,386 ohm-cm

- Soil Nails
  - Soil nails shall be constructed in conformance with "Structure Reference Specification 19-660," Section 10-1. This specification can be found at (http://www.dot.ca.gov/hq/esc/structurespecs).
  - Corrosion mitigation measures are required at any level of soil corrosivity, due to the vital character of the soil nails. Individual corrosion mitigation measures shall depend on the specific construction of the soil nails.
  - Soil nail bar reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications.
    - Grade 60 soil nails bar reinforcement shall also conform to ASTM Designation A 615/A 615M or A 706/A 706M requirements
    - Grade 75 soil nails bar reinforcement shall also conform to ASTM Designation A 615/A 615M
  - Soil nails shall be either a reinforcing bar encapsulated full length in a grouted corrugated plastic sheathing or an epoxy coated reinforcing bar partially encapsulated in a grouted corrugated plastic sheathing.
    - The bar shall be centered in the sheathing and the space between the sheathing and the bar shall be filled with grout.
    - The epoxy coating shall have a minimum thickness of 0.012 inch (12 mils).
- Tieback Anchors
  - Tieback anchors shall be constructed in conformance with "Structure Reference Specification 50-560," Section 10-1.

- Corrosion mitigation measures are required at any level of soil corrosivity due to the vital nature of the tieback anchors.
- Grouting procedures shall follow guidelines discussed in Section 50, "Prestressing Concrete," of the Standard Specifications.
- The tieback anchorage assembly and anchor steel shall be protected against rust, corrosion and physical damage prior to completion of all enclosure grouting or encasement in concrete per Section 50 of the Standard Specifications.
- Strand type tendons shall be encapsulated in a corrosion inhibiting grease per Structure Reference Specification 50-560. The environment shall always be considered corrosive for the purposes of determining the proper test criterion.

- Tiedown Anchors
  - Tiedown anchors shall be constructed in conformance with "Structure Reference Specification 50-570," Section 10-1.
  - Corrosion mitigation measures are required at any level of soil corrosivity due to the vital nature of the tiedown anchors.
  - Grouting procedures shall follow guidelines discussed in Section 50, "Prestressing Concrete," of the Standard Specifications.
  - Tiedown anchor steel shall be protected prior to completion of all grouting against rust, corrosion and physical damage per Section 50 of the Standard Specifications.
  - Strand type tendons shall be encapsulated in a corrosion inhibiting grease per Structure Reference Specification 50-570. The environment shall always be considered corrosive for the purposes of determining the proper test criterion.

Materials available for the project construction are summarized in Table 8-1.

9.1 RECOMMENDATIONS

The specifications for this project shall be Caltrans Standard Specifications dated 2003 or later, as applicable.

9.2 SPECIFICATIONS

9.2.1 Earthwork

Earthwork shall conform to the applicable portions of Section 19 of the Standard Specifications and to current Special Provisions.

Expansive fat clay (CH) and elastic silt (MH) were encountered in the following borings.

Table 9-1 Summary of Potentially Expansive Soil

Boring	Boring Station (feet)	Estimated Depth of CH or MH Soils (feet)	Estimated Limits of CH or MH Soils Station (feet)	
			From	To
RB13	300+54	3-10	299+00	303+00
RB14	305+99	2½- 4½	303+00	308+00
NB13	320+87	20-24½	320+50	322+00
RB07	270+16	8½ -12	268+00	273+00

Where these CH and MH soils are excavated, these soils shall be hauled offsite.

Structure Backfill

Structure backfill shall conform to the provisions in Section 19-3 of the Standard Specifications.

Embankment Construction

Embankment material for at least 4 feet below the grading plane shall conform to the requirements noted in the Special Provisions. All imported borrow shall conform to the provisions of Section 19-7.02 of the Standard Specifications and to current Special Provisions.

Unsuitable material was observed in an existing drainage ditch on the west side of Route 84 between "A1" Station 240+00 and "A1" 246+00. This unsuitable material shall be removed and hauled offsite.

9.2.2 Structural Pavement Sections

Hot Mix Asphalt (HMA)

Hot mix asphalt shall be Type A, ¾-inch maximum coarse graded and shall conform to the provisions in Section 39 of the Standard Specifications and to the requirements noted in the Standard Special Provisions.

Asphalt Treated Permeable Material (ATPB)

Asphalt treated permeable material shall conform to the provisions in Section 29 of the Standard Specifications and to the requirements noted in the Standard Special Provisions.

Aggregate Base (AB)

Aggregate base shall be Class 3, 1½-inch or ¾-inch maximum grading and shall conform to the provisions in Section 26 of the Standard Specifications and to the requirements noted in the Standard Special Provisions.

Aggregate Subbase (AS)

Aggregate subbase shall be Class 4 and shall conform to the provisions in Section 25 of the Specifications and to the requirements noted in the Standard Special Provisions.

9.2.3 Culverts And Drains

Edge Drains

Edge drains shall conform to the provisions in Section 68-3 of the Standard Specifications.

Filter Fabric

Filter fabric shall conform to the provisions in Section 88-1.03 of the Standard Specifications.

9.2.4 Standard Special Provisions

Aggregate Base (AB)

Aggregate base shall be Class 3, 1½-inch or ¾-inch maximum grading and shall conform to the provisions in Section 26 of the Standard Specifications and to the following Special Provisions.

The aggregate grading for Class 3 aggregate base is revised from the Class 2 aggregate base by changing "Percentage Passing" the No. 200 screen to:

	1½-inch Maximum		¾-inch Maximum	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance
No. 200	2-11	0-14	2-11	0-14

The quality requirements shall conform to the quality requirements shown on the following table.

Tests	California Test Method Number	Requirements	
		Operating Range	Contract Compliance
Sand Equivalent	217	25 Min.	22 Min.
Resistance (R-value)	301	-	78 Min.
Durability Index	229	-	35 Min.

Aggregate Subbase (AS)

Aggregate subbase shall be Class 4 and shall conform to the provisions in Section 25 of the Caltrans Standard Specifications and to the following Special Provisions.

Class 4 aggregate subbase shall be clean and free from vegetable matter and other deleterious substances.

The percentage composition by weight of Class 4 aggregate subbase shall conform to the following grading as determined by California Test Method No. 202.

	Percentage Passing	
Sieve Size	Moving Range	Individual Test Results
2½-inches	100	100
No. 4	30-65	25-70
No. 200	0-15	0-18

Class 4 aggregate subbase shall also conform to the quality requirements shown on the following table.

		Requirements	
Tests	California Test Method Number	Moving Average	Individual Test Results
Sand Equivalent	217	21 Min.	18 Min.
Resistance (R-value)	301	--	50 Min.

9.2.5 Special Provisions

Embankment Construction

The high R-value material excavated between Stations 290+00 and 415+00 shall be placed as fill exclusively within 4 feet of the grading plane (1) between Stations 290+00 and 415+00 and (2) along Vallecitos Road.

Settlement monitoring devices shall be installed prior to filling where new fill height exceeds 3.3 feet. These devices shall not be damaged by the Contractor. Settlement shall be measured once a week, plotted and submitted to URS for review.

Unsuitable material was observed in an existing drainage ditch on the west side of Route 84 between “A1” Station 240+00 and “A1” 246+00. This unsuitable material shall be removed and hauled offsite. This note is shown on the plans (sheet X-3).

The opinions, conclusions and recommendations contained in this Geotechnical Design Report and Materials Report are based upon the information obtained from explorations made at widely separated locations, geologic reconnaissance, review of available geologic and topographic information and historic data, and upon local experience and engineering judgment.

The recommendations presented in this report are based on the assumption that the soil and geologic conditions do not deviate substantially from those encountered in the exploratory borings. If any variations are encountered during construction, URS should be consulted so that supplementary recommendations can be made.

If the planned construction is changed from that presently conceived, URS should be retained to review the changes and make modifications to the original recommendations presented in this report in order to meet the project needs.

Geotechnical issues may arise during construction which are not apparent at this time. We should be retained during construction to review the soil conditions encountered and the construction procedures. All testing should be done under the direct observation of a representative of our firm.

The elevations shown on the logs of new borings are based on interpolation from spot and contour elevations shown on available topographic maps.

A specific review related to environmental and hazardous waste issues and an investigation for subsurface environmental contamination is being performed by Baseline Environmental and will be presented in a separate report.

As-built drawings pertinent only to the geotechnical investigation are included.

The recommendations presented in this Geotechnical Design Report and Materials Report were developed with the standard of care commonly used as state of the practice in the profession. No other warranties are included, either express or implied, as to the professional advice presented in this report.

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Tables

Table 1-1
Preliminary Cut/Fill Evaluation

Beg Station	End Station	Cut/Fill		Comment/Note
		Northbound	Southbound	
226+97	228+40	Fill	Fill	
228+40	230+00	Fill	Cut	
230+00	233+00	Cut	Cut	
233+00	234+00	Cut	Fill	
Ruby Hill Drive Intersection				Approximate location of intersection: Station 233+60 to 235+25
234+00	235+79	Fill	Fill	
235+79	237+20	Fill	Cut	
237+20	240+20	Cut	Cut	
240+20	244+60	Cut	Fill	
244+60	245+80	Fill	Fill	
245+80	257+00	Fill	Cut	
Vallecitos Road Intersection				Approximate location of intersection: Station 258+30 to 259+75
257+00	315+20	Cut	Cut	**Southbound:** Cut most likely over estimated for these stations, see note 1.
Vallecitos Road Intersection				Approximate location of intersection: Station 312+75 to 314+20
315+20	317+00	Fill	Cut	
317+00	322+00	Fill	Fill	
322+00	325+00	Fill	Cut	
325+00	345+73	Cut	Cut	**Southbound:** Cut most likely over estimated for these stations, see note 1.
Concannon Boulevard Intersection				Approximate location of intersection: Station 344+50 to 346+30
345+73	352+80	Cut	Cut	
352+80	365+20	Cut	Fill	**Northbound:** Cut most likely over estimated for these stations, see note 1.
365+20	393+20	Cut	Cut	**Northbound:** Cut most likely over estimated for these stations, see note 1.
Stanley Connector Intersection				Approximate location of intersection: Station 392+50 to 394+00
393+20	413+60	Cut	Cut	
413+60	415+25	Fill	Fill	
Discovery Drive Intersection				Approximate location of intersection: Station 424+50 to 426+20
415+25	446+50	Cut	Cut	
446+50	447+00	Cut	Fill	
Jack London Boulevard Intersection				Approximate location of intersection: Station 447+50 to 449+00
Note 1: Cut most likely over estimated for certain stations, In-roads shows a cut for new structural sections, however some sections will only be widening/overlay of existing structural section.				

TABLE 3-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	Sieve Analysis Results (Percent Passing)												R-value	Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
						%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200		Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
NB01	7-Mar-08			Lt.	1																	6,580	9.9	123
NB01	7-Mar-08			Lt.	10																		12.5	
NB02	7-Mar-08			Lt.	2																	1,240	13.9	116
NB02	7-Mar-08			Lt.	5														27	17	10		10.9	
NB02	7-Mar-08			Lt.	10																	3,220	9.2	125
NB03	14-Dec-07	245+90.1	A1	Lt. 27.8	5																		6	123
NB03	14-Dec-07	245+90.1	A1	Lt. 27.8	15														31	21	10	7,140	17.9	114
NB03	14-Dec-07	245+90.1	A1	Lt. 27.8	20																	11,800	19.3	112
NB03	14-Dec-07	245+90.1	A1	Lt. 27.8	25																	11,340	18.5	113
NB03	14-Dec-07	245+90.1	A1	Lt. 27.8	30																	19,850	18.1	114
NB03	14-Dec-07	245+90.1	A1	Lt. 27.8	35																	16,120	16.1	117
NB03	14-Dec-07	245+90.1	A1	Lt. 27.8	65																	10,580	14.2	121
NB04	27-Nov-07	248+46.5	A1	Rt. 51.4	3.5														31	14	17	13,650	9.9	120
NB04	27-Nov-07	248+46.5	A1	Rt. 51.4	8.5																	5,970	16.3	113
NB04	27-Nov-07	248+46.5	A1	Rt. 51.4	13.5																	21,250	15.5	119
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	5																		4.4	124
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	20																	19,720	13.8	121
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	25																	14,220	15.3	118
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	30																	15,660	15.8	117
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	35																	12,750	19.9	110
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	40																	15,860	15.5	119
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	45																	15,880	15.8	116
NB05	13-Dec-07	252+76.0	A1	Rt. 10.2	50																	15,080	18.1	113
NB05A	6-Mar-08			Lt.	1																	3,560	11.9	113
NB05A	6-Mar-08			Lt.	10																	8,300	15.5	114
NB06	17-Dec-07	258+83.4	A1	Lt. 38	1																		6.2	132
NB06	17-Dec-07	258+83.4	A1	Lt. 38	5																		8.2	130
NB06	17-Dec-07	258+83.4	A1	Lt. 38	10	100	85	78	71	63	49	39	30	24	19	16	14						7.4	136
NB06	17-Dec-07	258+83.4	A1	Lt. 38	35																	7,380	10.7	127
NB06	17-Dec-07	258+83.4	A1	Lt. 38	40																	13,500	19.8	109
NB06	17-Dec-07	258+83.4	A1	Lt. 38	45																	14,910	15.4	118
NB06	17-Dec-07	258+83.4	A1	Lt. 38	50																	17,980	16.3	116
NB06	17-Dec-07	258+83.4	A1	Lt. 38	55																	22,170	15.8	117
NB06	17-Dec-07	258+83.4	A1	Lt. 38	60																		14.5	121
NB07	10-Dec-07	293+10.8	A1	Lt. 53.8	1																	8,780	7.4	126
NB07	10-Dec-07	293+10.8	A1	Lt. 53.8	3																	10,570	13	120
NB07	10-Dec-07	293+10.8	A1	Lt. 53.8	5																	10,590	14.9	118
NB07	10-Dec-07	293+10.8	A1	Lt. 53.8	8.5																	12,920	15.7	117
NB09	26-Nov-07	314+51.4	A1	Rt. 63.7	1														22	19	3		5.1	
NB11	2-Jan-08	318+45.8	A1	Rt. 111.8	5		100	98	89	84	62	46	29	19	15	13	12						14	118
NB11	2-Jan-08	318+45.8	A1	Rt. 111.8	25																		8.7	134
NB11	2-Jan-08	318+45.8	A1	Rt. 111.8	45																		10.7	130

TABLE 3-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	Sieve Analysis Results (Percent Passing)												R-value	Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
						%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200		Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
NB13	18-Dec-07	320+87.3	A1	Rt. 15.7	5																		4.6	143
NB13	18-Dec-07	320+87.3	A1	Rt. 15.7	15	100	94	94	83	77	57	42	31	23	18	15	13						12	
NB13	18-Dec-07	320+87.3	A1	Rt. 15.7	20	100	94	100	92	91	88	80	71	65	62	60	53						17.8	109
NB13	18-Dec-07	320+87.3	A1	Rt. 15.7	65																		11.2	135
NB14	18-Jan-08	320+72.1	A1	Rt. 65.7	1														21	20	1		8.8	122
NB14	18-Jan-08	320+72.1	A1	Rt. 65.7	10			96	83	75	56	44	34	26	21	16	14						4.8	
NB14	18-Jan-08	320+72.1	A1	Rt. 65.7	15														33	21	12	1,680	27	99
NB14	18-Jan-08	320+72.1	A1	Rt. 65.7	30																		9.5	133
NB14	18-Jan-08	320+72.1	A1	Rt. 65.7	40																		7.9	143
NB14	18-Jan-08	320+72.1	A1	Rt. 65.7	58.5																		12.5	126
NB17	26-Nov-07	354+11.8	A1	Rt. 51.5	8.5		77	72	65	62	54	46	40	34	28	20	15							
NB18	26-Nov-07	359+40.0	A1	Rt. 51.3	1																		9.4	124
NB19	21-Nov-07	391+83.6	A1	Lt. 76.1	1																	1,810	13.3	113
NB19	21-Nov-07	391+83.6	A1	Lt. 76.1	2.5																			
NB19	21-Nov-07	391+83.6	A1	Lt. 76.1	3														22	18	4	1,080	15.1	112
NB19	21-Nov-07	391+83.6	A1	Lt. 76.1	8.5														24	15	9	3,470	11.2	120
NB20	21-Nov-07	395+45.2	A1	Lt. 63.8	3.5														23	17	6	2,880	6.2	114
NB20	21-Nov-07	395+45.2	A1	Lt. 63.8	8.5																	11,890	9.1	125
NB20	21-Nov-07	395+45.2	A1	Lt. 63.8	13.5																	15,270	8.8	126
NB20	21-Nov-07	395+45.2	A1	Lt. 63.8	18.5																	19,300	12.7	122
NB20	21-Nov-07	395+45.2	A1	Lt. 63.8	23.5																	7,950	12	114
NB21	21-Nov-07	408+03.9	A1	Lt. 34.2	1																	7,760	7.9	123
NB21	21-Nov-07	408+03.9	A1	Lt. 34.2	8.5		100	93	90	87	81	77	72	67	60	49	42						6.3	
NB21	21-Nov-07	408+03.9	A1	Lt. 34.2	13.5																	16,470	9.3	128
NB21	21-Nov-07	408+03.9	A1	Lt. 34.2	33.5														29	16	13	5,900	16.5	117
NB22	4-Dec-07	407+96.2	A1	Rt. 48.5	18.5																		6.2	127
NB22A	7-Dec-07	407+87.4	A1	Rt. 91.1	8.5														24	17	7		10.6	
NB22A	7-Dec-07	407+87.4	A1	Rt. 91.1	18.5																		6.3	126
NB22A	7-Dec-07	407+87.4	A1	Rt. 91.1	23.5																		6.7	136
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	1																		4.5	143
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	10																	6,680	12	127
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	30														31	18	13	1,960	22.4	103
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	35														27	18	9	2,020	21	99
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	50			91	81	77	64	47	32	23	17	14	12						7.5	136
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	55														23	18	5	2,860	17.5	116
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	60																	3,430	13.7	121
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	65																	2,390	13.5	125
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	80																	5,630	17.5	110
NB23	27-Dec-07	413+63.2	A1	Lt. 94.8	85																	5,590	12.1	127
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	1																	1,230	8	106
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	15	100	87	83	68	63	48	39	33	27	22	16	13						7.2	132
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	35																	9,640	13.2	126

TABLE 3-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	Sieve Analysis Results (Percent Passing)												R-value	Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
						%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200		Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	50																	3,140	8.2	137
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	55																	5,350	25	101
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	60														28	18	10	3,130	21.5	106
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	65																	12,830	13.8	123
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	70																	3,150	17.8	114
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	80														27	19	8	3,740	20	108
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	85																	6,450	18.9	110
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	95																	9,890	16.3	117
NB24	26-Dec-07	415+18.7	A1	Lt. 155.2	100																	7,210	22.3	104
NB25	5-Dec-07	435+92.1	A1	Rt. 61.8	3.5																		6.9	128
NB25	5-Dec-07	435+92.1	A1	Rt. 61.8	8.5																	4,110	14.5	117
NB25	5-Dec-07	435+92.1	A1	Rt. 61.8	13.5														25	16	9		7.3	129
NB25	5-Dec-07	435+92.1	A1	Rt. 61.8	18.5																		4.2	138
NB25A	7-Dec-07	435+92.0	A1	Rt. 92.4	13.5																	3,080	18.1	111
NB25A	7-Dec-07	435+92.0	A1	Rt. 92.4	18.5																	4,330	13.6	120
NB26	20-Nov-07	447+24.4	A1	Rt. 77.5	1																		6.4	116
NB26	20-Nov-07	447+24.4	A1	Rt. 77.5	8.5																		2.7	124
NB26	20-Nov-07	447+24.4	A1	Rt. 77.5	18.5														21	19	2	1,400	18.6	112
NB26	20-Nov-07	447+24.4	A1	Rt. 77.5	28.5																		8.3	119
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	3.5													15					5.8	123
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	5														21	16	5		9.5	127
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	8.5																	14,540	17.2	116
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	13.5																		8.3	
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	18.5																		21.3	
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	23.5																		10.7	127
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	28.5																		12.9	121
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	33.5																		10.5	
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	38.5																		19.3	
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	43.5																	16,900	13.6	122
NB30	9-Dec-08	51+26.5	VEX	Rt. 34	48.5																	14,510	16.8	117
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	1																		4.1	
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	3.5																		6.4	115
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	5																		8.2	123
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	8.5																		5.1	125
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	13.5																		18.7	111
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	18.5																		7.4	110
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	23.5																		11	
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	27.5																		11	
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	33.5																		13.8	
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	38.5																		11.5	
NB31	9-Dec-08	54+34.8	VEX	Rt. 45.3	48.5																	9,660	20.5	110
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	3.5																		7.2	

TABLE 3-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	Sieve Analysis Results (Percent Passing)												R-value	Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
						%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200		Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	8.5																		8.6	
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	18.5														31	20	11		20.8	
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	23.5																	9,390	23.8	106
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	28.5																	10,940	15.1	119
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	33.5																		18	109
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	38.5																	2,920	20.1	109
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	43.5																	3,930	20.3	108
NB32	5-Jan-09	103+81.5	V1	Lt. 8.7	49.5																	3,290	31.1	90
NB33	10-Dec-08	107+16.6	V1	Rt. 67.7	5														23	17	6		4.9	
NB33	10-Dec-08	107+16.6	V1	Rt. 67.7	8.5																		4.9	
NB33	10-Dec-08	107+16.6	V1	Rt. 67.7	13.5				100	99	99	97	95	93	89	76	60						10.1	
NB33	10-Dec-08	107+16.6	V1	Rt. 67.7	18.5																		9.6	
NB33	10-Dec-08	107+16.6	V1	Rt. 67.7	23.5																		13.4	
NB33	10-Dec-08	107+16.6	V1	Rt. 67.7	28.5																		20.5	
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	1																		6	
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	3.5																		10.9	
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	5														29	15	14		10.3	125
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	8.5																		9.7	111
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	18.5																		7.2	131
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	23.5																	14,900	15.3	119
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	28.5																	19,600	16.5	117
NB34	10-Dec-08	108+22.3	V1	Rt. 40.6	33.5																	13,150	15.7	120
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	2.5																		7.4	116
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	8.5		88	87	82	78	70	64	59	55	48	37	27						4.9	
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	13.5														25	15	10		17.5	117
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	23.5																		8.9	134
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	28.5																		9.1	129
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	33.5																	10,250	13.9	121
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	38.5																		11.2	127
NB35	6-Jan-09	111+44.2	V1	Lt. 22.8	43.5																		12	124
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	3.5													58					4.9	
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	8.5																		7.5	
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	18.5																		17.3	
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	23.5																	9,310	13.1	122
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	28.5																	8,490	15.9	120
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	33.5																	12,470	18.1	116
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	38.5																	18,670	12.8	126
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	43.5																		14.3	124
NB36	5-Jan-09	116+11.3	V1	Lt. 25.3	48.5																		13.2	127
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	5																	1,900	23	104
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	20																		8.3	133
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	25																		9.7	124

TABLE 3-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	Sieve Analysis Results (Percent Passing)												R-value	Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
						%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200		Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	30		93	84	80	75	60	46	34	25	19	15	12						11.8	
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	35																		8.4	133
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	45														NP	NP	NP		26.6	
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	50																		11	125
NB37	12-Dec-08	319+95.6	A1	Rt. 23.1	60	88	83	79	71	66	52	41	33	26	20	17	15						9.2	136
NB38	11-Dec-08	320+02	A1	Lt. 64.5	15																		9.3	130
NB38	11-Dec-08	320+02	A1	Lt. 64.5	25																		4.3	136
NB38	11-Dec-08	320+02	A1	Lt. 64.5	40			95	87	76	58	42	31	24	19	15	13						12.3	
NB38	11-Dec-08	320+02	A1	Lt. 64.5	65		93	81	75	68	57	47	38	31	25	21	18						9.4	133
RB01	4-Dec-07	230+68.3	A1	Lt. 5.6	1											71	56		37	16	21	7,750	14.4	119
RB01	4-Dec-07	230+68.3	A1	Lt. 5.6	3													1					12.6	121
RB01	4-Dec-07	230+68.3	A1	Lt. 5.6	5																		12.1	127
RB01	7-Mar-08	230+70	A1	Rt. 62	1.5													3						
RB02	4-Dec-07	238+09.6	A1	Rt. 75.9	5														30	16	14	1,340	12.5	124
RB03	27-Nov-07	243+42.4	A1	Rt. 27.6	1																	4,210	10.9	116
RB03	27-Nov-07	243+42.4	A1	Rt. 27.6	3.5													65					6.8	120
RB04	10-Dec-07	253+70.5	A1	Rt. 68	1																			
RB05	19-Nov-07	260+11.3	A1	Rt. 4.1	1													69	21	16	5	2,700	7.1	121
RB05	19-Nov-07	260+11.3	A1	Rt. 4.1	3																	8,840	10.1	114
RB05	19-Nov-07	260+11.3	A1	Rt. 4.1	5																		9.2	122
RB05	19-Nov-07	260+11.3	A1	Rt. 4.1	8.5																		8.5	123
RB06	19-Nov-07		A1	Lt.	8.5																	6,930	14	117
RB07	19-Nov-07	270+16.4	A1	Lt. 7.8	1													11						
RB07	19-Nov-07	270+16.4	A1	Lt. 7.8	8.5														17	16	1	1,620	12.1	115
RB07	19-Nov-07	270+16.4	A1	Lt. 7.8	12																	10,070	15.5	116
RB08	27-Nov-07	278+11.0	A1	Lt. 33.1	3.5																	2,180	9.9	125
RB08	27-Nov-07	278+11.0	A1	Lt. 33.1	8.5																		11.3	123
RB08	27-Nov-07	278+11.0	A1	Lt. 33.1	13.5													45					1.4	
RB09	27-Nov-07	280+36.2	A1	Lt. 33	1																	4,940	7.8	126
RB09	27-Nov-07	280+36.2	A1	Lt. 33	3.5																		7.2	124
RB09	27-Nov-07	280+36.2	A1	Lt. 33	8.5																		23.9	108
RB09	27-Nov-07	280+36.2	A1	Lt. 33	13.5																	2,390	13.4	112
RB10	19-Nov-07	284+94.3	A1	Lt. 3.2	1																			
RB10	19-Nov-07	284+94.3	A1	Lt. 3.2	3														32	17	15		16.2	
RB10	19-Nov-07	284+94.3	A1	Lt. 3.2	5																	8,200	15.3	117
RB10	19-Nov-07	284+94.3	A1	Lt. 3.2	8.5																		6.8	116
RB11	19-Nov-07	289+94.0	A1	Lt. 6.1	1																			
RB11	19-Nov-07	289+94.0	A1	Lt. 6.1	5																		15.1	116
RB11	19-Nov-07	289+94.0	A1	Lt. 6.1	10																		14.8	
RB12	20-Nov-07	295+52.0	A1	Lt. 32.7	1													12					8.2	
RB12	20-Nov-07	295+52.0	A1	Lt. 32.7	8.5																	4,970	11.2	124

TABLE 3-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	Sieve Analysis Results (Percent Passing)												R-value	Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
						%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200		Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
RB13	19-Nov-07	300+54.3	A1	Lt. 10.1	3														26	18	8		12.2	122
RB13	19-Nov-07	300+54.3	A1	Lt. 10.1	5														43	20	23	4,430	22	104
RB13	19-Nov-07	300+54.3	A1	Lt. 10.1	8.5													31				3,520	15.2	113
RB14	19-Nov-07	305+98.7	A1	Rt. 10.8	1																			
RB14	19-Nov-07	305+98.7	A1	Rt. 10.8	3																		11.8	114
RB15	10-Dec-07	312+65.8	A1	Lt. 3	1													31					12.1	
RB16	10-Dec-07	324+38.9	A1	Lt. 30	1																			
RB16	10-Dec-07	324+38.9	A1	Lt. 30	5																		12.3	125
RB17	19-Nov-07	328+24.4	A1	Rt. 56.6	8.5		77	72	65	62	54	46	40	34	28	20	15						6.3	
RB18	5-Dec-07	332+96.7	A1	Lt. 31.1	1																			
RB18	5-Dec-07	332+96.7	A1	Lt. 31.1	8.5													35					7.5	
RB19	3-Dec-07	341+68.3	A1	Lt. 11.3	8.5																		20.8	102
RB20	5-Dec-07	358+99.5	A1	Rt. 11.9	1																		19.9	97
RB21	19-Nov-07	356+49.4	A1	Lt. 11.8	1													51						
RB23	10-Dec-07	364+94.7	A1	Rt. 49.5	1																		20.8	99
RB23	10-Dec-07	364+94.7	A1	Rt. 49.5	3																		14.4	120
RB23	10-Dec-07	364+94.7	A1	Rt. 49.5	5																		13.3	124
RB23	10-Dec-07	364+94.7	A1	Rt. 49.5	8.5													59					3.5	131
RB24	20-Nov-07	369+58.3	A1	Lt. 49.2	1																		9.8	130
RB24	20-Nov-07	369+58.3	A1	Lt. 49.2	3																	2,010	6.1	124
RB24	20-Nov-07	369+58.3	A1	Lt. 49.2	8.5																	3,870	11	121
RB25	20-Nov-07	374+38.4	A1	Rt. 9.5	1													29						
RB25	20-Nov-07	374+38.4	A1	Rt. 9.5	3																		7.3	125
RB26	20-Nov-07	379+84.3	A1	Lt. 67.3	8.5																		10.5	127
RB27	5-Dec-07	388+29.9	A1	Rt. 52.3	3																		8.4	128
RB27	5-Dec-07	388+29.9	A1	Rt. 52.3	8.5																		9.7	118
RB28	3-Dec-07	393+05.8	A1	Rt. 125.3	1																			
RB29	3-Dec-07	395+79.7	A1	Rt. 422.9	3																	4,790	14.7	115
RB29	3-Dec-07	395+79.7	A1	Rt. 422.9	5														28	18	10	4,940	14.9	116
RB29	3-Dec-07	395+79.7	A1	Rt. 422.9	8.5													25				5,430	15.6	117
RB30	3-Dec-07	396+95.1	A1	Rt. 57.9	5																	1,930	12.2	125
RB31	3-Dec-07	400+72.6	A1	Rt. 412.8	1														29	19	10		14.6	117
RB31	3-Dec-07	400+72.6	A1	Rt. 412.8	3													54					76.2	76
RB31	3-Dec-07	400+72.6	A1	Rt. 412.8	5																		7	117
RB32	4-Dec-07	405+43.1	A1	Rt. 11	3																		6.4	106
RB32	4-Dec-07	405+43.1	A1	Rt. 11	8.5													68					6.9	135
RB33	4-Dec-07	408+67.3	A1	Rt. 36.8	1																		9.2	124
RB33	4-Dec-07	408+67.3	A1	Rt. 36.8	3																	14,970	49.3	93
RB33	4-Dec-07	408+67.3	A1	Rt. 36.8	8.5													57					2.4	135
RB35	20-Nov-07	422+03.4	A1	Lt. 12.6	1																		14.4	114
RB35	20-Nov-07	422+03.4	A1	Lt. 12.6	5																		7.5	116
RB35	20-Nov-07	422+03.4	A1	Lt. 12.6	8.5																	1,910	4.4	109

TABLE 3-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	Sieve Analysis Results (Percent Passing)												R-value	Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
						%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200		Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
RB37	20-Nov-07	432+76.2	A1	Lt. 5.7	1														24	20	4		15.9	
RB37	20-Nov-07	432+76.2	A1	Lt. 5.7	3													43					5.2	112
RB37	20-Nov-07	432+76.2	A1	Lt. 5.7	5														28	20	8		10.8	
RB37	20-Nov-07	432+76.2	A1	Lt. 5.7	8.5													18				17,030	11.3	122
RB38	20-Nov-07	437+67.8	A1	Lt. 14	8.5																	4,640	14.7	120
RB39	5-Dec-07	441+35.9	A1	Rt. 7.6	1													7					4.2	123
RB39	5-Dec-07	441+35.9	A1	Rt. 7.6	5																	4,090	13	119
RB40	10-Dec-07	447+24.5	A1	Lt. 2.4	1																			
RB40	10-Dec-07	447+24.5	A1	Lt. 2.4	5													72	26	17	9		15.8	120
RB41	6-Jan-09	230+16.7	A1	Rt. 6.8	2														30	15	15		13.4	
RB41	6-Jan-09	230+16.7	A1	Rt. 6.8	1 to 5													5						
RB42	6-Jan-09	237+88	A1	Lt. 9.1	1 to 5													7						

TABLE 8-1
MATERIALS AVAILABLE

Source:		Teichert Aggregate	Granite Rock Hot Mix Facility Pleasanton	Cemex	Vulcan Materials	Central Concrete	Hanson Aggregates Pleasanton			
		209-832-4150	925-600-8307	916-941-2850	925-373-1802	408-404-1073	925-846-8800			
Haul Distance (one way) Miles:		20.6	1	1	1	1	21			
Quarry:		Tracy		Eliot	Pleasanton Asphalt		Pleasanton			
Product:	Units:									
Portland Cement Concrete: Class A, 6 Sack 7 Sack, no CaC1 7 Sack, 2% CaC1	Cubic Yard			 $103 $110		 $114 $120				
Asphalt Concrete: Type A Open Graded	Ton	$40-$49.50	$58							
Rubberized (RAC-G)	Ton	$40-$49.50	$80-$100				*			
Cement Treated Base: Plant Mix	Ton			$94		$99				
Cement Treated Base Aggregate (Class A)	Ton			$103						
Asphalt Treated Permeable Base	Ton		$60							
Aggregate Base Rock, Class 2	Ton	$8.25-$8.50		$10		$16	$13.50			
Aggregate Sub-Base rock Class 4	Ton			$10						
Structural Backfill	Ton									
Permeable Material Class 1, Type A	Ton	$10.70-$11		$15.50						
Permeable Material Class 2	Ton			$16.50		$21.50				
Import Borrow	Load	$40-$60								
Gabion Rock	Ton									

*Set up temporary plant

Figures

INDEX OF PLANS

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY
IN ALAMEDA COUNTY
IN AND NEAR LIVERMORE AND PLEASANTON
FROM 0.1 MILE SOUTH OF RUBY HILL DRIVE TO JACK LONDON BOULEVARD

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

LOCATION MAP

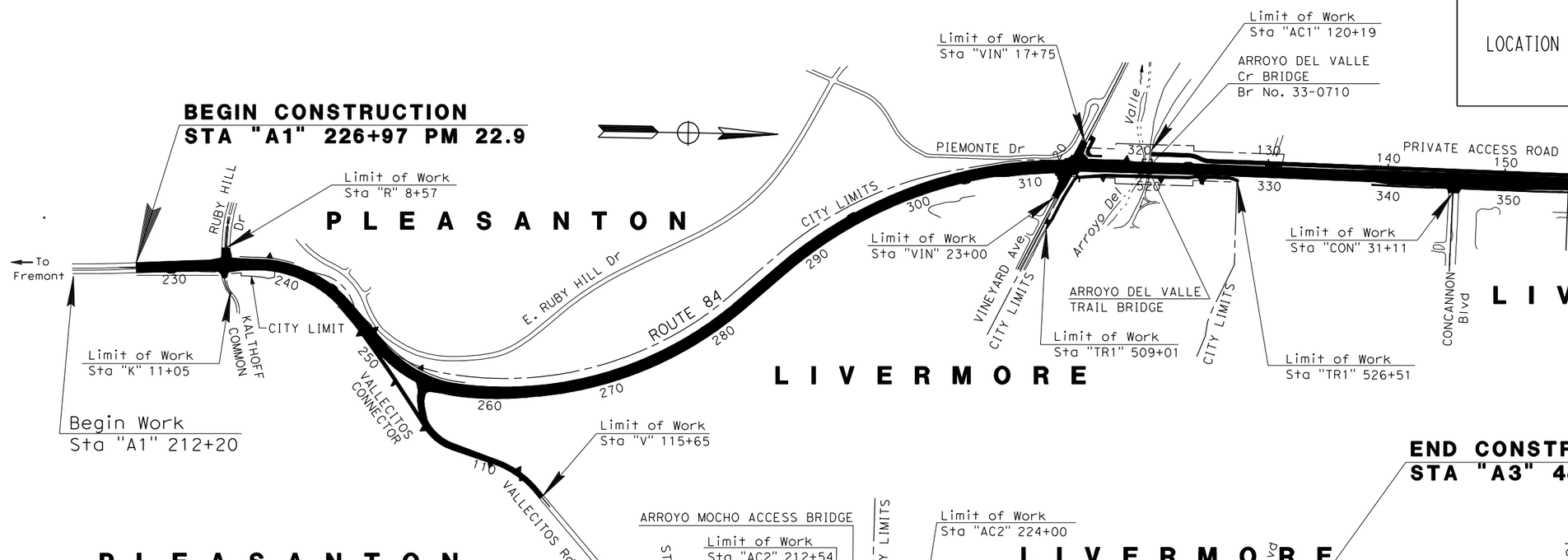

FIGURE 1-1

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

CITY ENGINEER — DATE
APPROVE AS TO FEATURES AFFECTING CITY OF LIVERMORE

PROJECT ENGINEER — DATE
REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

CONTRACT No. **04-297604**

LAST REVISION 00-00-00 DATE PLOTTED => 2/25/2010 TIME PLOTTED => 11:00:38 AM

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER — BEN RAZEGHI — REGISTRATION No. — LICENSE Exp DATE

CALTRANS DESIGN OVERSIGHT APPROVAL — NESTOR P. PEREZ — DATE SIGNED

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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Suite 800
Oakland, CA 95612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

INDEX TO PLANS

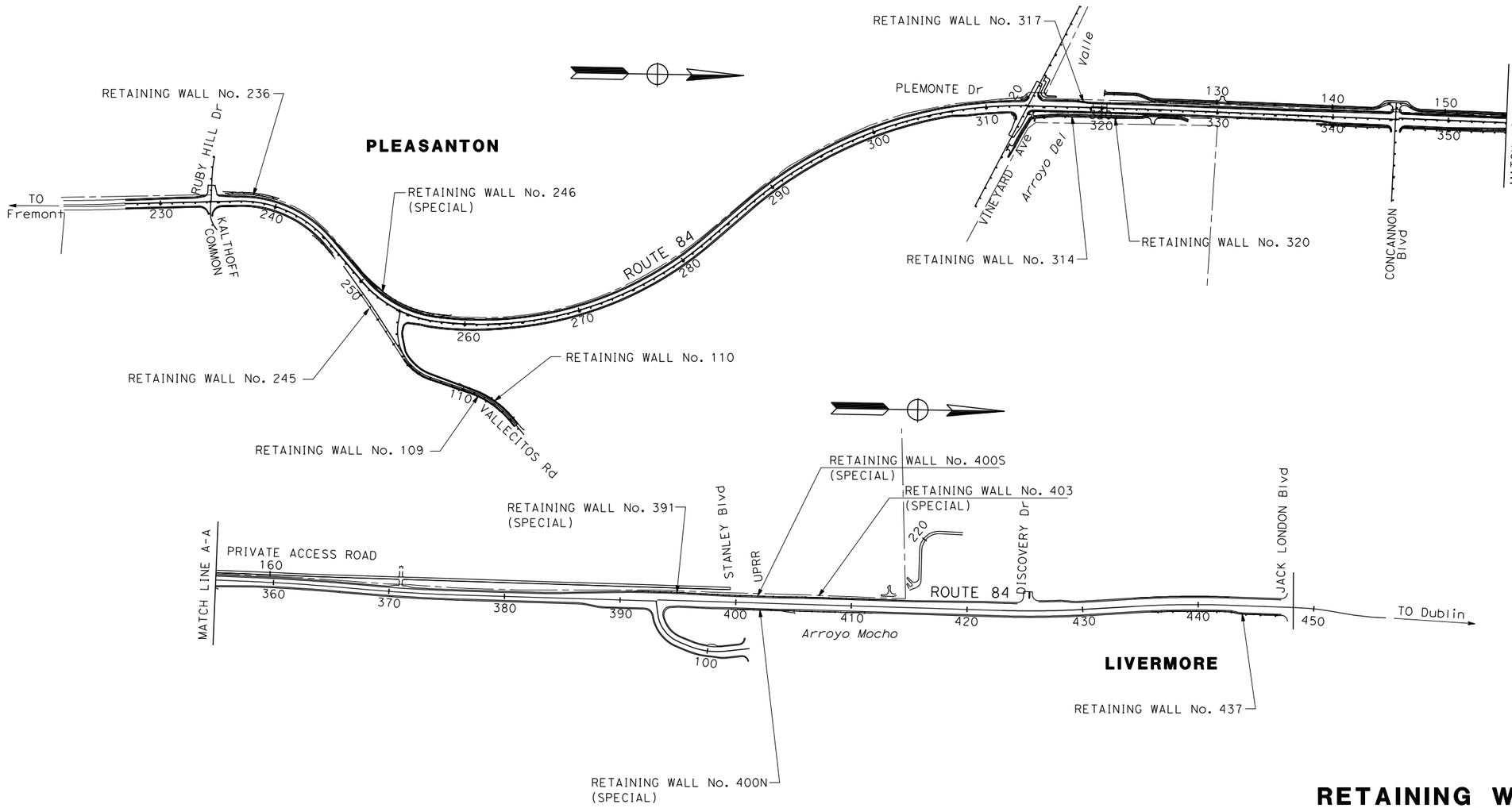
SHEET No.	TITLE
R-1	GENERAL PLAN
R-2	RETAINING WALL No. 236 - RETAINING WALL PLAN No. 1 OF 1
R-3	RETAINING WALL No. 314 - RETAINING WALL PLAN No. 1 OF 1
R-4	RETAINING WALL No. 317 - RETAINING WALL PLAN No. 1 OF 1
R-5	RETAINING WALL No. 320 - RETAINING WALL PLAN No. 1 OF 1
R-6	RETAINING WALL No. 437 - RETAINING WALL PLAN No. 1 OF 3
R-7	RETAINING WALL No. 437 - RETAINING WALL PLAN No. 2 OF 3
R-8	RETAINING WALL No. 437 - RETAINING WALL PLAN No. 3 OF 3
R-9	RETAINING WALL No. 109 - RETAINING WALL PLAN No. 1 OF 1
R-10	RETAINING WALL No. 110 - RETAINING WALL PLAN No. 1 OF 2
R-11	RETAINING WALL No. 110 - RETAINING WALL PLAN No. 2 OF 2
R-12	RETAINING WALL No. 245 - RETAINING WALL PLAN No. 1 OF 3
R-13	RETAINING WALL No. 245 - RETAINING WALL PLAN No. 2 OF 3
R-14	RETAINING WALL No. 245 - RETAINING WALL PLAN No. 3 OF 3
R-16	RETAINING WALL DETAILS

LEGEND

(B0-3 / 3-1) STANDARD PLAN SHEET No. / STANDARD PLAN DETAIL No.

(R16 / A) NON STANDARD PLAN SHEET No. / NON STANDARD DETAIL No.

TCE TEMPORARY CONSTRUCTION EASEMENT



THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

FIGURE 1-2

RETAINING WALL KEY MAP GENERAL PLAN

SCALE: 1" = 500'

R-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY .

CHECKED BY .

DATE REVISED	REVISED BY
.	.

LAST REVISION 00-00-00 DATE PLOTTED => 2/25/2010 TIME PLOTTED => 11:03:09 AM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => madhu_thummaluru
DGN FILE => ...\MatReport\Fig 1-2.dgn

CU 04256

EA 297601

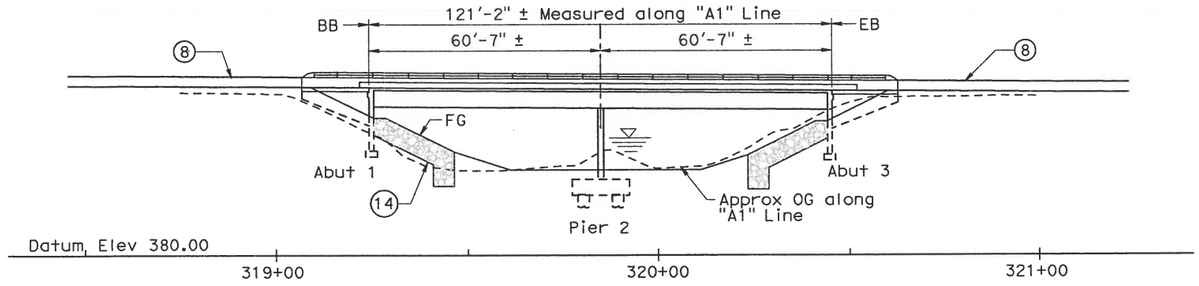
EVC, Sta 319+00.00
Elev 424.17

BVC, Sta 320+99.85
Elev 423.18

-0.50%

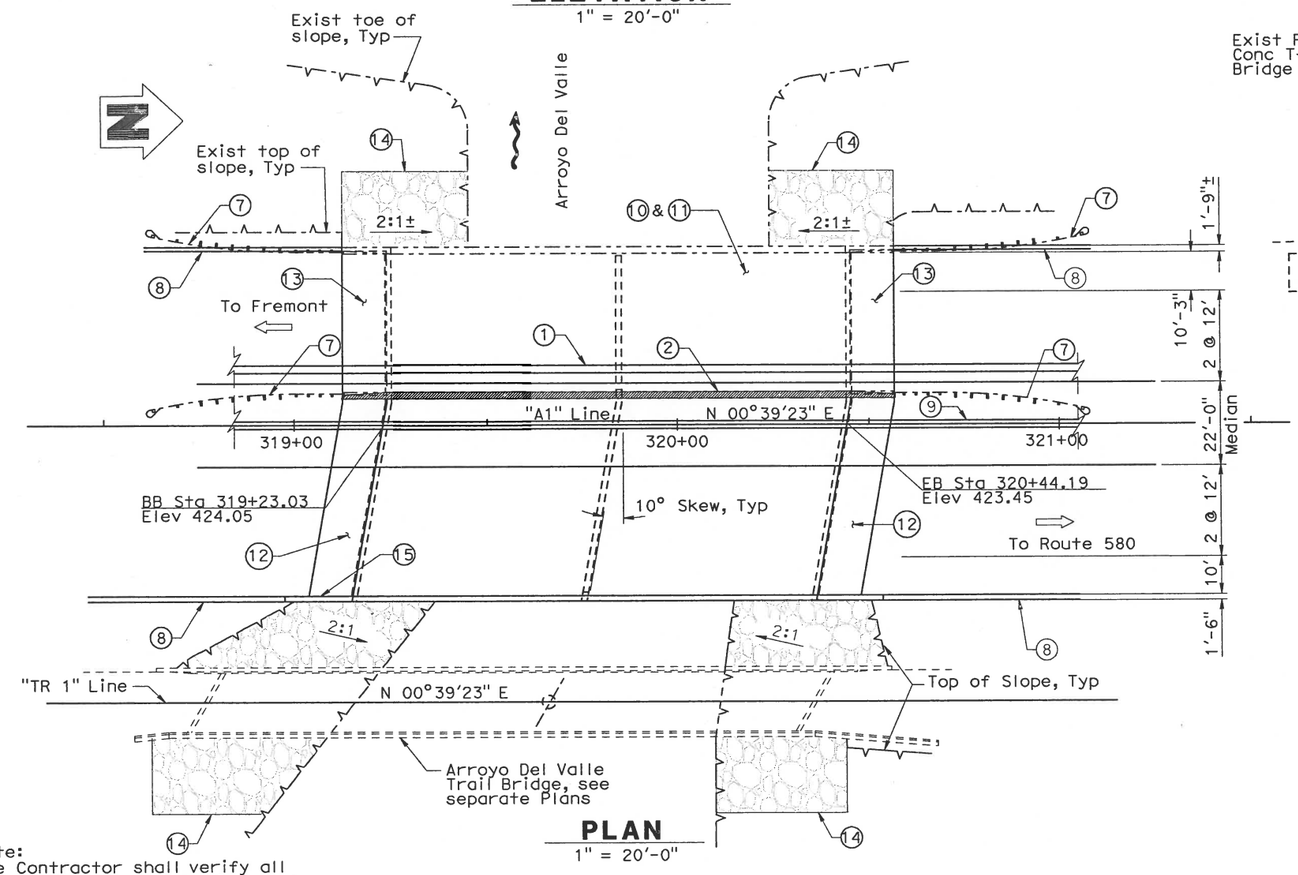
PROFILE GRADE

No Scale



ELEVATION

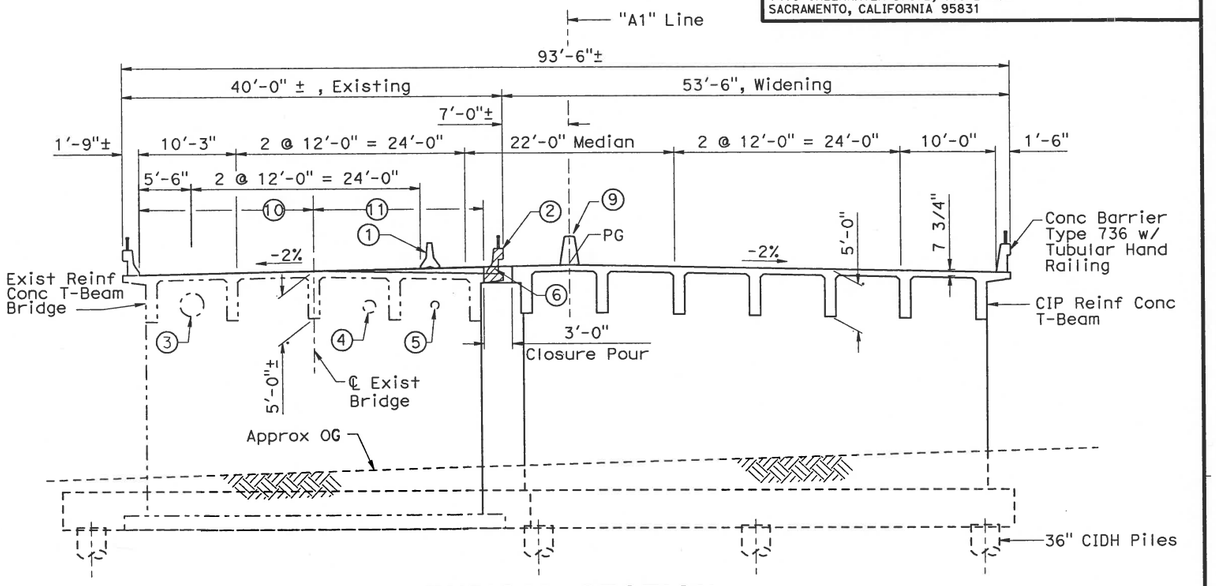
1" = 20'-0"



PLAN

1" = 20'-0"

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any materials.



TYPICAL SECTION

1/8" = 1'-0"

LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Concrete Removal

For General Notes and Index to Plans, see "INDEX TO PLANS".

For Pile Data Table, Spread Footing Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.

NOTES:

1. Temporary Railing (Type K), see "Road Plans"
2. Remove Existing Barrier, Railing & Overhang
3. Existing 30" ø Steel Casing to remain
4. Existing 16"ø D.I.P. Sewer Line to be relocated
5. Existing 12"ø Water Line to remain
6. Existing 2 - 3"ø Conduits to be relocated
7. Existing Metal Beam Guard Rail to be removed
8. Concrete Barrier, see "Road Plans"
9. Concrete Barrier Type 60A
10. Remove Unsound Concrete, prepare Concrete Bridge Deck and place Polyester Concrete Overlay
11. Remove Unsound Concrete, prepare Concrete Bridge Deck, place Concrete Overlay and place 3/4" Polyester Concrete Overlay
12. Structure Approach, Type N
13. Remove Exist Approach Slab and replace with Structure Approach, Type R
14. Rock Slope Protection (1-Ton, Method B)
15. Paint "Bridge No. 33-0710" & "Arroyo Del Valle Bridge"

FIGURE 1-3

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER _____ DATE _____

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/10 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE _____

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1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED D. Wang	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 WITH "LOW-BOY" AND PERMIT DESIGN VEHICLE		
	DETAILS	BY P. Zhao	CHECKED D. Wang	LAYOUT	BY G. Xu	CHECKED D. Wang	
SIGN OFF DATE	QUANTITIES	BY W. Sennett	CHECKED C. Miller	SPECIFICATIONS	BY K. Chen	PLANS AND SPECS COMPARED G. Xu	

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO. 33-0710
POST MILES 24.8

ARROYO DEL VALLE BRIDGE (WIDEN)

GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/08/08 | 04/07/08 | 05/15/08 | 10/14/08 | 12/18/08 | 05/04/09 | 01/22/10

SHEET 1 OF 18

FILE => $REQUEST

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/10 — CIVIL — STATE OF CALIFORNIA

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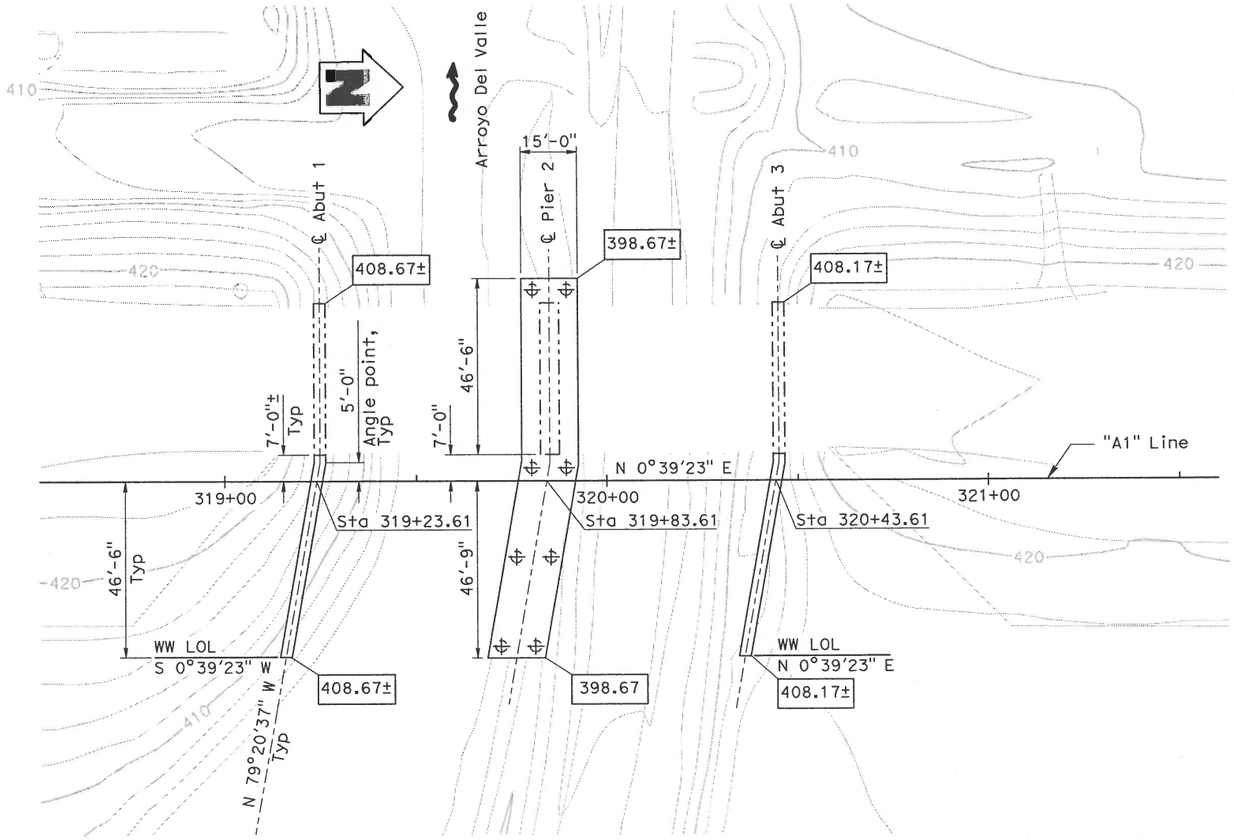
SACRAMENTO, CALIFORNIA 95831



FOUNDATION PLAN

1" = 20'-0"

SPREAD FOOTING DATA TABLE

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)	
	B	L			Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (ksf)
Abut 1	3.0	53.5	408.7	5.0	9.00	6.00
Abut 3	3.0	53.5	408.2	5.0	7.50	6.00

PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevations (ft)
		Compression	Tension		
Pier 2	36" CIDH	1,210	0	305.0 (1) 356.0 (2)	305.0

The design tip elevation is controlled by the following demands:
(1) Compression; (2) Lateral.

HYDROLOGIC SUMMARY

	Design Flood	Base Flood
Frequency (Years)	50	100
Discharge (Cubic feet per second)	5,400	7,000
Water Surface (Elevation at bridge)	410.06	411.18

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.

LEGEND

- Indicates Existing Structure
- Indicates New Construction
- Indicates Direction of Flow
- XXX.xx Indicates Bottom of Footing Elevation
- Indicates 36" CIDH Piles

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any materials.

FIGURE 1-4

GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT

SIGN OFF DATE

SCALE: 1"=20'-0" | VERT. DATUM NAVD88 | HORZ. DATUM NAD83
PHOTOGRAMMETRY AS OF: | ALIGNMENT TIES
SURVEYED BY | DRAFTED BY
FIELD CHECKED BY | CHECKED BY

	BY	CHECKED
DESIGN	G. Xu	D. Wang
DETAILS	P. Zhao	D. Wang
QUANTITIES	W. Sennett	C. Miller

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

BRIDGE NO. 33-0710
POST MILE 24.8

ARROYO DEL VALLE BRIDGE (WIDEN)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/09/08 | 04/07/08 | 09/15/08 | 10/14/08 | 12/18/08 | 05/07/09 | 01/14/10

SHEET 3 OF 18

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Guoping Xu No. C 63977 Exp. 09/30/10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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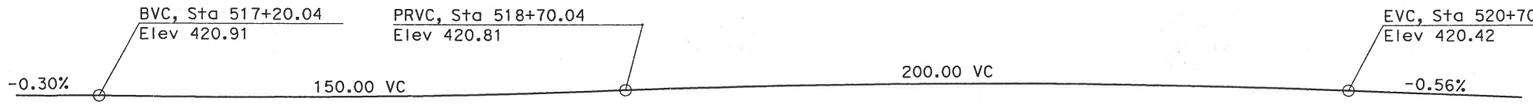
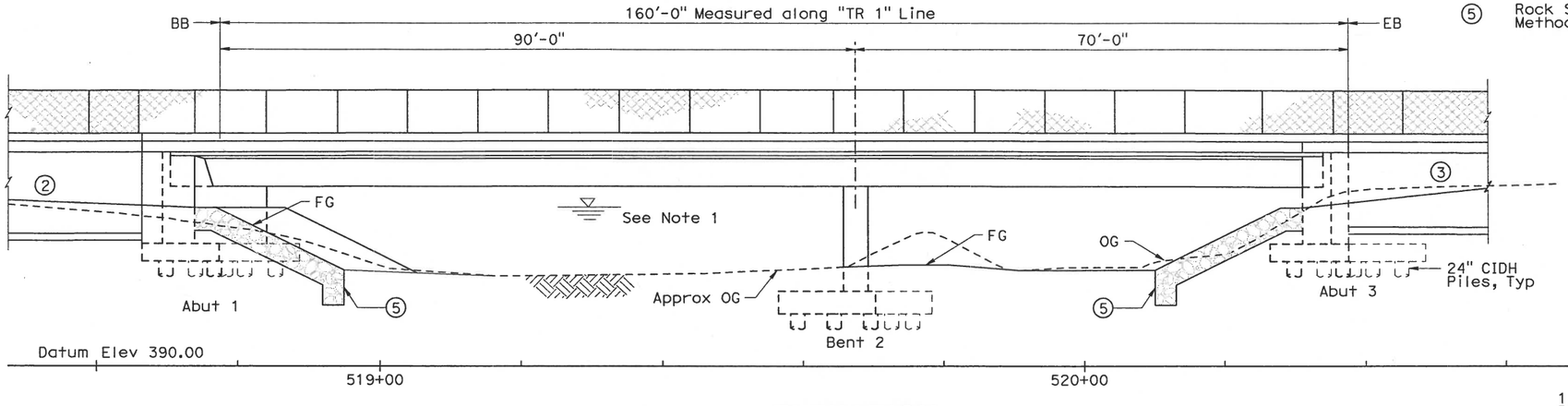
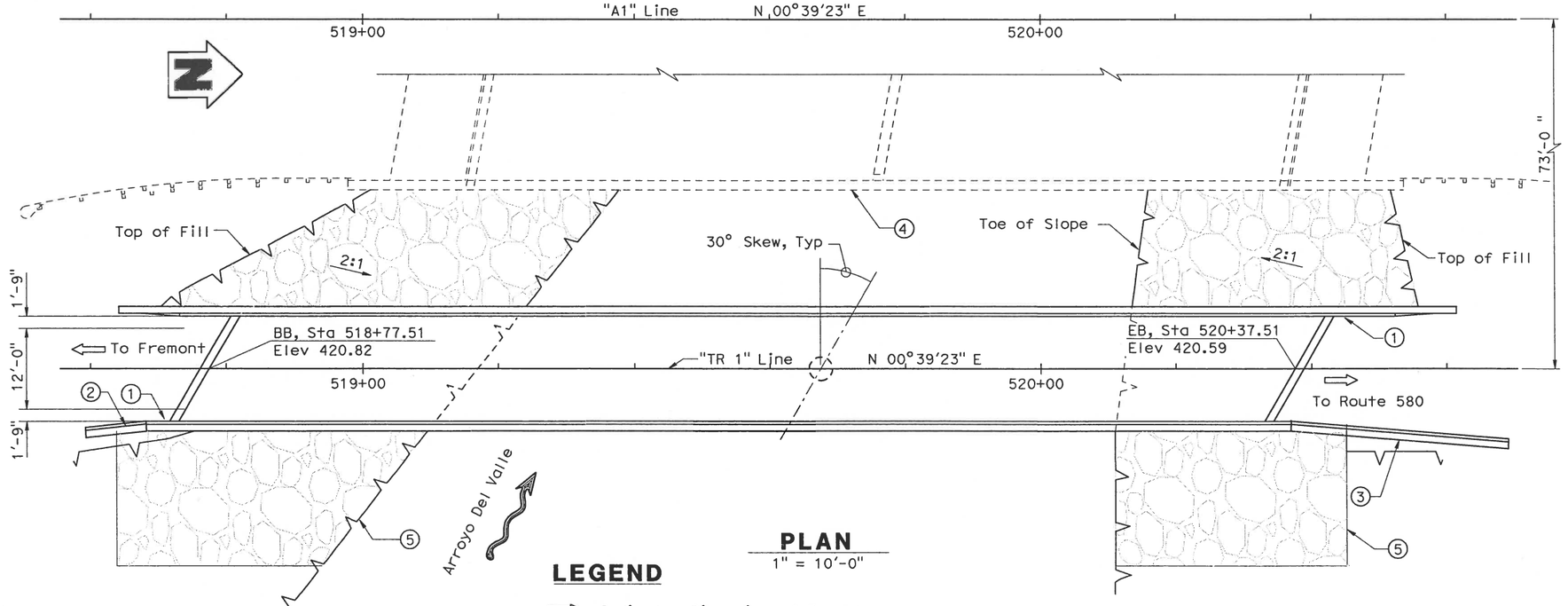


PROFILE GRADE
No Scale



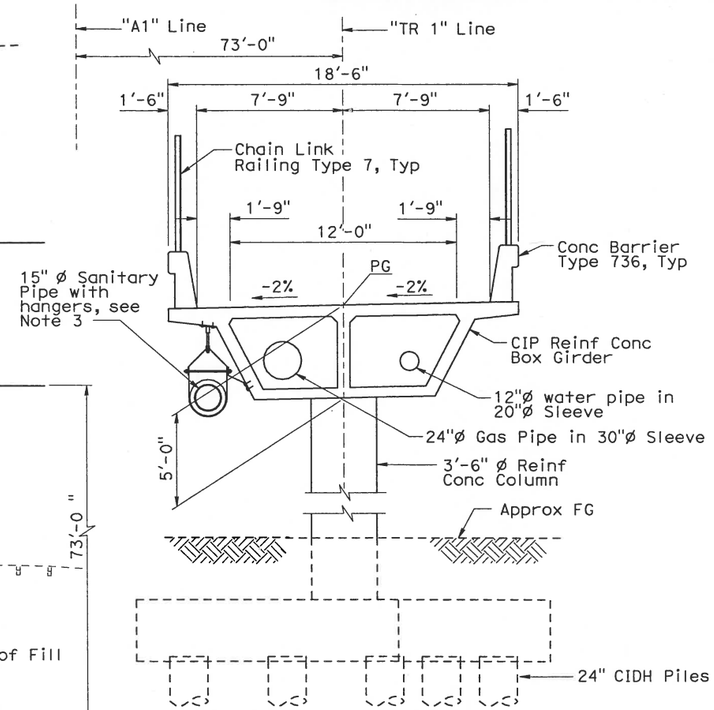
ELEVATION
1" = 10'-0"



PLAN
1" = 10'-0"

LEGEND
⇨ Indicates Direction of Travel
〰➔ Indicates Direction of Flow

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.



TYPICAL SECTION
1/4" = 1'-0"

NOTES:
1. For General Notes, Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
2. For Index to Plans, see "DECK CONTOURS" sheet.
3. Refer to "SANITARY SEWER DETAILS" sheet for Pipe Hanger Assembly. Sanitary Pipe Support Connections shall be reviewed by the Engineer prior to installation.

NOTES:
1. Paint "Bridge No. xxx", and "Arroyo Del Valle Trail Bridge"
2. RW 314, see "Road Plans"
3. RW 320, see "Road Plans"
4. Arroyo Del Valle Bridge (Widen) Bridge No. 33-0710, see Separate Plans
5. Rock Slope Protection (1/4-Ton, Method B)

FIGURE 1-5

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED D. Wang	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: 0.085 KSF PEDESTRIAN AND H10 (20 K) TRUCK		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu PROJECT ENGINEER	BRIDGE NO. N/A	ARROYO DEL VALLE TRAIL BRIDGE
	DETAILS	BY P. Zhao	CHECKED D. Wang	LAYOUT	BY G. Xu	CHECKED D. Wang			POST MILES N/A	GENERAL PLAN
SIGN OFF DATE	QUANTITIES	BY D. Vang	CHECKED W. Sennett	SPECIFICATIONS	BY K. Chen	PLANS AND SPECS COMPARED G. Xu				
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)				ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3				CU 04254 EA 297601	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) 02/09/08 04/07/08 09/15/08 11/12/08 12/23/08 05/14/09 01/22/10 — SHEET 1 OF 17

FILE => $REQUEST

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Guoping Xu
No. C 63977
Exp. 09/30/10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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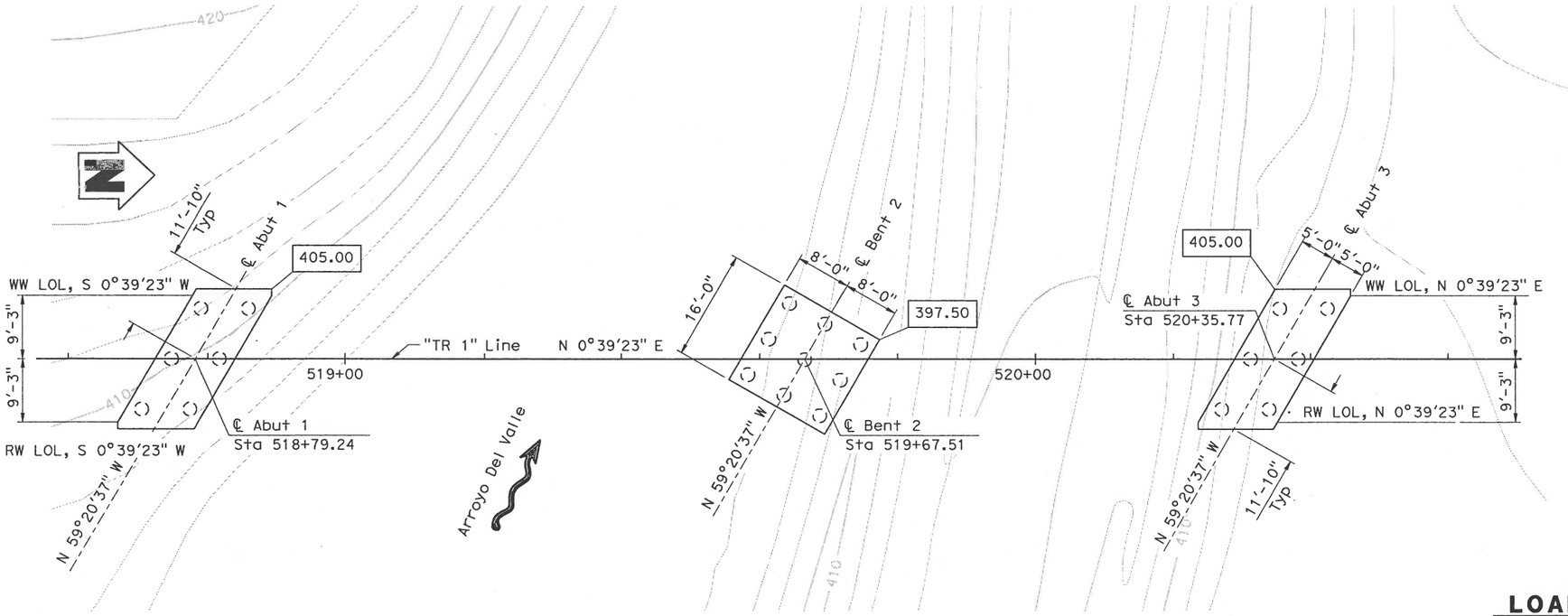
OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



BENCHMARK DATA

BM-16 - MONUMENT GTS220. MONUMENT IS A SET MAG NAIL IN DECORATIVE BRICK. MONUMENT IS LOCATED ON ISLAND AT NW RETURN OF ISABEL AND BINEYARD, 4.5 FT. FROM SE CORNER OF ISLAND.
ELEVATION: 425.51′ NORTHING: 2062597.788
EASTING: 6183687.773

BM-17 - MONUMENT GTS219. MOUNMENT IS A SET MAG NAIL WITH WASHER IN AC LABELED "GTS CONTROL POINT." MONUMENT IS LOCATED ON THE EAST SIDE OF ISABEL 60 FT NORTH OF BRIDGE ABUTMENT FOR CREEK NORTH OF VINEYARD, 2 FT NORTH OF END OF BARRIER RAIL.
ELEVATION: 421.73′ NORTHING: 2063315.901
EASTING: 6183722.273

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

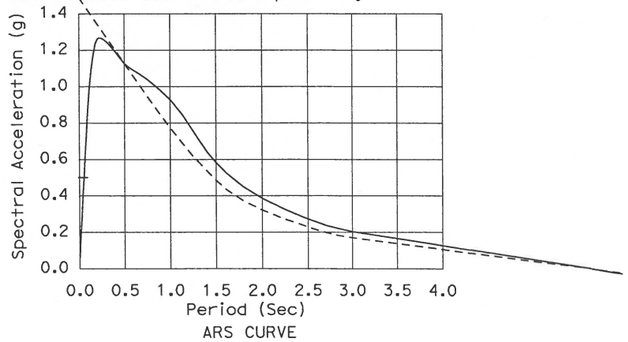
DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition and the Caltrans Amendments, Preface dated December 2008.

SEISMIC DESIGN: Caltrans Seismic Design Criteria (SDC) Version 1.4 dated June 2006

DEAD LOAD: Includes 35 psf for future wearing surface

LIVE LOADING: 85 psf Pedestrian Load or H10 (20 Kip) Truck + 30% impact.

SEISMIC LOADING: Modified Caltrans SDC ARS Curve
Soil Profile Type D
Magnitude Group (7.25±.25)
Peak Rock Acceleration = 0.5g
20% Increase due to fault proximity



CONCRETE: fy = 60 ksi
f'c = 3.6 ksi
n = 8

FOUNDATION PLAN
1" = 10′-0"

HYDROLOGIC SUMMARY

	Design Flood	Base Flood
Frequency (Years)	50	100
Discharge (Cubic feet per second)	5,400	7,000
Water Surface (Elevation at bridge)	410.55	411.71

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.

LEGEND

Indicates Direction of Flow

XXX.xx Indicates Bottom of Footing Elevation

Indicates 24" CIDH Piles

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

PILE DATA TABLE

B2-3

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevations (ft)
		Compression	Tension		
Abut 1	24" CIDH	280	0	357.0 (1) 376.0 (3)	357.0
Bent 2	24" CIDH	310	120	340.0 (1) 354.0 (2) 366.0 (3)	340.0
Abut 3	24" CIDH	230	0	363.0 (1) 376.0 (3)	363.0

Design tip elevation is controlled by the following demands:
(1) Compression, (2) Tension, (3) Lateral

FIGURE 1-6

GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT	SCALE: 1"=10'-0"	VERT. DATUM NAVD88	HORZ. DATUM NAD83	DESIGN	BY G. Xu	CHECKED D. Wang	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS	BY P. Zhao	CHECKED D. Wang	
SIGN OFF DATE	SURVEYED BY	DRAFTED BY		QUANTITIES	BY D. Vang	CHECKED W. Sennett	
	FIELD CHECKED BY	CHECKED BY					

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO.	ARROYO DEL VALLE TRAIL BRIDGE
N/A	
POST MILE	FOUNDATION PLAN
N/A	

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

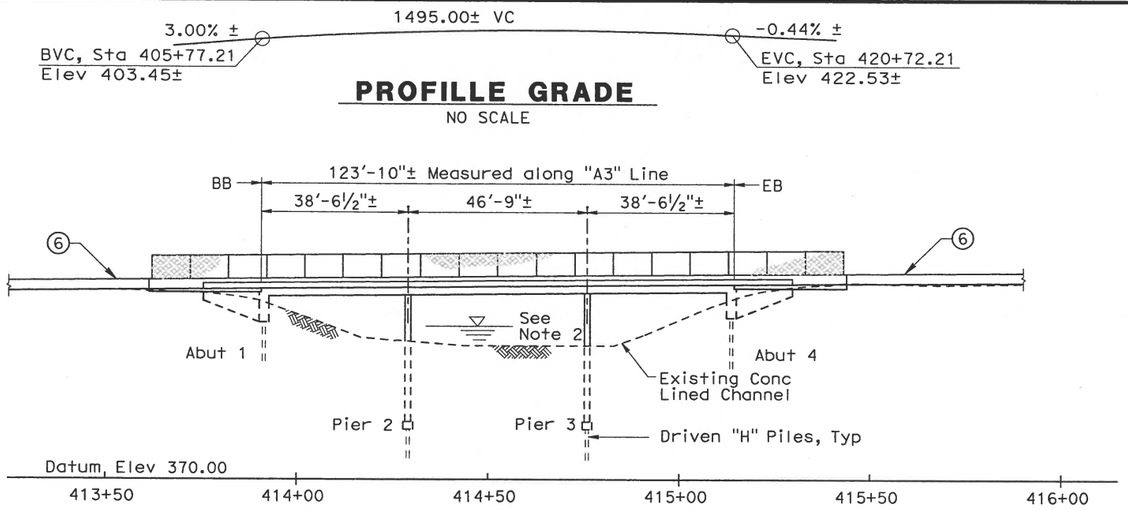
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/08/08 | 04/07/08 | 08/18/08 | 10/14/08 | 12/23/08 | 01/22/10

SHEET 3 OF 17

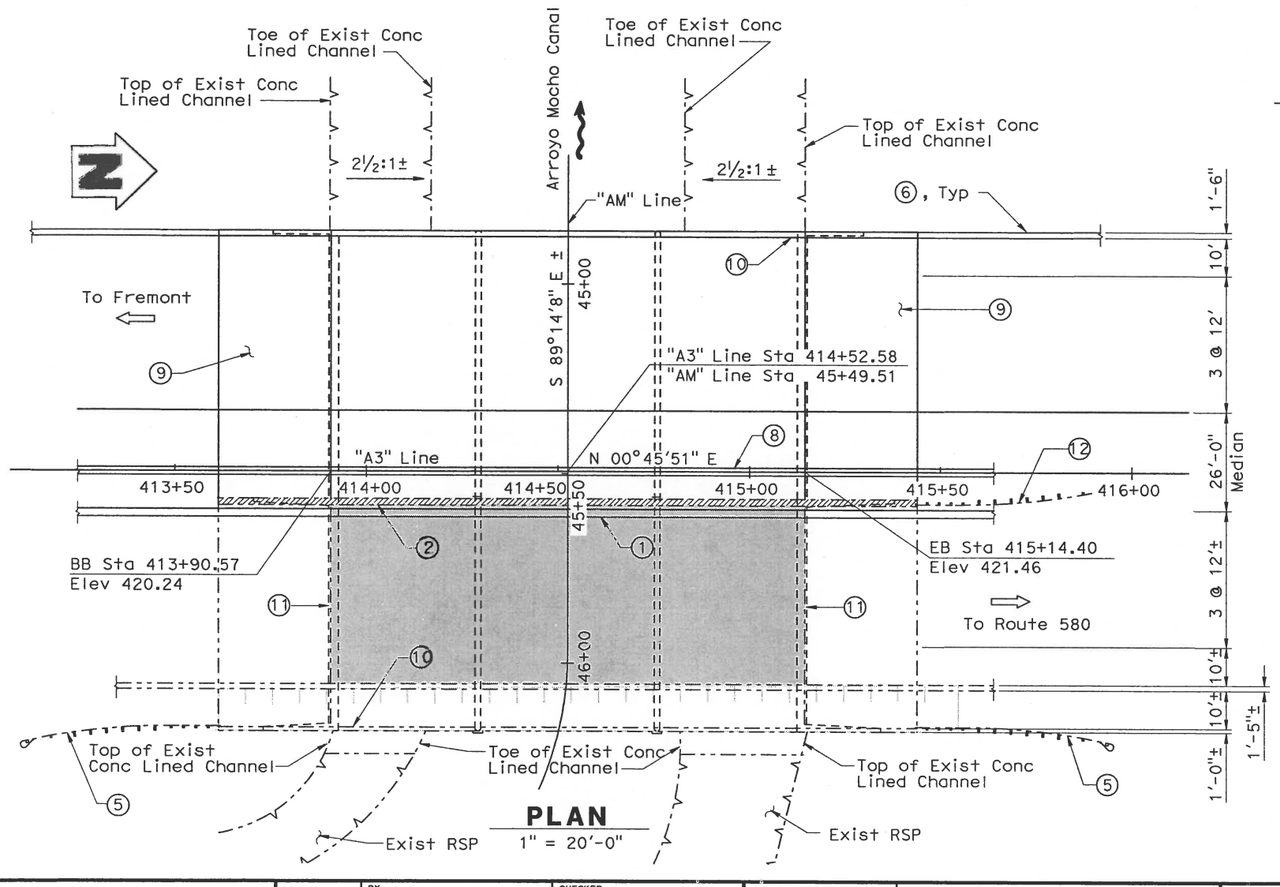


PROFILLE GRADE

NO SCALE

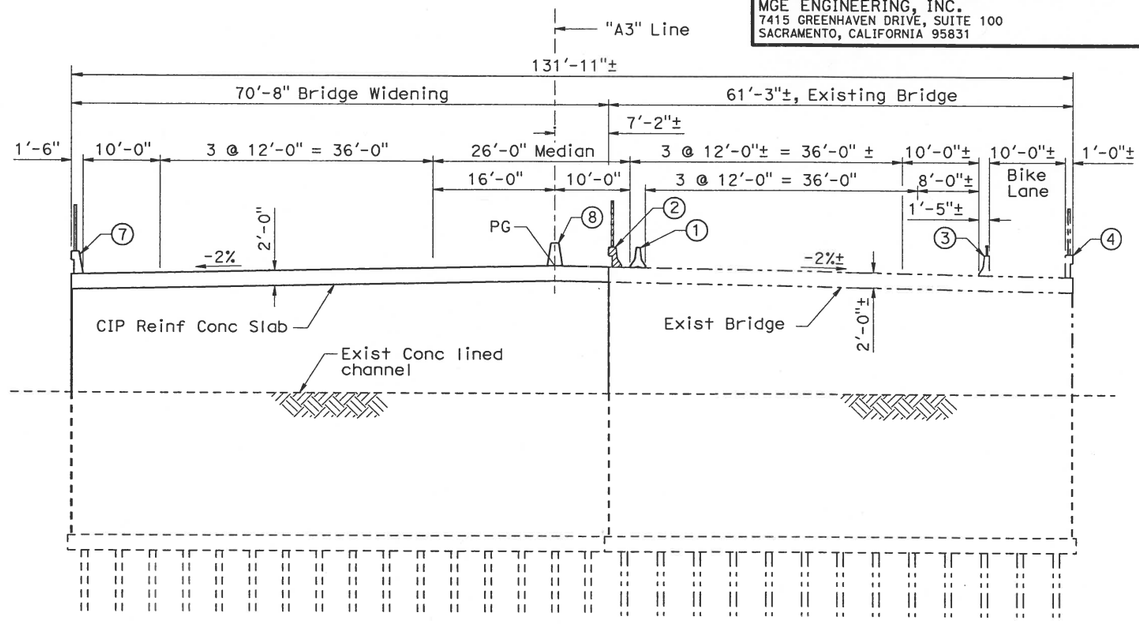
MIRROR ELEVATION

1" = 20'-0"



PLAN

1" = 20'-0"



TYPICAL SECTION

1" = 10'-0"

NOTES:

1. Temporary Railing (Type K), see "Road Plans"
2. Remove Existing Concrete Barrier Type 25 and Chain Link Railing
3. Exist Conc Barrier Type 27 w/ Tubular Handrail to remain
4. Exist Conc Barrier Type 26 (Mod) w/ Chain Link Railing (Type 7) to remain
5. Existing Metal Beam Guard Rail to remain
6. Concrete Barrier (Type 60C), see "Road Plans"
7. Conc Barrier Type 736 w/ Type 7 Chain Link Railing, Vinyl Clad
8. Conc Barrier Type 60A
9. Structure Approach Type N(30D)
10. Paint "Bridge No. 33-0713 PM R27.10 2003"
11. Remove and Replace Exist Joint Seal
12. Existing Metal Beam Guard Rail to be removed

LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Concrete Removal
- Indicates limits of remove unsound concrete and replace with rapid setting concrete, clean and treat bridge deck with Methacrylate

NOTES:

1. For General Notes and Index to Plans, see "INDEX TO PLANS" sheet.
2. For Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
3. The Contractor shall verify all controlling field dimensions before ordering or fabricating any materials.

FIGURE 1-7

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/10 — CIVIL — STATE OF CALIFORNIA

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OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED R. Sennett	LOAD & RESISTANCE FACTOR DESIGN — LIVE LOADING: HL93 W/ "LOW-BOY" AND PERMIT DESIGN VEHICLE	
	DETAILS	BY P. Zhao	CHECKED R. Sennett	LAYOUT: BY G. Xu	CHECKED R. Sennett
SIGN OFF DATE	QUANTITIES	BY W. Sennett	CHECKED J. Jakobsen	SPECIFICATIONS: BY K. Chen	PLANS AND SPECS COMPARED G. Xu

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

FILE => $REQUEST

BRIDGE NO. 33-0713
POST MILES 26.6

ARROYO MOCHO BRIDGE (WIDEN)

GENERAL PLAN

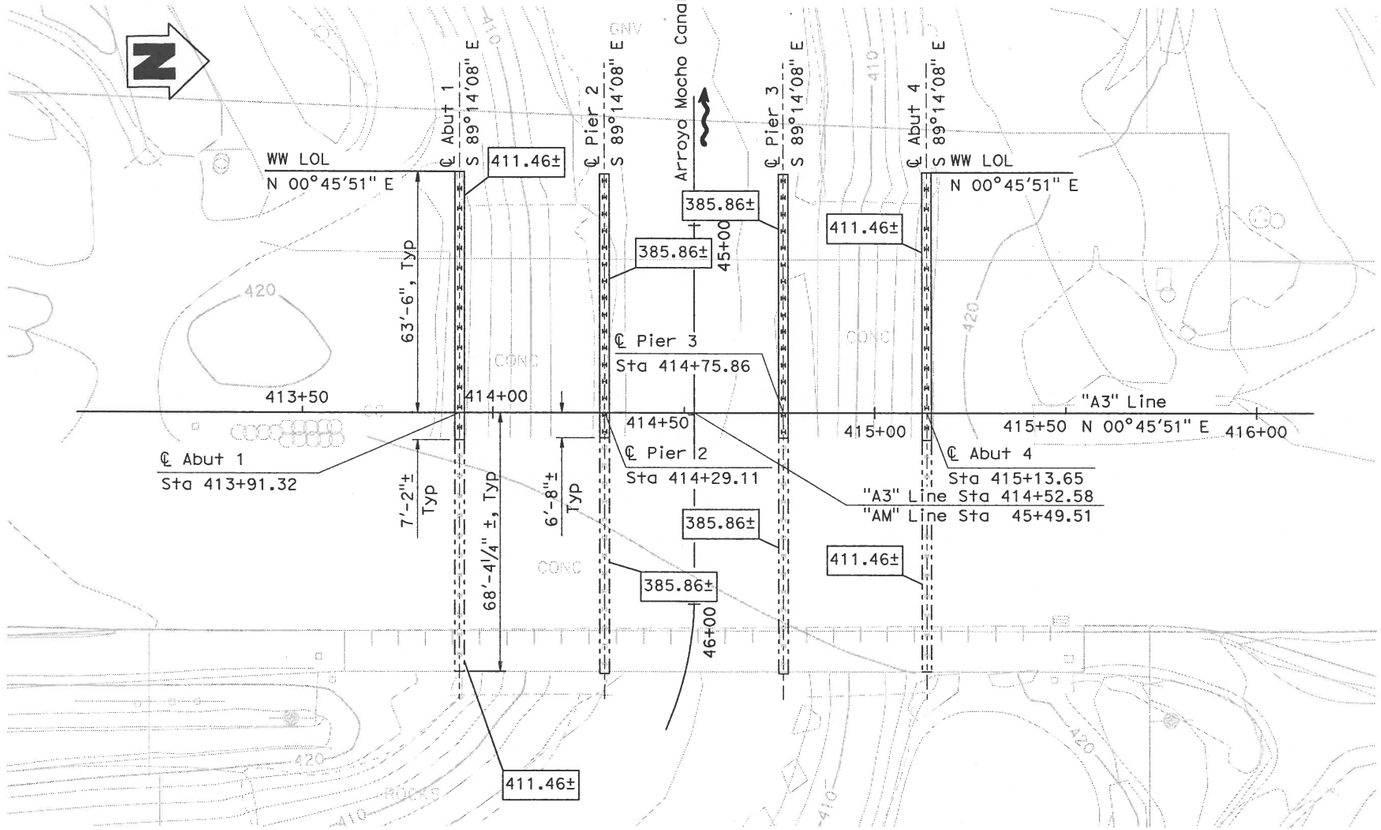
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/08/08 | 04/07/08 | 09/15/08 | 05/01/09 | 01/22/10

SHEET 1 OF 16



FOUNDATION PLAN

1" = 20'-0"

LEGEND

- ---- Indicates Existing Structure
- ——— Indicates New Construction
- ~~~➤ Indicates Direction of Flow
- XXX.XX Indicates Bottom of Footing Elevation
- H Indicates New Pile
- H Indicates Exist Pile

HYDROLOGIC SUMMARY

	Design Flood	Base Flood
Frequency (Years)	50	100
Discharge (Cubic feet per second)	3,900	4,800
Water Surface (Elevation at bridge)	413.97	415.01

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.

PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevations (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	HP 10x57	150	0	377.0 (1); 390.0 (2)	377.0	150
Pier 2	HP 10x57	290	0	331.0 (1); 360.0 (2)	331.0	290
Pier 3	HP 10x57	290	0	331.0 (1); 360.0 (2)	331.0	290
Abut 4	HP 10x57	150	0	377.0 (1); 390.0 (2)	377.0	150

Design tip elevations are controlled by the following demands:
(1) Compression; (2) Lateral.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any materials.

FIGURE 1-8

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84			

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PLANS APPROVAL DATE

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MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT

SIGN OFF DATE

SCALE: 1"=20'-0" | VERT. DATUM NAVD88 | HORZ. DATUM NAD83

PHOTOGRAMMETRY AS OF: | ALIGNMENT TIES

SURVEYED BY | DRAFTED BY

FIELD CHECKED BY | CHECKED BY

	BY	CHECKED
DESIGN	G. Xu	R. Sennett
DETAILS	P. Zhao	R. Sennett
QUANTITIES	W. Sennett	J. Jakobsen

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601
FILE => $REQUEST

BRIDGE NO. 33-0713
POST MILE 26.6

ARROYO MOCHO BRIDGE (WIDEN)
FOUNDATION PLAN

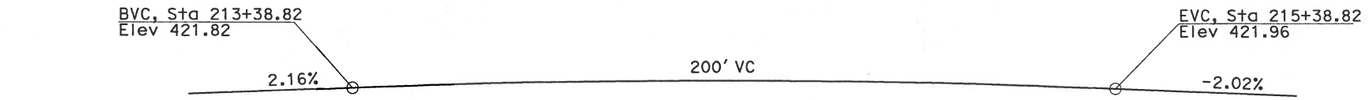
FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

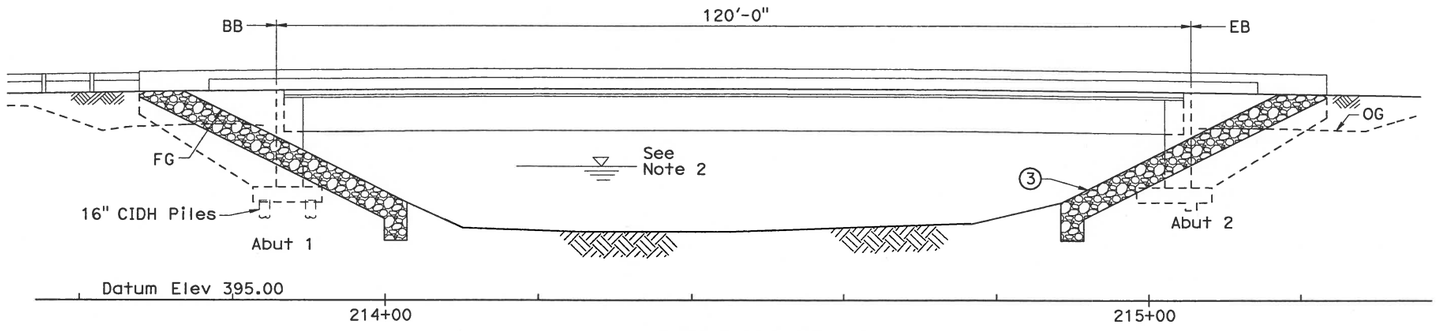
DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/08/08 | 04/07/08 | 09/15/08 | 12/19/08 | 05/07/09 | 01/22/10

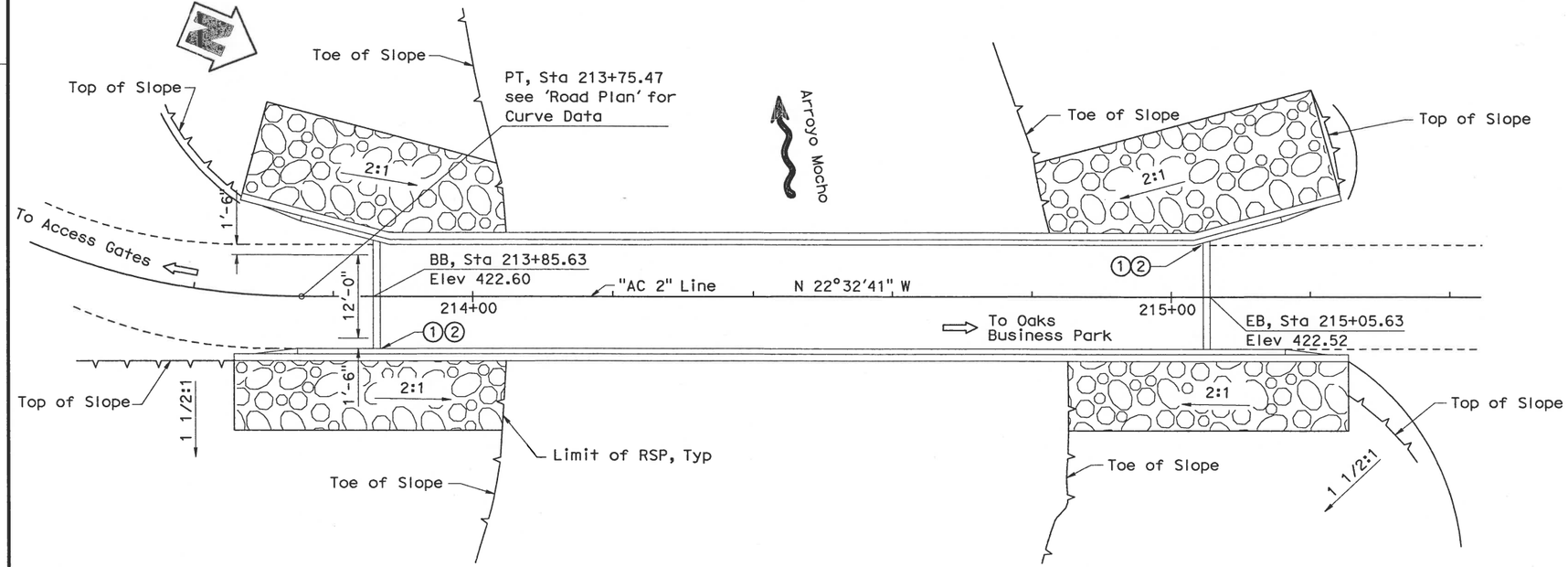
SHEET 3 OF 16



PROFILE GRADE
No Scale



ELEVATION
1" = 10'-0"



PLAN
1" = 10'-0"

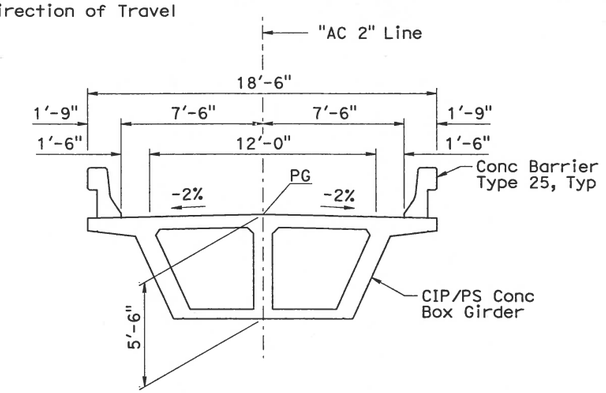
NOTES:

1. For General Notes and Spread Footing Data Table, see "FOUNDATION PLAN" sheet.
2. For Hydrologic Summary, see "FOUNDATION PLAN" sheet.

NOTES:

① Paint Bridge Name, "Arroyo Mocho Access Bridge"
② Paint "Bridge No. 33-xxx"
③ Rock Slope Protection (1/4Ton, Method B)

LEGEND
Indicates Direction of Flow
Indicates Direction of Travel



TYPICAL SECTION
1/4" = 1'-0"

INDEX TO PLANS

Sheet No.	Title
1	GENERAL PLAN
2	DECK CONTOURS
3	FOUNDATION PLAN
4	ABUTMENT LAYOUT
5	ABUTMENT DETAILS NO. 1
6	ABUTMENT DETAILS NO. 2
7	ABUTMENT DETAILS NO. 3
8	TYPICAL SECTION
9	GIRDER LAYOUT
10	MISCELLANEOUS
11-13	LOG OF TEST BORINGS
14	AS-BUILT LOG OF TEST BORINGS

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

Guoping Xu
No. C 63977
Exp. 09/30/10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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SACRAMENTO, CALIFORNIA 95831

FIGURE 1-9

DESIGN OVERSIGHT	DESIGN	P. Zhao	R. Sennett	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING:	HL93 WITH "LOW-BOY", PERMIT DESIGN VEHICLE	
SIGN OFF DATE	DETAILS	P. Zhao	R. Sennett	LAYOUT	P. Zhao	R. Sennett	
	QUANTITIES	R. Huang	S. Mareddy	SPECIFICATIONS	K. Chen	PLANS AND SPECS COMPARED G. Xu	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

FILE => $REQUEST

BRIDGE NO.	ARROYO MOCHO ACCESS BRIDGE
N/A	
POST MILES	GENERAL PLAN
N/A	

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/08/08 | 04/07/08 | 09/15/08 | 12/15/08 | 04/30/09 | 01/22/10

SHEET 1 OF 14

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84			

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PLANS APPROVAL DATE

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Exp. 09/30/10
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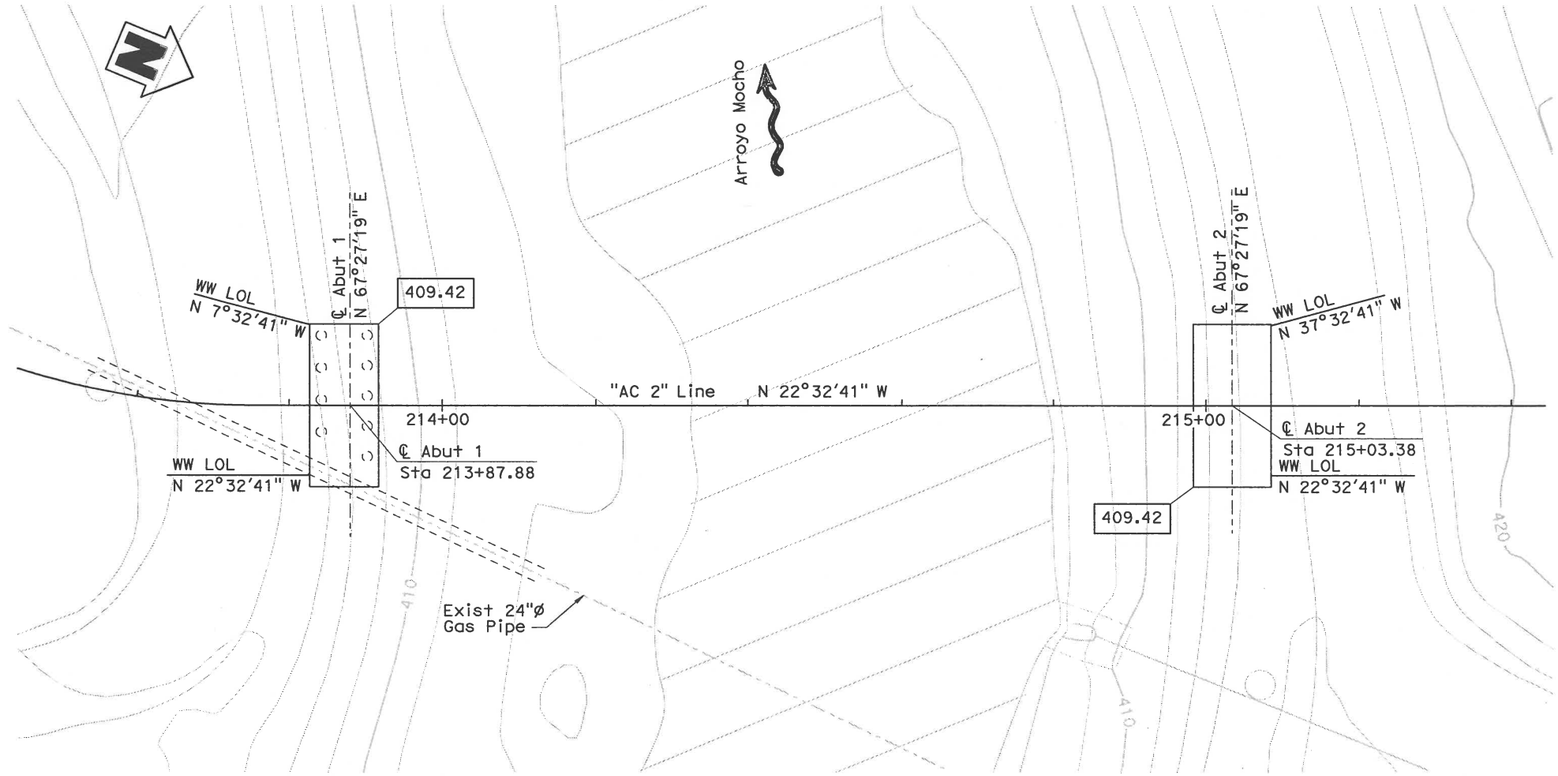
LEGEND

Indicates Direction of Flow

XXX.xx Indicates Bottom of Footing Elevation



BENCHMARK DATA

B-31 - MONUMENT GTS205 MONUMENT IS A SET 5/8" REBAR WITH PLASTIC CAP LABELED "GTS CTRL PT." MONUMENT IS LOCATED ON THE WEST SIDE OF ISABEL JUST SOUTH OF THE CREEK THAT IS +/- 1000 FT SOUTH OF DISCOVERY DR. IT IS 21 FT SOUTH OF 6FT CHAIN LINK FENCE AND 25.5 FT WEST OF ABUTMENT WALL.
ELEVATION: 419.84' NORTHING: 2072557.560
EASTING: 6183906.224

B-33 - MONUMENT GTS303 MONUMENT IS A SET 5/8" REBAR WITH PLASTIC CAP LABELED "GTS CTRL PT." MONUMENT IS LOCATED ON THE SOUTH SIDE OF THE CHANNEL THAT IS SOUTH OF DISCOVERY DR, +/- 200 FT WEST OF ISABEL, 8FT SOUTH OF ANGLE POINT OF CONCRETE WALL.
ELEVATION: 414.26' NORTHING: 2072505.810
EASTING: 6183714.251

HYDROLOGIC SUMMARY

	Design Flood	Base Flood
Frequency (Years)	50	100
Discharge (Cubic feet per second)	3,900	4,800
Water Surface (Elevation at bridge)	413.62	414.66

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.

FOUNDATION PLAN

1" = 10'-0"

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

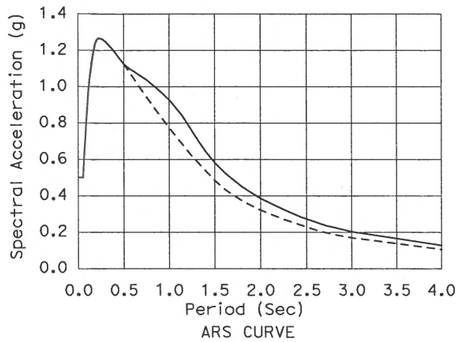
DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition and the Caltrans Amendments, Preface dated December 2008.

SEISMIC DESIGN: Caltrans Seismic Design Criteria (SDC) Version 1.4 dated June 2006

DEAD LOAD: Includes 35 psf for future wearing surface

LIVE LOADING: HL93 and Permit Design Load

SEISMIC LOADING: Modified Caltrans SDC ARS Curve
Soil Profile Type D
Magnitude Group (7.25±0.25)
Peak Rock Acceleration = 0.5g
20% Increase due to fault proximity



ARS CURVE

CONCRETE: fy = 60 ksi
f'c = 3.6 ksi
n = 8

PILE FOOTING DATA TABLE

Support Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)
		Compression	Tension		
Abut 1	16" CIDH	260	0	376.0(a) 394.0(b)	376.0

SPREAD FOOTING DATA TABLE

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)	
	B	L			Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (ksf)
Abut 2	10.0	21.5	409.42	5.0	7.00	6.00

FIGURE 1-10

GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT	SCALE: 1"=10'-0"	VERT. DATUM NAVD88	HORZ. DATUM NAD83	DESIGN	BY P. Zhao	CHECKED R. Sennett	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu PROJECT ENGINEER	BRIDGE NO. N/A
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS	BY P. Zhao	CHECKED R. Sennett			POST MILE N/A
SIGN OFF DATE	SURVEYED BY	DRAFTED BY		QUANTITIES	BY R. Huang	CHECKED S. Mareddy		CU 04254 EA 297601	
	FIELD CHECKED BY	CHECKED BY						FILE => $REQUEST	

ARROYO MOCHO ACCESS BRIDGE
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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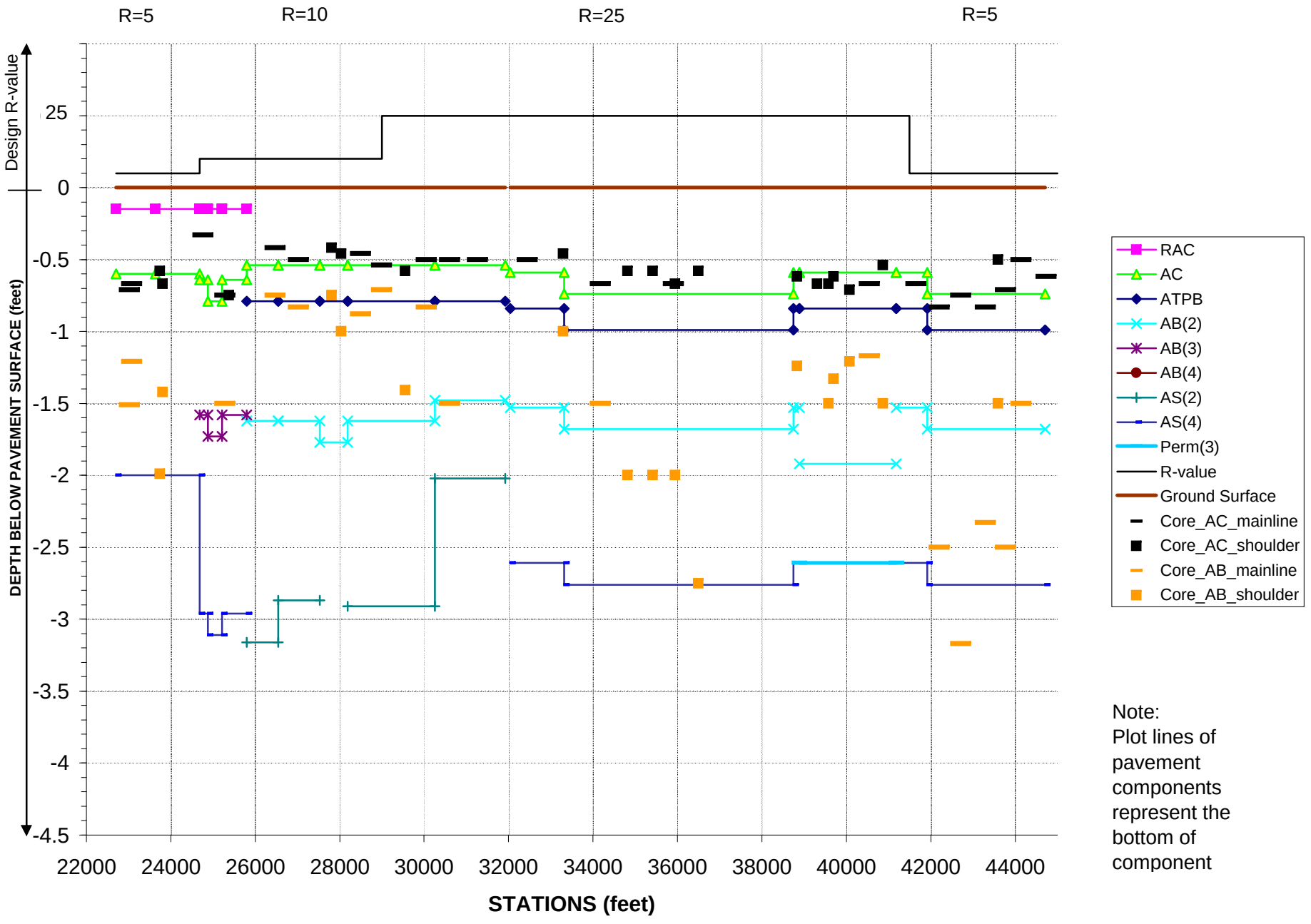
SHEET 3 OF 14

Figure 2-1 Schematic Profile of Existing Pavement Components



Note:
Plot lines of pavement components represent the bottom of component

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. _____ Exp. _____ CIVIL — STATE OF CALIFORNIA

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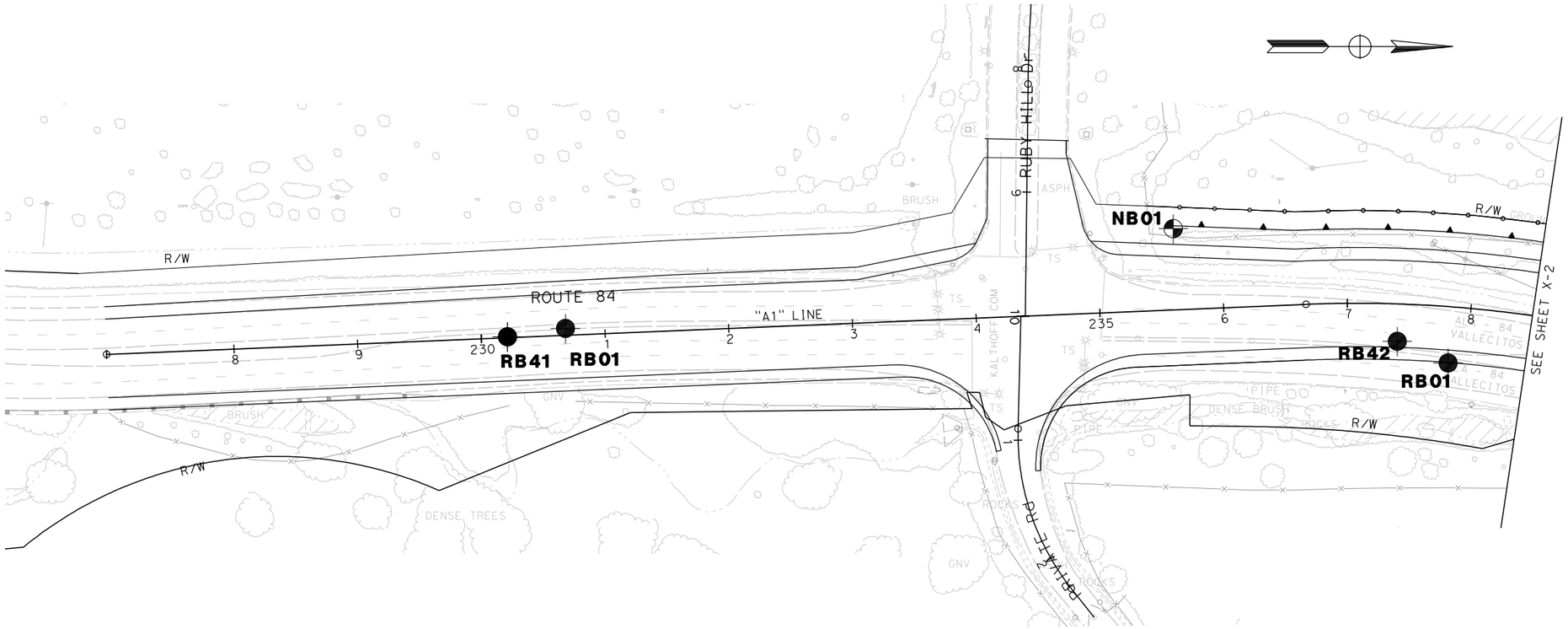

LEGEND:

- EXISTING BRIDGE BORING.
- NEW BORING FOR BRIDGES, RETAINING WALLS AND SOUND WALLS.
- NEW BORING FOR ROADWAY.

FIELD EXPLORATION LOCATION PLAN 3-1

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-1

LAST REVISION 00-00-00 | DATE PLOTTED => 2/25/2010 | TIME PLOTTED => 11:05:38 AM

CALCULATED-DESIGNED BY . | CHECKED BY . | REVISED BY | DATE REVISED

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | Caltrans | CONSULTANT FUNCTIONAL SUPERVISOR .

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => madhu_thummaluru | DGN FILE => ...\OC-Geotech\Layouts\LOB-01.dgn | CU 04256 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

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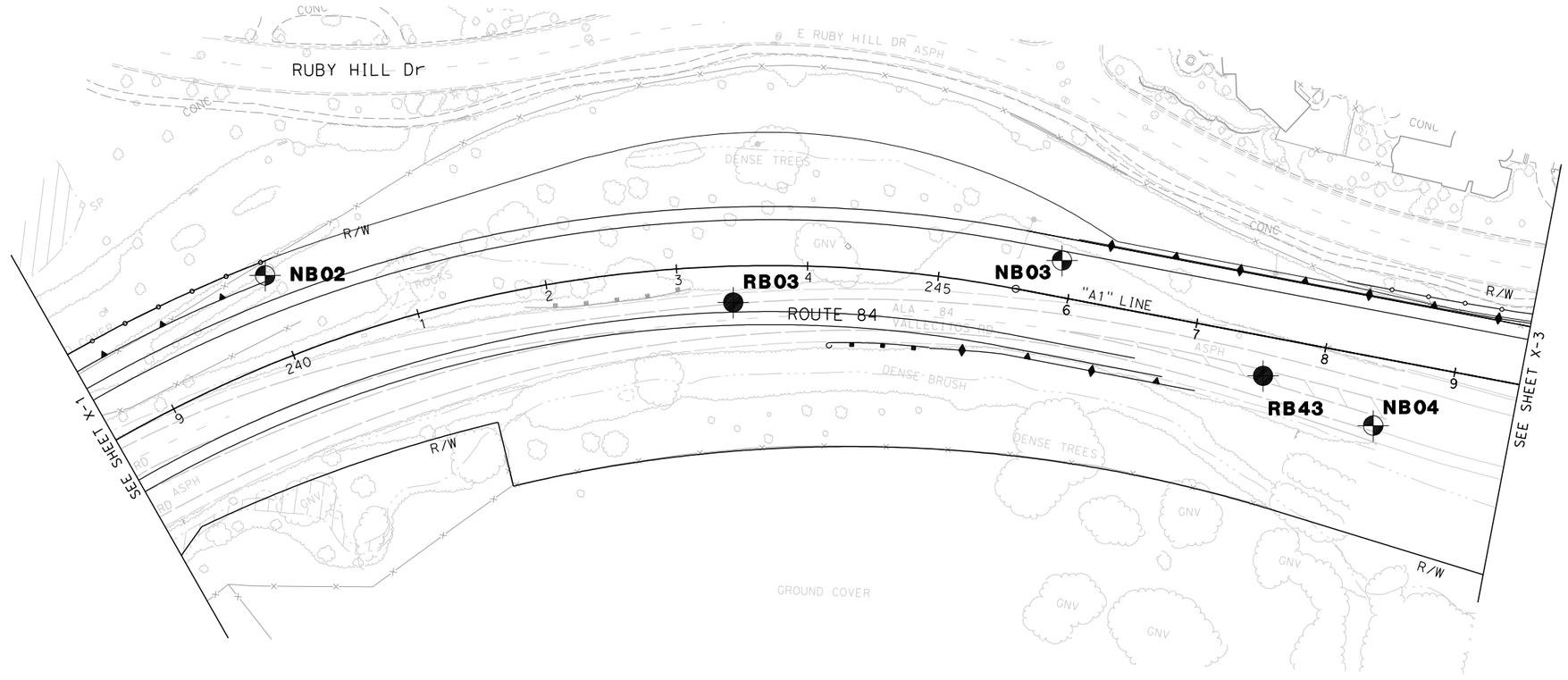
1333 Broadway, Suite 300
Oakland, CA 94612

. FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1.



FIELD EXPLORATION LOCATION PLAN 3-2

SCALE 1"=50'

X-2

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY .
CHECKED BY .

CONSULTANT FUNCTIONAL SUPERVISOR .

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00
DATE PLOTTED => 2/25/2010
TIME PLOTTED => 11:05:48 AM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

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CU 04256

EA 297601

FOR NOTES, ABBREVIATIONS
AND LEGEND, SEE SHEET X-1.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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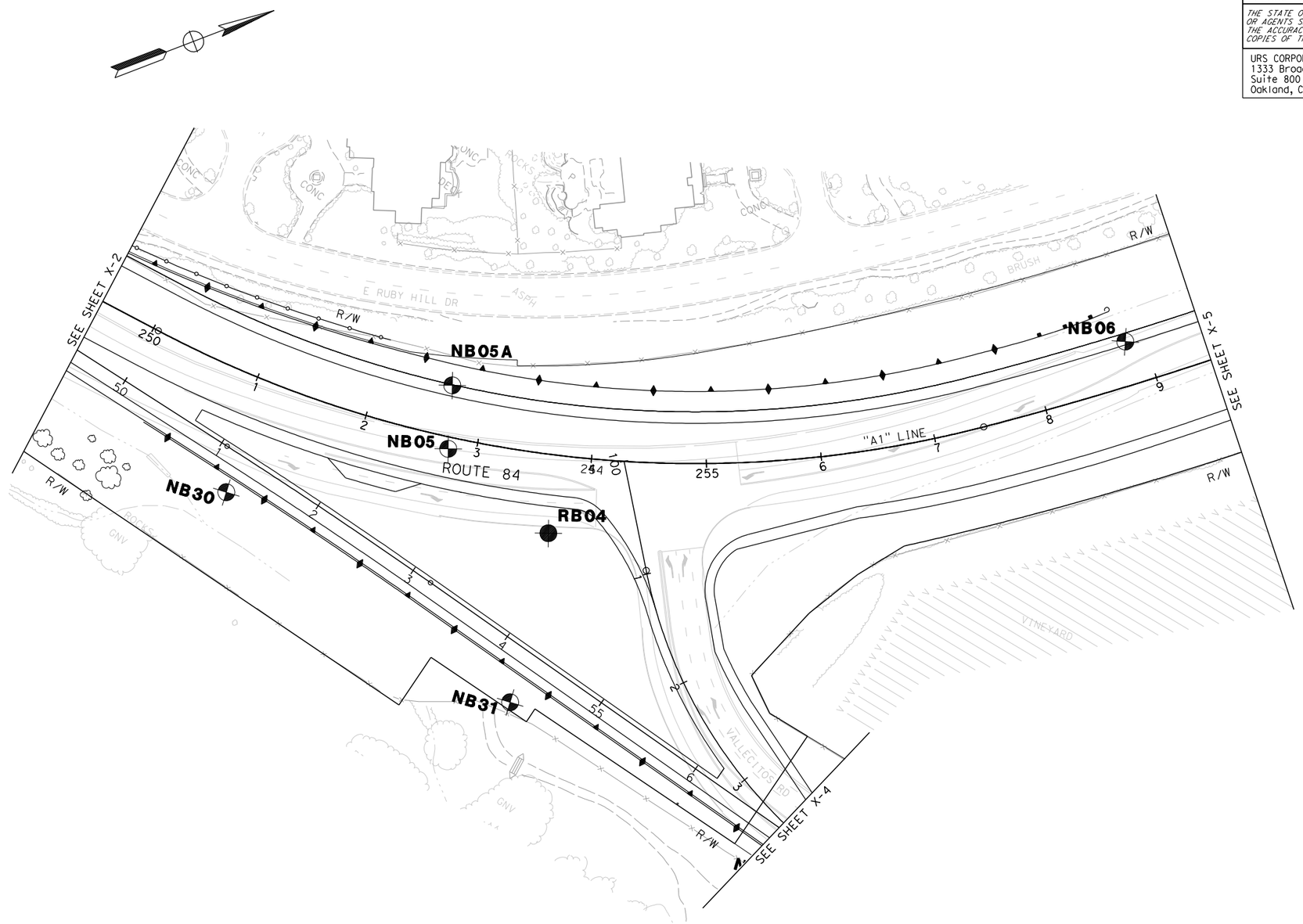

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FIELD EXPLORATION LOCATION PLAN 3-3

SCALE 1"=50'

X-3

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EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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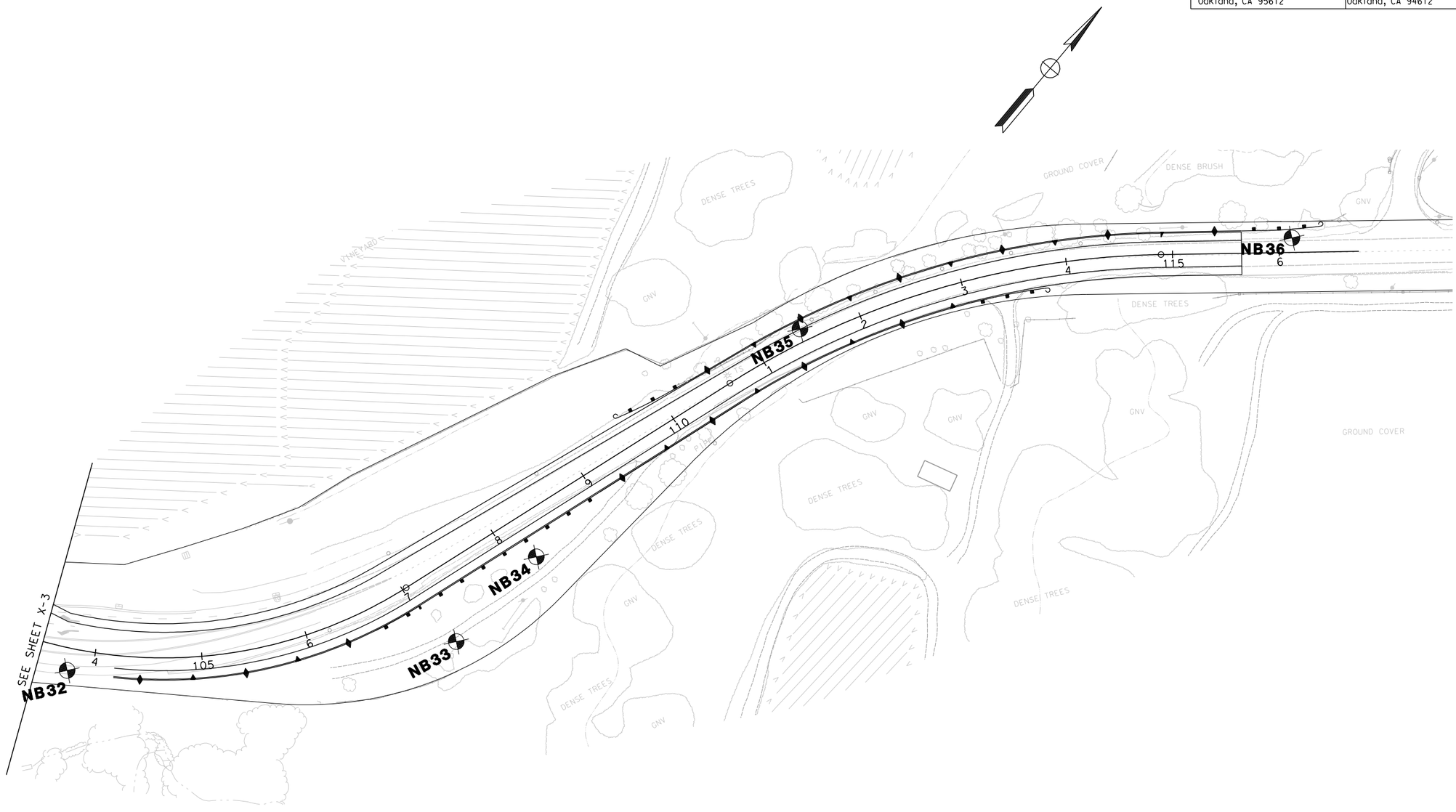

FIELD EXPLORATION LOCATION PLAN 3-4

SCALE 1"=50'

X-4

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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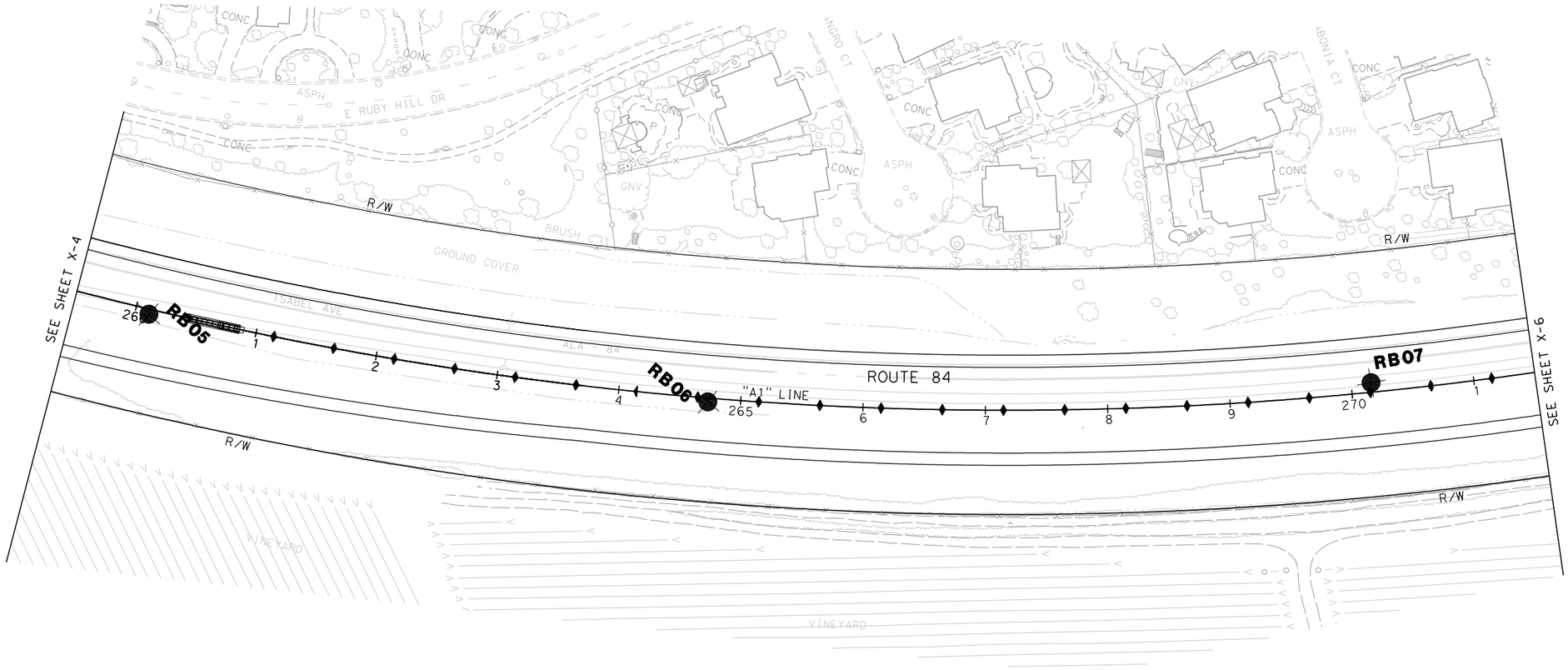

FIELD EXPLORATION LOCATION PLAN 3-5

SCALE 1"=50'

X-5

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04	Ala	84	22.9/27.1		

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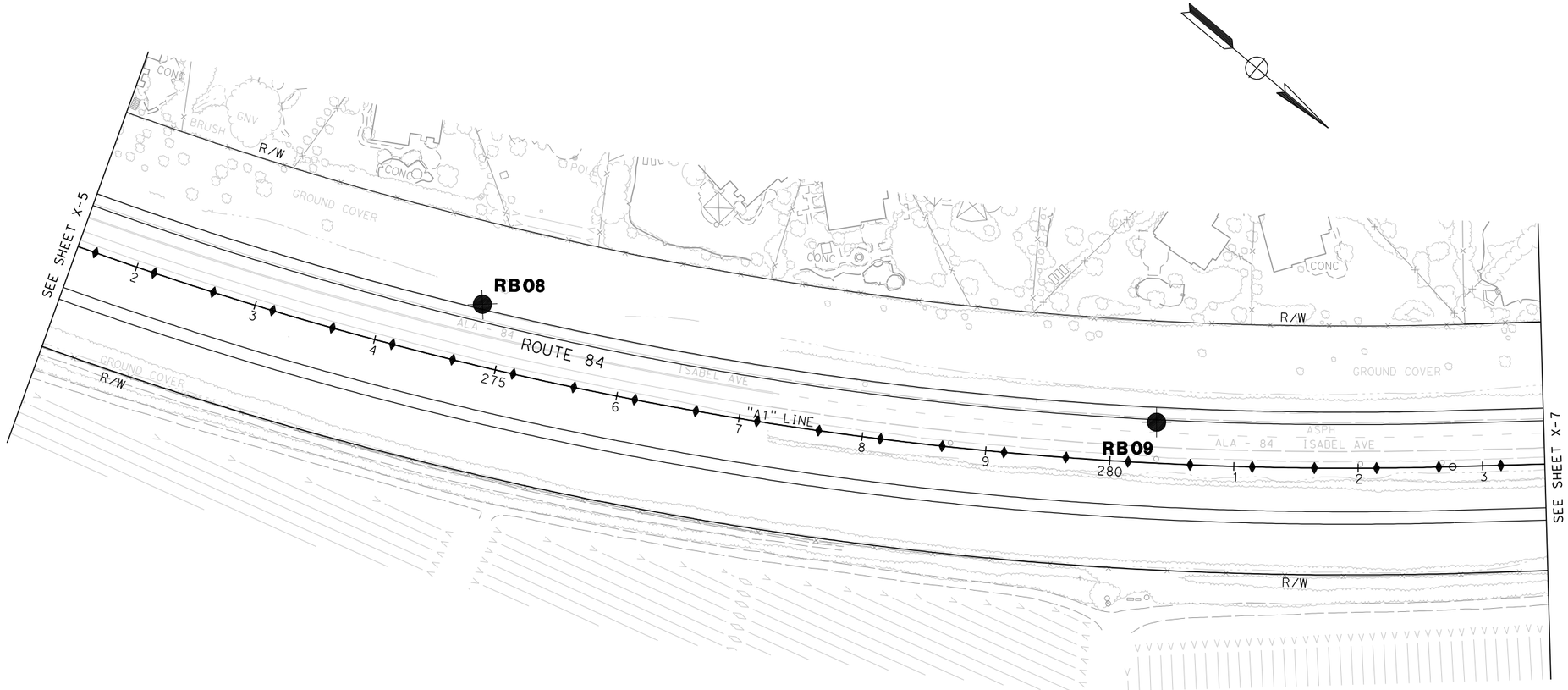

FIELD EXPLORATION LOCATION PLAN 3-6

SCALE 1"=50'

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X-6

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04	Ala	84	22.9/27.1		

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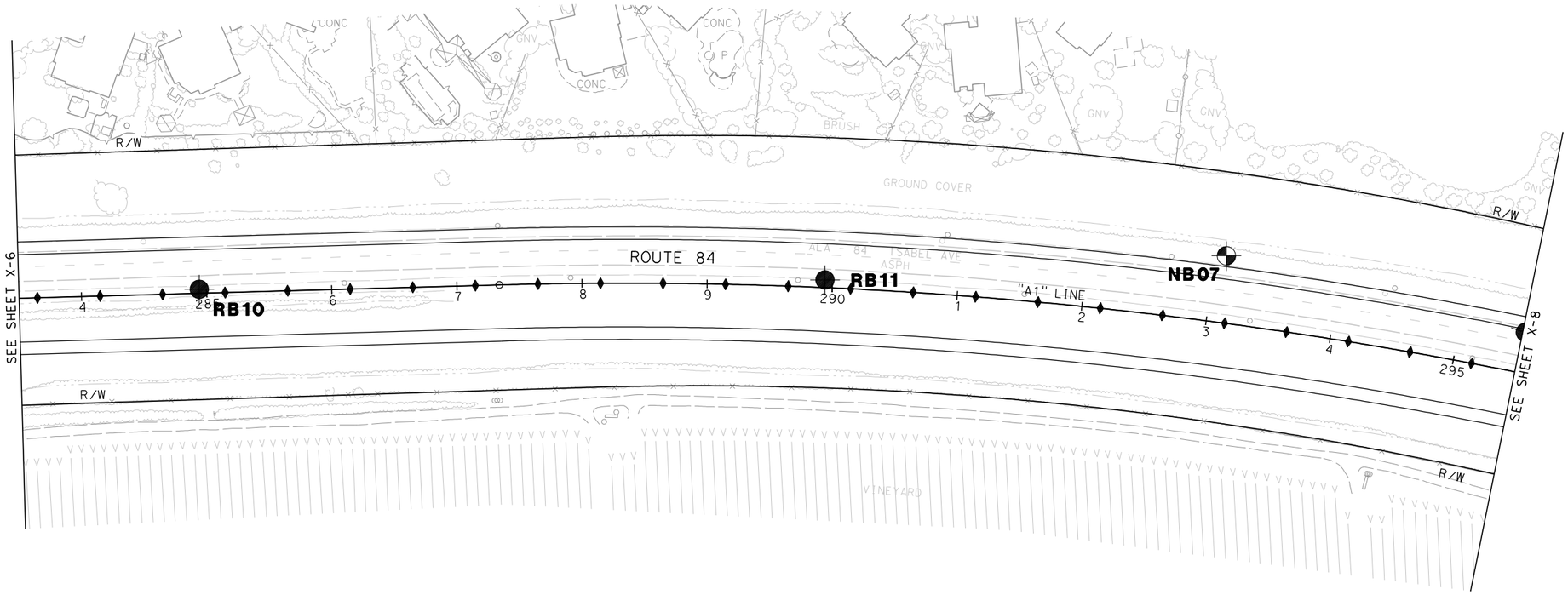

FIELD EXPLORATION LOCATION PLAN 3-7

SCALE 1"=50'

X-7

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04	Ala	84	22.9/27.1		

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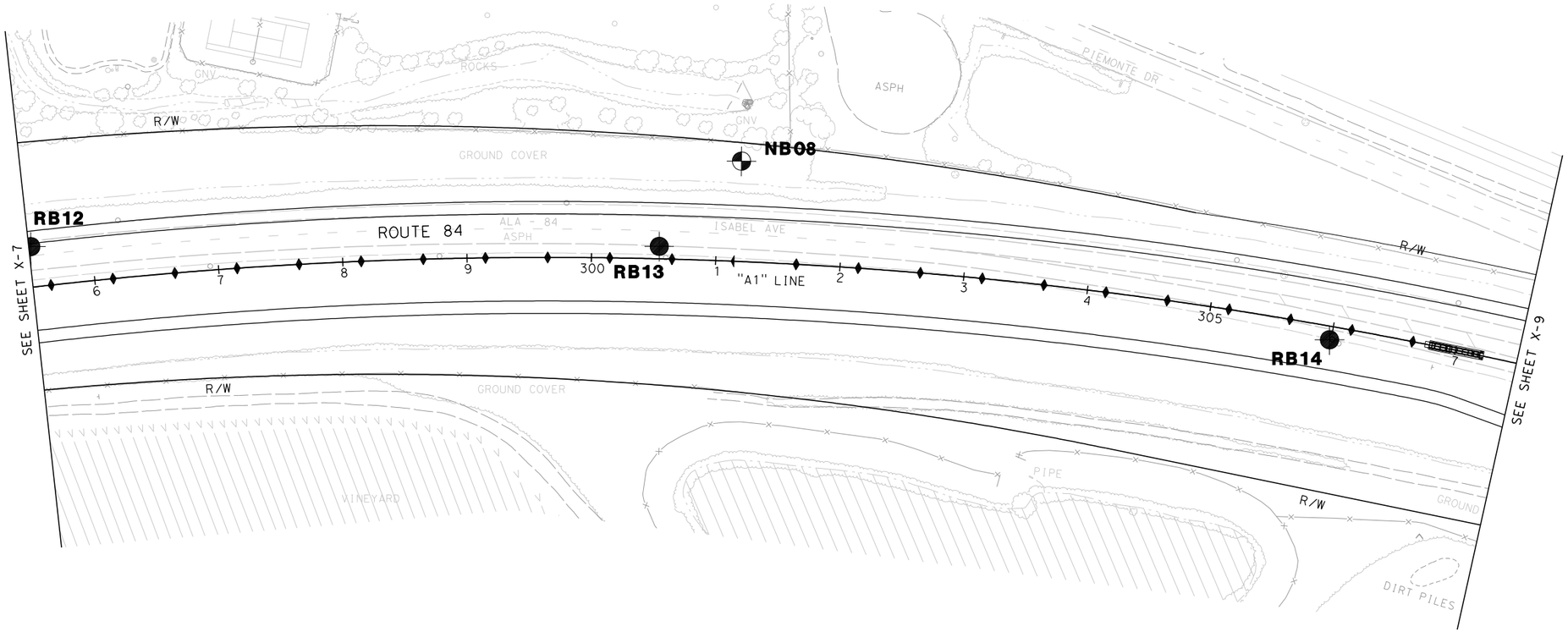

FIELD EXPLORATION LOCATION PLAN 3-8

SCALE 1"=50'

X-8

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04	Ala	84	22.9/27.1		

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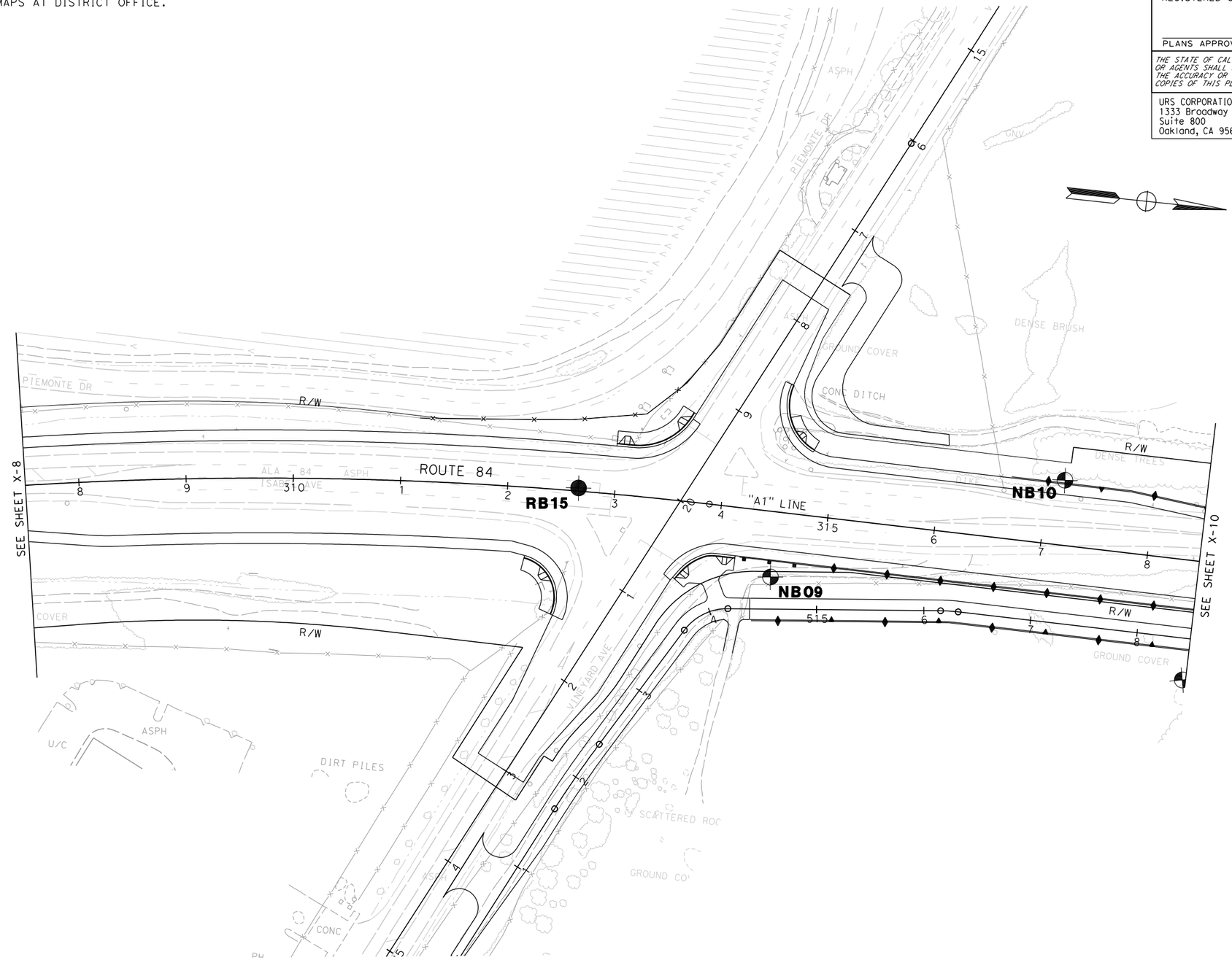

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FIELD EXPLORATION LOCATION PLAN 3-9

SCALE 1"=50'

X-9

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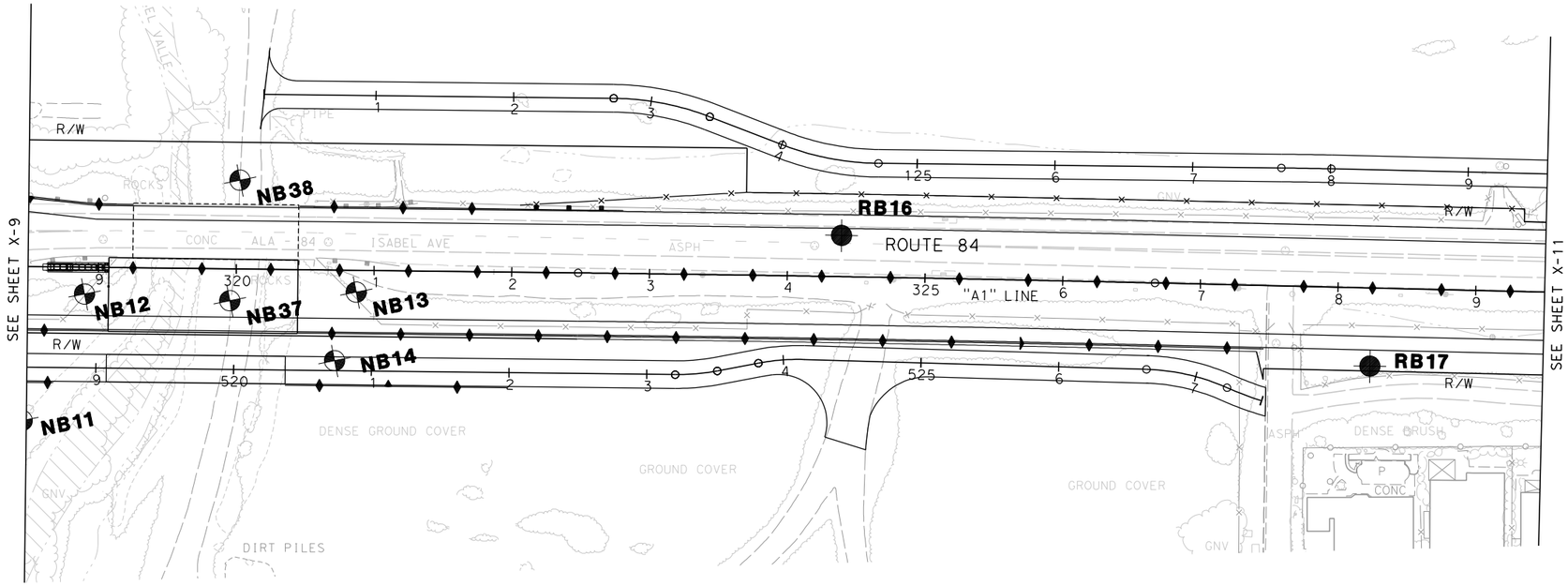

FIELD EXPLORATION LOCATION PLAN 3-10

SCALE 1"=50'

X-10

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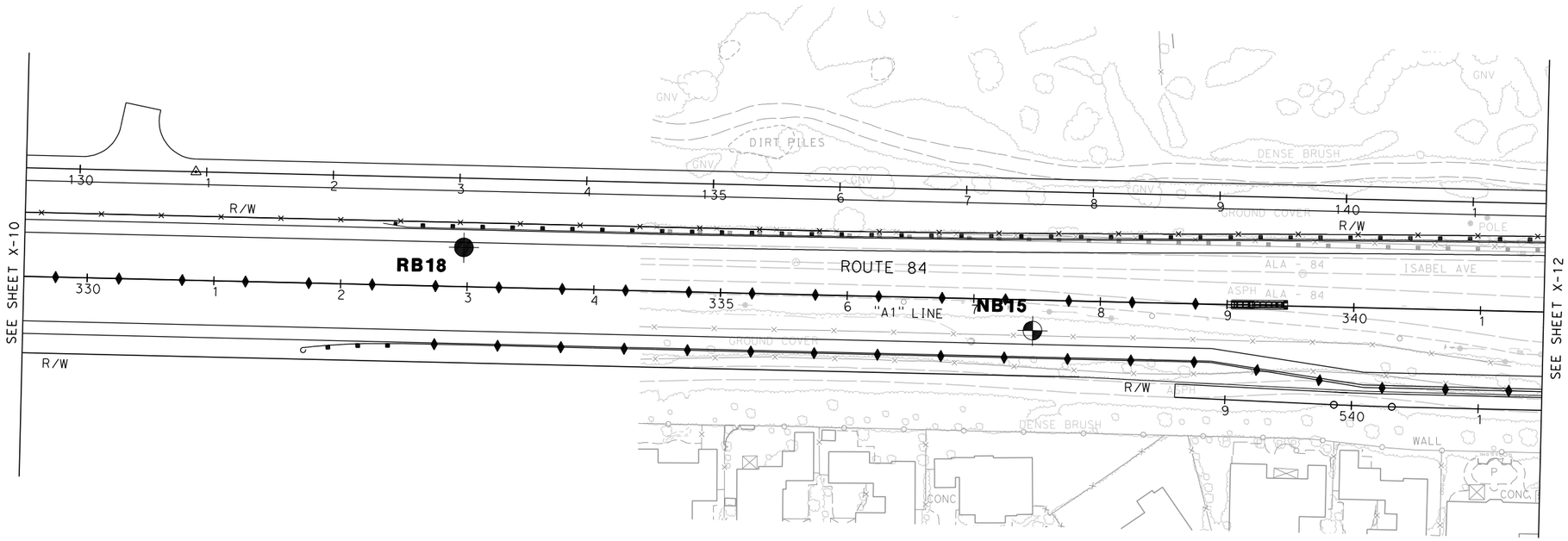

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FIELD EXPLORATION LOCATION PLAN 3-11

SCALE 1"=50'

X-11

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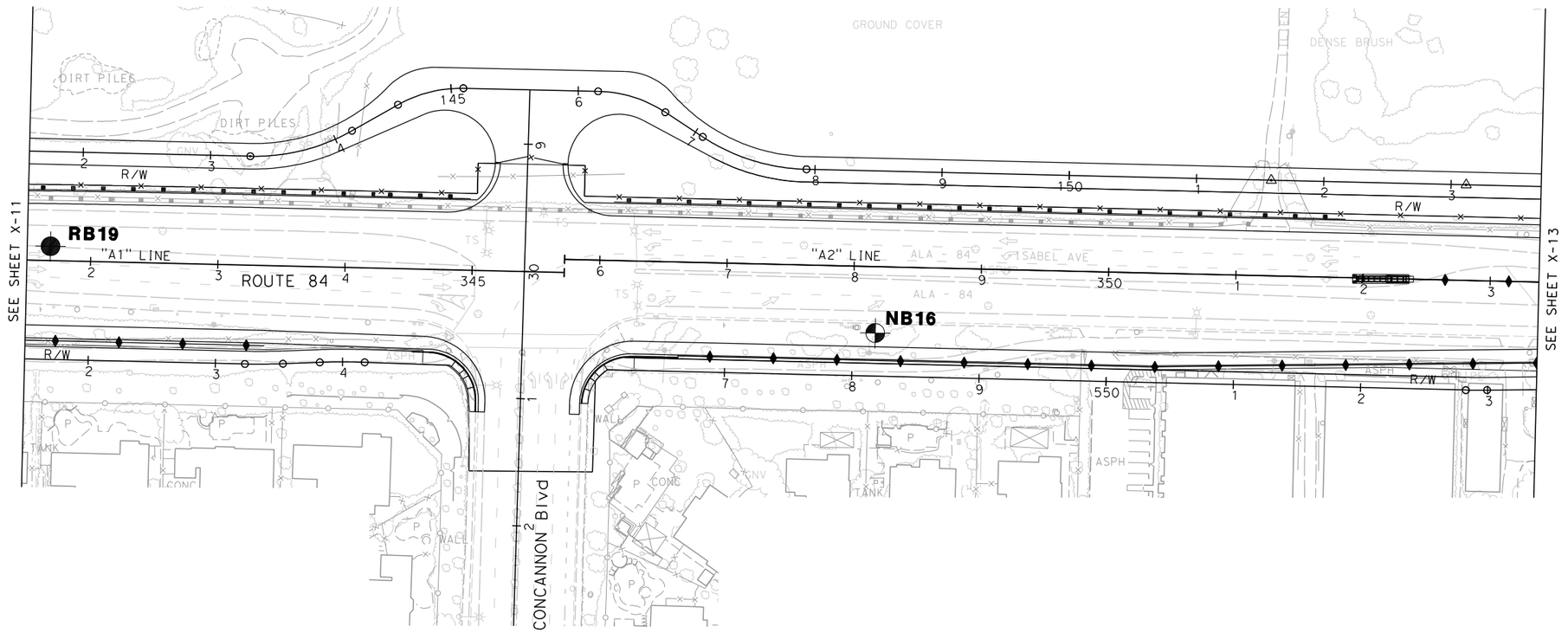

FIELD EXPLORATION LOCATION PLAN 3-12

SCALE 1"=50'

X-12

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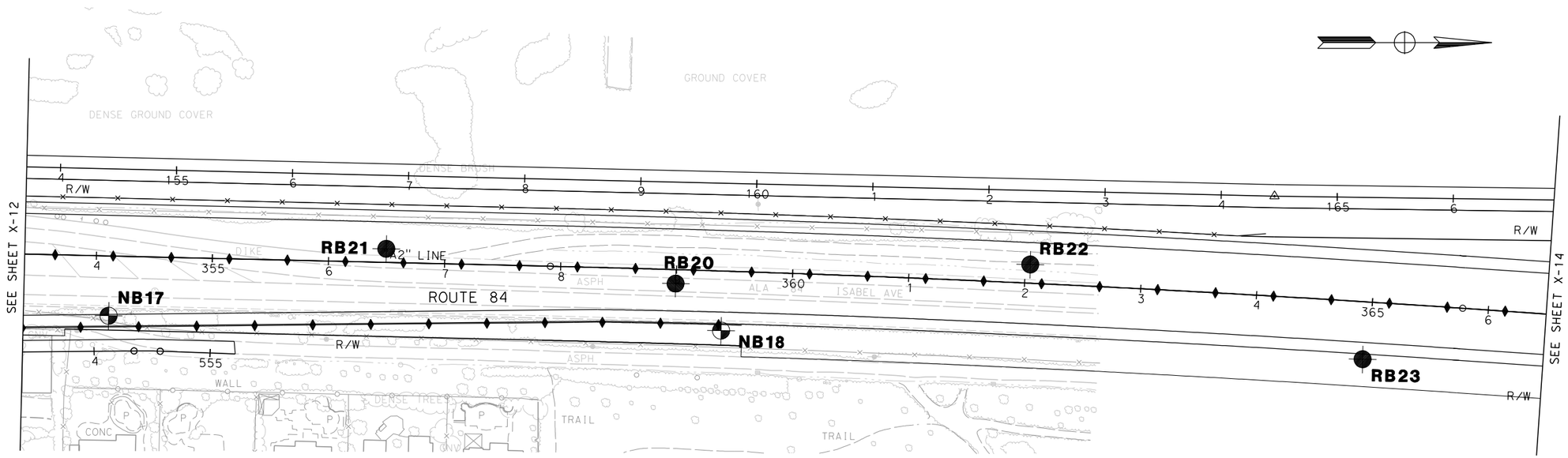

FIELD EXPLORATION LOCATION PLAN 3-13

SCALE 1"=50'

X-13

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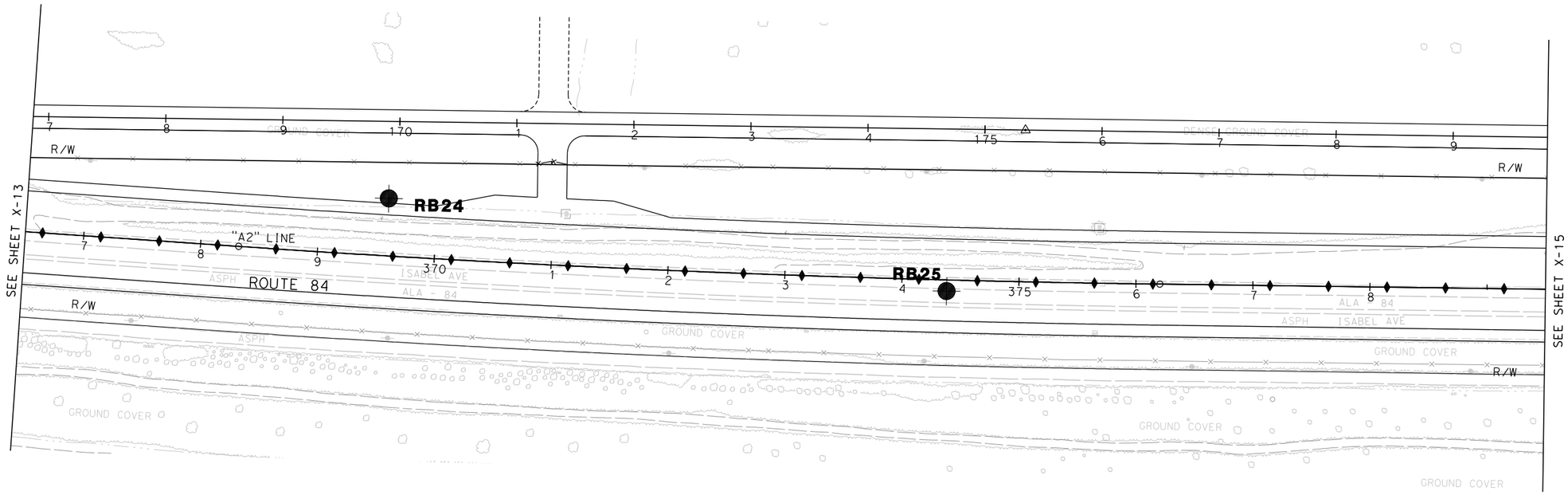

FIELD EXPLORATION LOCATION PLAN 3-14

SCALE 1"=50'

X-14

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04	Ala	84	22.9/27.1		

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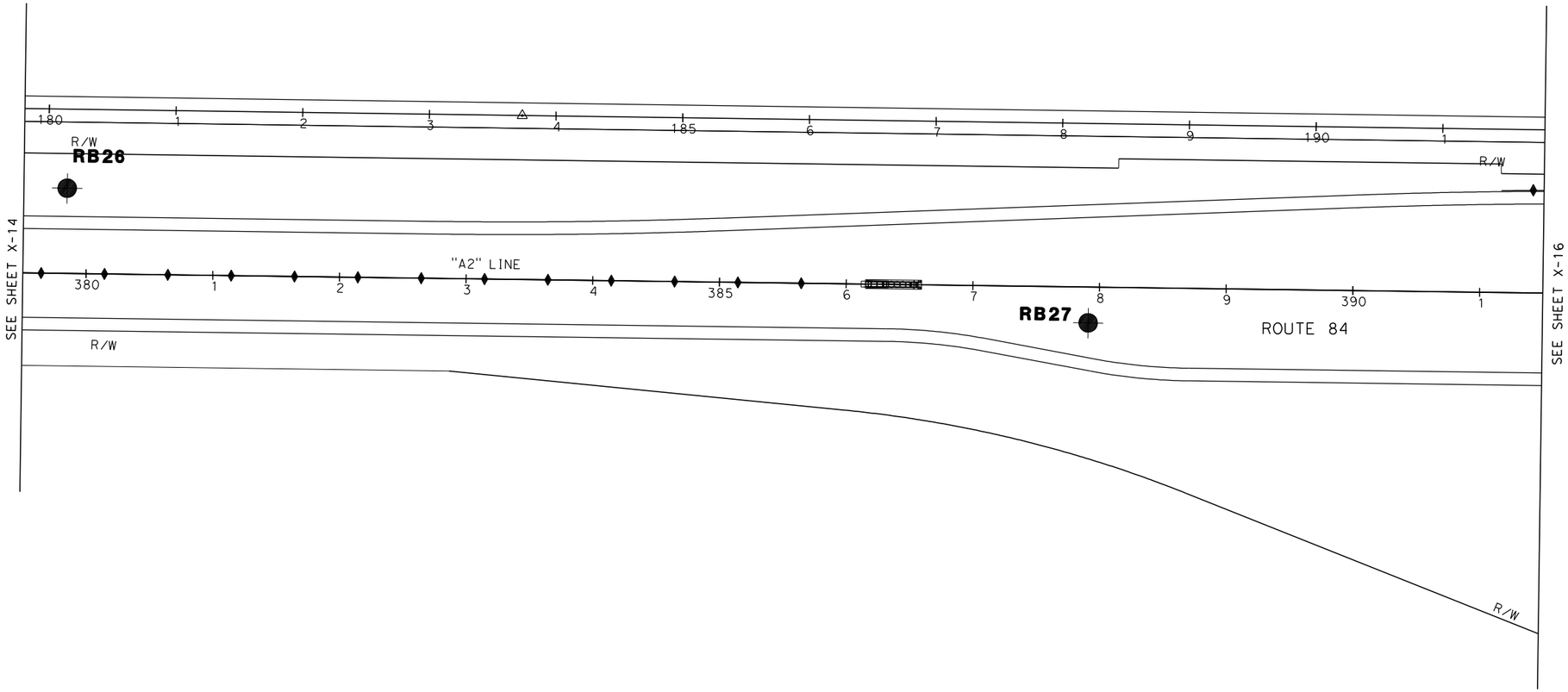

FIELD EXPLORATION LOCATION PLAN 3-15

SCALE 1"=50'

X-15

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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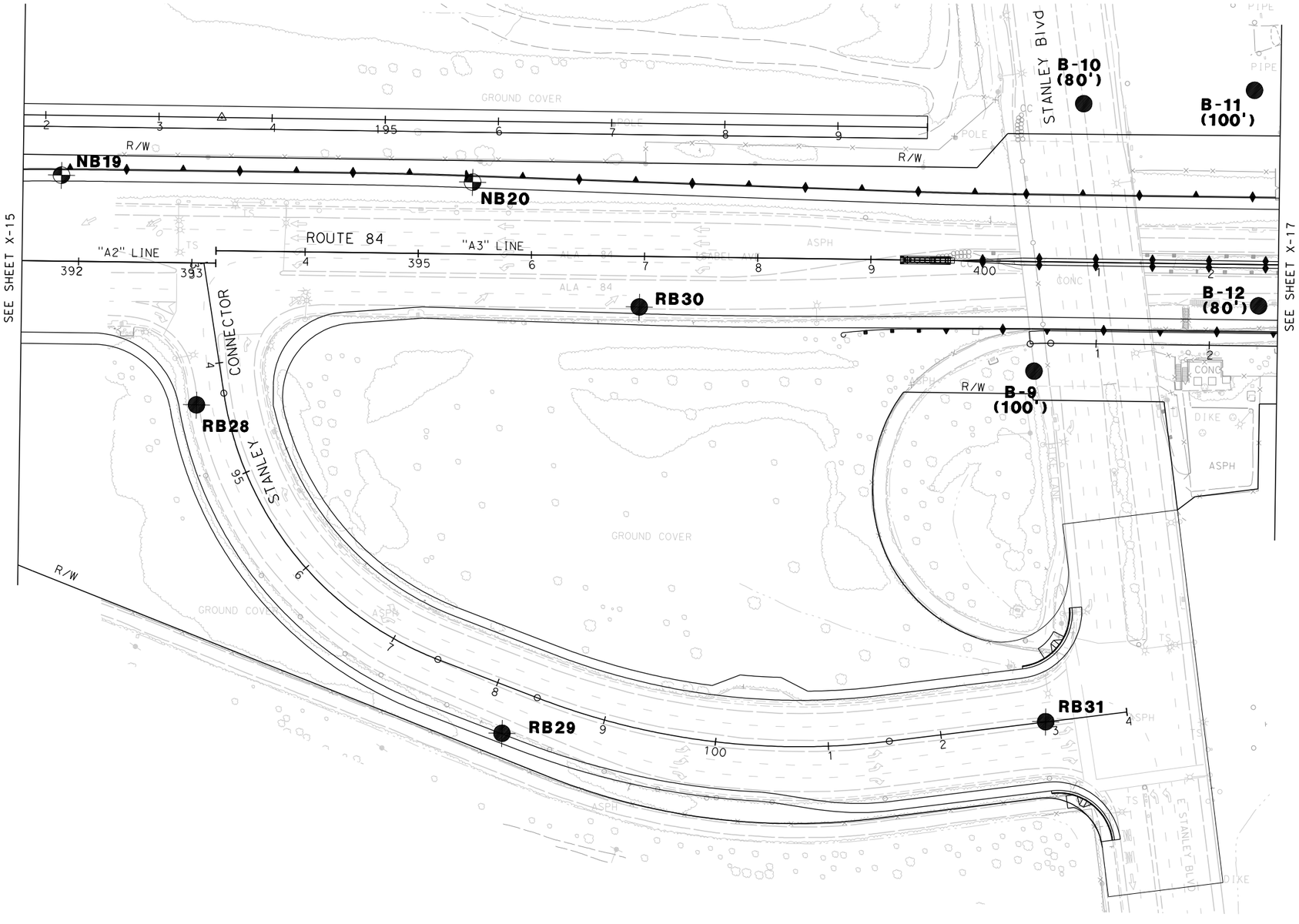

FIELD EXPLORATION LOCATION PLAN 3-16

SCALE 1"=50'

X-16

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DATE PLOTTED => 2/25/2010
TIME PLOTTED => 11:08:11 AM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

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DGN FILE => ...\qc-geotech\layouts\LOB-16.dgn

CU 04256

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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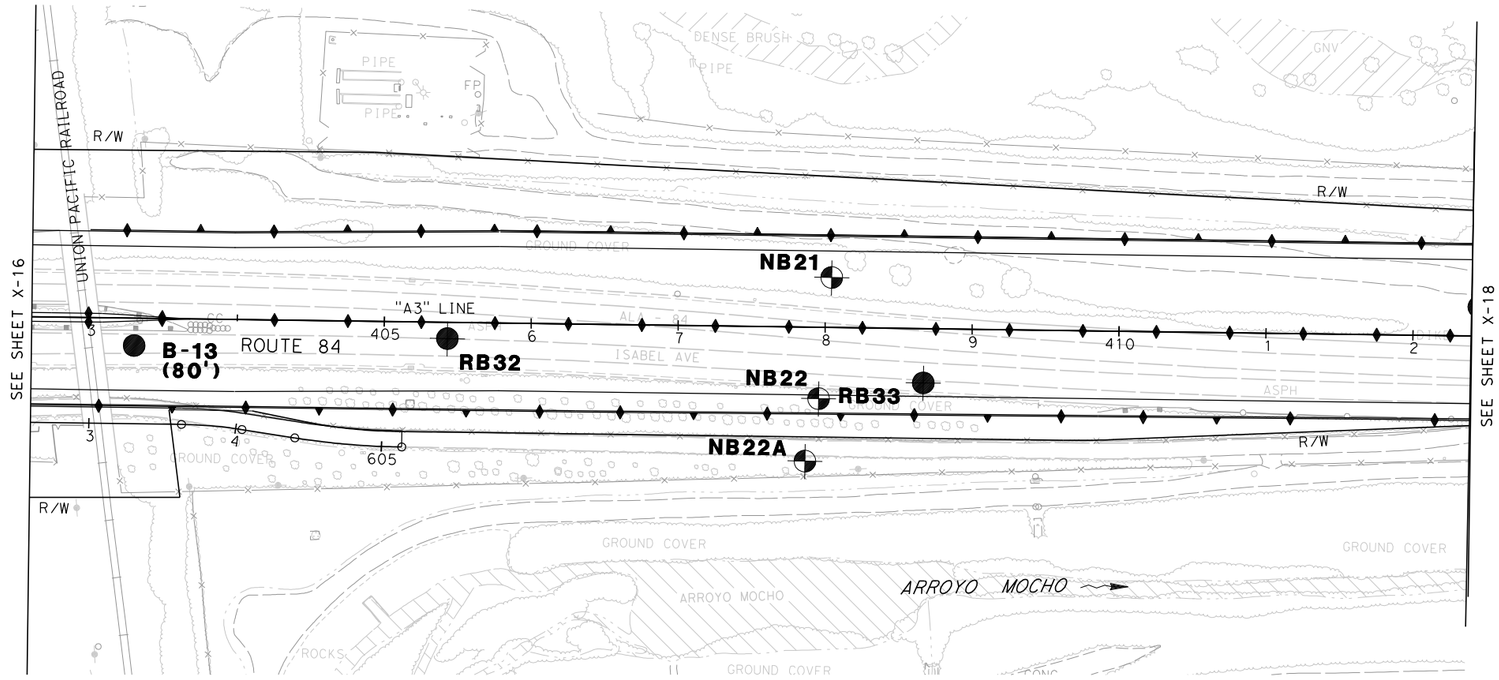

FIELD EXPLORATION LOCATION PLAN 3-17

SCALE 1"=50'

X-17

ALL DIMENSIONS ARE IN FEET
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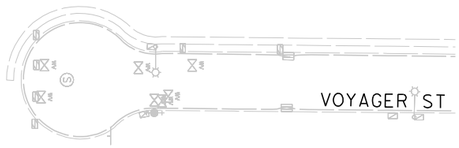
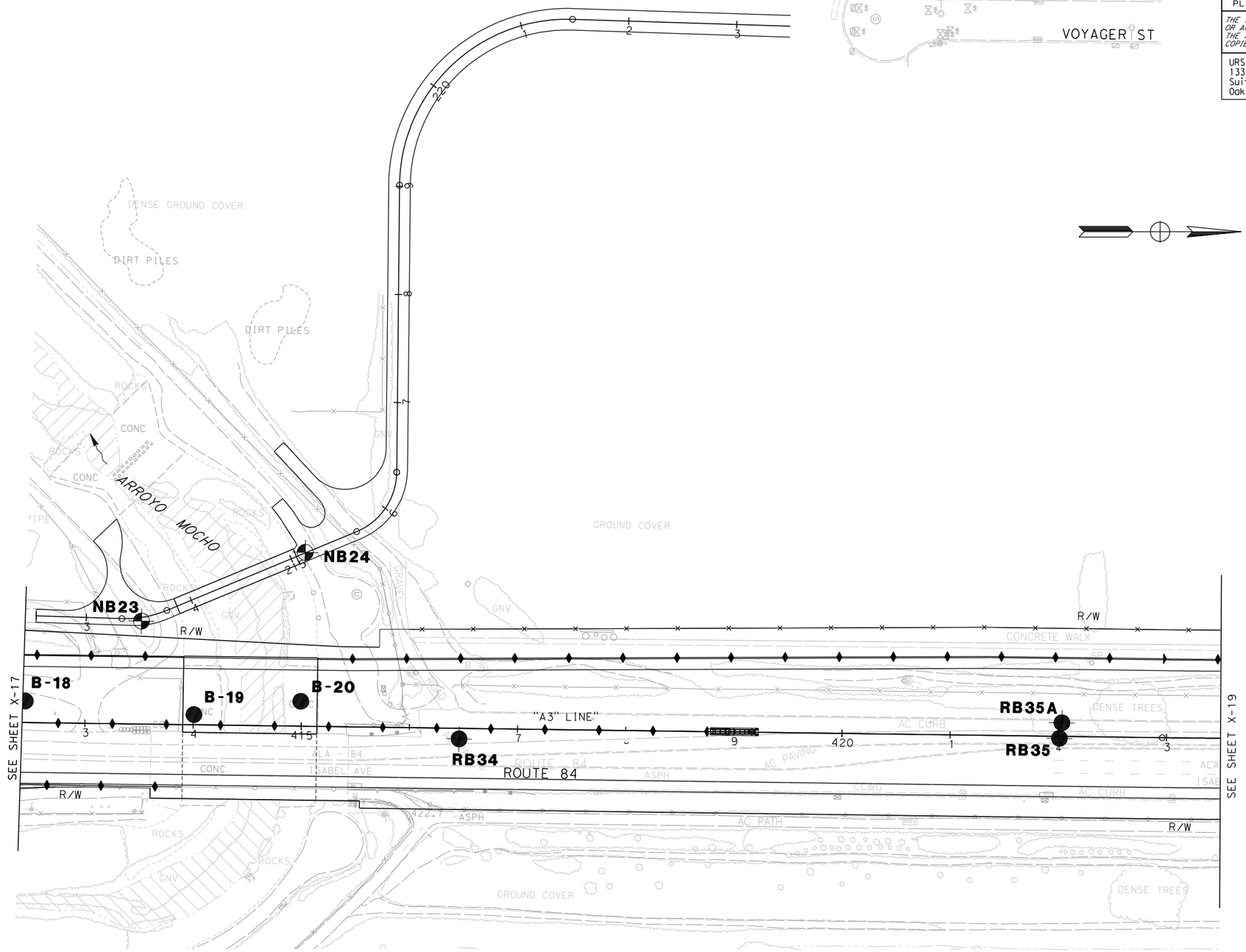
DGN FILE => ...\qc-geotech\layouts\LOB-17.dgn

CU 04256

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.





Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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FIELD EXPLORATION LOCATION PLAN 3-18

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-18

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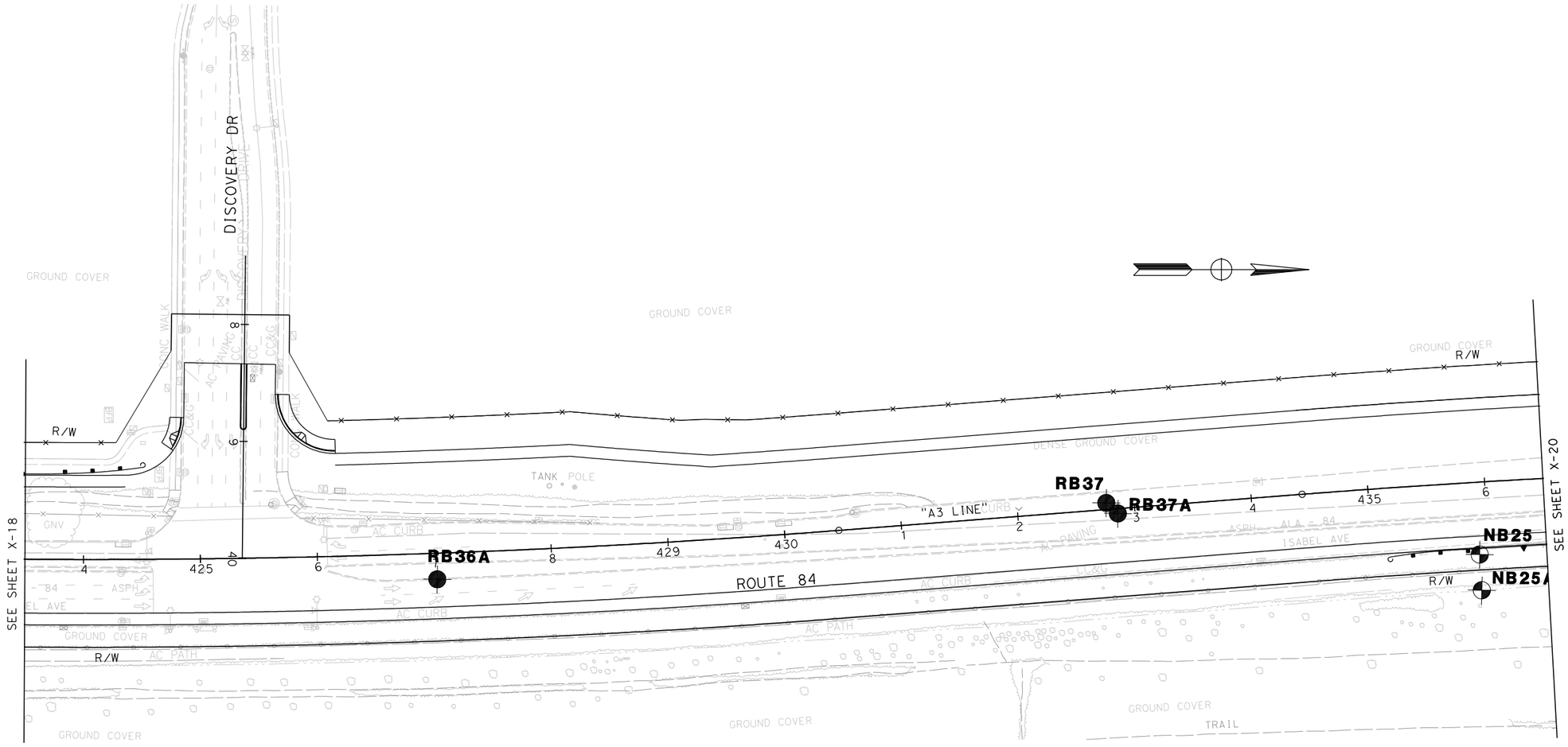
DGN FILE => ...\qc-geotech\layouts\LOB-18.dgn

CU 04256

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



FIELD EXPLORATION LOCATION PLAN 3-19

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-19

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. . Exp. . CIVIL — STATE OF CALIFORNIA

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DGN FILE => ...\qc-geotech\layouts\LOB-19.dgn

CU 04256

EA 297601

NOTE:
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SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER
No. _____
Exp. _____
CIVIL
STATE OF CALIFORNIA

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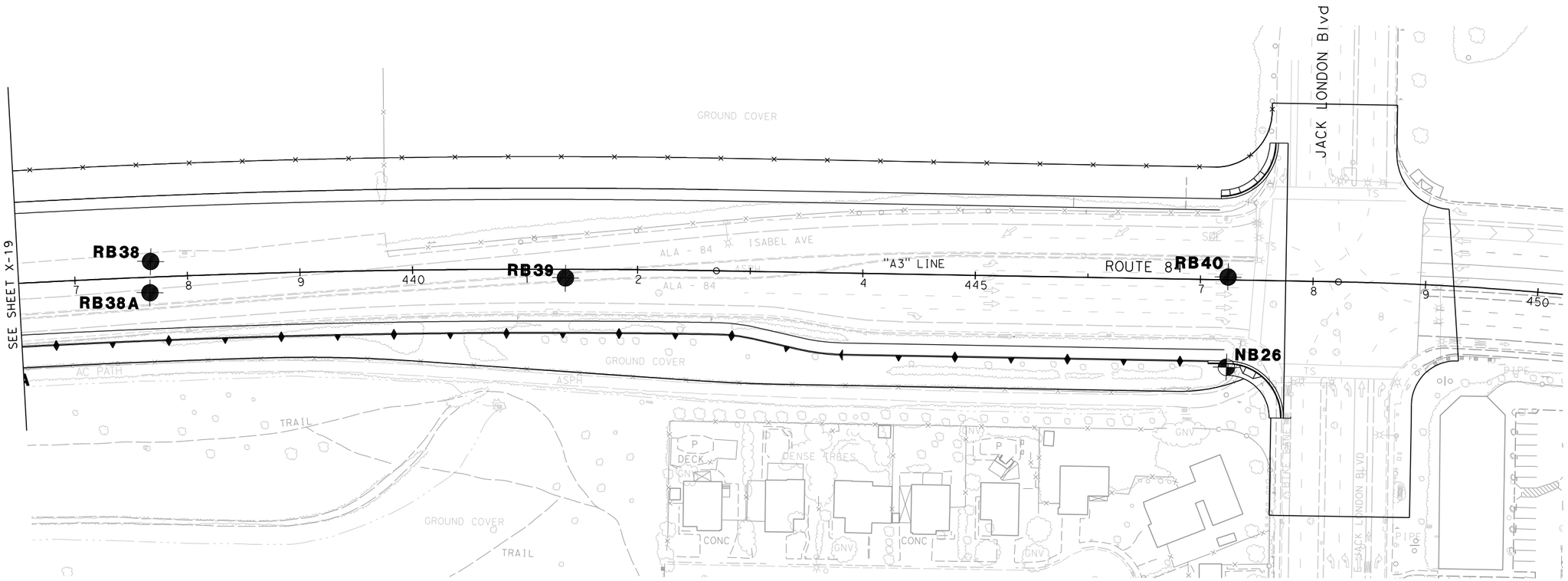

FIELD EXPLORATION LOCATION PLAN 3-20

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-20

	REVISED BY	DATE REVISED

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CHECKED BY .

CONSULTANT FUNCTIONAL SUPERVISOR .

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DATE PLOTTED => 2/25/2010
TIME PLOTTED => 11:09:02 AM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

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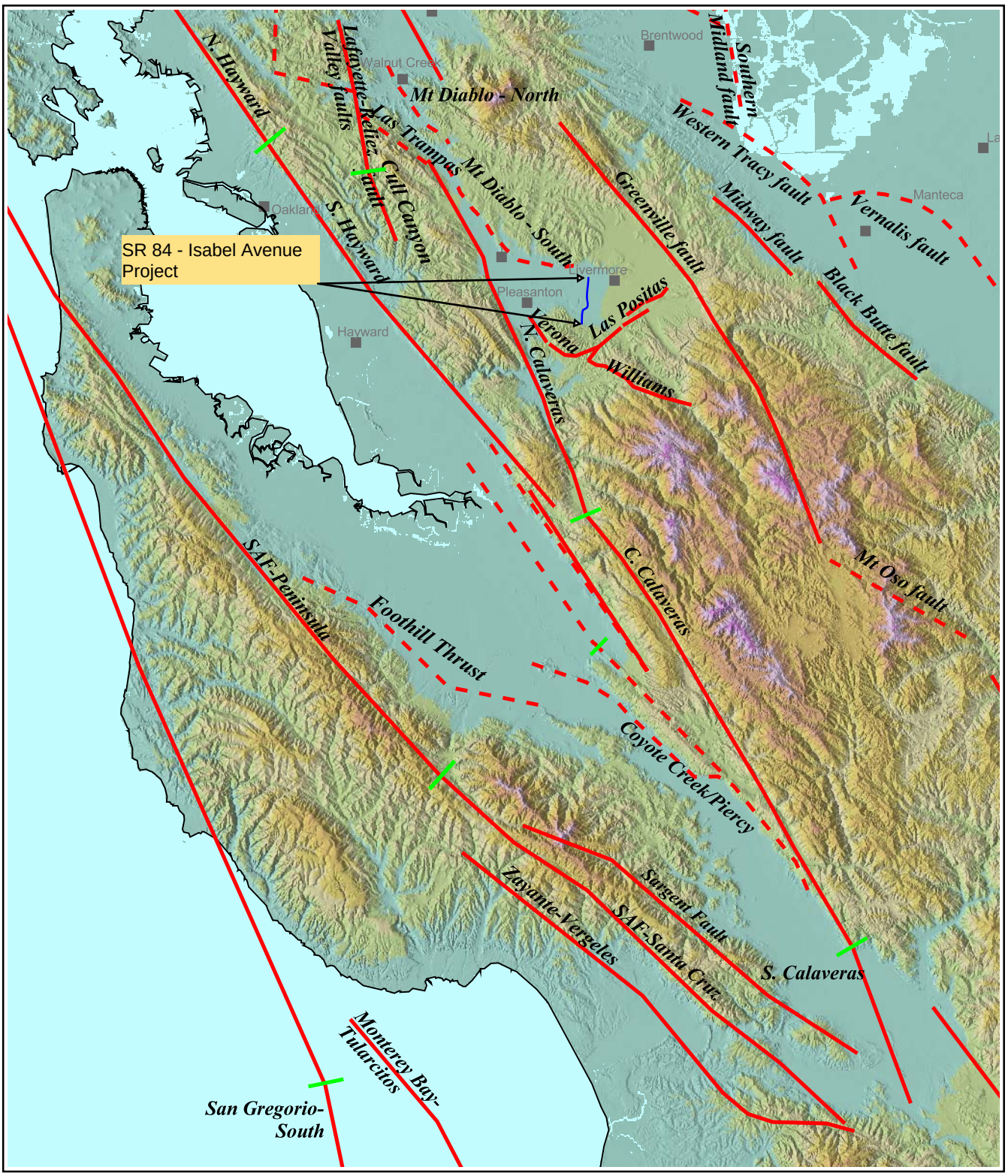
CU 04256

EA 297601



Fault Sources: URS Seismic Hazard Model

URS	28649640 SR 84 - Isabel Ave Livermore, CA	ACTIVE FAULTS IN THE SITE REGION	Figure 4-1

R-value Distribution
Route 84 Expressway Widening
Rubyhill Drive to Jack London Blvd
Livermore, California

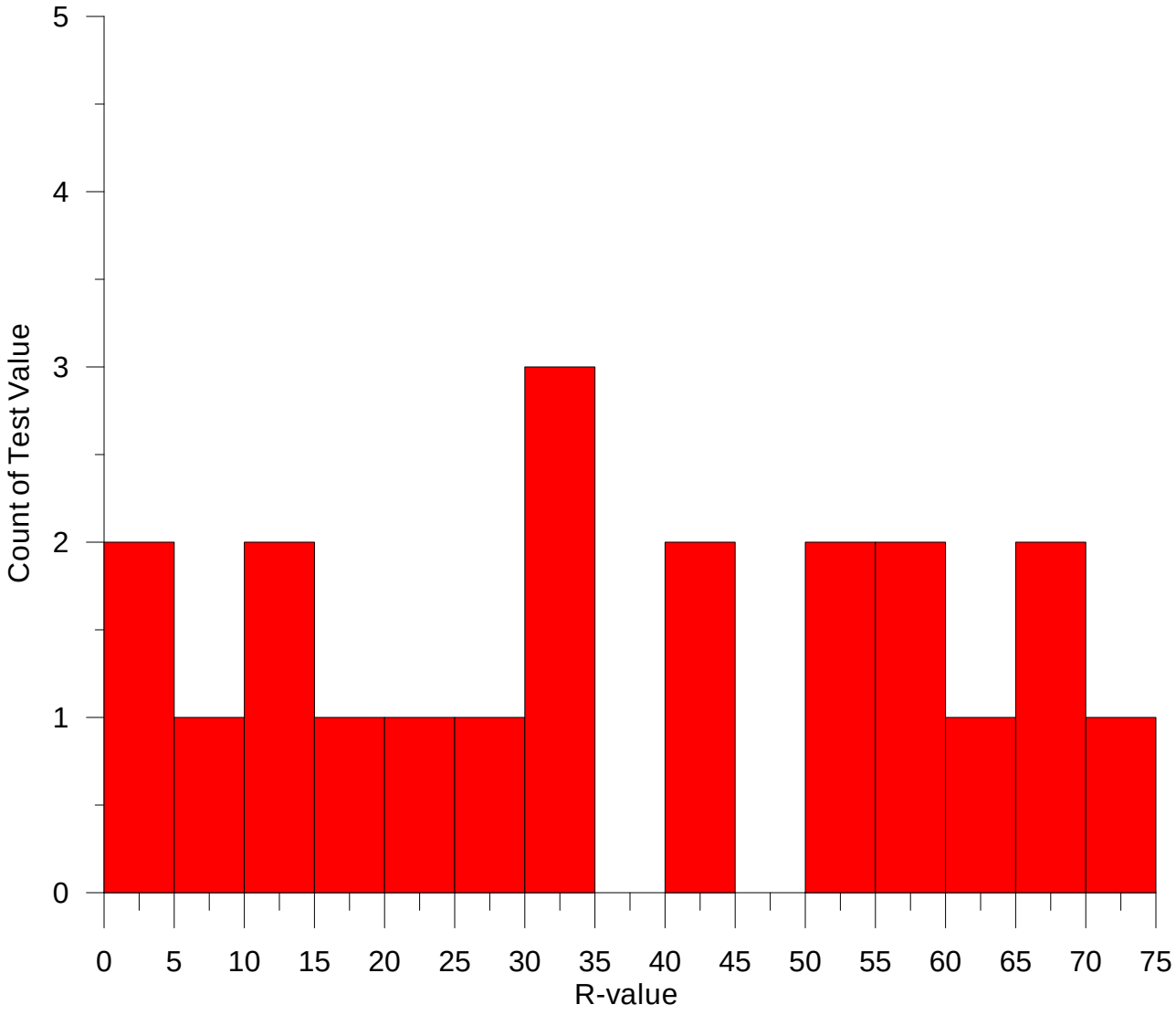


FIGURE 5-1

R-value Distribution along Project Alignment
Route 84 Highway Expansion Project
Ruby Hill Drive to Jack London Blvd
Livermore, California

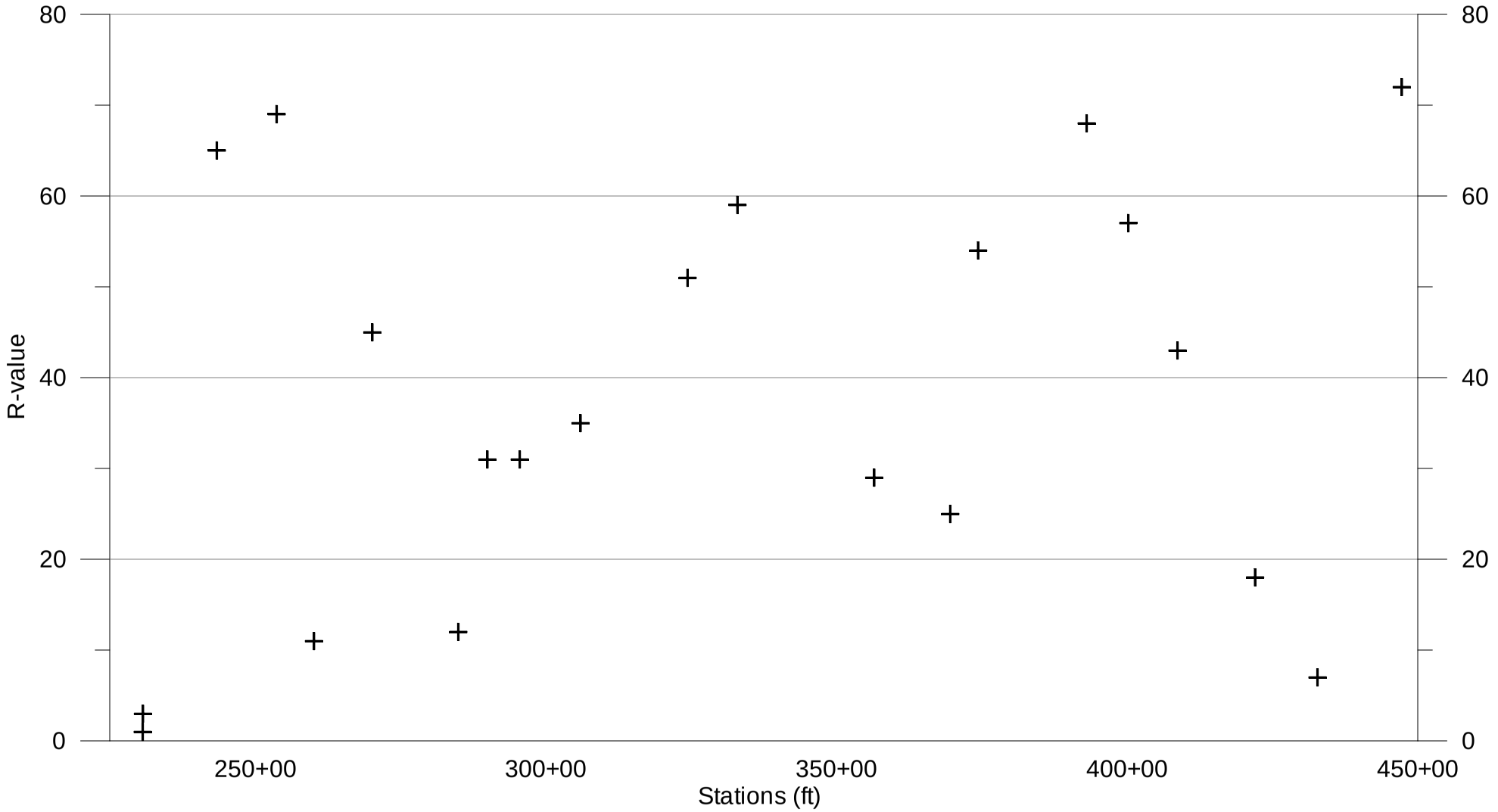


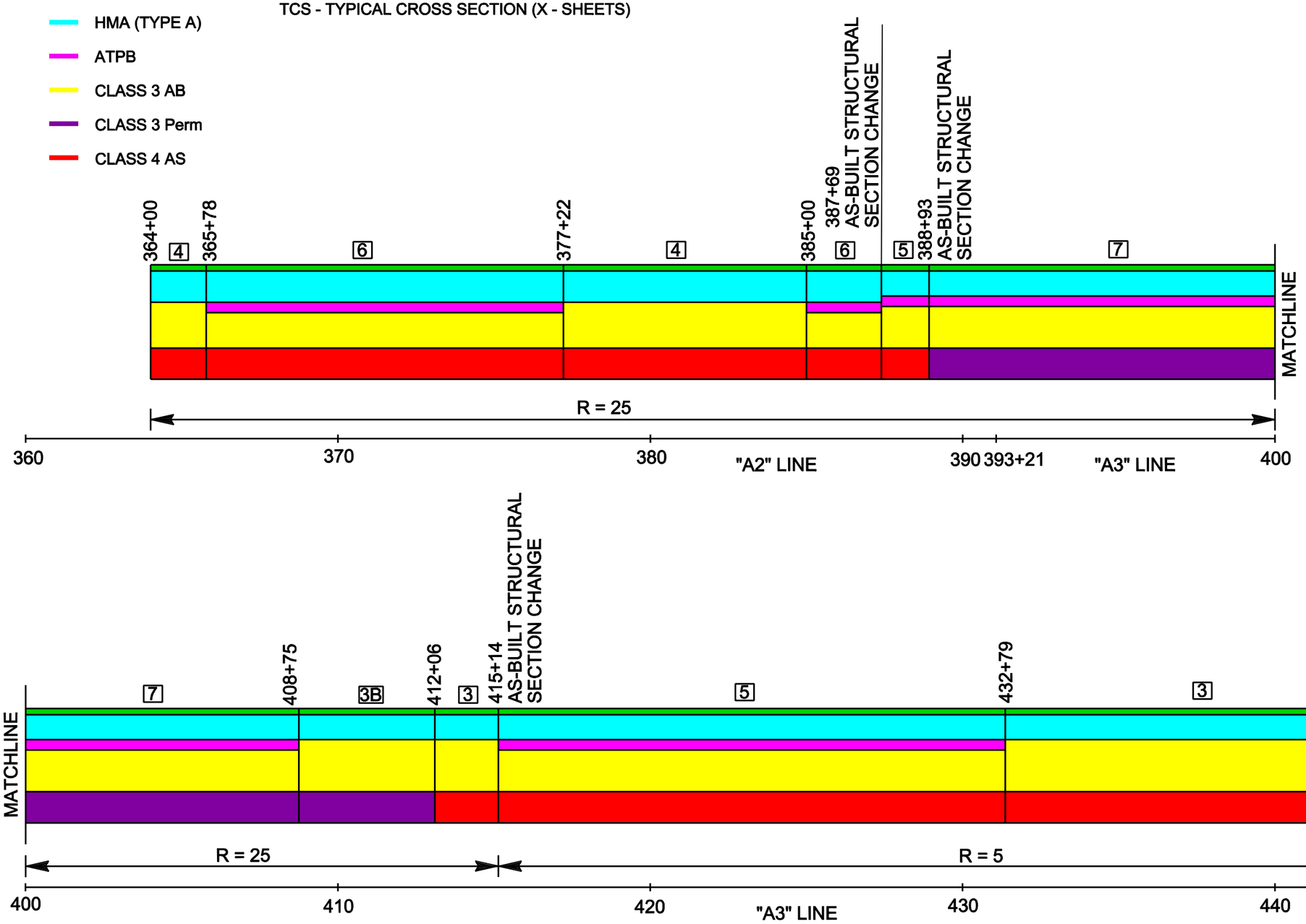
FIGURE 5-2

LEGEND:

- RHMA-G
- HMA (TYPE A)
- ATPB
- CLASS 3 AB
- CLASS 3 Perm
- CLASS 4 AS

SPCS - STRUCTURAL PAVEMENT CROSS SECTION

TCS - TYPICAL CROSS SECTION (X - SHEETS)



SPCS 1 = TCS [3] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.60' HMA (TYPE A)
- 1.25' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 2 = TCS [3B] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.60' HMA (TYPE A)
- 1.25' Cl 2 AB
- 0.75' Cl 3 Perm

SPCS 3 = TCS [4] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.75' HMA (TYPE A)
- 1.10' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 4 = TCS [5] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.60'-1.2' HMA (TYPE A)
- 0.25' ATPB
- 1.0' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 5 = TCS [6] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.75' - 1.8' HMA (TYPE A)
- 0.25' ATPB
- 0.85' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 6 = TCS [7] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.60'-1.6' HMA (TYPE A)
- 0.25' ATPB
- 1.0' Cl 2 AB
- 0.75' Cl 3 Perm

West Sawcut SR 84 - North Segment
Structure Pavement Sections Profile

**PRELIMINARY PLANS,
SUBJECT TO REVISION**

FIGURE 5-3

URS
100 W San Fernando Street, Suite 200
San Jose, CA 95113
(408) 297-6962

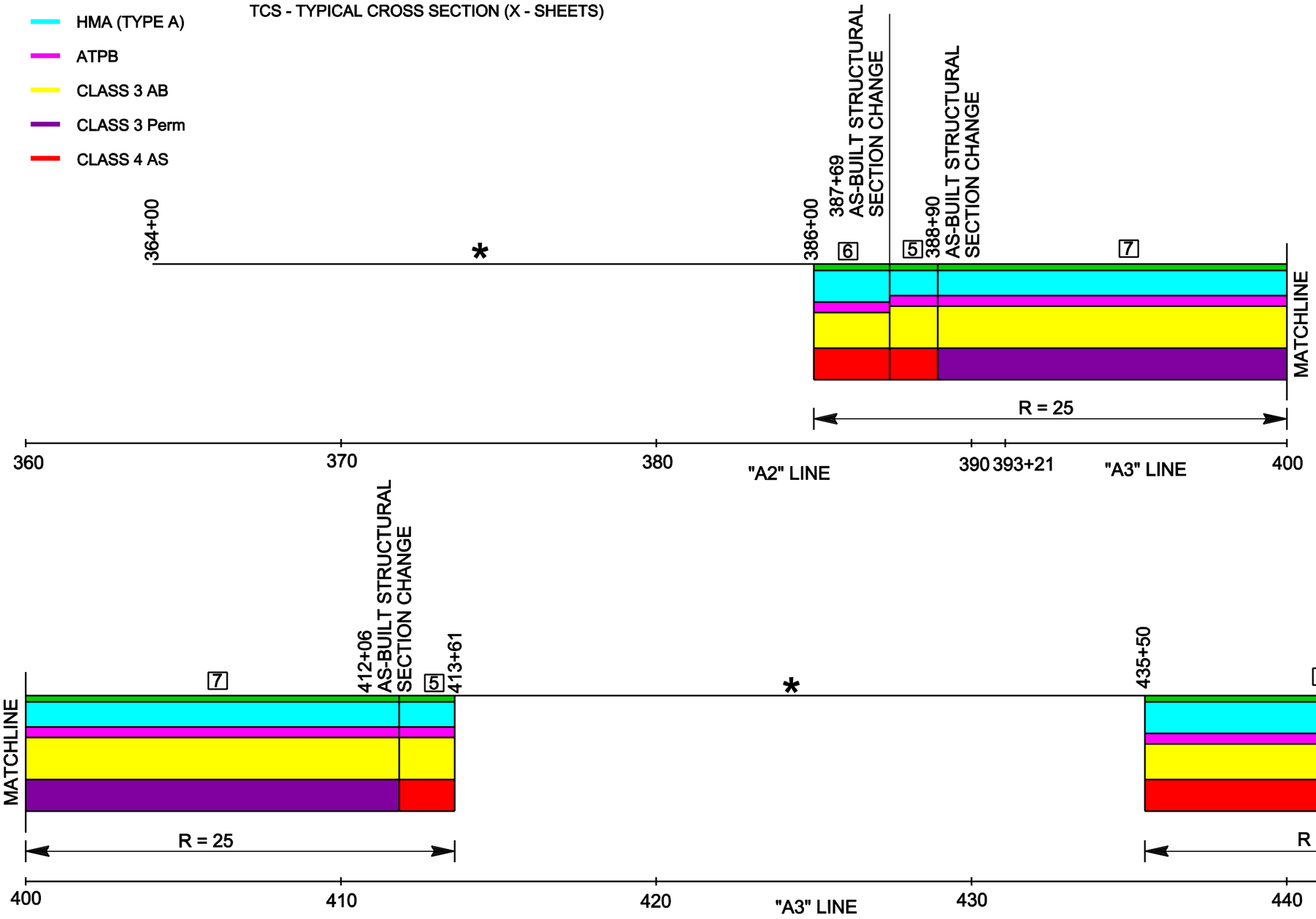
December 21, 2010

LEGEND:

- RHMA-G
- HMA (TYPE A)
- ATPB
- CLASS 3 AB
- CLASS 3 Perm
- CLASS 4 AS

SPCS - STRUCTURAL PAVEMENT CROSS SECTION

TCS - TYPICAL CROSS SECTION (X - SHEETS)



SPCS 1 = TCS [3] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.60' HMA (TYPE A)
- 1.25' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 3 = TCS [4] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.75' HMA (TYPE A)
- 1.10' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 4 = TCS [5] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.60'-1.2' HMA (TYPE A)
- 0.25' ATPB
- 1.0' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 5 = TCS [6] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.75' - 1.8' HMA (TYPE A)
- 0.25' ATPB
- 0.85' Cl 2 AB
- 0.75' Cl 4 AS

SPCS 6 = TCS [7] TRAVELED WAY AND Shld (Typ)
- 0.15' RHMA-G
- 0.60'-1.6' HMA (TYPE A)
- 0.25' ATPB
- 1.0' Cl 2 AB
- 0.75' Cl 3 Perm

* OVERLAY OR SLIVER WIDENING

East Sawcut SR 84 - North Segment
Structure Pavement Sections Profile

PRELIMINARY PLANS, SUBJECT TO REVISION

FIGURE 5-4

URS
100 W San Fernando Street, Suite 200
San Jose, CA 95113
(408) 297-6962

November 30, 2010

LEGEND:

- RHMA-G
- HMA (TYPE A)
- ATPB
- CLASS 3 AB
- CLASS 3 Perm
- CLASS 4 AS

SPCS - STRUCTURAL PAVEMENT CROSS SECTION

SPCS 3 TRAVELED WAY AND Shld (Typ)

0.15' RHMA-G
0.75' HMA (TYPE A)
1.10' Cl 2 AB
0.75' Cl 4 AS

SPCS 5 TRAVELED WAY AND Shld (Typ)

0.15' RHMA-G
0.75' - 1.8' HMA (TYPE A)
0.25' ATPB
0.85' Cl 2 AB
0.75' Cl 4 AS

SPCS 7 TRAVELED WAY AND Shld (Typ)

0.15' RHMA-G
0.55'HMA (TYPE A)
0.25' ATPB
0.60' Cl 2 AB
1.00' Cl 4 AS

SPCS 8 TRAVELED WAY AND Shld (Typ)

0.15' RHMA-G
0.55' HMA (TYPE A)
0.85' Cl 2 AB
1.00' Cl 4 AS

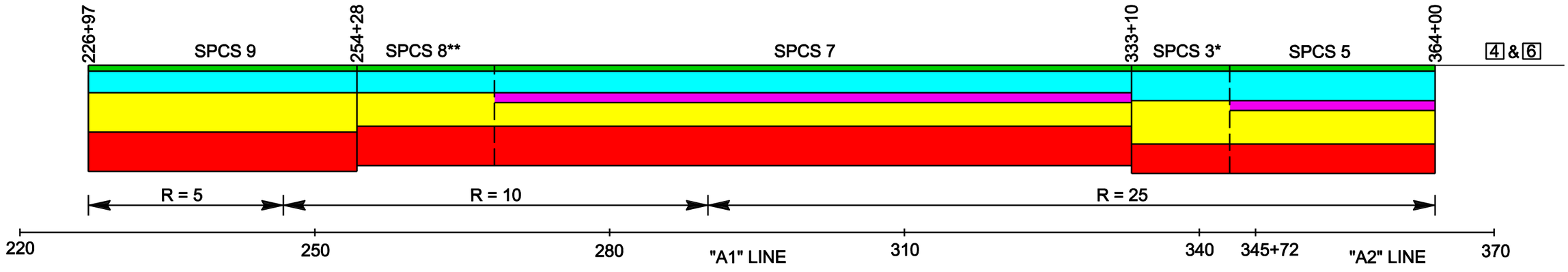
SPCS 9 TRAVELED WAY AND Shld (Typ)

0.15' RHMA-G
0.55' HMA (TYPE A)
1.00' Cl 2 AB
1.00' Cl 3 AS

NOTES:

* USE SPCS 3 WHEN UPGRADIENT FROM EXISTING ATPB ANYWHERE BETWEEN STATIONS 333+10 TO 364+00.

**USE SPCS 8 WHEN UPGRADIENT FROM EXISTING ATPB ANYWHERE BETWEEN STATIONS 254+28 TO 333+10.



SR 84 - South Segment
Structure Pavement Sections Profile

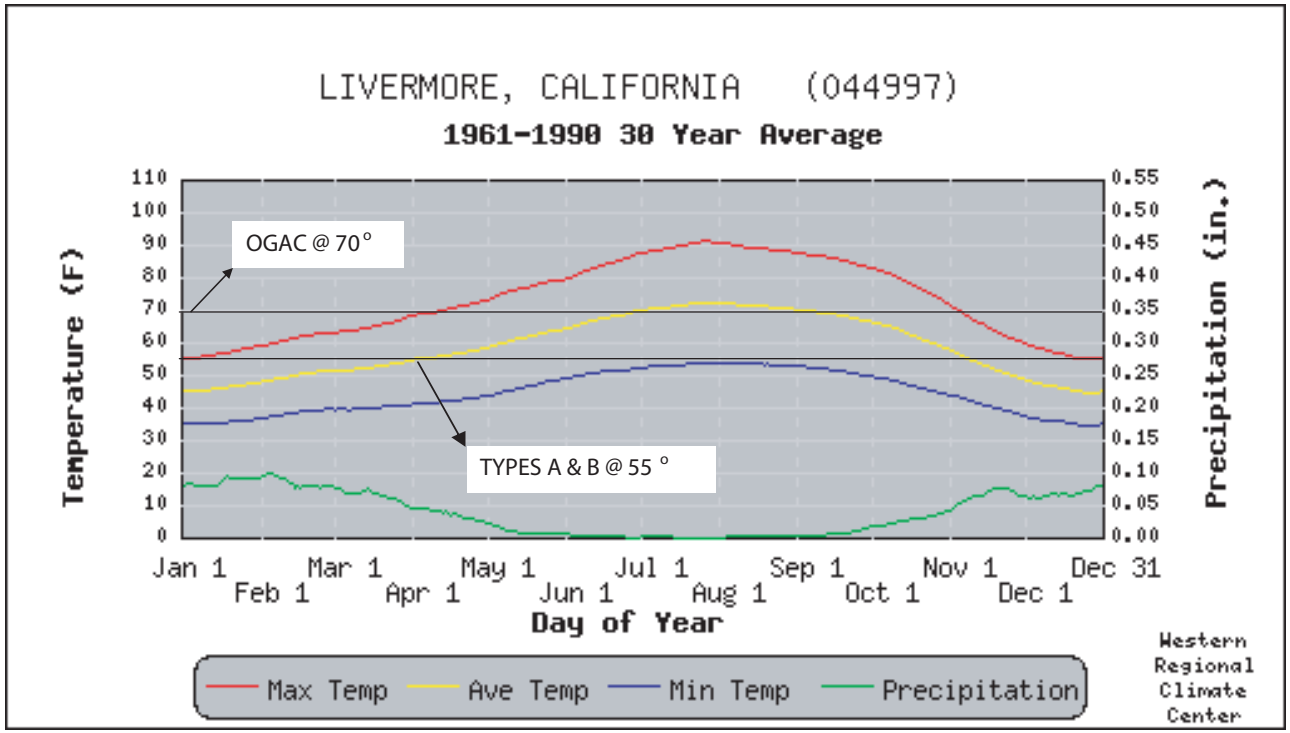
PRELIMINARY PLANS, SUBJECT TO REVISION

FIGURE 5-5

URS
100 W San Fernando Street, Suite 200
San Jose, CA 95113
(408) 297-6962

November 30, 2010

LIVERMORE, CALIFORNIA
1961 - 1990 Temperature and Precipitation



Data is smoothed using a 29 day running average.

- Max. Temp. is the average of all daily maximum temperatures recorded for the day of the year between the years 1961 and 1990.
- Ave. Temp. is the average of all daily average temperatures recorded for the day of the year between the years 1961 and 1990.
- Min. Temp. is the average of all daily minimum temperatures recorded for the day of the year between the years 1961 and 1990.
- Precipitation is the average of all daily total precipitation recorded for the day of the year between the years 1961 and 1990.

FIGURE 5-6

04-ALA-84-PM22.9/27.1

EA297601
JANUARY 14, 2011

VOLUME II OF II
GEOTECHNICAL DESIGN REPORT AND MATERIALS REPORT

ROUTE 84 EXPRESSWAY WIDENING LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Improvement Authority
1333 Broadway, Suite 300
Oakland, CA 94612

URS

100 W. San Fernando Street, Suite 200
San Jose, California 95113

`

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — State of California

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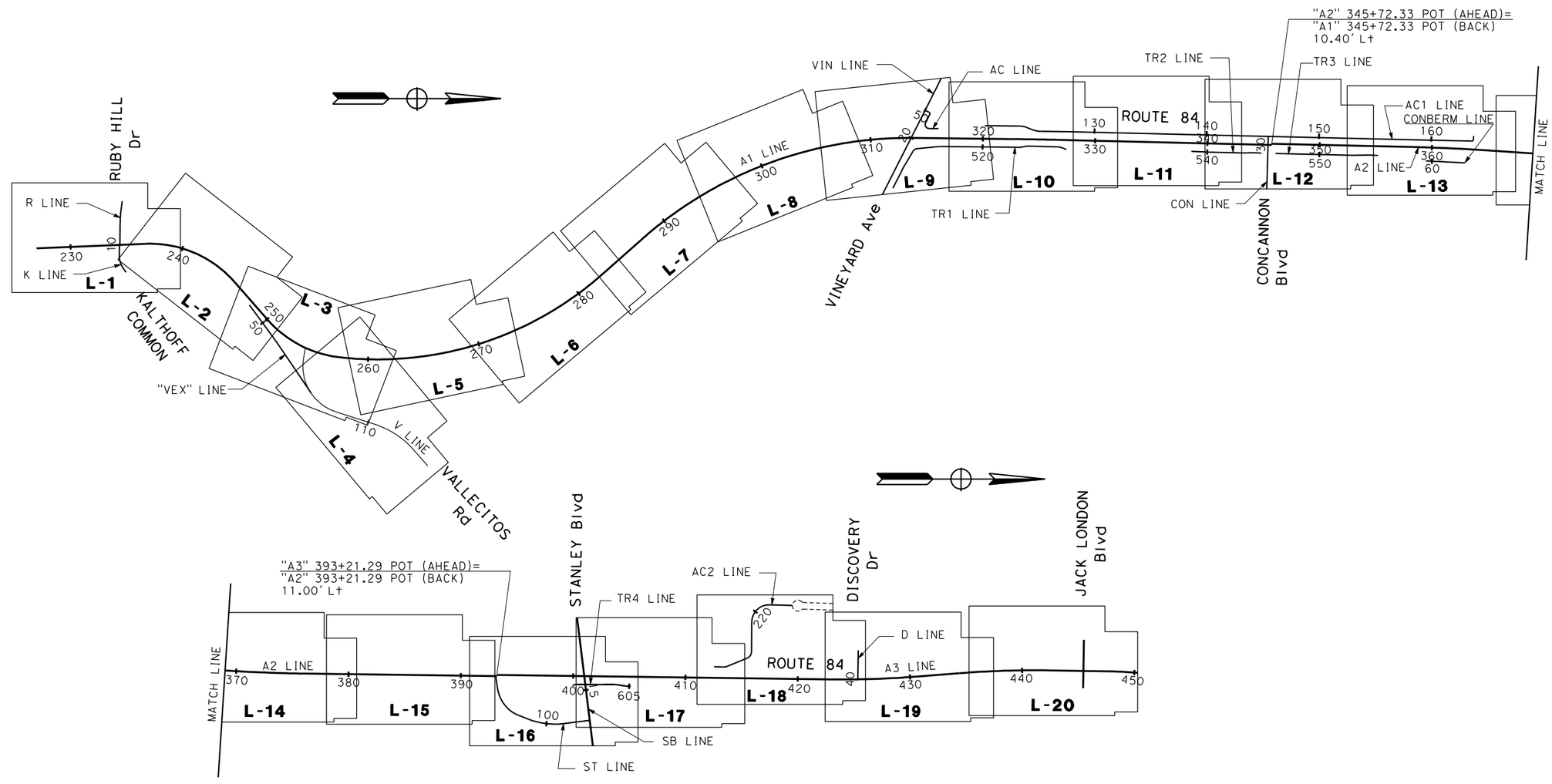

KEY MAP AND LINE INDEX

NO SCALE

K-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

REVISED BY | DATE REVISED

LAST REVISION 08-31-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 10:37:40 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => madhu_thummaluru | DGN FILE => ...\DA-Keymap\429760da001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

Excerpts from the following plan sets:

- Project Plans for Construction on State Highway in Alameda County near Livermore from 0.5 Km East of Route 680 to 1.1 Km East of Vallecitos Atomic Laboratory Road and from 0.5 Km West of Ruby Hills Drive to 0.2 Km East of Isabel Avenue, Contract No. 04-272614, dated August 13, 2004.
- Project Plans for Construction on Isabel Avenue / Vallecitos Road Intersection Realignment, Project No. 1999-13, City of Livermore, Alameda County, California, dated July 31, 2007.
- Improvement Plan, Isabel Avenue – Phase 1, City of Livermore, Alameda County, California, dated July 15, 1999. Project limits on Isabel Avenue from Station 2+60 to 21+80 (Metric Units) (approximate SR 84 Station "A1" 246+81 to 252+18).
- Project Plans for Construction on Isabel Avenue Extension – Phase 2 in Alameda County in Livermore from 1.0 km South of Concannon Blvd to Airway Blvd.
  - Isabel Avenue Extension-Phase 2, Project 1, City of Livermore Project No. 89-50, dated May 11, 1999. Project limits on SR84 extend from Station "I" 101+60 to 145+50.
  - Isabel Avenue Extension-Phase 2, Project 2, City of Livermore Project No. 96-91, dated May 11, 1999. Project limits on SR84 extend from Station "RH" 4+60 to Station "I" 101+60.
- Oaks Business Park – Tract 7300, Construction Plans for Isabel Avenue (SR 84) Widening, in Alameda County, in Livermore, from Arroyo Mocho Bridge to 300M South of Jack London Boulevard and at Jack London Boulevard, dated January 25, 2008.

INDEX OF SHEETS

Sheet No.	Description
1	Title and Location Map
2	Typical Cross Sections
3-11	Layouts
12-15	Construction Details
16	Temporary Water Pollution Control Details (Temporary Concrete Washout Facility)
17	Drainage Profiles
18	Drainage Details
19	Drainage Quantities
20	Stage Construction
21	Construction Area Signs
22-29	Pavement Delineation and Sign Plan
30	Pavement Delineation
31-32	Pavement Delineation and Sign Quantities
33-34	Summary of Quantities
35-36	Modify Signal and Lighting
37-40	Revised Standard Plans

THE STANDARD PLANS LIST APPLICABLE TO THIS CONTRACT IS INCLUDED IN THE NOTICE TO CONTRACTORS AND SPECIAL PROVISIONS BOOK.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

ACSTP-S048(031)E

PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY
IN ALAMEDA COUNTY
NEAR LIVERMORE FROM 0.5 KM EAST OF ROUTE 680 TO 1.1 KM EAST OF VALLECITOS ATOMIC LABORATORY ROAD AND FROM 0.5 KM WEST OF RUBY HILLS DRIVE TO 0.2 KM EAST OF ISABEL AVENUE

To be supplemented by Standard Plans dated July, 1999

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	1	40

LOCATION MAP

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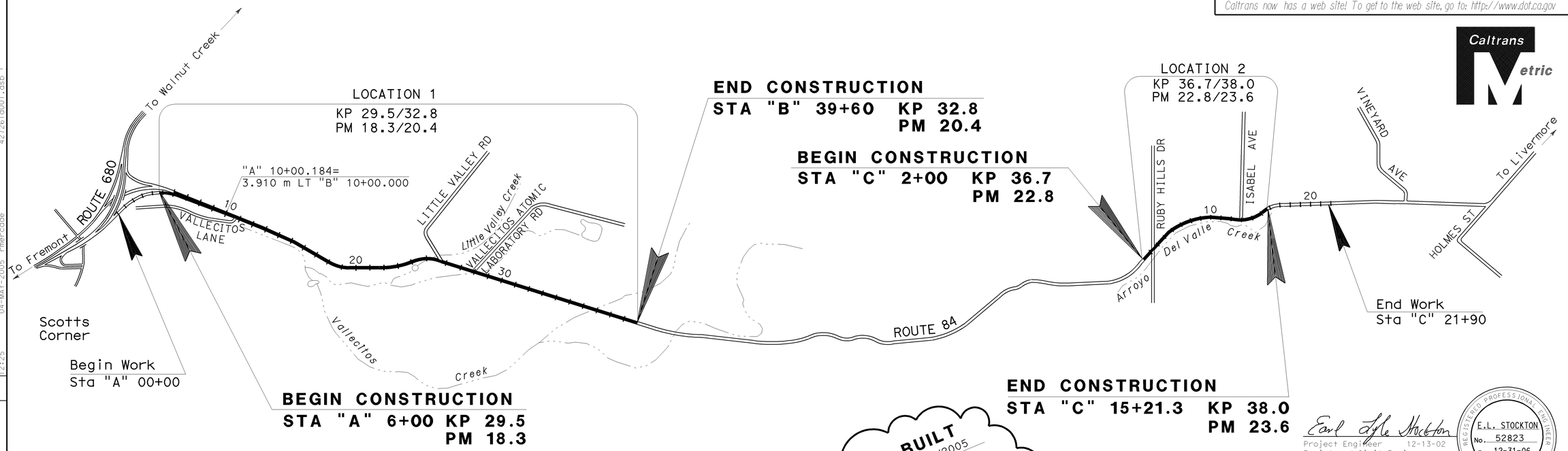

NO SCALE

AS-BUILT
DATE: 04/11/2005
TYPE OF WORK: NOT AVAILABLE

NO Construction Changes

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004
AS BUILT
RESIDENT ENGINEER Moin Shaikh

Earl Lyle Stockton
Project Engineer 12-13-02
Registered Civil Engineer

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

April 14, 2003
Plans Approval Date

The Contractor shall possess the Class (or Classes) of license as specified in the ''Notice to Contractors''.

PROJECT ENGINEER	DATE	PROJECT MANAGER	DATE
E.L. STOCKTON		R. KIAAINA	

Contract No. 04-272614

LAST REVISION 00-00-00

DATE PLOTTED => 04-MAY-2005 12:25

427261a001.asb 04-MAY-2005 rmercade 12:25

FORM DC-OE-93-PF (REV. 3/88)

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => rmercade
DGN FILE => 427261a001.asb

CU 03258 EA 272611

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	2	04

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

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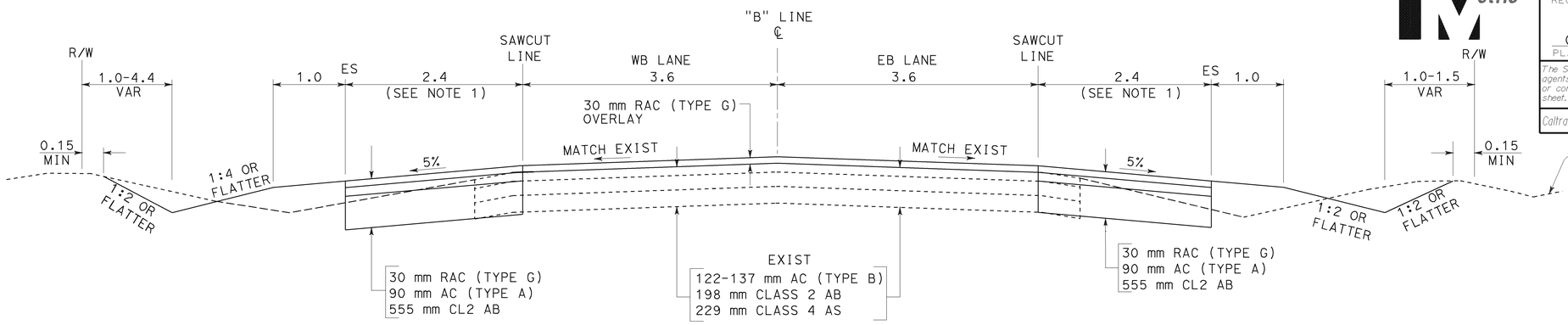
Caltrans Metric

LEGEND

RAC RUBBERIZED ASPHALT CONCRETE



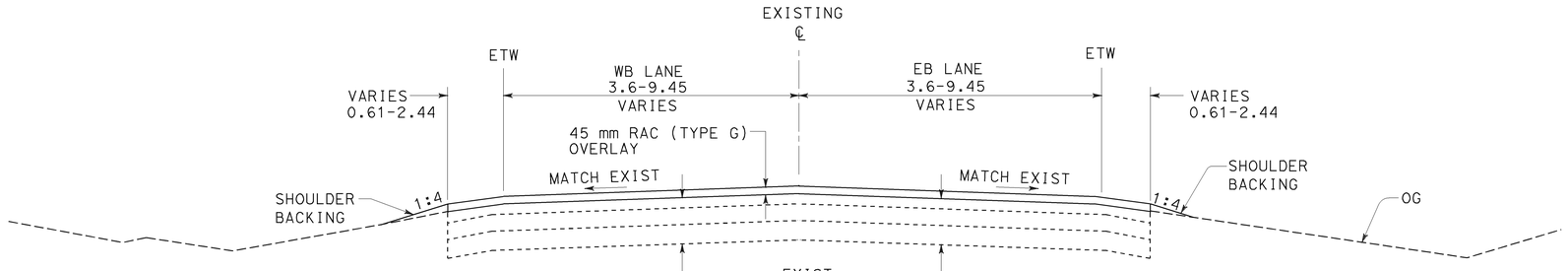
NOTES:

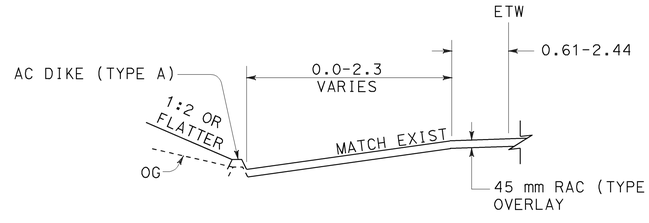
1. CONSTRUCT OUTSIDE SHOULDER WIDENING PRIOR TO PLACING RAC OVERLAY
2. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
3. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.

ROUTE 84

OUTSIDE SHOULDER WIDENING AND RAC OVERLAY

STA "B" 30+10 TO 39+60



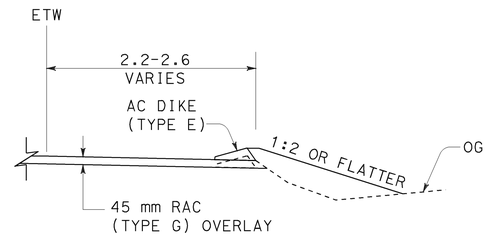


STA "B" LT 10+00 TO 13+43.7
STA "B" LT 22+75.5 TO 24+13.2

ROUTE 84

AC OVERLAY

STA "A" 6+00 TO 10+00
STA "B" 10+00 TO 30+10
STA "C" 2+00 TO 15+21.3



STA "B" RT 11+53.9 TO 13+16.6

NO Construction Changes

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004

AS BUILT

RESIDENT ENGINEER Moin Shaikh

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

TYPICAL CROSS SECTIONS

NO SCALE

X-1

DATE REVISED BY | DATE REVISED
CALCULATED/DESIGNED BY | CHECKED BY
PROJECT ENGINEER
E.L. STOCKTON

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NORTH REGION
OFFICE OF DESIGN, WEST
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Caltrans

427261b001.dsb 04-MAY-2005 rmercade 12:26

LAST REVISION 00-00-00
DATE PLOTTED => 04-MAY-2005
TIME PLOTTED => 12:26

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => rmercade
DGN FILE => 427261b001.dsb

CU 03258 | EA 272611

NOTE: 1. FOR COMPLETE RIGHT OF WAY DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

2. EXISTING UTILITY FACILITIES HAVE NOT BEEN PLOTTED ON PORTIONS OF THESE PLANS

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	9	40

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

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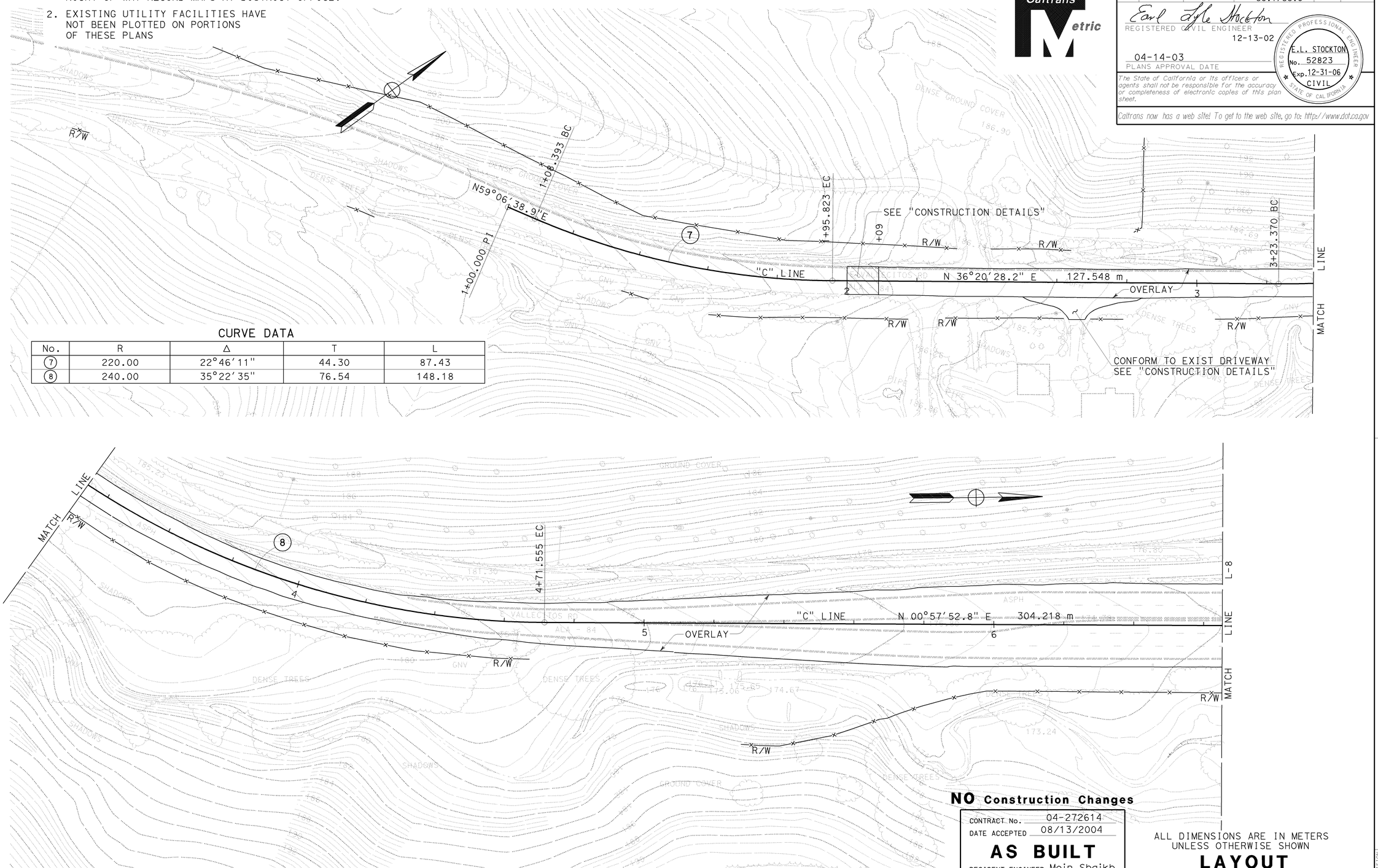

CURVE DATA

No.	R	Δ	T	L
(7)	220.00	22°46'11"	44.30	87.43
(8)	240.00	35°22'35"	76.54	148.18

NO Construction Changes

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004

AS BUILT

RESIDENT ENGINEER Moin Shaikh

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

LAYOUT

SCALE 1:500

L-7

DATE | REVISED BY | DATE REVISED
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PROJECT ENGINEER
E.L. STOCKTON

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427261e007.asb
04-MAY-2005 rmercade
13:46

LAST REVISION 00-00-00
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TIME PLOTTED => 13:46

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DGN FILE => 427261e007.asb

CU 03258

EA 272611

NOTE: 1. FOR COMPLETE RIGHT OF WAY DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

2. EXISTING UTILITY FACILITIES HAVE NOT BEEN PLOTTED ON PORTIONS OF THESE PLANS

CURVE DATA

No.	R	Δ	T	L
(9)	365.76	54°22'20"	187.86	347.10

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	10	40

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER E.L. STOCKTON No. 52823 Exp. 12-31-06 CIVIL STATE OF CALIFORNIA

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CURB & GUTTER CONFORM SEE "CONSTRUCTION DETAILS"

CONFORM TO LOCAL ROAD SEE "CONSTRUCTION DETAILS"

R/W

+57.7

+87.8

MATCH L LINE

304.218 m

"C" LINE

N 00°57'52.8" E

OVERLAY

7+75.773 BC

+33.1

+97.6

L-7

CONFORM TO LOCAL ROAD SEE "CONSTRUCTION DETAILS"

CURB & GUTTER CONFORM SEE "CONSTRUCTION DETAILS"

DENSE GROUND COVER

(9)

"C" +37.4 TERMINAL ANCHOR ASSEMBLY (TYPE SFT)

SALVAGE 53.6 m MBGR
38.35 m MBGR
"C" +75.7 TERMINAL SYSTEM (TYPE SRT)

MATCH L LINE

+99.1

11+22.869 EC

DIKE CONFORM SEE "CONSTRUCTION DETAILS"

L-9

"C" LINE

4.3

OVERLAY

N 55°20'12.2" E 262.606 m

12
2.9

OVERLAY

"C" +10.6 SEE "CONSTRUCTION DETAILS"

RECONSTRUCT 80.8 m MBGR

+10.8

"C" +01.8 TERMINAL SYSTEM (TYPE SRT)

"C" +97.8 TERMINAL ANCHOR ASSEMBLY (TYPE SFT)

NO Construction Changes

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004

AS BUILT

RESIDENT ENGINEER Moin Shaikh

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE 1:500

L-8

DATE REVISED BY | DATE REVISED
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PROJECT ENGINEER E.L. STOCKTON

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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04-MAY-2005 rmercade 427261e008.asb 14:04

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USERNAME => rmercade
DGN FILE => 427261e008.asb

CU 03258 | EA 272611

LAST REVISION 00-00-00 DATE PLOTTED => 04-MAY-2005 TIME PLOTTED => 14:04

NOTE: 1. FOR COMPLETE RIGHT OF WAY DATA, SEE
RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

2. EXISTING UTILITY FACILITIES HAVE
NOT BEEN PLOTTED ON PORTIONS
OF THESE PLANS

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	11	40

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

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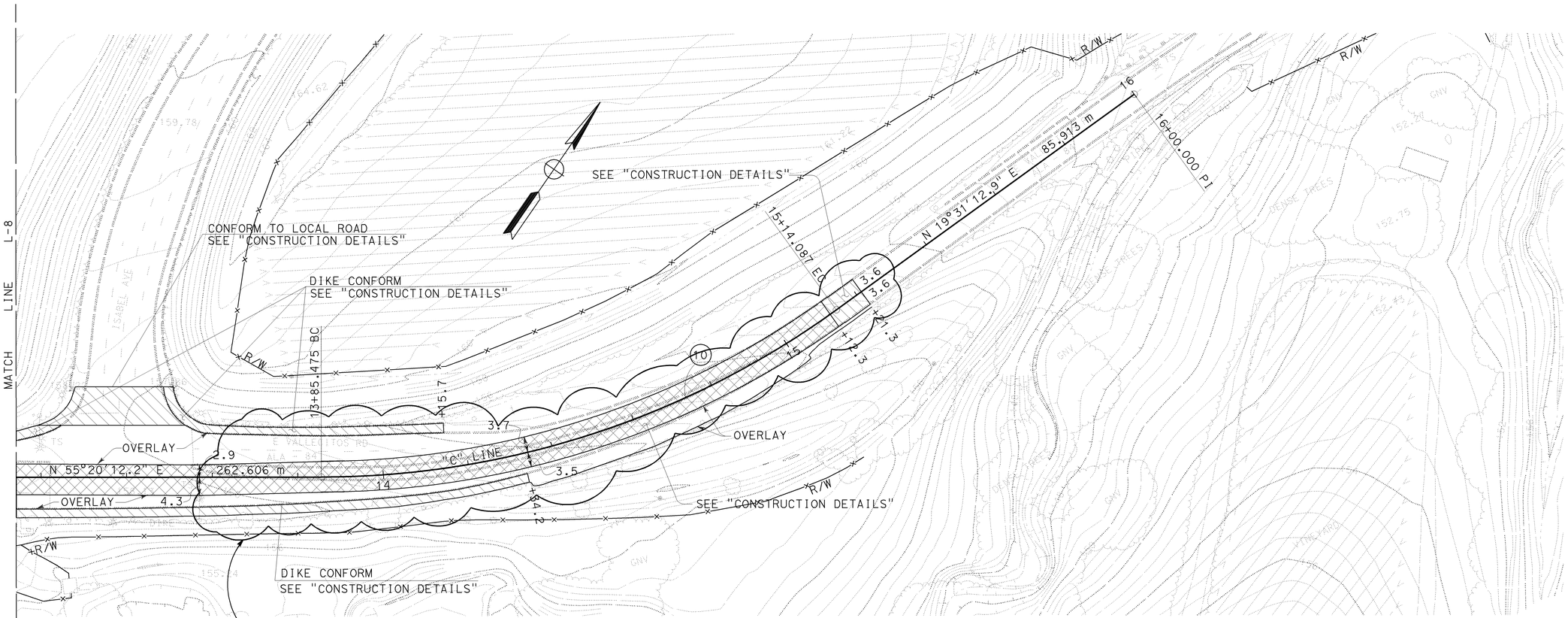
CURVE DATA

No.	R	Δ	T	L
(10)	205.74	35°48'57"	66.48	128.61



AS CONCURRED BY THE PROJECT MANAGER FROM "C" LINE, STATION 13+55 AND EASTWARD RELINQUISHED TO THE CITY OF LIVERMORE

Resident Engineer Responsible for *Construction Changes*

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004
AS BUILT
RESIDENT ENGINEER Moin Shaikh
Moin 01/11/05
SIGNATURE DATE
CHECKED BY R L DATE 04/2005

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

LAYOUT
SCALE 1:500

L-9

DATE	REVISED BY	DATE REVISED

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PROJECT ENGINEER
E.L. STOCKTON

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NORTH REGION
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04-MAY-2005 rmercade
14:58

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DGN FILE => 427261e009.asb

CU 03258

EA 272611

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	12	40

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
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REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
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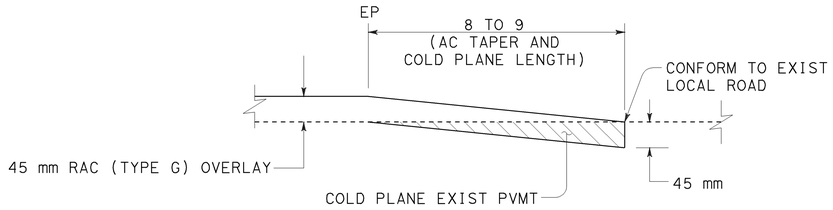
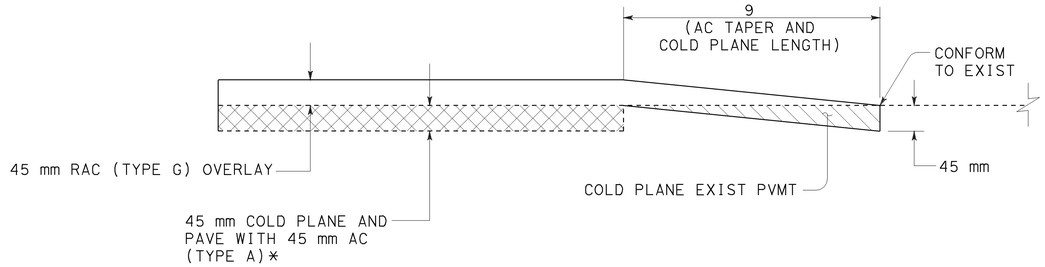
NOTE: CONTRACTOR SHALL VERIFY THE EXACT LOCATIONS OF PAVEMENT REMOVAL. NEW AC OVERLAY SHALL CONFORM TO EXISTNG AC. PAVEMENT TRANSITION SHALL BE PROVIDED BEFORE OPENING TRAFFIC LANES TO THE PUBLIC DURING ANY STAGE CONSTRUCTION.

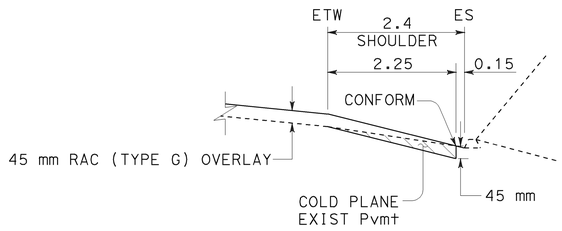


CONFORM TO LOCAL ROADS

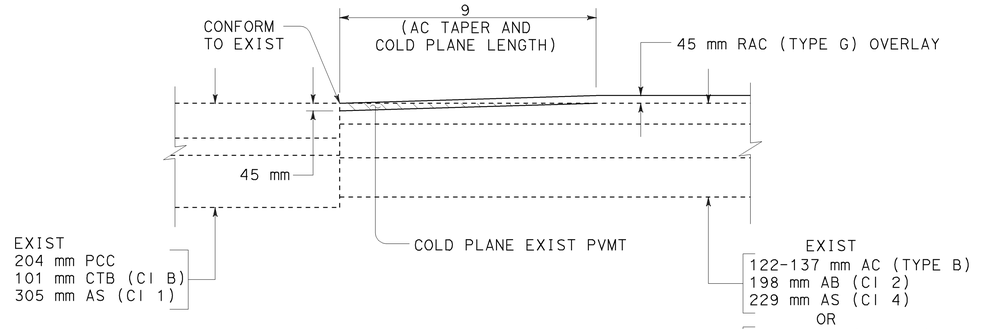


*COLD PLANE EXISTING AC PAVEMENT 45 mm DEEP AND PAVE WITH 45 mm AC (TYPE A) PRIOR TO RAC OVERLAY. SEE LAYOUT SHEETS FOR LIMITS.

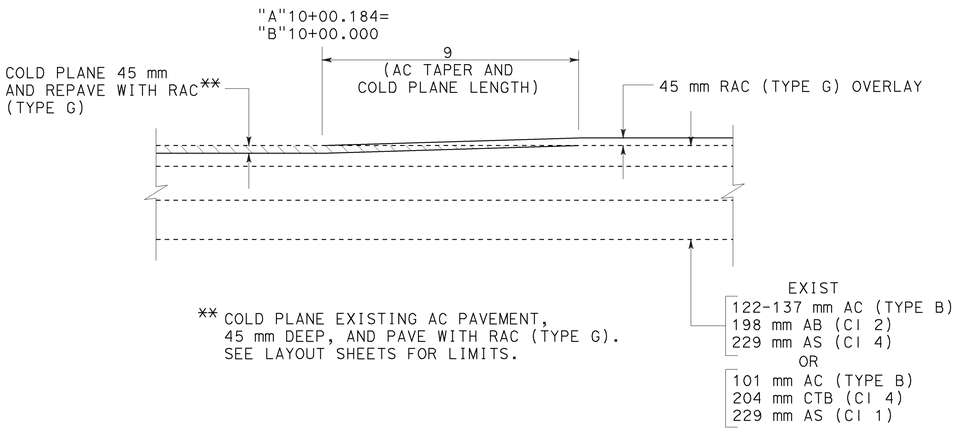
STA "C" 12+10.6 TO 15+21.3



DIKE CONFORM



WB STA L† "B" 10+00 TO 10+09



** COLD PLANE EXISTING AC PAVEMENT, 45 mm DEEP, AND PAVE WITH RAC (TYPE G). SEE LAYOUT SHEETS FOR LIMITS.

EB STA R† "B" 10+00 TO STA 10+09

NO Construction Changes

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004
AS BUILT
RESIDENT ENGINEER Moin Shaikh

PAVEMENT TRANSITIONS

SEE LAYOUT SHEETS FOR LOCATIONS

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

CONSTRUCTION DETAILS

NO SCALE

C-1

PROJECT ENGINEER
E.L. STOCKTON

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NORTH REGION
OFFICE OF DESIGN, WEST
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CU 03258

EA 272611

LAST REVISION 00-00-00
DATE PLOTTED => 04-MAY-2005
TIME PLOTTED => 14:58

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	13	40

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

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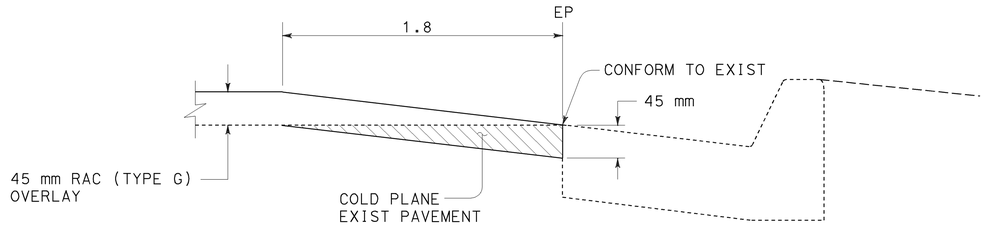
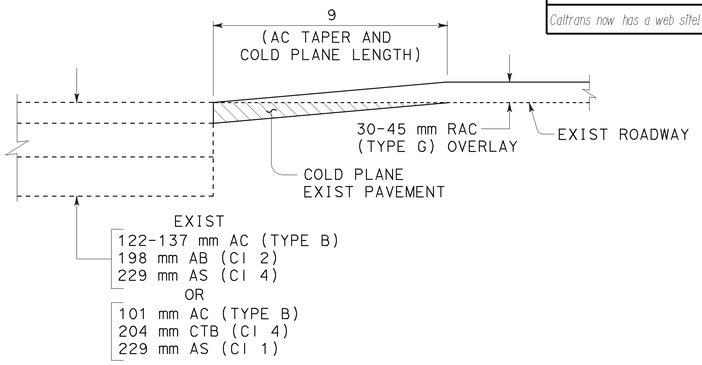
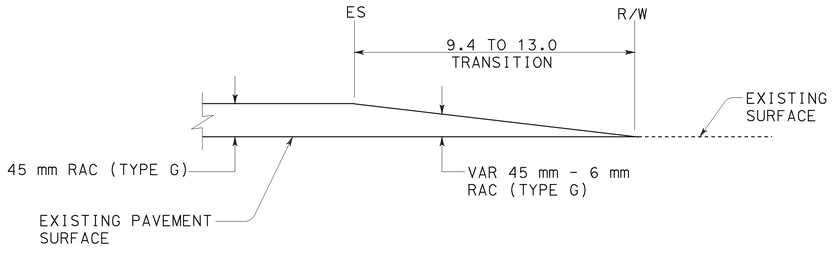


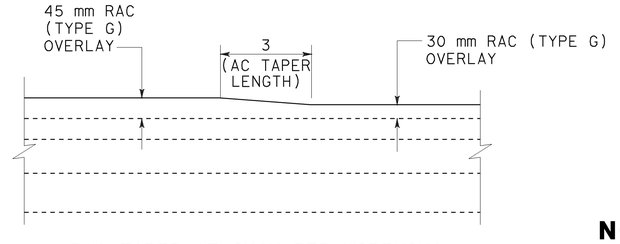
CURB & GUTTER CONFORM



CONFORM TO EXIST ROADWAY
STA "B" 39+60 TO 39+69
STA "C" 2+00 TO 2+09



CONFORM TO EXIST DRIVEWAY



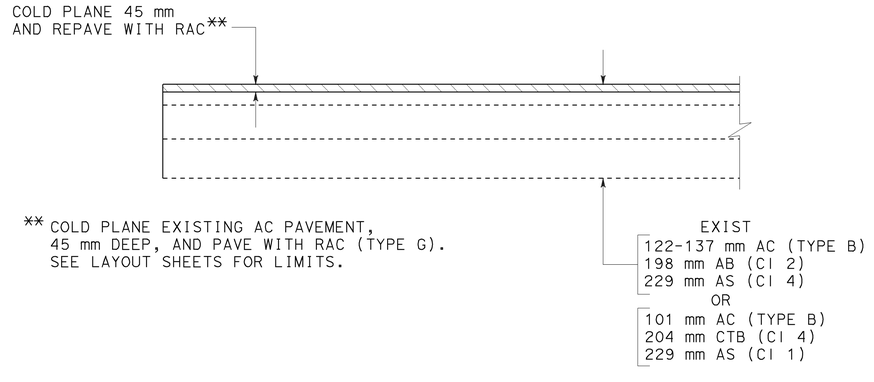
RAC TAPER AT SHOULDER WIDENING
STA "B" 30+07 TO 30+10

NO Construction Changes

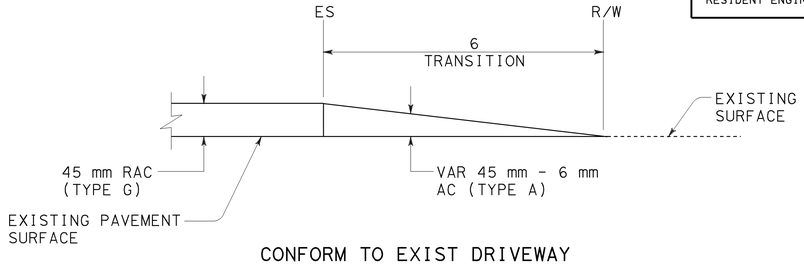
CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004

AS BUILT

RESIDENT ENGINEER Moin Shaikh



NB STA "A" 6+00 TO STA 10+00.184



CONFORM TO EXIST DRIVEWAY
STA "C" 2+25

PAVEMENT TRANSITIONS

SEE LAYOUT SHEETS FOR LOCATIONS

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

CONSTRUCTION DETAILS

NO SCALE

C-2

DATE REVISED BY | DATE REVISED
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CU 03258

EA 272611

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	14	40

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp. 12-31-06
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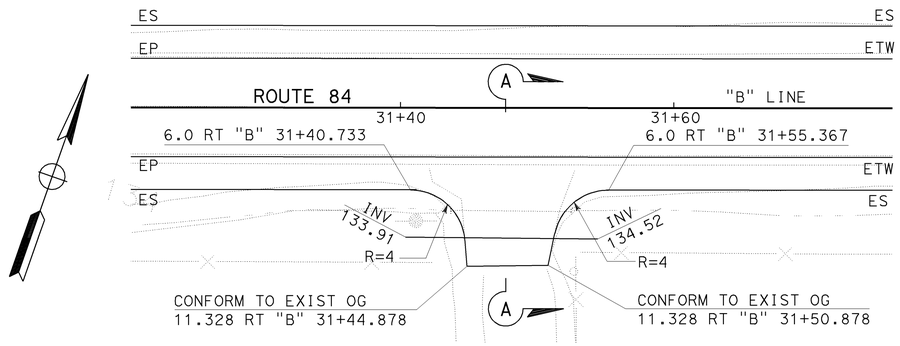
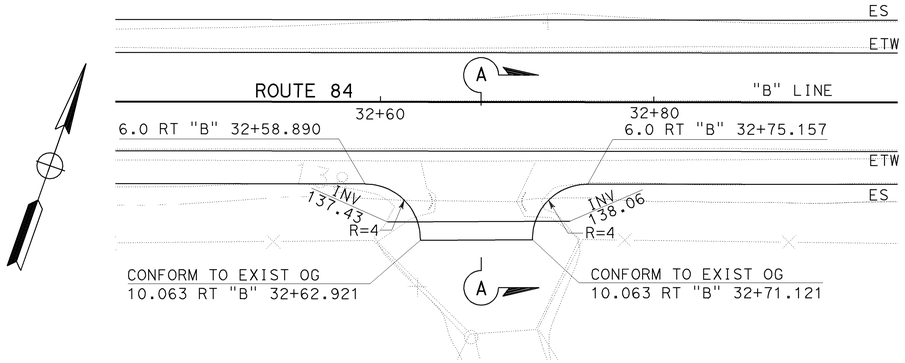
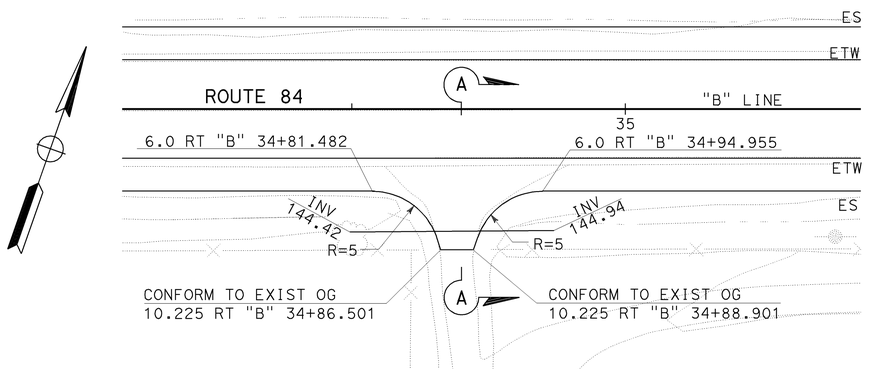


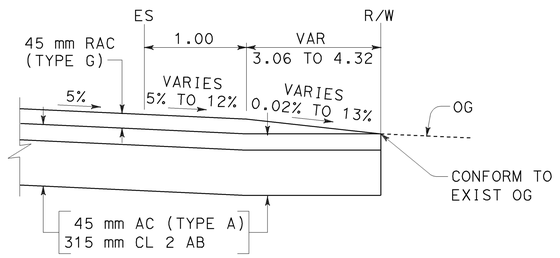
PLAN



PLAN



PLAN



SECTION A-A

NO Construction Changes

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004

AS BUILT

RESIDENT ENGINEER Moin Shaikh

ALL DIMENSIONS ARE IN METERS
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CONSTRUCTION DETAILS

NO SCALE

C-3

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E.L. STOCKTON

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CU 03258

EA 272611

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	15	40

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp. 12-31-06
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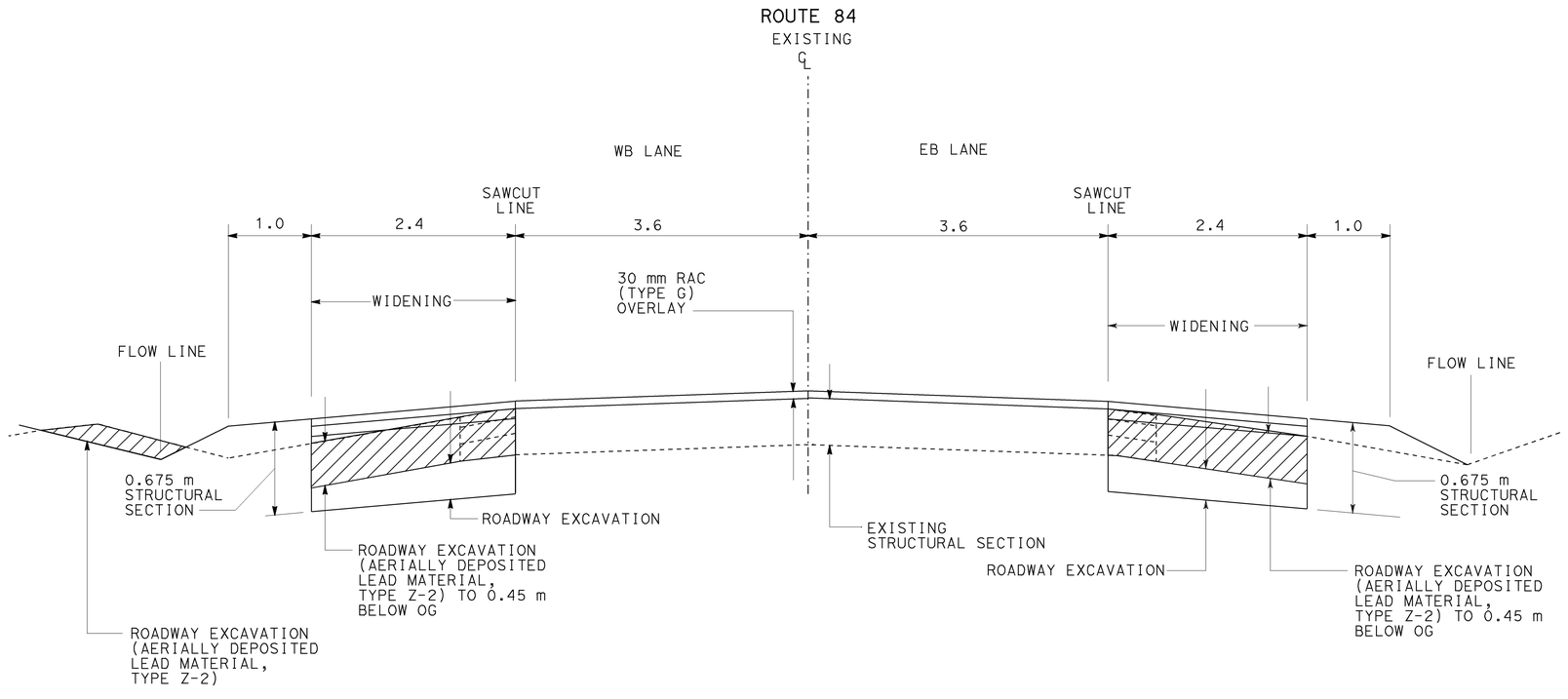
LEGEND

AERIALLY DEPOSITED LEAD MATERIAL



EXCAVATION OF AERIALLY DEPOSITED LEAD MATERIAL

OUTSIDE SHOULDER WIDENING AND AC OVERLAY AREA

KP 31.68/PM 19.68 TO KP 32.86/PM 20.41
STA 28 + 50 TO STA 40 + 20

NO Construction Changes

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004

AS BUILT

RESIDENT ENGINEER Moin Shaikh

ALL DIMENSIONS ARE IN METERS
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CONSTRUCTION DETAILS

NO SCALE

C-4

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CU 03258 | EA 272611

INDEX OF SHEETS

SHEET No.	SHEET NAME	DESCRIPTION
1	T-1	TITLE SHEET
2	X-1	NOTES/ABBREVIATION/LEGEND
3-7	X-2 - X-6	TYPICAL SECTIONS
8	L-1	LAYOUT
9-10	PS-1 - PS-2	PROFILES
11	G-1	CONTOUR GRADING
12-13	D-1 & DP-1	DRAINAGE PLAN AND PROFILES
14	U-1	UTILITY PLAN
15-17	C-1 - C-3	CONSTRUCTION DETAILS
18-24	WPCD-1 - WPCD-7	TEMPORARY WATER POLLUTION CONTROL DETAILS
25-28	EC-1 - EC-4	EROSION CONTROL PLAN AND DETAILS
29-30	SC-1 - SC-2	STAGE CONSTRUCTION
31-32	TH-1 - TH-2	TRAFFIC HANDLING
33-34	CS-1 - CS-2	CONSTRUCTION AREA SIGNS
35	PD-1	PAVEMENT DELINEATION
36-37	S-1 & SQ-1	SIGN PLAN & QUANTITIES
38-39	E-1 - E-2	SIGNAL & LIGHTING
40-44	XS-1 - XS-5	CROSS SECTIONS
45	PP-1	HIGHWAY PLANTING PLAN
46	SCP-1	SURVEY CONTROL PLAN

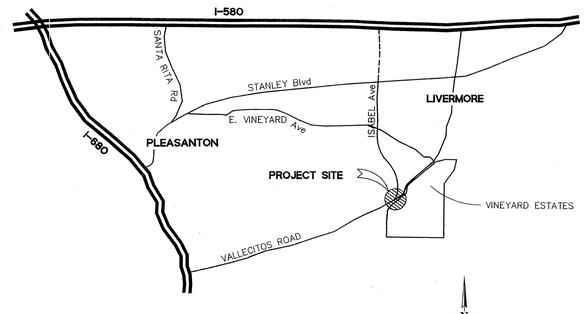
PROJECT PLANS FOR CONSTRUCTION ON

ISABEL AVENUE / VALLECITOS ROAD INTERSECTION REALIGNMENT

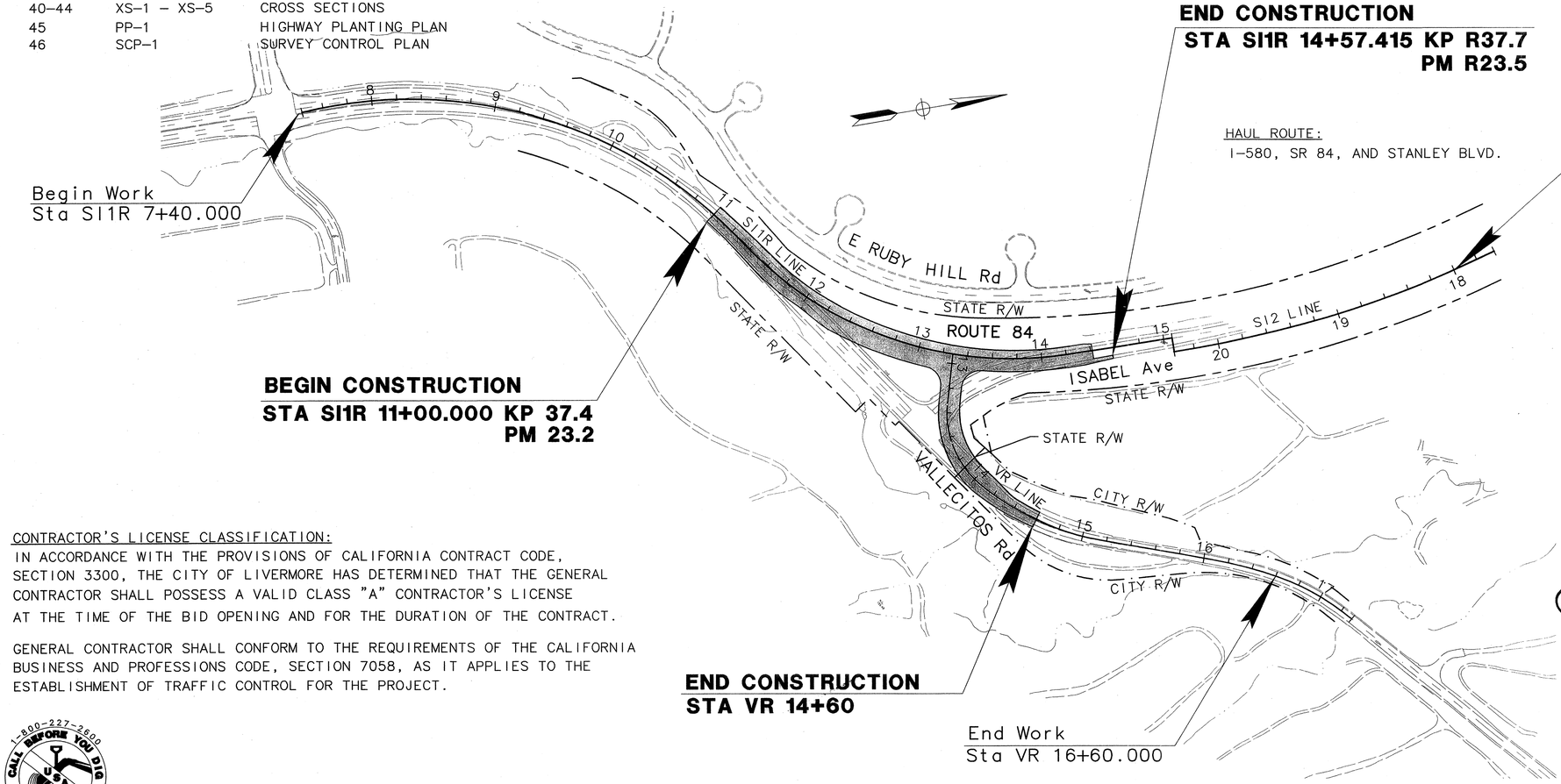
PROJECT No. 1999-13

IN ALAMEDA COUNTY, IN LIVERMORE

ON ROUTE 84 FROM 0.2 KM SOUTH TO 0.1 KM NORTH OF ROUTE 84 / VALLECITOS RD INTERSECTION AND TO 0.2 KM EAST OF VALLECITOS RD FROM ROUTE 84 / VALLECITOS RD INTERSECTION



VICINITY MAP
N.T.S.



CONTRACTOR'S LICENSE CLASSIFICATION:
IN ACCORDANCE WITH THE PROVISIONS OF CALIFORNIA CONTRACT CODE, SECTION 3300, THE CITY OF LIVERMORE HAS DETERMINED THAT THE GENERAL CONTRACTOR SHALL POSSESS A VALID CLASS "A" CONTRACTOR'S LICENSE AT THE TIME OF THE BID OPENING AND FOR THE DURATION OF THE CONTRACT.

GENERAL CONTRACTOR SHALL CONFORM TO THE REQUIREMENTS OF THE CALIFORNIA BUSINESS AND PROFESSIONS CODE, SECTION 7058, AS IT APPLIES TO THE ESTABLISHMENT OF TRAFFIC CONTROL FOR THE PROJECT.

Caltrans Metric

CITY OF LIVERMORE, APPROVED BY:

Cheri R Sheets 2/28/06

CHERI R. SHEETS, CITY ENGINEER — DATE
RCE 38751, EXPIRES 3/31/07

RECOMMENDED FOR APPROVAL:

Michael T. Cavalieri 2/28/06

MICHAEL T. CAVALIERI, — DATE
ASSISTANT CITY ENGINEER
RCE 40571, EXPIRES 3/31/07

Lourdes Barrozo 2/28/06

LOURDES C. BARROZO, SENIOR CIVIL ENGINEER — DATE

FOR DNP 2/28/06

MOHAMMAD POURNIA, TRANSPORTATION MANAGER — DATE

PREPARED UNDER THE DIRECTION OF:
BKF ENGINEERS

02/17/06

NATALINA BERNARDI, PROJECT MANAGER — DATE
RCE 45407, EXPIRES 9/30/06

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY Mike Hamm
DATE 7-31-07

1-800-227-2600 CALL BEFORE YOU DIG USA UNDERGROUND SERVICE ALERT

PROFESSIONAL ENGINEER — NATALINA BERNARDI — No. 45407 — Exp. 9/30/06 — CIVIL — STATE OF CALIFORNIA

BKF ENGINEERS | SURVEYORS | PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY

PROJECT ENGINEER — DATE
CHECKED — DATE

ISABEL AVENUE / VALLECITOS ROAD INTERSECTION REALIGNMENT PROJECT
TITLE SHEET
T-1

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 02/17/06	SHEET	OF
DRAWN:	PROJECT NO.	1	46

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STANDARD GENERAL NOTES

1. THE CONTRACTOR AGREES THAT, IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, THE CONTRACTOR WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS. THE CONTRACTOR FURTHER AGREES TO DEFEND, INDEMNIFY AND HOLD OWNER AND ENGINEER HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXEMPTING LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF ENGINEER.
2. EXCAVATIONS SHALL BE ADEQUATELY SHORED, BRACED AND SHEETED SO THAT THE EARTH WILL NOT SLIDE OR SETTLE AND SO THAT ALL EXISTING IMPROVEMENTS OF ANY KIND WILL BE FULLY PROTECTED FROM DAMAGE. ANY DAMAGE RESULTING FROM A LACK OF ADEQUATE SHORING, BRACING AND SHEETING, SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND HE SHALL EFFECT NECESSARY REPAIRS OR RECONSTRUCTION AT HIS OWN EXPENSE.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO OBTAIN PERMITS NECESSARY TO PERFORM THE WORK SHOWN IN THESE PLANS FROM THE APPROPRIATE AGENCIES.
4. THE CONTRACTOR SHALL PROVIDE ALL LIGHTS, SIGNS BARRICADES, FLAGGERS OR OTHER DEVICES NECESSARY TO PROVIDE FOR SAFETY.
5. CONTRACTOR SHALL PROTECT ALL EXISTING IMPROVEMENTS NOT DESIGNATED FOR REMOVAL AND REPLACEMENT. ALL DAMAGED EXISTING IMPROVEMENTS AND THOSE IMPROVEMENTS THAT HAVE BEEN REMOVED OR TEMPORARILY RELOCATED SHALL BE RESTORED BY THE CONTRACTOR TO A CONDITION EQUAL TO OR BETTER THAN ITS CONDITION PRIOR TO CONSTRUCTION AT NO COST TO THE CITY.
6. STATIONING, HEREON IS ALONG STREET CENTERLINE UNLESS OTHERWISE SHOWN OR INDICATED.
7. PRIOR TO CONSTRUCTION, ENGINEER AND CONTRACTOR SHALL FIELD VERIFY DEMOLITION LIMITS, PAVEMENT / CONSTRUCTION JOINTS, CONFORM LIMITS, AND ELEVATIONS, LOCATIONS, & SIZE OF ALL EXISTING UTILITIES WHICH CROSS THE LINE OF CONSTRUCTION.
8. FOR CALTRANS ACCURATE RIGHT OF WAY AND ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT 4 OFFICE AND AT THE ENGINEERING DIVISION IN THE CITY OF LIVERMORE.
9. CONTRACTOR IS TO VERIFY WORK IN THE FIELD AND SHALL SATISFY HIMSELF AS TO THE ACCURACY BETWEEN THE WORK SET FORTH ON THESE PLANS AND THE WORK IN THE FIELD. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO START OF CONSTRUCTION.
10. FOR ABBREVIATIONS NOT SHOWN, SEE CALTRANS STANDARD PLANS A-10A AND A-10B.
11. FOR DRAINAGE IMPROVEMENTS, SEE DRAINAGE PLAN & PROFILE (SEE SHEETS 12 & 13).
12. FOR UTILITY IMPROVEMENTS, SEE UTILITY PLAN (SEE SHEET 14).
13. FOR LIMITS OF GRADING AND FINISHED PAVEMENT ELEVATION SEE CONTOUR GRADING PLAN (SHEET 11).
14. FOR PROPOSED PAVEMENT SECTION, SEE TYPICAL SECTION (SHEETS 3 THRU 7).
15. FOR SIGNING IMPROVEMENTS, INCLUDING REPLACEMENT WORK, SEE SIGN PLAN (SHEET 36).
16. FOR STRIPING IMPROVEMENTS, SEE PAVEMENT DELINEATION PLAN (SHEET 35).
17. FOR STAGE CONSTRUCTION INFORMATION, INCLUDING PROJECT PHASING, TRAFFIC CONTROL AND CONSTRUCTION AREA SIGNS, SEE STAGE CONSTRUCTION (SHEETS 29 & 30). CONSTRUCTION AREA SIGN (SHEETS 33 & 34), AND TRAFFIC HANDLING PLAN (SHEETS 31, & 32).
18. FOR TRAFFIC SIGNAL INSTALLATION, SEE TRAFFIC SIGNAL PLANS (SHEETS 38 & 39).
19. FOR TEMPORARY WATER POLLUTION CONTROL DETAILS, SEE TEMPORARY WATER POLLUTION CONTROL DETAIL PLANS (SHEETS 18 THRU 24).
20. LENGTHS OF STORM DRAINS ARE HORIZONTAL DISTANCES FROM CENTER TO CENTER OF STRUCTURES.
21. IF ARCHEOLOGICAL MATERIALS ARE UNCOVERED DURING GRADING, TRENCHING OR OTHER EXCAVATION, WORK WITHIN 30 METERS OF THESE MATERIALS SHALL BE STOPPED UNTIL A PROFESSIONAL ARCHAEOLOGIST WHO IS CERTIFIED BY THE SOCIETY OF CALIFORNIA ARCHAEOLOGY (SCA) AND/OR THE SOCIETY OF PROFESSIONAL ARCHAEOLOGY (SOPA) HAS HAD AN OPPORTUNITY TO EVALUATE THE SIGNIFICANCE OF THE FIND AND SUGGEST APPROPRIATE MITIGATION MEASURES, IF THEY ARE DEEMED NECESSARY, AND TO CONSULT WITH APPROPRIATE AGENCIES AND/OR PARTIES.
22. THE CONTRACTOR SHALL COMPLY WITH AND FOLLOW ALL NPDES REQUIREMENTS IN EFFECT AT THE TIME OF CONSTRUCTION.
23. ALL CONSTRUCTION SHALL CONFORM TO CONTRACT SPECIFICATIONS, DETAILS AND DRAWINGS, TO THE CITY OF LIVERMORE STANDARD SPECIFICATIONS AND DETAILS DATED MAY 14, 2001 (AND ANY SUBSEQUENT REVISIONS), TO CALTRANS STANDARD PLANS DATED JULY 2004 AND CALTRANS STANDARD SPECIFICATIONS DATED JULY 1999.
24. UPON COMPLETION OF THE WORK THE CONTRACTOR SHALL CERTIFY THAT ALL WORK WAS PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS. VARIATIONS SHALL BE DECLARED AND PRESENTED TO THE ENGINEER IN WRITING UPON COMPLETION OF CONSTRUCTION.
25. ALL WORK THAT IS WITHIN STATE RIGHT OF WAY SHALL BE IN CONFORMANCE WITH MOST CURRENT STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION, STANDARD SPECIFICATION, AND STANDARD PLANS.
26. CONTRACTOR SHALL NOTIFY ENGINEER 2 WEEKS IN ADVANCE TO COORDINATE WORK SCHEDULE WITH UTILITY OWNERS PRIOR TO CONSTRUCTION.
27. THE LOCATION, DIAMETER, TYPE, DEPTH/ELEVATION, AND MATERIALS INDICATED OF UNDERGROUND UTILITIES SHOWN ON THE PLANS ARE APPROXIMATE ONLY. ALL EXISTING UTILITIES SHOWN ARE BASED ON RECORD DRAWINGS. THE CONTRACTOR SHALL BE RESPONSIBLE TO CONTACT ALL UTILITY COMPANIES SO THAT THOSE COMPANIES MAY MARK THE LOCATIONS OF THEIR LINES PRIOR TO EXCAVATION. THE CONTRACTOR SHALL NOTIFY UNDERGROUND SERVICES ALERT (USA) AT (800) 227-2600 IN ACCORDANCE WITH THE SPECIFICATIONS PRIOR TO EXCAVATION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING THE EXISTING UTILITIES AND TO FIELD VERIFY THE LOCATION AND DEPTH OF ALL EXISTING UTILITIES IN ADVANCE OF CONSTRUCTION.
28. CONTRACTOR SHALL NOTIFY THE ENGINEER TWO WEEKS IN ADVANCE PRIOR TO THE DISTURBANCE OR REMOVAL OF ANY EXISTING MONUMENTS.
29. THE CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL AND SIGNING PLAN (INCLUDING STREET CLOSURE DETAILS) TO THE ENGINEER DURING THE PRECONSTRUCTION MEETING. THE NOTICE TO PROCEED SHALL NOT BE ISSUED UNTIL SAID TRAFFIC CONTROL PLAN HAS BEEN SUBMITTED AND APPROVED. TRAFFIC CONTROL SHALL BE IN ACCORDANCE WITH CALTRANS "MANUAL OF TRAFFIC CONTROLS IN MAINTENANCE AND WORK ZONES" CURRENT EDITION.
30. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE IMPLEMENTED BY OCTOBER 15TH ALL IN ACCORDANCE WITH THE EROSION CONTROL PLAN AND THE STORM WATER POLLUTION PREVENTION PLAN.
31. THE CONTRACTOR SHALL IMPLEMENT DUST CONTROL MEASURES BOTH ON-SITE AND ON THE HAUL ROUTE WHICH INCLUDES: 1) WATERING ACTIVE CONSTRUCTION AREAS AT LEAST DAILY; 2) COVERING HAUL TRUCKS; 3) SWEEPING STREETS DAILY.
32. CONSTRUCTION HOURS SHALL BE MONDAY TO FRIDAY ONLY FROM 9:00 A.M. TO 5:00 P.M. IN THE SOUTHBOUND DIRECTION, AND 7:00 A.M. TO 3:00 P.M. IN THE NORTHBOUND DIRECTION.
33. THE ONLY EXEMPTION TO THE NIGHT-TIME NOISE ORDINANCE LIMITATIONS SHALL APPLY TO PLACEMENT OF "K" RAILS AND STRIPING, BUT THESE ACTIVITIES SHALL BE CONDUCTED BETWEEN 12:00 A.M. AND 5:00 A.M., MONDAY TO FRIDAY ONLY.
34. WORK STOPPAGE AND INVESTIGATION SHALL OCCUR IN CASE OF DISCOVERY OF POTENTIAL HAZARDOUS MATERIALS.
35. NIGHT TIME PLACEMENT OF "K" RAILS AND STRIPING ACTIVITIES BETWEEN 7 P.M. AND 7 A.M. SHALL NOT EXCEED 86 DBA AT DISTANCE OF 15M.

LEGEND

PROPOSED	DESCRIPTION	EXISTING
	STATE R/W	
	CITY R/W	
	CITY PARCEL	
	CENTER LINE	
168	CONTOUR	168
	MONUMENT	
	STORM DRAIN	
	STORM WATER INLET	
	TRAFFIC SIGN	
	FENCE	X X
	GUARD RAILING	
	TRAFFIC SIGNAL	
	SIGNAL	
	ELECTRICAL BOX	
	TREE	
	FLARED END SECTION	
	MANHOLE	

ABBREVIATION

AB	AGGREGATE BASE
AC	ASPHALT CONCRETE
AS	AGGREGATE SUBBASE
DA	DEPRESSION APRON
EP	EDGE OF PAVEMENT
ETW	EDGE OF TRAVELED WAY
ESA	ENVIRONMENTAL SENSITIVE AREA
FEN	FENCE
FES	FLARED END SECTION
FG	FINISH GRADE
GB	GRADE BREAK
HP	HINGE POINT
LOW PNT	LOW POINT
MBGR	METAL BEAM GUARD RAILING
OG	ORIGINAL GROUND
PG	PROFILE GRADE
PNT	POINT
R	R-VALUE (RESISTANCE VALUE)
R/W	RIGHT OF WAY
RAC	RUBBERIZED ASPHALT CONCRETE
SGD	STANDARD GUTTER DEPRESSION
Std	STANDARD
SWI	STORM WATER INLET
SWMH	STORM WATER MANHOLE
TI	TRAFFIC INDEX
TRANS	TRANSITION
TS	TRAFFIC SIGNAL
W/	WITH

Caltrans Metric

CITY OF LIVERMORE - GENERAL NOTES

A. BENCHMARK:

STANDARD BRASS DISK MONUMENT LOCATED ON WEST BOUND SHOULDER OF HIGHWAY 84 APPROXIMATELY 361 METERS SOUTHWEST OF THE INTERSECTION OF VALLECITOS ROAD AND ISABEL AVENUE, STAMPED "MARK THOMAS & CO. INC. MK-23, LS 6438"

ELEV. 166.609 METERS (NAD 83)

STANDARD BRASS DISK MONUMENT, FLUSH, LOCATED ON THE EAST BOUND SHOULDER OF HIGHWAY 84, APPROXIMATELY 463 METERS NORTHEAST OF MK-23, 3 METERS FROM WIRE FENCE AND 22.8 METERS SOUTHEAST OF A TELOPHONE POLE. STAMPED "MARK THOMAS & CO. INC. MK-24, LS 6438"

ELEV. 157.858 METERS (NAD 83)

B. ELEVATIONS SHOWN ARE FINISHED PAVEMENT ELEVATIONS UNLESS OTHERWISE NOTED.

C. THE CONTRACTOR IS RESPONSIBLE TO NOTIFY ALL UTILITIES 48 HOURS PRIOR TO ANY EXCAVATION SO THAT THEIR LINES CAN BE MARKED. THOSE TO BE NOTIFIED INCLUDE, BUT MAY NOT BE LIMITED TO :
UNDERGROUND SERVICE ALERT: (800) 227-2600.
PG&E: (925) 674-6433
CITY OF LIVERMORE: (925) 960-4500

D. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO IMMEDIATELY NOTIFY THE CITY INSPECTOR AND THE DESIGN ENGINEER UPON DISCOVERY OF ANY FIELD CONFLICTS.

E. THE CONTRACTOR SHALL NOTIFY THE CITY ENGINEER 24 HOURS PRIOR TO REQUIRED INSPECTION (925) 960-4500.

F. THE CITY SHALL BE NOTIFIED A MINIMUM OF 72 HOURS IN ADVANCE OF WHEN FIELD STAKING IS TO BE REQUIRED.

G. CONTRACTOR SHALL KEEP EXISTING STREETS FREE FROM DIRT AND DEBRIS DURING ALL PHASES OF CONSTRUCTION.

H. WHERE UNSTABLE OR UNSUITABLE MATERIALS ARE ENCOUNTERED DURING SUBGRADE PREPARATION, THE AREA IN QUESTION SHALL BE OVER EXCAVATED AND REPLACED BY SELECT BACKFILL MATERIAL AS DIRECTED IN THE FIELD BY THE CITY ENGINEER.

I. WHERE ABANDONED UNDERGROUND STRUCTURES ARE ENCOUNTERED IN THE STREET AREAS, REMOVE TO SUFFICIENT DEPTH TO ALLOW UNDERGROUND LINES TO CROSS, BACKFILL AND COMPACT DURING ROUGH GRADING. THE CITY INSPECTOR MAY REQUIRE FURTHER WORK TO BE DONE IF VISUAL INSPECTION INDICATES DURING CONSTRUCTION.

J. TRAFFIC WARNING, REGULATORY, AND GUIDE SIGNS SHALL BE INSTALLED AT LOCATIONS SHOWN ON PLANS IN ACCORDANCE WITH CALTRANS STANDARD JULY 2004.

K. ALL TRENCHING OPERATIONS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF TITLE 8 (CAL/OSHA).

L. PERMITS SHALL BE OBTAINED WHENEVER THE WORK COMES UNDER THE JURISDICTION OF ANY OF THE FOLLOWING AGENCIES. AFTER PERMIT IS OBTAINED, THE AGENCY MUST BE NOTIFIED PRIOR TO WORK BEING DONE AS REQUIRED IN THE PERMIT:
(i) CALIFORNIA DEPARTMENT OF TRANSPORTATION
(ii) CITY OF LIVERMORE

M. COMPACTION TEST WILL BE PERFORMED ON ALL TRENCHES AND STREET WORK TO VERIFY THAT COMPACTION CONFORMS TO CITY STANDARDS AND AS SPECIFIED IN SPECIAL PROVISIONS. THE INITIAL TEST AND ONE RE-TEST WILL BE PERFORMED BY THE CITY (24 HOUR NOTICE REQUIRED). ALL ADDITIONAL TESTING WILL BE AT THE CONTRACTOR'S EXPENSE.

N. THE CONTRACTOR WILL BE REQUIRED TO PAY AN ADDITIONAL FEE FOR INSPECTION OF ANY WORK PERFORMED OUTSIDE OF THE CITY'S NORMAL WORKING HOURS. SAID FEE WILL BE IN ACCORDANCE WITH THE LATEST PUBLIC WORKS OVERTIME AND OVERTIME INSPECTION FEE POLICY.

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY [signature]
DATE 7-31-07

REGISTERED PROFESSIONAL ENGINEER — V. BERNARD — No. 45407 — Exp. 9/30/06 — CIVIL — STATE OF CALIFORNIA

BKF — ENGINEERS / SURVEYORS / PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY

PROJECT ENGINEER ______ DATE
CHECKED ______ DATE

ISABEL AVENUE / VALLECITOS ROAD INTERSECTION REALIGNMENT PROJECT
NOTES/ABBREVIATION/LEGEND
X-1

CITY OF LIVERMORE, CALIFORNIA — INCORPORATED 1876 — COUNTY OF ALAMEDA

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	2	46

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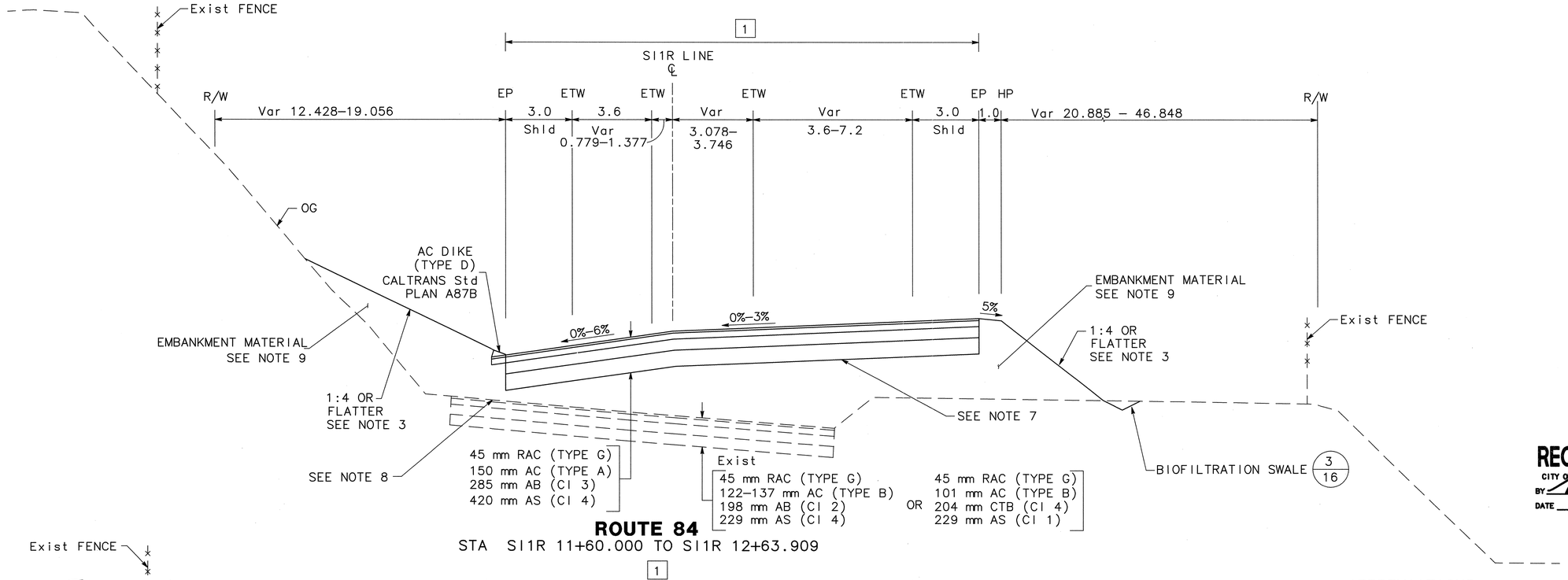
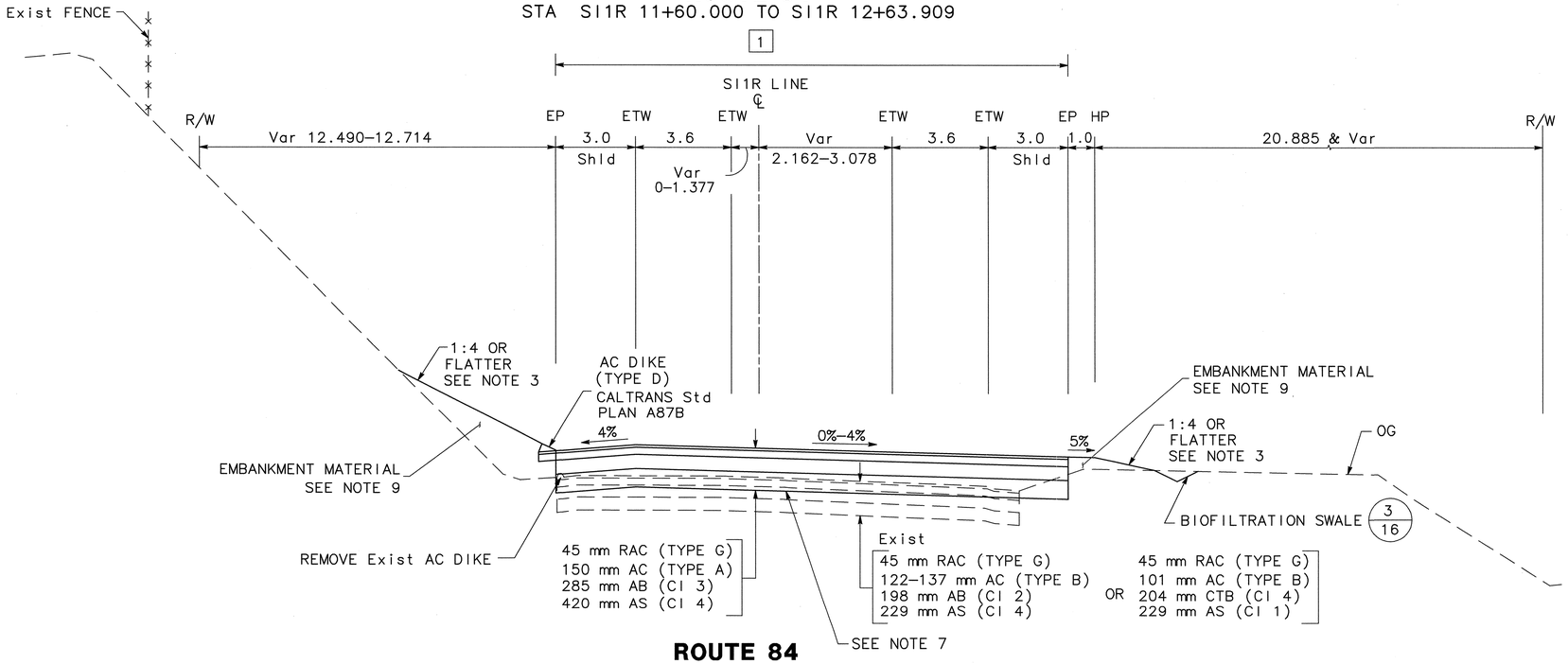


ROUTE 84

STA SI1R 11+60.000 TO SI1R 12+63.909



ROUTE 84

STA SI1R 11+00.000 TO SI1R 11+60.000

FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEET 2.

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY
DATE 7-31-07

ABBREVIATIONS:

No. STRUCTURAL SECTION TYPE

1/16 DETAIL NUMBER DESIGNATION (DETAIL 1 ON SHEET 16)

NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE CALTRANS STANDARD SPECIFICATIONS.
2. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR DIKE LOCATIONS, TYPE, AND LIMITS, SEE LAYOUT PLANS.
4. FOR LIMITS OF AC DITCHES AND BIOFILTRATION SWALE LOCATIONS, SEE DRAINAGE PLAN AND PROFILES.
5. FOR CONTOUR GRADING, SEE GRADING PLAN.
6. ALL PROPOSED STRUCTURAL SECTION WAS DESIGNED USING R=9 AND TI=12.
7. SUBGRADE SHALL BE COMPACTED TO 95% RELATIVE COMPACTION.
8. EXIST PVMT OUTSIDE OF PROPOSED ROADWAY PRISM SHALL BE REMOVED TO THE DEPTH OF 150 mm AS SPECIFIED IN THE SPECIAL PROVISIONS. FOR EXACT LIMITS, SEE LAYOUT PLANS.
9. NATIVE MATERIAL SHALL BE USED AS EMBANKMENT MATERIAL & SHALL BE COMPACTED TO 90% RELATIVE COMPACTION AS SPECIFIED IN THE SPECIAL PROVISIONS.

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

1-800-227-2600 CALL BEFORE YOU DIG UNDERGROUND SERVICE ALERT

REGISTERED PROFESSIONAL ENGINEER — RAY L. BERNARDO — 45407 — Exp 6/30/08 — CIVIL — STATE OF CALIFORNIA
BkF ENGINEERS | SURVEYORS | PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY

PROJECT ENGINEER _____ DATE

CHECKED _____ DATE

ISABEL AVENUE / VALLECITOS ROAD
INTERSECTION REALIGNMENT PROJECT
TYPICAL CROSS SECTIONS
X-2

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	3	46

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NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE CALTRANS STANDARD SPECIFICATIONS.
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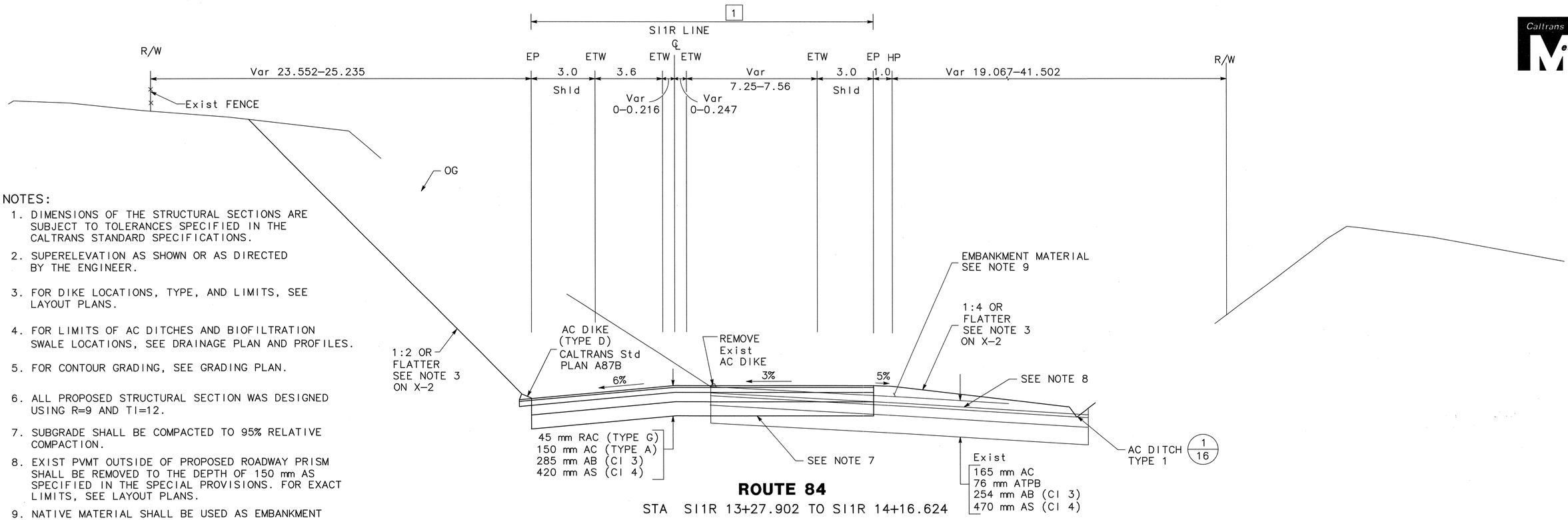
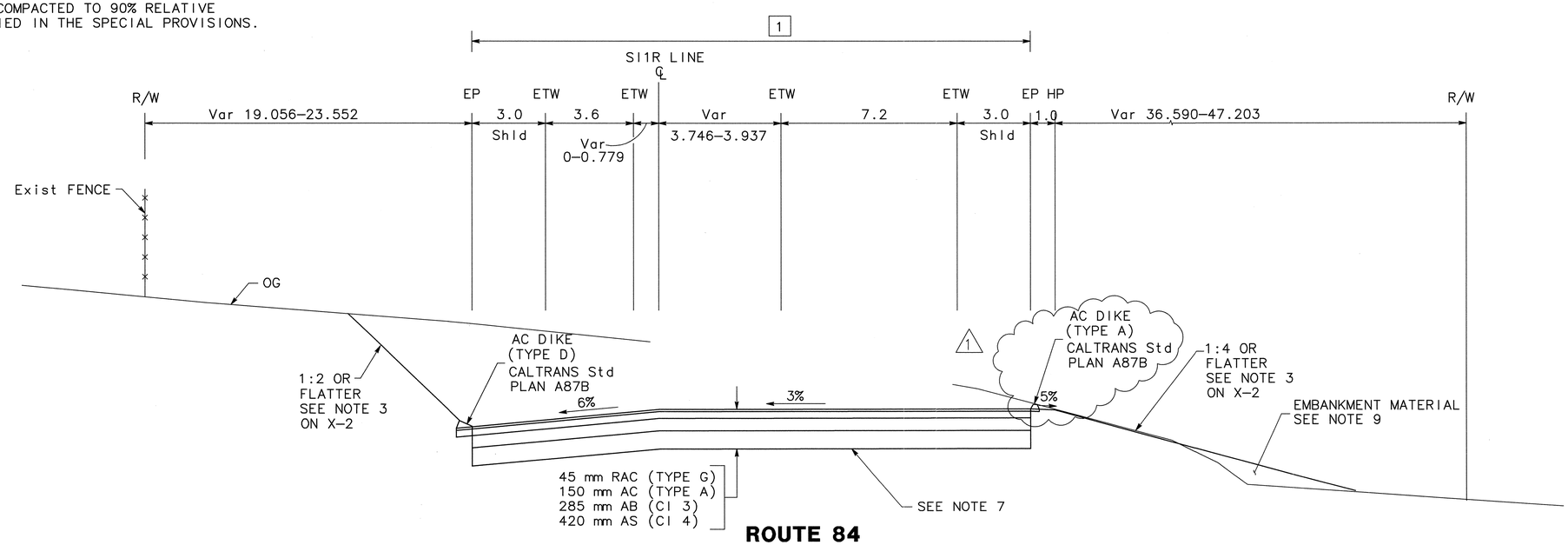


ROUTE 84

STA SI1R 13+27.902 TO SI1R 14+16.624



ROUTE 84

STA SI1R 12+63.909 TO SI1R 13+27.902

FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEETS 2 & 3.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY Mike Sloan
DATE 7-31-07

CALL BEFORE YOU DIG 1-800-227-2600 UNDERGROUND SERVICE ALERT

BKF ENGINEERS | SURVEYORS | PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY
1 ADDENDUM NO. 1	3/16/06	

PROJECT ENGINEER — DATE
CHECKED — DATE

ISABEL AVENUE / VALLECITOS ROAD
INTERSECTION REALIGNMENT PROJECT
TYPICAL CROSS SECTIONS
X-3

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	4	46

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Caltrans Metric

NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE CALTRANS STANDARD SPECIFICATIONS.
2. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR DIKE LOCATIONS, TYPE, AND LIMITS, SEE LAYOUT PLANS.
4. FOR LIMITS OF AC DITCHES, AC SIDE GUTTER AND BIOFILTRATION SWALE LOCATIONS, SEE DRAINAGE PLAN AND PROFILES.
5. FOR CONTOUR GRADING, SEE GRADING PLAN.
6. ALL PROPOSED STRUCTURAL SECTION WAS DESIGNED USING R=9 AND TI=12.
7. SUBGRADE SHALL BE COMPACTED TO 95% RELATIVE COMPACTION.
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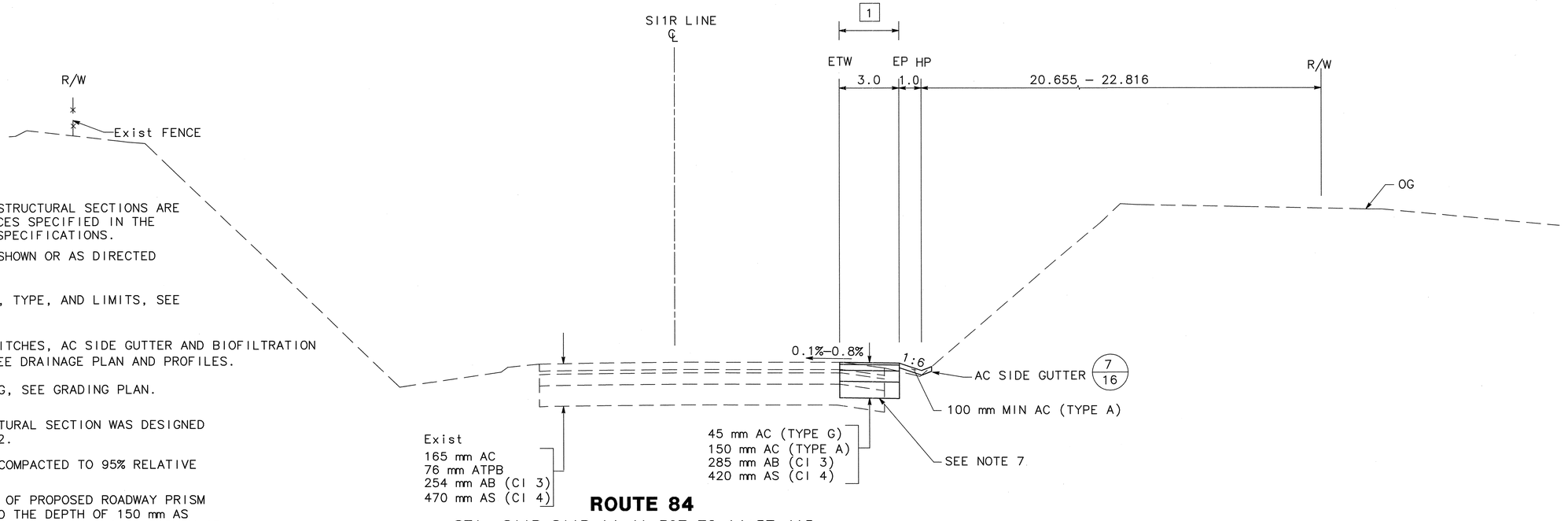
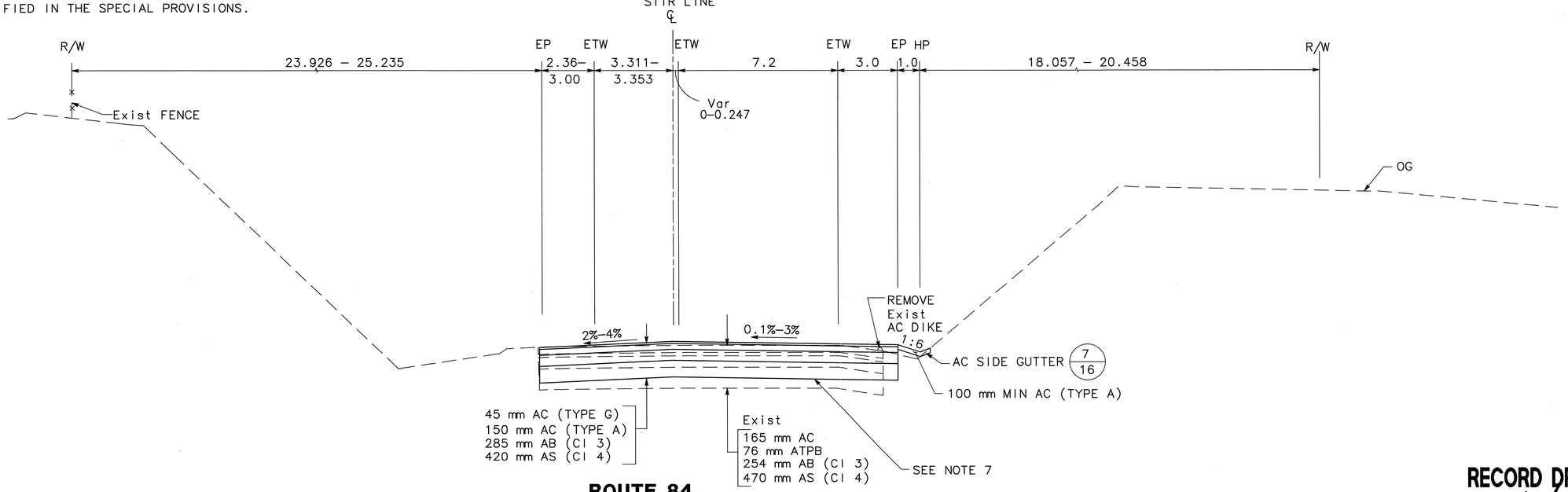
9. NATIVE MATERIAL SHALL BE USED AS EMBANKMENT MATERIAL & SHALL BE COMPACTED TO 90% RELATIVE COMPACTION AS SPECIFIED IN THE SPECIAL PROVISIONS.



ROUTE 84

STA SI1R SI1R 14+41.397 TO 14+57.415



ROUTE 84

STA SI1R 14+16.624 TO SI1R 14+41.397

FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEETS 2 & 3.

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY
DATE 7-31-07

1-800-227-2600 CALL BEFORE YOU DIG USA UNDERGROUND SERVICE ALERT

R. V. BERNARD
No 45407
Exp 9/30/08
CIVIL
STATE OF CALIFORNIA
PROFESSIONAL ENGINEER

BkF
ENGINEERS / SURVEYORS / PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY

PROJECT ENGINEER _____ DATE _____

CHECKED _____ DATE _____

ISABEL AVENUE / VALLECITOS ROAD INTERSECTION REALIGNMENT PROJECT
TYPICAL CROSS SECTIONS
X-4

CITY OF LIVERMORE, CALIFORNIA
INCORPORATED 1876
COUNTY OF ALAMEDA

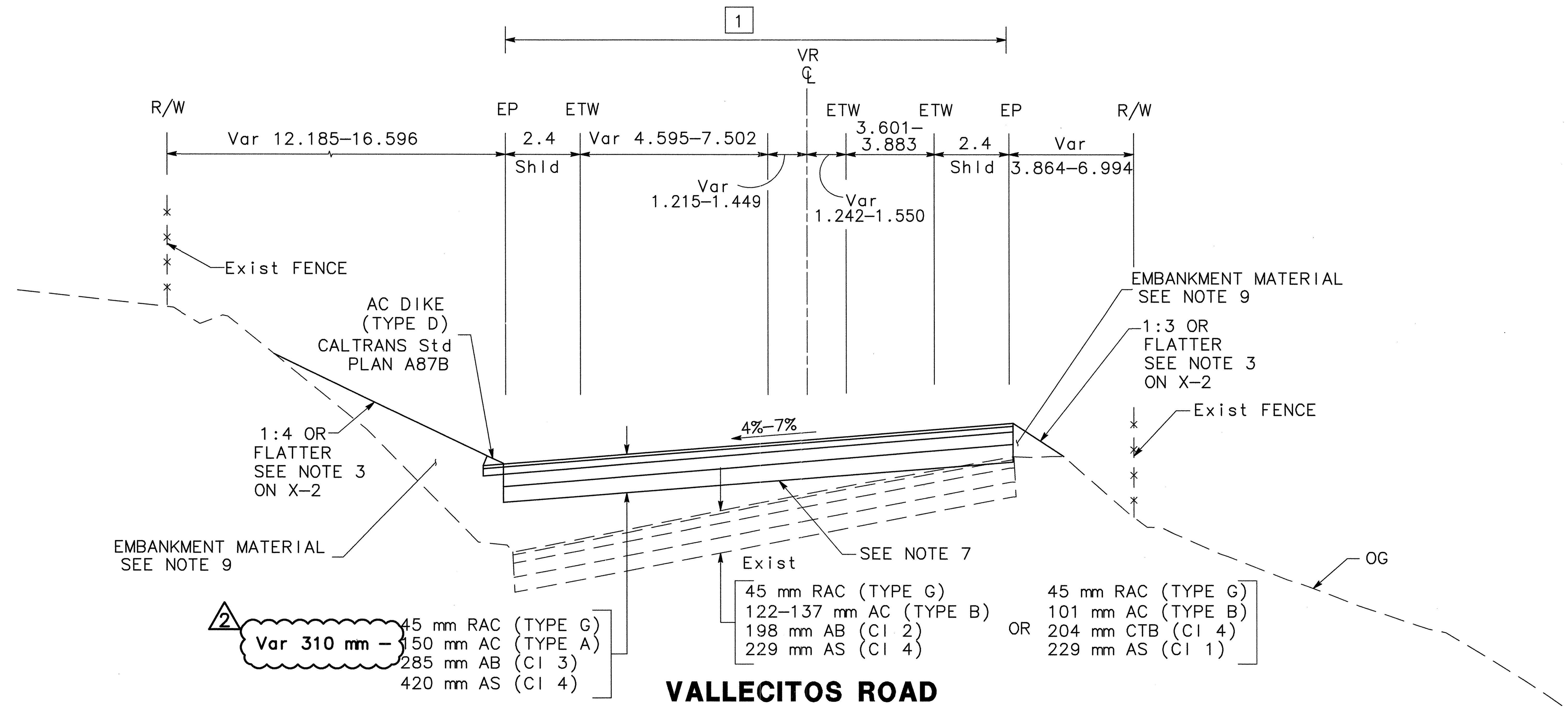
CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	5	46

P:\Engd4\jw704\VD-BUILTS - 0703\SHEETS\TYPICAL\x-4.dwg 23 Jul 2007 8:47:40pm clem

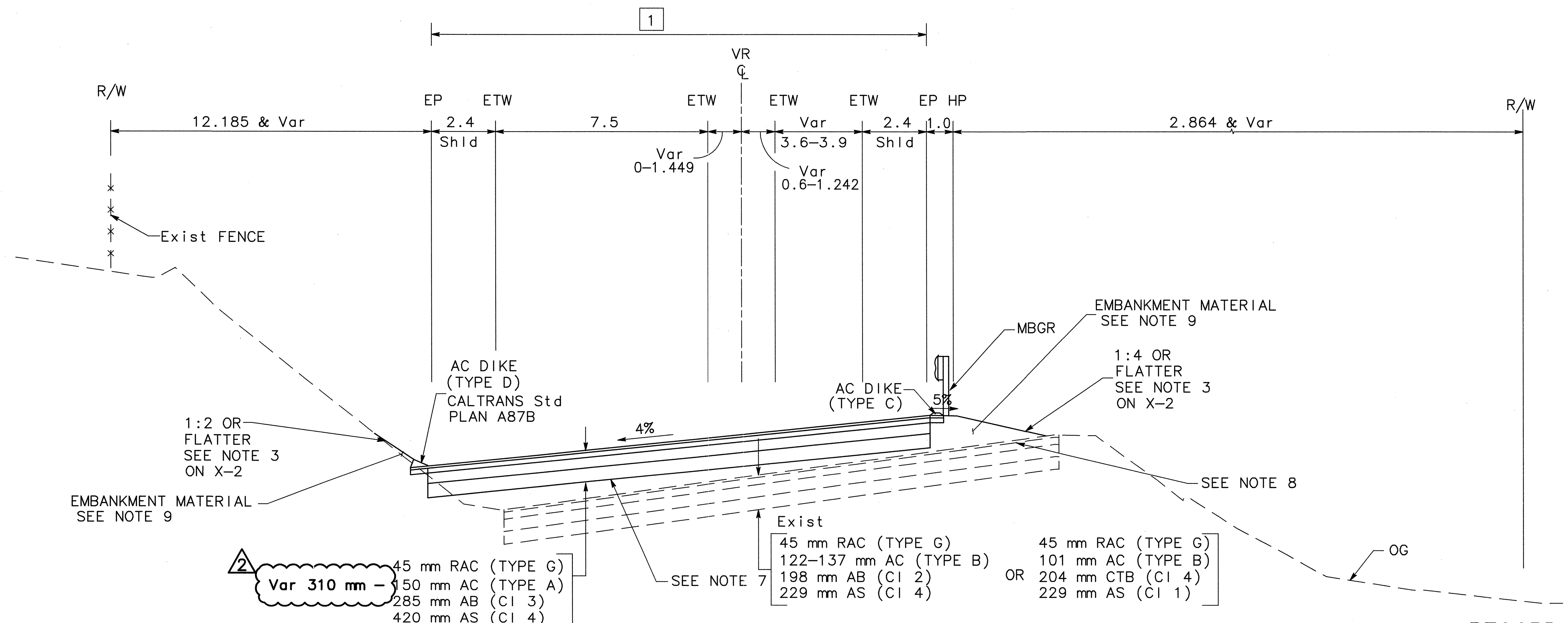
NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE CALTRANS STANDARD SPECIFICATIONS.
2. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR DIKE LOCATIONS, TYPE, AND LIMITS, SEE LAYOUT PLANS.
4. FOR LIMITS OF AC DITCHES AND BIOFILTRATION SWALE LOCATIONS, SEE DRAINAGE PLAN AND PROFILES.
5. FOR CONTOUR GRADING, SEE GRADING PLAN.
6. ALL PROPOSED STRUCTURAL SECTION WAS DESIGNED USING R=9 AND TI=12.
7. SUBGRADE SHALL BE COMPACTED TO 95% RELATIVE COMPACTION.
8. EXIST PVMT OUTSIDE OF PROPOSED ROADWAY PRISM SHALL BE REMOVED TO THE DEPTH OF 150 mm AS SPECIFIED IN THE SPECIAL PROVISIONS. FOR EXACT LIMITS, SEE LAYOUT PLANS.
9. NATIVE MATERIAL SHALL BE USED AS EMBANKMENT MATERIAL & SHALL BE COMPACTED TO 90% RELATIVE COMPACTION AS SPECIFIED IN THE SPECIAL PROVISIONS.



VALLECITOS ROAD

STA VR 13+89.146 TO VR 14+28.845



VALLECITOS ROAD

STA VR 13+08.856 TO VR 13+89.146

FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEETS 2 & 3.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY
DATE 7-31-07

BKF ENGINEERS / SURVEYORS / PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY
2 AS-BUILT CHANGES	7/23/07	DN

PROJECT ENGINEER ____ DATE

CHECKED ____ DATE

ISABEL AVENUE / VALLECITOS ROAD INTERSECTION REALIGNMENT PROJECT

TYPICAL CROSS SECTIONS

X-5

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	6	46

NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE CALTRANS STANDARD SPECIFICATIONS.
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3. FOR DIKE LOCATIONS, TYPE, AND LIMITS, SEE LAYOUT PLANS.
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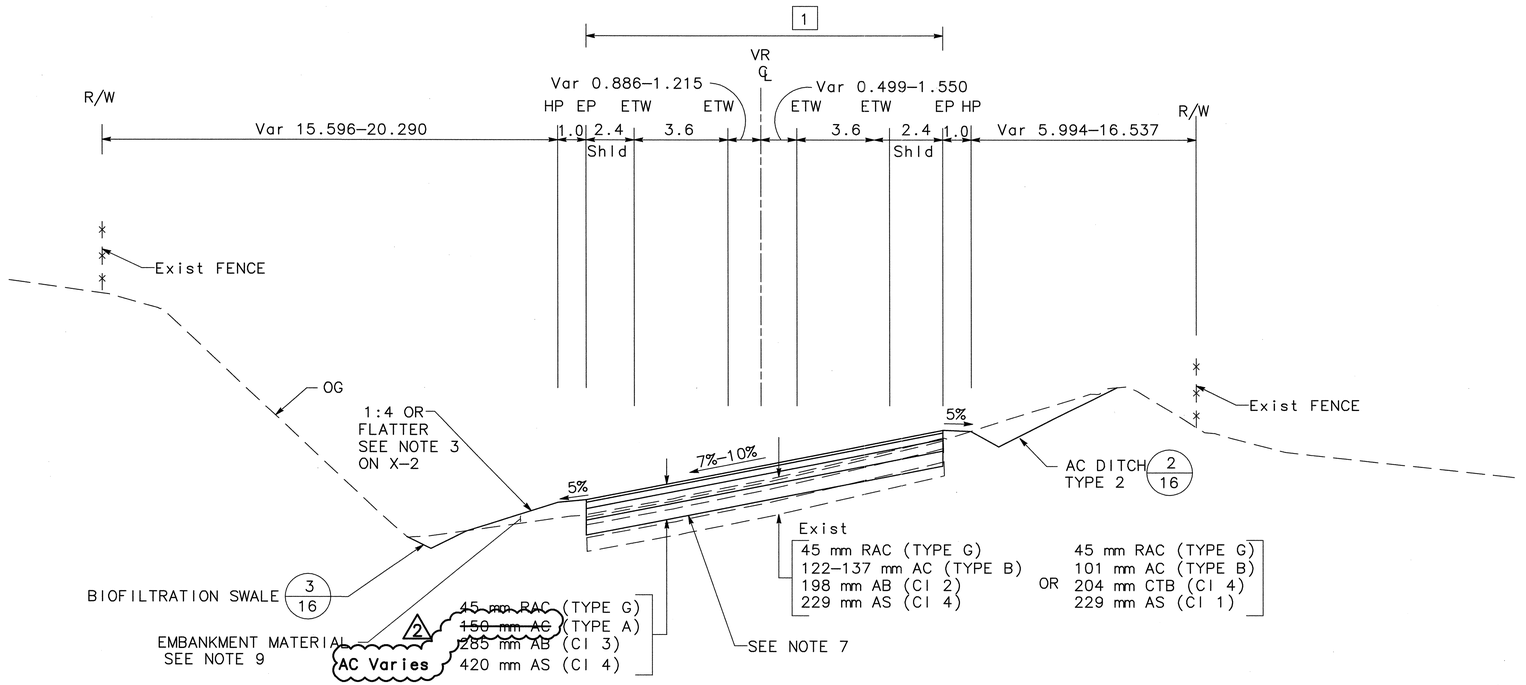


VALLECITOS ROAD

STA VR 14+28.845 TO VR 14+60.000

FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEETS 2 & 3.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY
DATE 7-31-07

1-800-227-2600 CALL BEFORE YOU DIG UNDERGROUND SERVICE ALERT

REGISTERED PROFESSIONAL ENGINEER — STEVEN V. BERNARDINI — No. 46407 — Exp. 9/30/08 — CIVIL — STATE OF CALIFORNIA

BkF ENGINEERS / SURVEYORS / PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY
2 AS-BUILT CHANGES	7/23/07	DN

PROJECT ENGINEER _____ DATE
CHECKED _____ DATE

ISABEL AVENUE / VALLECITOS ROAD
INTERSECTION REALIGNMENT PROJECT
TYPICAL CROSS SECTIONS
X–6

CITY OF LIVERMORE, CALIFORNIA — INCORPORATED 1876 — COUNTY OF ALAMEDA

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	7	46

P:\Engdata\04704RA\S-BUILTS - 07230\SHEETS\TYPICAL\X-6.dwg 23 Jul 2007 5:47:03pm clem

CURVE DATA						
No.	RADIUS	LENGTH	TANGENT	DELTA	NORTHING	EASTING
1	365.726	379.329	208.720	59°25'37"	626572.5711	1885461.3292
2	300.000	284.136	153.736	54°15'57"	627127.5193	1885093.2718
3	75.000	73.127	39.765	55°51'55"	627092.0398	1885436.3786
4	205.721	109.319	55.983	30°26'48"	627192.2646	1885352.4568
5	310.200	83.142	41.821	15°21'24"	627126.6933	1885097.1496
6	15.000	21.845	13.374	83°26'26"	627002.3285	1885397.6300
7	86.300	54.434	28.157	36°08'23"	627096.4796	1885436.8543
8	82.400	31.982	16.195	22°14'19"	627092.8199	1885438.2019
9	65.100	60.953	32.917	53°38'44"	627092.6123	1885434.3721
10	15.000	23.112	14.556	88°16'49"	627047.7759	1885408.9165
11	293.400	238.690	126.394	46°36'43"	627129.5499	1885093.5910

CURVE DATA						
No.	RADIUS	LENGTH	TANGENT	DELTA	NORTHING	EASTING
12	100.000	10.280	5.145	5°53'24"	626987.0733	1885224.3733
13	306.600	71.525	35.926	13°21'59"	627126.6933	1885097.1496
14	137.672	12.135	6.072	5°03'02"	626934.8005	1885561.6663
15	196.000	45.553	22.880	13°18'59"	627176.6367	1885361.5228
16	100.000	10.085	5.047	5°46'42"	626966.8560	1885228.0526
17	306.600	31.795	15.912	5°56'30"	627126.6933	1885097.1496
18	922.269	272.033	137.011	16°54'00"	627221.4540	1884483.4113

Caltrans Metric

7.851 Lt SI1R 11+00.000
BEGIN AC DIKE TRANS
BEGIN REMOVE AC DIKE
CONFORM
7.942 Lt SI1R 11+00.770
ANGLE PNT
7.935 Lt SI1R 11+02.935
END AC DIKE TRANS
BEGIN AC DIKE (TYPE D)
8.346 Lt SI1R 11+20.036
ANGLE PNT
SI1R 11+22.145 EC
N 55°06'16" E
15.596
8.986 Lt SI1R 11+40.260
ANGLE PNT
SI1R 11+37.741 BC
8.280 Lt SI1R 11+68.917
BC
7.876 Lt SI1R 11+79.469
PCC
REMOVE AC DIKE
REMOVE MBGR
AC DIKE (TYPE D)
9.943 Rt SI1R 11+91.076
BEGIN 36 m BAY TAPER
13.774 Rt SI1R 12+29.786
END 36 m BAY TAPER
NEW MBGR
REMOVE RAIL
SI1R LINE
7.966 Rt SI1R 11+00.000
BEGIN REMOVE AC DIKE
CONFORM
7.969 Rt SI1R 11+00.397
ANGLE PNT
8.051 Rt SI1R 11+20.309
ANGLE PNT
9.281 Rt SI1R 11+53.527
BC
9.706 Rt SI19 11+63.290
PCC
15.870 Rt SI1R 11+97.030
END REMOVE AC DIKE
18.167 Rt SI1R 12+00.184
BEGIN REMOVE MBGR
~~BEGIN MBGR (TYPE 11IE LAYOUT)~~
~~TERMINAL SYSTEM~~
~~TYPE (SRT)~~
~~CALTRANS Std PLAN A77E3~~
12+81.098
20.916 Rt SI1R 12+15.727
END REMOVE MBGR
~~END MBGR (TYPE 11IE LAYOUT)~~
CONNECT TO EX MBGR
10.247 Rt SI1R 12+43.157
REMOVE AC DIKE
49.447 Rt SI1R 12+81.098
BEGIN REMOVE AC DIKE
VR 13+40.000
BEGIN MBGR
(TYPE 11E LAYOUT)
TERMINAL SYSTEM
(TYPE SRT)
CALTRANS Std PLAN A77E2
VR 13+75.616
END MBGR (TYPE 11E LAYOUT)
TERMINAL SYSTEM (TYPE SRT)
CALTRANS Std PLAN A77E2
SI1R 13+27.902 POC=
VR 12+92.306 POT
13.972 Rt SI1R 12+70.000
BEGIN AC DIKE (TYPE A) D
14.100 Rt SI1R 13+09.229
PRC
AC DIKE (TYPE A) D
27.758 Rt SI1R 13+22.846 EC
END AC DIKE (TYPE A) D
BEGIN AC DIKE TRANS
8.897 Rt VR 13+22.707
END AC DIKE TRANS
BEGIN AC DIKE (TYPE C)
31.990 Rt SI1R 13+23.102
REMOVE AC DIKE
28.900 Rt VR 13+31.594
BC
AC DIKE (TYPE C)
7.322 Rt VR 13+81.466
PCC
7.350 Rt VR 13+82.550
END AC DIKE (TYPE C)
VR 14+05.482 PCC
7.964 Rt VR 14+10.789
PCC
8.651 Rt VR 14+35.239
END REMOVE AC DIKE
6.710 Rt VR 14+54.741
EC
6.311 Lt SI1R 14+23.912
EC
END OF AC DIKE (TYPE D)
END REMOVE AC DIKE
6.311 Lt SI1R 14+34.784
ANGLE PNT
4.779 Rt SI1R 14+33.021
REMOVE & RESET
BRASS DISK MONUMENT
SI1R 14+21.877 EC
REMOVE AC DIKE
5.506 Lt SI1R 14+41.397
CONFORM
SI2 20+36.360 BC
CONFORM LIMIT
15+06.876
S 00°50'19" W 84.999
ISABEL AVENUE
SI1R 15+06.876 POT=
SI2 20+36.360 BC
20+36.360
11.099 Rt SI2 20+36.360 BC
8.793 Rt SI1R 14+57.415
CONFORM
9.158 Rt SI1R 14+35.042
BEGIN REMOVE AC DIKE
10.406 Rt SI1R 14+35.213
ANGLE PNT
10.489 Rt SI1R 14+33.354
ANGLE PNT
10.490 Rt SI1R 14+21.134
EC
REMOVE AC DIKE
10.562 Rt SI1R 13+52.037 PRC
BEGIN AC DIKE (TYPE A) D
9.900 Lt VR 13+18.091 EC
END AC DIKE (TYPE A) D
BEGIN AC DIKE TRANS
9.900 Lt VR 13+21.091
END AC DIKE TRANS
BEGIN AC DIKE (TYPE D)
9.900 Lt VR 13+30.268
BC
VR 13+32.354 BC
AC DIKE (TYPE D)
11.568 Lt VR 14+01.114
BC
10.854 Lt VR 14+14.376
EC
10.430 Lt VR 14+17.382
END REMOVE AC DIKE
8.631 Lt VR 14+26.963
BEGIN 36 m BAY TAPER
6.987 Lt VR 14+40.312
END AC DIKE (TYPE D)
6.616 Lt VR 14+58.526
EC 36 m BAY TAPER
6.580 Lt VR 14+60.000
CONFORM
CITY R/W
CONFORM LIMIT
6.579 Rt VR 14+60.000
CONFORM
VR 15+14.801 EC
ROUTE 84
E RUBY HILL ROAD
VALLECITOS ROAD
STATE R/W
CITY R/W
VR LINE
CONFORM LIMIT
REMOVE BASE AND SURFACING TO DEPTH INDICATED IN THE SPECIAL PROVISIONS. BACKFILL WITH EMBANKMENT MATERIAL
STRUCTURAL SECTION TYPE
CURVE DATA
CONFORM LINE
REMOVE TREE
ENVIRONMENTAL SENSITIVE AREA
TEMPORARY FENCE (TYPE ESA)
ESA
TFESA
DENSE TREES
GROUND COVER
VINEYARD
ASPH
FENCE
GAS
GW
OHW
SHADOWS
ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY Mike Stern
DATE 7-31-07

FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEET 2.

1-800-227-2600 CALL BEFORE YOU DIG UNDERGROUND SERVICE ALERT

REGISTERED PROFESSIONAL ENGINEER
M. C. BERNARD
No. 45407
Exp. 9/30/08
CIVIL
STATE OF CALIFORNIA

BKF ENGINEERS / SURVEYORS / PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

REVISIONS	DATE	BY
1 ADDENDUM NO. 1	3/16/06	
2 AS-BUILT CHANGES	7/23/07	DN

PROJECT ENGINEER _____ DATE
CHECKED _____ DATE

ISABEL AVENUE / VALLECITOS ROAD INTERSECTION REALIGNMENT PROJECT
LAYOUT
L-1

CITY OF LIVERMORE, CALIFORNIA, INCORPORATED 1876, COUNTY OF ALAMEDA

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: 1:500	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	8	46

P:\Eng64\04704\AS-BUILTS - 072307\SHEETS\LAYOUT\L-1.dwg 23 Jul 2007 6:13:28pm clem

IMPROVEMENT PLAN
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA

BENCHMARK

THE MOST EASTERLY OF THE TWO BRASS PINS LOCATED ON THE SOUTHEAST ABUTMENT OF THE CONCRETE BRIDGE ON VALLECITOS ROAD ACROSS ARROYO CREEK.

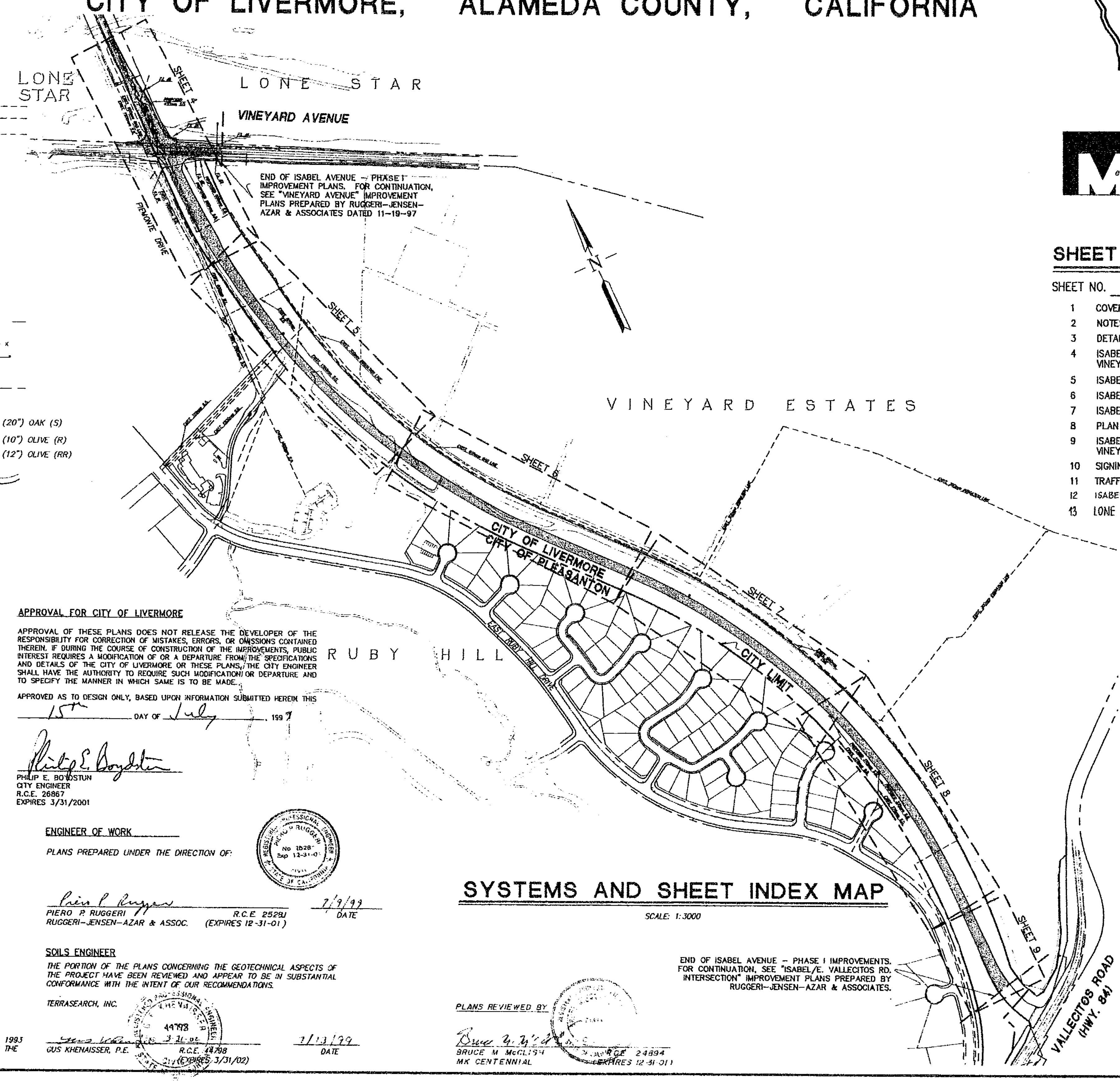
ELEVATION = 456.680 FEET (N.G.V.D. 1929)
ELEVATION = 139.196 meters (N.G.V.D. 1929)

LEGEND

PROPOSED	DESCRIPTION	EXISTING
△	CALTRANS "TYPE A" SURVEY MONUMENT	
	TRACT BOUNDARY	
	R/W LINE	
	LOT LINE	
	CENTER LINE	
	LIMITS OF GRADING	
	RETAINING WALL	
	EASEMENT LINE	
	STORM DRAIN	
SS	SANITARY SEWER	SS
W	IRRIGATION WATER	W
VC	VELOCITY CONTROL DIKE	
	STORM WATER INLET (S.W.I.)	
	MANHOLE (MH)	
	610mm x 610mm FIELD INLET	
	FIRE HYDRANT	
	BLOW OFF (BO)	
	SANITARY SEWER CLEAN OUT (S.S.C.O.)	
	WATER METER	
	WATER VALVE	
	TRAFFIC SIGN	
	MONUMENT (RAILROAD SPIKE) (TO BE SET PER TRACT 6875)	
	IRRIGATION SERVICE	
	STREET LIGHT	
	POWER POLE	
	FENCE	
	BARRICADE	
	CORP JURISDICTIONAL BOUNDARY	
	EDGE DRAIN PIPE	
R/W	RIGHT OF WAY	
F/C	FACE OF CURB	
	SAVE TREE	505mm (20") OAK (S)
	REMOVE TREE	255mm (10") OLIVE (R)
	REMOVE/REPLACE OR RELOCATE TREE	305mm (12") OLIVE (RR)
	EXISTING GROUND CONTOUR ELEVATION	130
130	FINISH GRADE CONTOUR ELEVATION	
C.L.	CENTER LINE	
C.S.	CURB STATION	
E.C.	END OF CURVE	
B.C.	BEGINNING OF CURVE	
B.V.C.	BEGIN VERTICAL CURVE	
E.V.C.	END VERTICAL CURVE	
P.R.C.	POINT OF REVERSE CURVE	
F.G.	FINISH GRADE	
H.P.	HIGH POINT	
T.C.	TOP OF CURB	
L.P.	LOW POINT	
F.I.	FIELD INLET	
F.L.	FLOW LINE	
V.C.	VERTICAL CURVE	
P.C.V.C.	POINT OF COMPOUND VERTICAL CURVE	
P.R.V.C.	POINT OF REVERSE VERTICAL CURVE	
P.C.C.	POINT OF COMPOUND CURVE	
P.V.I.	POINT OF VERTICAL INTERSECTION	
RET.	CURB RETURN	
INV.	INVERT ELEVATION	
G.B.	GRADE BREAK	
P.S.E.	PUBLIC SERVICE EASEMENT	
S.W.I.	STORM WATER INLET	
A.C.	ASPHALTIC CONCRETE	
A.B.	AGGREGATE BASE	
C.P.	CENTER POINT	
GR.	GRATE	
P.L.	PROPERTY LINE	
T.W.	TOP OF WALL	
B.W.	BOTTOM OF WALL	
	1.8m EARTH DITCH	
C.M.P.	CORRUGATED METAL PIPE	
R.C.P.	REINFORCED CONCRETE PIPE	
D.I.P.	DUCTILE IRON PIPE	
S.O.	SIDE OPENING	
	A.C. PAVEMENT	

BASIS OF BEARINGS

THE GRID BEARING N50°11'38"W AS SHOWN ON R/S 981, FILED FEBRUARY 10, 1993 IN BOOK 16 R/S PAGES 52-64, ALAMEDA COUNTY RECORDS, WAS TAKEN AS THE BASIS OF BEARINGS FOR THIS MAP.



SYSTEMS AND SHEET INDEX MAP

SCALE: 1:3000

APPROVAL FOR CITY OF LIVERMORE

APPROVAL OF THESE PLANS DOES NOT RELEASE THE DEVELOPER OF THE RESPONSIBILITY FOR CORRECTION OF MISTAKES, ERRORS, OR OMISSIONS CONTAINED THEREIN. IF DURING THE COURSE OF CONSTRUCTION OF THE IMPROVEMENTS, PUBLIC INTEREST REQUIRES A MODIFICATION OF OR A DEPARTURE FROM THE SPECIFICATIONS AND DETAILS OF THE CITY OF LIVERMORE OR THESE PLANS, THE CITY ENGINEER SHALL HAVE THE AUTHORITY TO REQUIRE SUCH MODIFICATION OR DEPARTURE AND TO SPECIFY THE MANNER IN WHICH SAME IS TO BE MADE.

APPROVED AS TO DESIGN ONLY, BASED UPON INFORMATION SUBMITTED HEREIN THIS 15th DAY OF July, 1999

PHILIP E. BOYDSTUN
CITY ENGINEER
R.C.E. 26867
EXPIRES 3/31/2001

ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI — R.C.E. 25291 — 7/9/99 DATE
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

SOILS ENGINEER

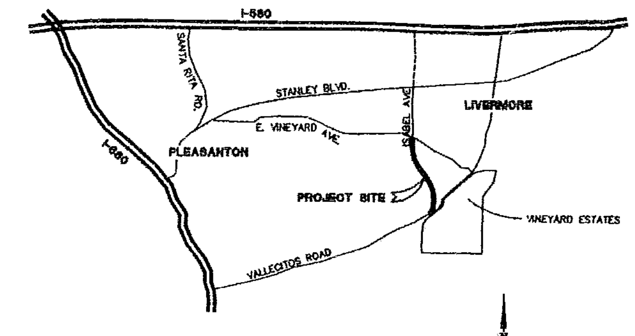
THE PORTION OF THE PLANS CONCERNING THE GEOTECHNICAL ASPECTS OF THE PROJECT HAVE BEEN REVIEWED AND APPEAR TO BE IN SUBSTANTIAL CONFORMANCE WITH THE INTENT OF OUR RECOMMENDATIONS.

TERRASEARCH, INC.

GUS KHENAISSER, P.E. — R.C.E. 44798 (EXPIRES 3/31/02) — 7/13/99 DATE

PLANS REVIEWED BY

BRUCE M. McCLISH — R.C.E. 24894
MK CENTENNIAL — EXPIRES 12-31-01



VICINITY MAP
N.T.S.

METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

SHEET INDEX

SHEET NO.	DESCRIPTION
1	COVER SHEET & SITE INDEX MAP
2	NOTES
3	DETAILS
4	ISABEL AVENUE PLAN & PROFILE STA. 2+41.183 TO STA. 6+00.00 VINEYARD AVENUE PLAN STA. 59+82.418 TO STA. 61+03.788
5	ISABEL AVENUE PLAN & PROFILE STA. 6+00.00 TO STA. 9+80.00
6	ISABEL AVENUE PLAN & PROFILE STA. 9+80.00 TO STA. 13+40.00
7	ISABEL AVENUE PLAN & PROFILE STA. 13+40.00 TO STA. 17+00.00
8	PLAN & PROFILE STA. 17+00.00 TO STA. 20+60.00
9	ISABEL AVENUE PLAN & PROFILE STA. 20+60.00 TO STA. 21+80.00 VINEYARD AVENUE PROFILE STA. 60+16.456 TO STA. 61+03.788
10	SIGNING & STRIPING PLAN/SIGNAL INTERCONNECT PLAN
11	TRAFFIC CONTROL PLAN
12	ISABEL/VINEYARD TRAFFIC CONTROL PLANS
13	LONE STAR STORM DRAIN LINE

REV. NO.	SHEET NO.	DATE	APPVD. BY CITY
1	3, 4, 8	8/4/99	DMS
2	3-9		

GENERAL APPROVAL NOTE FOR CITY OF PLEASANTON:

APPROVAL OF THESE PLANS IS FOR WORK WITHIN THE CITY OF PLEASANTON STREET RIGHT OF WAY AND PUBLIC UTILITY SYSTEMS WITHIN PUBLIC SERVICE EASEMENTS UNLESS OTHERWISE NOTED AS FOLLOWS:

APPROVAL OF THESE PLANS DOES NOT RELEASE THE DEVELOPER OF THE RESPONSIBILITY FOR THE CORRECTION OF MISTAKES, ERRORS, OR OMISSIONS CONTAINED THEREIN. IF DURING THE COURSE OF CONSTRUCTION OF THE IMPROVEMENTS PUBLIC INTEREST REQUIRES A MODIFICATION OR A DEPARTURE FROM THE SPECIFICATIONS AND DETAILS OF THE CITY OF PLEASANTON OR THESE PLANS THE CITY ENGINEER SHALL HAVE THE AUTHORITY TO REQUIRE SUCH MODIFICATION OR DEPARTURE AND TO SPECIFY THE MANNER IN WHICH SAME IS TO BE MADE.

APPROVED AS TO DESIGN ONLY BASED UPON INFORMATION SUBMITTED HEREON THIS 13 DAY OF MAY 1999

ROGER D. HIGDON
CITY ENGINEER
CITY OF PLEASANTON
PLEASANTON, CALIFORNIA

Ruggeri-Jensen-Azar & Associates
4601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

IMPROVEMENT PLAN
COVER SHEET & SITE INDEX MAP
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

SCALE AS SHOWN · DATE 5-10-99 · DRAWN R.T.C./R.V. · CHECKED · PROJ. MGR. J.M.A.

SHEET NO. 1 OF 11 SHEETS
JOB NO. 971038

123306

STANDARD GENERAL NOTES

1. THE CONTRACTOR AGREES THAT, IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, THE CONTRACTOR WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS. THE CONTRACTOR FURTHER AGREES TO DEFEND, INDEMNIFY AND HOLD OWNER AND ENGINEER HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXEMPTING LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF ENGINEER.

2. EXCAVATIONS SHALL BE ADEQUATELY SHORED, BRACED AND SHEETED SO THAT THE EARTH WILL NOT SLIDE OR SETTLE AND SO THAT ALL EXISTING IMPROVEMENTS OF ANY KIND WILL BE FULLY PROTECTED FROM DAMAGE. ANY DAMAGE RESULTING FROM A LACK OF ADEQUATE SHORING, BRACING AND SHEETING, SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND HE SHALL EFFECT NECESSARY REPAIRS OR RECONSTRUCTION AT HIS OWN EXPENSE. WHERE THE EXCAVATION FOR A CONDUIT TRENCH, AND /OR STRUCTURE IS FIVE FEET OR MORE IN DEPTH, THE CONTRACTOR SHALL PROVIDE ADEQUATE SHEETING, SHORING AND BRACING OR EQUIVALENT METHOD, FOR THE PROTECTION OF LIFE, OR LIMB, WHICH SHALL CONFORM TO THE APPLICABLE CONSTRUCTION SAFETY ORDERS OF THE DIVISION OF INDUSTRIAL SAFETY OF THE STATE OF CALIFORNIA. THE CONTRACTOR SHALL ALWAYS COMPLY WITH OSHA REQUIREMENTS.

3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO OBTAIN PERMITS NECESSARY TO PERFORM THE WORK SHOWN IN THESE PLANS FROM THE APPROPRIATE AGENCIES.

4. THE CONTRACTOR SHALL TAKE EFFECTIVE ACTION TO PREVENT THE FORMATION OF AN AIRBORNE DUST NUISANCE AND SHALL BE RESPONSIBLE FOR ANY DAMAGE RESULTING FROM HIS FAILURE TO DO SO.

5. THE CONTRACTOR SHALL PROVIDE ALL INGRESS AND EGRESS FOR PRIVATE PROPERTY ADJACENT TO WORK THROUGHOUT THE PERIOD OF CONSTRUCTION.

6. THE CONTRACTOR SHALL PROVIDE ALL LIGHTS, SIGNS BARRICADES, FLAGGERS OR OTHER DEVICES NECESSARY TO PROVIDE FOR SAFETY.

7. THE CONTRACTOR SHALL POST EMERGENCY TELEPHONE NUMBERS FOR POLICE, FIRE, AMBULANCE, AND THOSE AGENCIES RESPONSIBLE FOR MAINTENANCE OF UTILITIES IN THE VICINITY OF THE JOB SITE.

8. ANY EXTRA CONSTRUCTION STAKING NECESSITATED SOLELY BY THE CONTRACTOR'S NEGLIGENCE WILL BE CHARGED TO THE CONTRACTOR ON A TIME AND EXPENSE BASIS, AND PAID FOR BY THE CONTRACTOR.

9. STATIONING, HERE ON IS ALONG STREET CENTERLINE UNLESS OTHERWISE SHOWN OR INDICATED.

10. ALL QUANTITIES AND PAY ITEMS ARE AND WILL BE BASED ON HORIZONTAL MEASUREMENTS.

11. LENGTHS OF STORM DRAINS ARE HORIZONTAL DISTANCES FROM CENTER TO CENTER OF STRUCTURES, ROUNDED OFF TO THE NEAREST FOOT.

12. EXISTING UNDERGROUND UTILITIES AND IMPROVEMENTS ARE SHOWN IN THEIR APPROXIMATE LOCATIONS BASED UPON RECORD INFORMATION AVAILABLE TO THE ENGINEER AT THE TIME OF PREPARATION OF THESE PLANS. LOCATIONS MAY NOT HAVE BEEN VERIFIED IN THE FIELD AND NO GUARANTEE IS MADE AS TO THE ACCURACY OR COMPLETENESS OF THE INFORMATION SHOWN. THE CONTRACTOR SHALL NOTIFY UTILITY COMPANIES AT LEAST 2 WORKING DAYS IN ADVANCE OF CONSTRUCTION TO FIELD LOCATE UTILITIES. CALL UNDERGROUND SERVICE ALERT (U.S.A.), AT 800-642-2444. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE THE EXISTENCE AND LOCATION OF THOSE UTILITIES SHOWN ON THESE PLANS, INDICATED IN THE FIELD BY LOCATING SERVICES, OR EVIDENCED BY FACILITIES VISIBLE AT OR ADJACENT TO THE JOB SITE. ANY ADDITIONAL COSTS INCURRED AS A RESULT OF CONTRACTOR'S FAILURE TO VERIFY LOCATIONS OF EXISTING UTILITIES PRIOR TO BEGINNING CONSTRUCTION IN THEIR VICINITY SHALL BE BORNE BY THE CONTRACTOR AND ASSUMED INCLUDED AND MERGED IN THE CONTRACT UNIT PRICE.

13. ALL EXISTING UTILITIES AND IMPROVEMENTS THAT BECOME DAMAGED DURING CONSTRUCTION SHALL BE COMPLETELY RESTORED TO THE SATISFACTION OF THE LOCAL AGENCY ENGINEER AND THE OWNER THEREOF, AT THE CONTRACTOR'S SOLE EXPENSE.

14. THE CONSTURCTION OF ALL GRAVITY UNDERGROUND LINES (SANITARY SEWERS AND STORM DRAINS) SHALL BEGIN AT THE MOST DOWNSTREAM END, UNLESS OTHERWISE SPECIFICALLY APPROVED BY RUGGERRI-JENSEN-AZAR & ASSOCIATES.

15. ANY RELOCATION OF PUBLIC UTILITIES SHALL BE CONDUCTED IN ACCORDANCE WITH ANY AND ALL REQUIREMENTS OF THE UTILITY COMPANY, INCLUDING FEES, BONDS, PERMITS AND WORKING CONDITIONS, ETC. THIS WORK SHALL BE DONE AT NO EXPENSE TO THE UTILITY COMPANY. THE OWNER SHALL PAY THE COST OF ALL SUCH RELOCATION WORK INCLUDING FEES, BONDS, PERMITS, ETC.

16. IF ARCHEOLOGICAL MATERIALS ARE UNCOVERED DURING GRADING, TRENCHING OR OTHER EXCAVATION, EARTHWORK WITHIN 100 FEET OF THESE MATERIALS SHALL BE STOPPED UNTIL A PROFESSIONAL ARCHAEOLOGIST WHO IS CERTIFIED BY THE SOCIETY OF CALIFORNIA ARCHAEOLOGY (SCA) AND/OR THE SOCIETY OF PROFESSIONAL ARCHAEOLOGY (SOPA) HAS HAD AN OPPORTUNITY TO EVALUATE THE SIGNIFICANCE OF THE FIND AND SUGGEST APPROPRIATE MITIGATION MEASURES, IF THEY ARE DEEMED NECESSARY.

17. RUGGERI-JENSEN-AZAR & ASSOCIATES DOES NOT SPECIFY NOR RECOMMEND THE USE OR INSTALLATION OF ANY MATERIAL OR EQUIPMENT WHICH IS MADE FROM, OR WHICH CONTAINS ASBESTOS FOR USE IN THE CONSTRUCTION OF THESE IMPROVEMENTS. ANY PARTY INSTALLING OR USING SUCH MATERIALS OR EQUIPMENT SHALL BE SOLELY RESPONSIBLE FOR ALL INJURIES, DAMAGES, OR LIABILITIES, OF ANY KIND, CAUSED BY THE USE OF SUCH MATERIALS OR EQUIPMENT. THE PROVISIONS OF THIS NOTE SHALL APPLY UNLESS THEY ARE EXPRESSLY WAIVED IN WRITING BY RUGGERI-JENSEN-AZAR & ASSOCIATES.

18. THE CONTRACTOR SHALL COMPLY WITH AND FOLLOW ALL NPDES REQUIREMENTS IN EFFECT AT THE TIME OF CONSTRUCTION.

19. SHOULD IT APPEAR THAT THE WORK TO BE DONE OR ANY MATTER RELATIVE THERETO IS NOT SUFFICIENTLY DETAILED OR EXPLAINED ON THESE PLANS, THE CONTRACTOR SHALL CONTACT RUGGERI-JENSEN-AZAR & ASSOC. AT (510) 227-9100 FOR SUCH FURTHER EXPLANATIONS AS MAY BE NECESSARY.

CITY OF LIVERMORE – GENERAL NOTES

a. ALL CONSTRUCTION SHALL CONFORM TO CITY OF LIVERMORE STANDARD PLANS AND SPECIFICATIONS DATED DECEMBER 15, 1997.

b. BENCHMARK: CITY OF LIVERMORE MONUMENT B.M. "ISA-ALDEN" AT THE INTERSECTION OF ISABEL AVENUE AND ALDEN LANE. FOUND ELEV. 127.455 (ELEV. 127.519 CITY DATUM)
PLAN ELEV. = CITY DATUM -0.064

c. FINISH GRADE PROFILE REPRESENTS CENTERLINE OF PAVEMENT OR AS NOTED.

d. ALL LOT FILL SHALL BE DONE IN CONFORMANCE TO THE SOILS ENGINEER'S RECOMMENDATIONS.

e. ANY EXISTING WELLS ENCOUNTERED SHALL BE ABANDONED AND SEALED PER ALAMEDA COUNTY ZONE 7 REQUIREMENTS.

f. THE CONTRACTOR IS RESPONSIBLE TO NOTIFY ALL UTILITIES 48 HOURS PRIOR TO ANY EXCAVATION SO THAT THEIR LINES CAN BE MARKED. THOSE TO BE NOTIFIED INCLUDE, BUT MAY NOT BE LIMITED TO:

UNDERGROUND SERVICE ALERT (800) 642-2444

PG&E, PACIFIC BELL, TCI CABLEVISION, CALIFORNIA WATER SERVICE COMPANY, ZONE 7 AND THE CITY OF LIVERMORE.

g. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO IMMEDIATELY NOTIFY THE CITY INSPECTOR AND THE DESIGN ENGINEER UPON DISCOVERY OF ANY FIELD CONFLICTS.

h. ANY DEVIATIONS OR CHANGES IN THESE PLANS WITHOUT OFFICIAL APPROVAL OF THE DESIGN ENGINEER SHALL ABSOLVE THE DESIGN ENGINEER OF ANY AND ALL RESPONSIBILITY OF SAID DEVIATION OR CHANGE.

i. THE CONTRACTOR SHALL NOTIFY THE CITY ENGINEER 24 HOURS PRIOR TO REQUIRED INSPECTION (373-5240). THE CONTRACTOR SHALL SUBMIT CUT SHEETS FOR SANITARY SEWERS, STORM DRAINS AND CURB AND GUTTER 24 HOURS PRIOR TO CONSTRUCTION.

j. THE SURVEYOR SHALL BE NOTIFIED 48 HOURS IN ADVANCE OF WHEN FIELD STAKING IS TO BE REQUIRED.

k. CONTRACTOR SHALL KEEP EXISTING STREETS FREE FROM DIRT AND DEBRIS DURING ALL PHASES OF CONSTRUCTION.

l. THE DEVELOPER/CONTRACTOR WILL BE REQUIRED TO PAY AN ADDITIONAL FEE FOR INSPECTION OF ANY WORK PERFORMED OUTSIDE OF THE CITY'S NORMAL WORKING HOURS. SAID FEE WILL BE IN ACCORDANCE WITH THE LATEST PUBLIC WORKS OVERTIME AND OVERTIME INSPECTION FEE POLICY.

m. COMPACTION TESTS WILL BE PERFORMED ON ALL TRENCHES AND STREET WORK TO VERIFY THAT COMPACTION CONFORMS TO CITY STANDARDS. THE INITIAL TEST AND ONE RE-TEST WILL BE PERFORMED BY THE CITY (24 HOUR NOTICE REQUIRED). ALL ADDITIONAL TESTING WILL BE AT THE DEVELOPER'S/CONTRACTOR'S EXPENSE.

n. ALL WORK ADJACENT TO EXISTING PAVEMENT SECTION SHALL BUTT UP TO FULL EXISTING SECTION. WHERE FULL SECTION IS NOT ENCOUNTERED, CONTINUE REMOVAL OF ADDITIONAL PAVEMENT UNTIL A FULL SECTION IS FOUND. SEE CITY STANDARD DETAIL ST-25.

o. WHERE UNSTABLE OR UNSUITABLE MATERIALS ARE ENCOUNTERED DURING SUBGRADE PREPARATION, THE AREA IN QUESTION SHALL BE OVER EXCAVATED AND REPLACED BY SELECT BACKFILL MATERIAL AS DIRECTED IN THE FIELD BY THE CITY ENGINEER.

p. WHERE ABANDONED UNDERGROUND STRUCTURES ARE ENCOUNTERED IN THE STREET AREAS, REMOVE TO SUFFICIENT DEPTH TO ALLOW UNDERGROUND LINES TO CROSS, BACKFILL AND COMPACT DURING ROUGH GRADING. ANY ABANDONED UNDERGROUND PIPELINES 600mm OR LARGER IN DIAMETER ARE TO BE REMOVED COMPLETELY. THE CITY INSPECTOR MAY REQUIRE FURTHER WORK TO BE DONE BY VISUAL INSPECTION DURING THE COURSE OF CONSTRUCTION.

q. ALL MANHOLES, VALVES AND MONUMENT FRAMES SHALL BE SET TO FINISH GRADE AFTER PAVING.

r. MONUMENTS SHALL BE INSTALLED AT LOCATIONS SHOWN ON THE FINAL MAP IN ACCORDANCE WITH CITY STANDARD DETAIL ST-13.

s. STREET NAME SIGNS AND STOP SIGNS SHALL BE INSTALLED AT LOCATIONS SHOWN ON THE STREET SIGN LEGEND ON THIS SHEET IN ACCORDANCE WITH CITY STANDARD DETAILS ST-17, ST-18, AND ST-19.

t. STOP LEGENDS TO BE INSTALLED AT EACH STOP SIGN LOCATION.

u. TRAFFIC WARNING, REGULATORY, AND GUIDE SIGNS SHALL BE INSTALLED AT LOCATIONS SHOWN ON PLANS IN ACCORDANCE WITH CITY STANDARD DETAIL ST-19.

v. MAIL BOXES SHALL BE INSTALLED AT EACH LOT PER CITY STANDARD DETAIL ST-24.

w. ALL PIPE GRADES SHOWN AS FLOW LINE ELEVATIONS.

x. ALL TRENCH EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH CITY STANDARD DETAIL S-1.

y. ALL TRENCHES OVER 1.5 meters IN DEPTH SHALL BE SHORED IN ACCORDANCE WITH CAL-OSHA "CONSTRUCTION SAFETY ORDERS" CURRENT EDITION. CONTRACTOR MUST HAVE VALID TRENCH SHORING PERMIT ISSUED BY CAL-OSHA.

z. LOT COMPACTION TESTS RESULTS AND CERTIFICATION OF PAD ELEVATION SHALL BE SUBMITTED TO BUILDING DEPT.

aa. IN ORDER TO EXPEDITE THE WORK IN CONJUNCTION WITH SUBDIVISION DEVELOPMENT AND TO AVOID IRREPARABLE DAMAGE TO, OR DTERIORATION OF QUALITY OF, ANY PORTION OF THE PUBLIC WORKS IMPROVEMENTS, IT SHALL BE THE DUTY AND RESPONSIBILITY OF THE DEVELOPER/CONTRACTOR TO SCHEDULE THE MAJOR ITEMS IN THE FOLLOWING ORDER:
 (i) STREET EXCAVATION AND ROUGH GRADING.
 (ii) STORM AND SANITARY SEWERS.
 (iii) UNDERGROUND GAS, ELECTRIC, TELEPHONE, TV, WATER FACILITIES AND THEIR SERVICES.
 (iv) CURB, GUTTER, AND SIDEWALK
 (v) STREET SUB-BASE (IF REQUIRED)
 (vi) BASE ROCK.
 (vii) PAVING.

bb. ALL FIELD INLETS SHALL BE CALTRANS 900mm DIAMETER G.C.P (UNLESS OTHERWISE NOTED).

ff. CONTRACTOR SHALL PROVIDE DUST CONTROL AT ALL TIMES. PRIOR TO OBTAINING WATER FROM FIRE HYDRANTS, CONTRACTOR MUST OBTAIN WATER METER FROM WATER COMPANY.

gg. TRAFFIC CONTROL
 (i) PRIOR TO BEGINNING ANY WORK ON EXISTING STREETS, ADVANCE WARNING SIGNS (C18 AND C13) SHALL BE INSTALLED.
 (ii) TWO-WAY TRAFFIC (3.66 meters MINIMUM LANES) SHALL BE MAINTAINED AT ALL TIMES UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
 (iii) TRAFFIC CONTROL SHALL BE PROVIDED IN ACCORDANCE WITH CALTRANS "MANUAL OF TRAFFIC CONTROLS FOR CONSTRUCTION AND MAINTENANCE WORK ZONES" CURRENT EDITION. FAILURE TO COMPLY MAY RESULT IN IMMEDIATE STOPPAGE OF WORK UNTIL THE PROPER TRAFFIC CONTROL IS IN ORDER.
 (iv) THE CONTRACTOR SHALL SUBMIT A CONSTRUCTION STAGING AND TRAFFIC HANDLING PLAN TO THE CITY FOR APPROVAL AT LEAST 5 DAYS BEFORE BEGINNING WORK. THE PLAN MUST BE APPROVED BY THE CITY BEFORE WORK ON ISABEL AVENUE OR VINEYARD AVENUE CAN BEGIN.

jj. PERMITS SHALL BE OBTAINED WHENEVER THE WORK COMES UNDER THE JURISDICTION OF ANY OF THE FOLLOWING AGENCIES. AFTER PERMIT IS OBTAINED, THE AGENCY MUST BE NOTIFIED PRIOR TO WORK BEING DONE AS REQUIRED IN THE PERMIT:
 (i) CORP OF ENGINEERS
 (ii) DEPARTMENT OF FISH AND GAME
 (iii) ALAMEDA COUNTY ZONE 7
 (iv) U.S. FISH AND WILDLIFE
 (v) REGIONAL WATER QUALITY CONTROL BOARD

GRADING NOTES

1. GRADING SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS AND RECOMMENDATIONS CONTAINED IN THE SOILS REPORT PREPARED BY TERRASEARCH INC. DATED JUNE 9, 1994.

2. THIS GRADING PLAN IS TO BE USED IN CONJUNCTION WITH THE FOLLOWING:
 A. SOILS REPORT – SEE NOTE 1.
 B. IMPROVEMENT PLANS AND SPECIFICATIONS FOR TRACT 6686 PREPARED BY RUGGERI-JENSEN-AZAR & ASSOCIATES.

3. THE EXISTING TOPOGRAPHY SHOWN ON THESE PLANS IS BASED ON AN AERIAL SURVEY PREPARED BY AEROMETRIC CO. CONTOURS SHOWN ON THIS PLAN REPRESENT GROUND ELEVATIONS AS MEASURED AT THE TIME OF SAID SURVEY.

4. THE CONTRACTOR SHALL BE RESPONSIBLE TO CONFIRM THE GROUND ELEVATIONS AND OVERALL TOPOGRAPHY OF THE SITE PRIOR TO START OF CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY RUGGERI-JENSEN-AZAR & ASSOCIATES IN WRITING IMMEDIATELY OF ANY DIFFERENCES IN TOPOGRAPHY FROM THAT SHOWN IN THIS PLAN WHICH MAY REQUIRE CHANGES IN DESIGN AND/OR AFFECT THE EARTHWORK QUANTITY.

5. EARTHWORK QUANTITIES SHOWN ON THIS PLAN ARE APPROXIMATE AND ARE FURNISHED FOR THE CONTRACTOR'S INFORMATION ONLY. THEY HAVE BEEN CALCULATED FROM EXISTING GROUND, BASED ON THE TOPOGRAPHY REFERENCED ABOVE, TO FINISHED GRADE. THE ACTUAL AMOUNT OF EARTH MOVED WILL VARY DEPENDING ON COMPACTION, CONSOLIDATION, STRIPPING AND THE CONTRACTOR'S METHOD OF OPERATION.

6. THE CONTRACTOR SHALL CONFIRM THE EARTHWORK QUANTITIES TO HIS SATISFACTION PRIOR TO THE START OF CONSTRUCTION AND SHALL ARRANGE FOR DISPOSAL OF EXCESS MATERIAL OR ACQUISITION OF IMPORT MATERIAL AS REQUIRED TO COMPLETE THE GRADING AS SHOWN ON THIS PLAN. NO ADDITIONAL COMPENSATION WILL BE MADE FOR ANY EXPORT OR IMPORT REQUIRED.

7. THE CONTRACTOR MAY UNDERCUT THE STREET SUBGRADE DURING ROUGH GRADING IN ORDER THAT THE TRENCH SPOILS MAY BE LEFT IN THE STREET AREA AND COMPACTED DURING FINAL SUBGRADE COMPACTION PRIOR TO PLACEMENT OF BASE ROCK. THE UNDERCUT SHOULD BE ADEQUATE TO ACCEPT ALL TRENCH SPOILS, INCLUDING JOINT TRENCH SPOILS. CONSIDERATION MUST BE GIVEN TO MINIMUM COVER REQUIRED FOR INSTALLATION OF UNDERGROUND UTILITIES WHEN SELECTING AREAS AND DEPTHS OF UNDERCUT.

8. THE CONTRACTOR AND/OR HIS SUBCONTRACTORS SHALL PREVENT THE FORMATION OF AN AIRBORNE DUST NUISANCE AT ALL TIMES. THEY SHALL DO SO BY WATERING AND/ OR TREATING THE SITE OF WORK, AND SHALL MAINTAIN DUST CONTROL EQUIPMENT ON THE SITE AT ALL TIMES DURING CONSTRUCTION AND UNTIL FINAL COMPLETION. THEY SHALL BE RESPONSIBLE FOR ANY DAMAGE DONE BY DUST FROM THEIR CONSTRUCTION ACTIVITIES IN PERFORMING THE WORK UNDER THIS CONTRACT. THE PRICES FOR THE VARIOUS ITEMS OF WORK SHALL INCLUDE PROVIDING ADEQUATE DUST CONTROL, AS REQUIRED BY THE LOCAL AGENCY.

TRUCK ACCESS AND HAUL ROADS

ACCESS TO THE DEVELOPMENT BY CONSTRUCTION EQUIPMENT, MATERIAL DELIVERY AND OTHER HEAVY LOADS SHALL BE LIMITED BY THE DEVELOPER TO THE FOLLOWING ROUTE:

VINEYARD AVENUE – ROUTE 84 – SITE

THE WHEEL-LOADING ON THE ABOVE ROUTE SHALL NOT EXCEED STATE LOAD LIMITS.

EROSION CONTROL NOTES

1. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE EFFECTIVE FOR CONSTRUCTION DURING THE RAINY SEASON (OCTOBER 15 TO APRIL 15).

2. NO STORM RUNOFF WATER SHALL BE ALLOWED TO DRAIN DIRECTLY INTO THE EXISTING UNDERGROUND STORM SYSTEM BEFORE THE ONSITE STORM DRAIN SYSTEM IS INSTALLED.

3. AS SOON AS IS PRACTICAL AFTER THE NEW ONSITE STORM SYSTEM IS INSTALLED, THE CATCH BASINS SHALL BE INSTALLED AND STRAWBALES SHALL BE PLACED AROUND THE CATCH BASINS, PER A.B.A.G. STANDARDS.

4. SHOULD THE PROPOSED ONSITE STORM SYSTEM NOT BE INSTALLED BY OCTOBER 15, TEMPORARY SEDIMENT BASINS SHALL BE CONSTRUCTED AROUND THE OPENINGS OF ANY EXISTING STORM PIPES WHICH DRAIN THE SITE, PER A.B.A.G. STANDARDS.

5. A MINIMUM OF 15m OF DRAIN ROCK, 40mm DIAMETER OR LARGER, AT A MINIMUM DEPTH OF 150mm, SHALL BE INSTALLED AT EACH DRIVEWAY ENTRANCE TO THE SITE. THIS DOES NOT NEED TO BE DONE AT DRIVEWAYS WHICH WILL BE CLOSED BY IMMOVABLE BARRICADES DURING CONSTRUCTION. ANY MUD THAT IS TRACKED ONTO PUBLIC STREETS SHALL BE REMOVED THE SAME DAY AND AS REQUIRED BY THE CITY OF LIVERMORE.

6. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE MAINTAINED UNTIL DISTURBED AREAS ARE STABILIZED. CHANGES TO THE EROSION AND SEDIMENTATION CONTROL PLAN SHALL BE MADE TO MEET FIELD CONDITIONS, BUT ONLY WITH THE APPROVAL OF OR AT THE DIRECTION OF THE CITY ENGINEER.

7. DURING THE RAINY SEASON SPECIFIED IN NOTE 1 ALL PAVED AREAS SHALL BE KEPT CLEAR OF EARTH MATERIALS AND DEBRIS. THE SITE SHALL BE MAINTAINED SO AS TO MINIMIZE SEDIMENT LADEN RUNOFF FROM ENTERING ANY STORM DRAINAGE SYSTEM.

8. THE EROSION AND SEDIMENTATION CONTROL PLAN COVERS ONLY THE FIRST WINTER DURING WHICH CONSTRUCTION IS TO TAKE PLACE. PLANS ARE TO BE RESUBMITTED PRIOR TO SEPTEMBER 1ST OF EACH SUBSEQUENT YEAR UNTIL THE SITE IMPROVEMENTS ARE ACCEPTED BY THE CITY.

9. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO INSPECT AND REPAIR ALL EROSION CONTROL FACILITIES AT THE END OF EACH WORK DAY DURING THE RAINY SEASON.

10. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT TEMPORARY MEASURES SATISFACTORY TO THE CITY ENGINEER.

11. CUT AND FILL SLOPES STEEPER THAN 10% WITH HEIGHTS OF 1 meter OR GREATER SHALL BE HYDROSEEDED. THE HYDROSEED MIX SHALL BE: (VOLUMES SHOWN ARE PER HECTARE OF SLOPE)

FERTILIZER = 227kg 16-6-8

CHEMICAL TACKIFIER = 908kg WOOD CELLULOSE
37kg ORGANIC BINDER

OR PER CITY REQUIREMENTS

SEED: GRASSLAND EROSION CONTROL BLEND "CRITICAL COASTAL MIX"

30% WIMMERA 62 RYEGRASS
20% CALIFORNIA OATS
15% BLANDO BROMEGRASS
15% CRIMSON CLOVER
15% LANA VATCH
5% CALIFORNIA FIELD FLOWERS

SEED: 84 Kilograms/Hectare

12. THIS PLAN MAY NOT COVER ALL SITUATIONS THAT ARISE DURING CONSTRUCTION DUE TO UNANTICIPATED FIELD CONDITIONS. VARIATIONS MAY BE MADE TO THE PLAN IN THE FIELD SUBJECT TO THE APPROVAL OF THE CITY.

13. OWNER SHALL COMPLY WITH ALL URBAN RUNOFF PROGRAM REGULATION AS SET BY THE CITY OF LIVERMORE.

14. PERSON RESPONSIBLE FOR IMPLEMENTATION OF THE EROSION CONTROL MEASURES:

MR. STEVE MILLAR
SIGNATURE PROPERTIES
4670 WILLOW ROAD, SUITE 200
PLEASANTON, CA 94588
(925) 463-1122

PERMIT# 8929
Date Accepted: 6/9/00
[illegible]
☒ No Changes [illegible]
☐ Changes Noted [illegible]

REGISTERED PROFESSIONAL ENGINEER
PIERO P. RUGGERI
No. 25281
Exp. 1[illegible]01
CIVIL
STATE OF CALIFORNIA

ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

7/9/99
DATE

123308

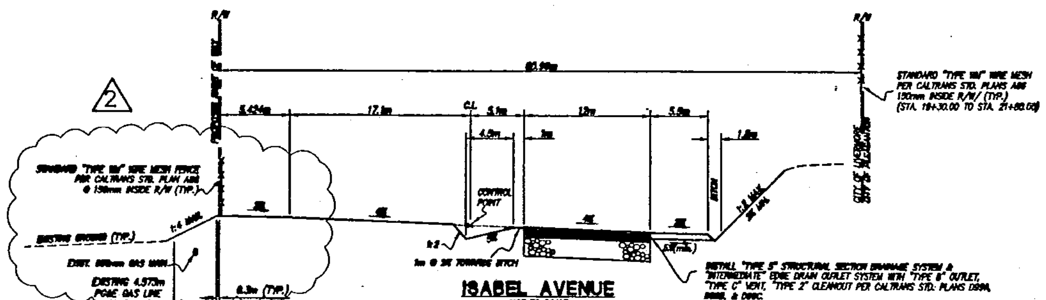
Ruggeri-Jensen-Azar & Associates
6601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

IMPROVEMENT PLAN
NOTES
ISABEL AVENUE – PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

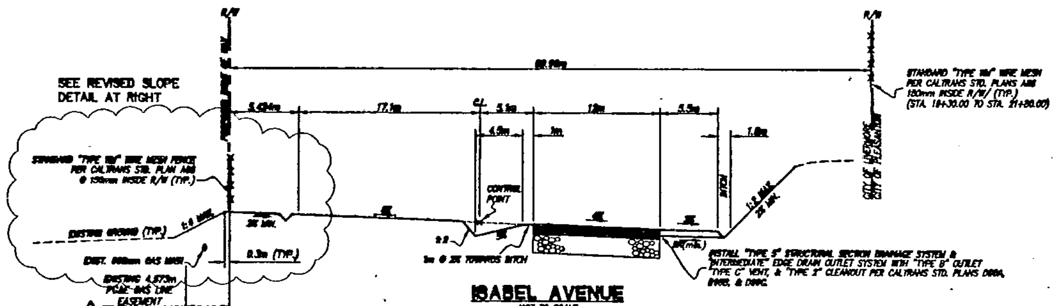
DATE	MK	SHEET REVISIONS	BY	CK

SCALE:
DATE 7-7-99
DRAWN A.F.C./R.V.
CHECKED
PROJ. MGR. J.H.A.

SHEET NO. 2
OF 12 SHEETS
JOB NO. 971038



ISABEL AVENUE
NOT TO SCALE
STA. 16+80.000 TO STA. 19+59.211



ISABEL AVENUE
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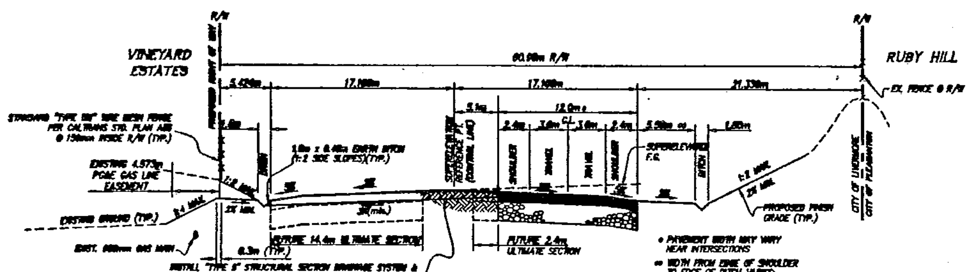
STA. 12+77.540 TO STA. 16+80.000



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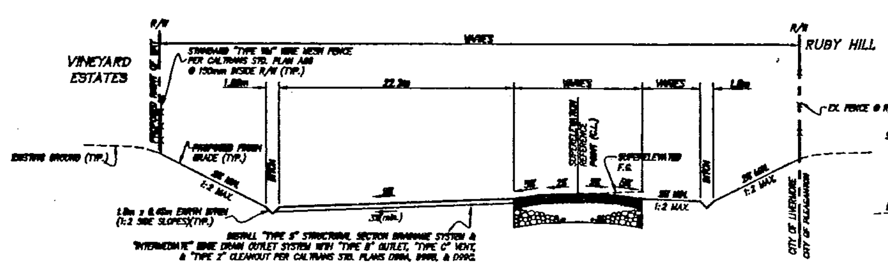
STA. 7+48.802 TO STA. 12+77.540



ISABEL AVENUE
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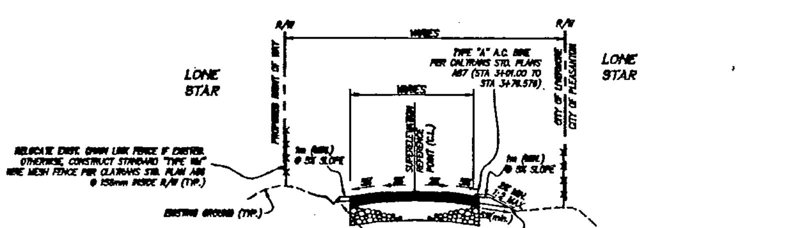
STA. 4+01.000 TO STA. 7+48.802

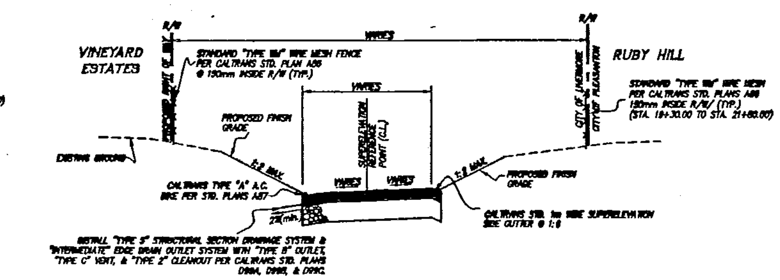


ISABEL AVENUE
NOT TO SCALE
STA. 2+41.183 TO STA. 4+01.000

METRIC DIMENSIONS

DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

NOTE:
ALL SLOPES (i.e. 1:2) ARE REFERENCED AS A RATIO OF VERTICAL TO HORIZONTAL.



ISABEL AVENUE
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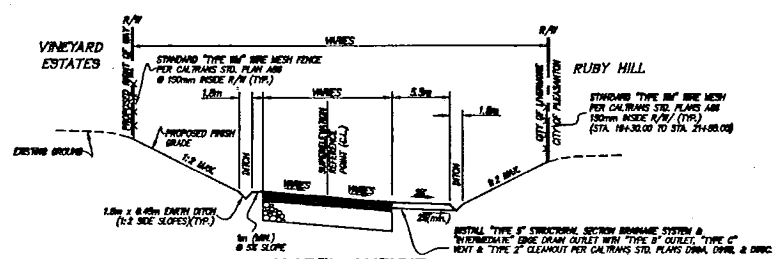
STA. 21+07.775 TO STA. 21+80.00



ISABEL AVENUE
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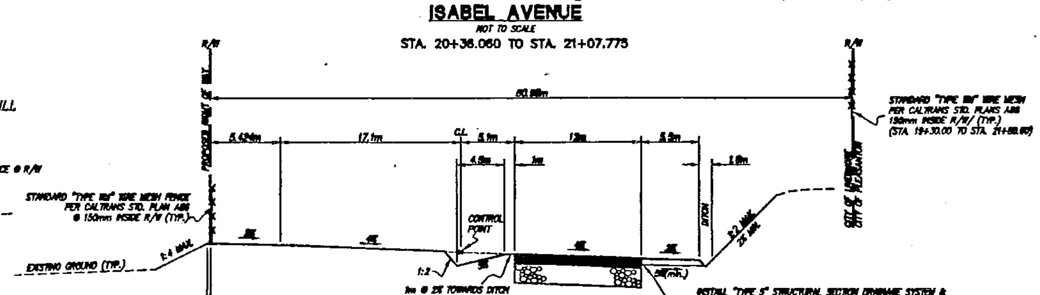
STA. 20+36.060 TO STA. 21+07.775



ISABEL AVENUE
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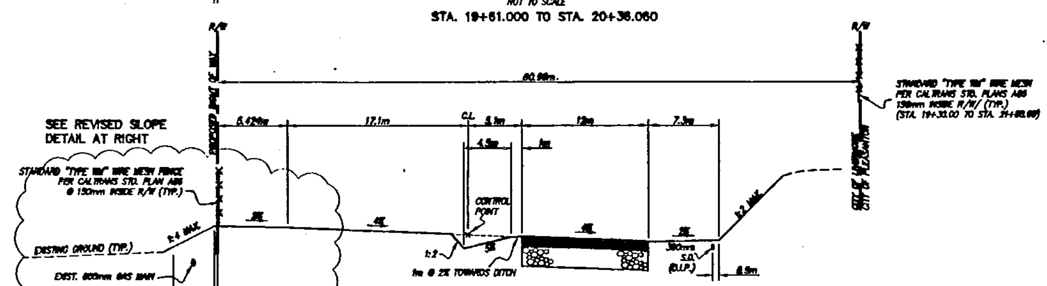
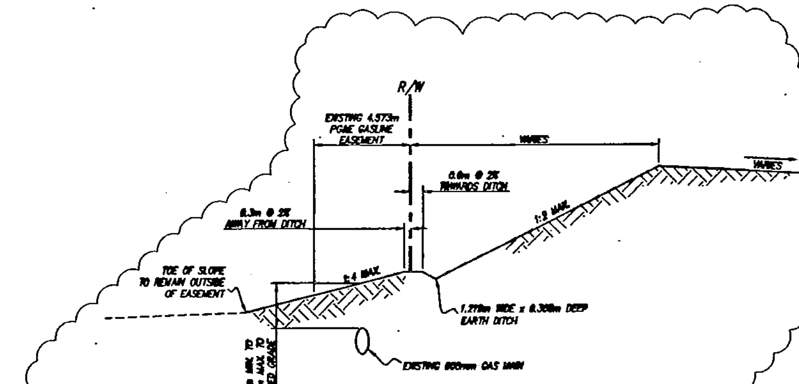


ISABEL AVENUE
NOT TO SCALE
STA. 19+59.211 TO STA. 19+61.000



ISABEL AVENUE
NOT TO SCALE
(LEFT SIDE SLOPE & DITCH DETAIL FROM STA. 13+50.006 TO STA. 19+59.211)

NOTE:
THE PAVEMENT DESIGN SECTIONS ARE BASED ON PRELIMINARY "R" VALUE. FINAL SECTIONS MAY DIFFER IF DIFFERENT SOILS ARE ENCOUNTERED DURING GRADING. FINAL STREET SECTION WILL BE DETERMINED AFTER FINAL "R" VALUE TEST OF SUBGRADE IS COMPLETED.

PRELIMINARY PAVEMENT DESIGN CHART

STREET TYPE	STREET NAME	TRAFFIC INDEX	"R" VALUE*	PAVEMENT SECTION A.C.	A.T.P.B.	A.B. (CL II)	A.S.B. (CL II)
MAJOR	ISABEL AVENUE STA 2+41.183 TO STA 7+50.00	12	40	165mm	76mm	210mm	165mm
MAJOR	ISABEL AVENUE STA 7+50.00 TO STA 13+80.00	12	15	165mm	76mm	254mm	394mm
MAJOR	ISABEL AVENUE STA 13+80.00 TO STA 15+80.00	12	47	165mm	76mm	300mm	–
MAJOR	ISABEL AVENUE STA 15+80.00 TO STA 18+60.00	12	17	165mm	76mm	254mm	381mm
MAJOR	ISABEL AVENUE STA 18+60.00 TO STA 23+50.00	12	9	165mm	76mm	254mm	470mm
MAJOR	VINEYARD AVENUE STA 59+64.00 TO STA 60+40.00	12	40	See Note Below	See Note Below	See Note Below	See Note Below
MAJOR	VINEYARD AVENUE STA 60+40.00 TO STA 60+79.00	12	40	165mm	76mm	210mm	165mm
MAJOR	VINEYARD AVENUE STA 60+79.00 TO STA 61+03.760	8	34	102mm	–	229mm	102mm

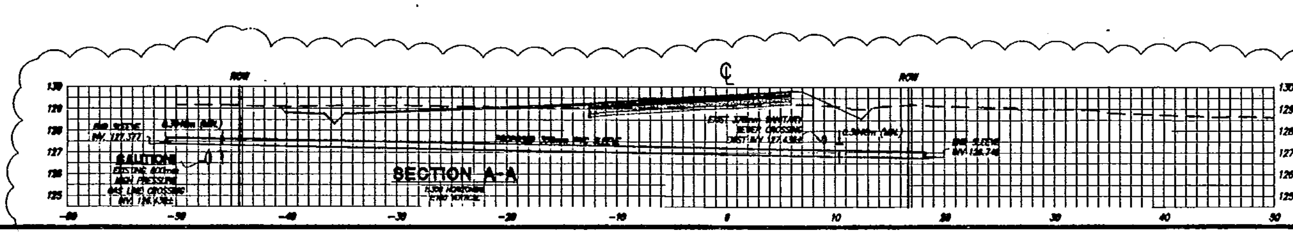
NOTE:
VINEYARD AVENUE FROM STA 59+64.00 TO STA 60+40.00 IS TO HAVE A "FULL-DEPTH AC" SECTION CONSISTING OF 165mm A.C. TYPE "A" OVER 75mm A.T.P.B. OVER 195mm A.C. TYPE "A"

SEE SHEET 3 FOR LOCATION OF PROPOSED FULL DEPTH A.C. SECTION AT ISABEL/VINEYARD INTERSECTION.

ESTIMATED EARTHWORK SUMMARY

ITEM	CUT (m³)	FILL (m³)	NET EXPORT
ROUGH GRADING	71,929	38,087	
SHRINKAGE @ 5%		1,904	
TOTAL	71,929	39,991	31,938

All quantities shown on this plan are approximate, calculated cut and fill are to "rough grade" and existing ground. The actual amount of earth moved is variable dependent on compaction, consolidation, stripping requirements, and the contractor's method of operation.



ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

7/9/99
DATE

Contract Number: PERMIT # 8929
City Project Number:
Date Accepted: 6/9/00
AS-BUILT DRAWING

REGISTERED PROFESSIONAL ENGINEER
PIERO P. RUGGERI
No. 25281
Exp. 12-31-01
CIVIL
STATE OF CALIFORNIA

DATE	MK.	SHEET REVISIONS	BY	CK
7/28/99	1	ADDED WATER SERVICE AND SLEEVE	BV	
9/29/99	2	REVISED MATCH SLOPE	BV	

SCALE AS SHOWN
DATE 7-7-99
DRAWN
CHECKED
PROJ. MGR. J.M.A.

Ruggeri-Jensen-Azar & Associates
8801 OWENS DRIVE, SUITE 150 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

IMPROVEMENT PLAN
DETAILS
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

SHEET NO. 3 OF 12 SHEETS
JOB NO. 971038

123307

METRIC DIMENSIONS

DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

PROFILE SCALES:
1:500 HORIZONTAL
1:50 VERTICAL

LOCATION AND ELEVATIONS OF ALL EXISTING UTILITIES ARE UNKNOWN. CONTRACTOR TO POTHOLE AND VERIFY LOCATIONS PRIOR TO STARTING CONSTRUCTION. CONTRACTOR SHALL CONTACT CIVIL ENGINEER IF THERE ARE CONFLICTS WITH THE DESIGN.

BEFORE EXCAVATING
CALL U.S.A.
UNDERGROUND SERVICE ALERT
800-642-2444 TOLL FREE
48 HOURS BEFORE ALL
PLANNED WORK OPERATIONS

Curve Table

No.	Type	Radius	Delta	Length
C1	EPI	1066.31m	01°59'24"	34.818m
C2	EPI	1000.00m	01°49'21"	31.826m
C3	EPI	842.34m	03°09'18"	92.973m
C4	EPI	48.81m	07°43'51"	6.582m
C5	EPI	808.43m	03°08'40"	44.011m
C6	EPI	48.00m	07°27'44"	6.368m
C7	EPI	12.00m	62°39'26"	14.708m
C8	EPI	13.00m	106°53'59"	24.255m
C9	EPI	12.00m	61°01'56"	12.904m
C10	EPI	14.00m	107°26'49"	26.496m
C11	EPI	54.95m	15°17'21"	14.137m
C12	EPI	48.72m	15°17'21"	13.162
C13	EPI	1084.80m	05°11'58"	98.816m
C14	EPI	1016.00m	05°11'58"	92.630m
C15	EPI	58.00m	09°47'12"	13.913m
C16	CL	1079.400m	15°17'21"	288.186m
C17	CL	1083.200m	15°17'21"	289.361m
C18	FC	22.000m	15°17'21"	5.874m
C19	FC	21.700m	30°19'59"	12.276m
C20	FC	0.600m	139°17'40"	1.457m
C21	FC	0.600m	139°17'40"	1.457m
C22	FC	0.600m	117°19'38"	1.229m
C23	FC	0.600m	117°19'38"	1.229m
C24	FC	0.600m	114°58'30"	1.419m
C25	FC	0.600m	123°59'13"	1.298m

LEGEND:
- PROPOSED FULL-DEPTH A.C. SECTION (440mm A.C. TYPE "A")
- PROPOSED FULL-DEPTH A.C. SECTION (165mm A.C. TYPE "A", 75mm A.T.P.B., 200mm A.C. TYPE "A")

NOTE: AXLE LOADS OVER THE GAS LINE ARE NOT TO EXCEED 22,000 POUNDS. CONTRACTOR TO MAINTAIN AT LEAST 560mm OF COVER OVER THE GAS PIPELINE.

INSTALL TYPE 5 STRUCTURAL SECTION DRAINAGE SYSTEM, INTERMEDIATE TYPE EDGE DRAIN OUTLET W/ TYPE B OUTLET, TYPE F VENT PER CALTRANS STD. PLANS D99A, D99B, & D99C AT THE FOLLOWING (ADDITIONAL) STATIONS:
1. STA. 60+42.000 2. STA. 3+78.378

PROPOSED SIGNAL SLEEVE
SEE TRAFFIC SIGNAL PLANS PREPARED BY T.J.K.W.

CAUTION
Exist. 800mm HIGH PRESSURE GAS LINE CROSSING

CAUTION
(IN WATER)
EXISTING 800mm GAS LINE (STEEL)

MATCH LINE STA. 6+00.00 SEE SHEET 5

MATCH LINE STA. 6+00.00 SEE SHEET 5

LONE STAR

RUBY HILL

PIEMONTE DRIVE

VINEYARD

ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

REGISTERED PROFESSIONAL ENGINEER PIERO P. RUGGERI No. 25281 Exp. 12-31-01 CIVIL STATE OF CALIFORNIA

7/1/99
DATE

123308

Ruggeri - Jensen - Azar & Associates
4901 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

IMPROVEMENT PLAN
STA. 2+41.183 TO STA. 6+00.00

ISABEL AVENUE - PHASE I

CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

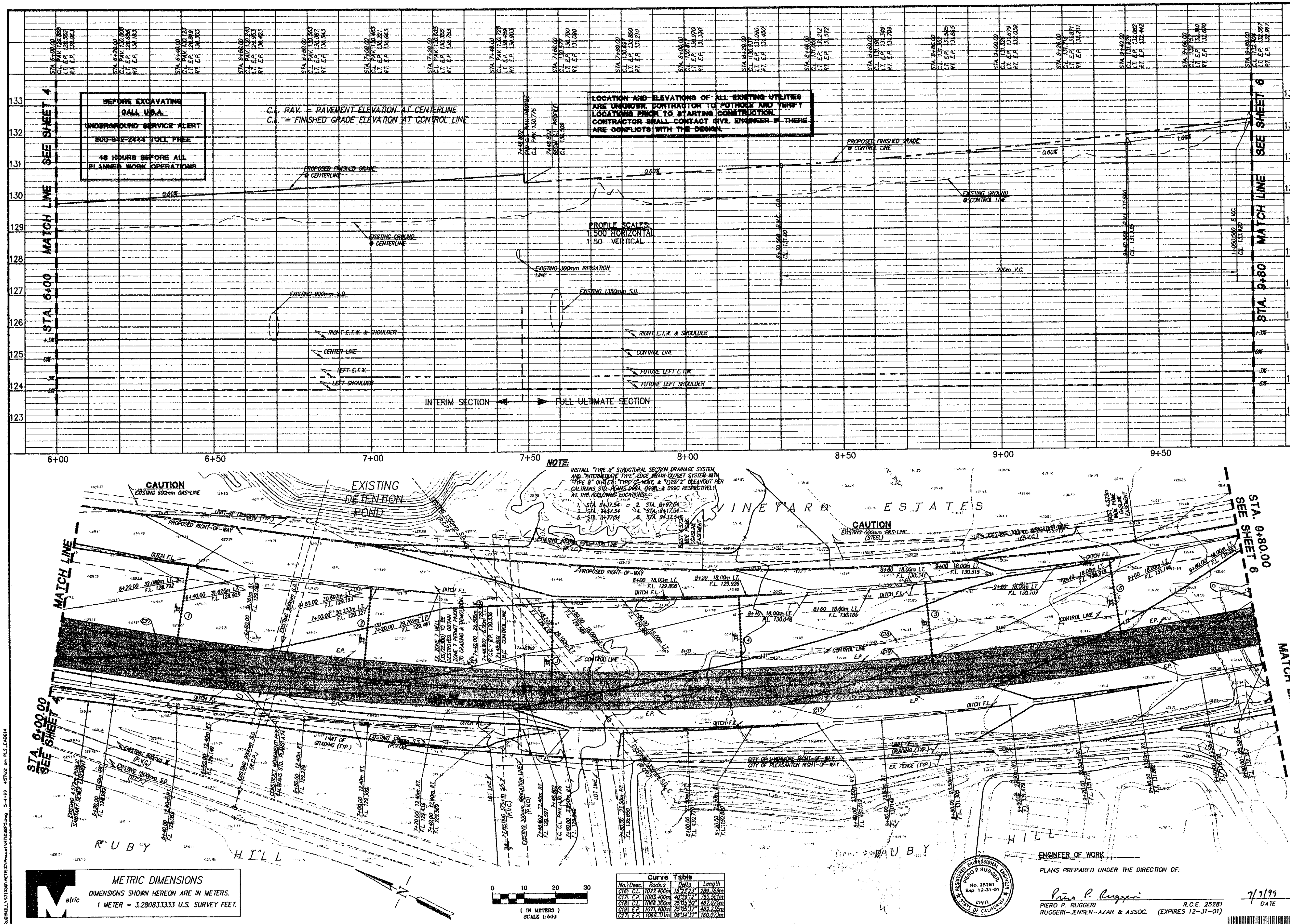
DATE	MK	SHEET REVISIONS
7/26/99	1	ADDED WATER SERVICE & SLEEVE
9/29/99	2	REVISED PAVEMENT SECTION & STORM DRAIN LINE ADDED EARTH SWALE
		REVISED CURB RETURNS PROFILE

SCALE: AS SHOWN
DATE: 7-1-99
DRAWN: R.P.C./R.V.
CHECKED:
PROJ. MGR.: LMK
BY: CK
BY:

SHEET NO. 4 OF 12 SHEETS

JOB NO. 971038

F:\RUBYHILL\971038\CNSTRCT\Phase1\971038P4.dwg 9-29-99 3:44:2 pm PLS_CADD2



Curve Table				
No.	Desc.	Radius	Delta	Length
C16	C.L.	1077.400m	15°23'23"	289.389m
C17	E.P.	1083.400m	40°29'12"	765.561m
C18	C.L.	1066.300m	25°05'30"	467.070m
C19	E.P.	1071.400m	25°05'37"	469.235m
C27	E.P.	1069.311m	08°34'37"	160.073m

ENGINEER OF WORK
PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

7/7/99
DATE

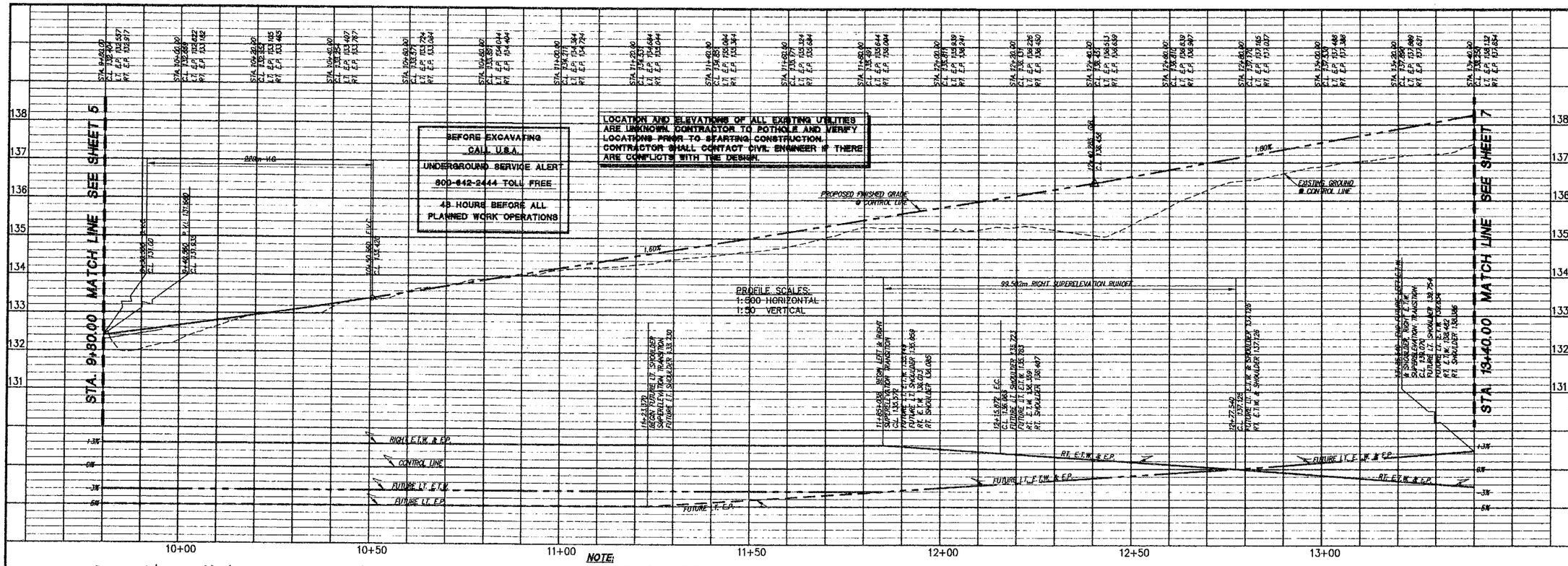
Ruggeri - Jensen - Azar & Associates
8601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

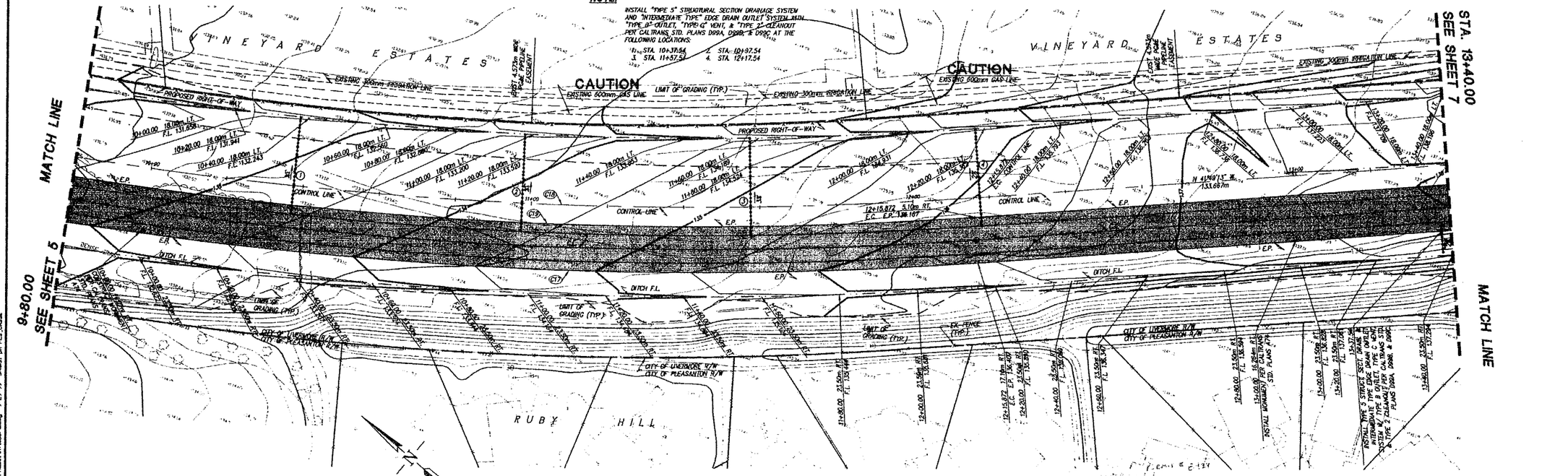
IMPROVEMENT PLAN
STA. 6+00.00 TO STA. 9+80.00
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

DATE	MK	SHEET REVISIONS	BY	CK
9/29/99	1	ADDED NOTE		

SCALE AS SHOWN
DATE 7-7-99
DRAWN R.F.C./B.V.
CHECKED
PROJ. MGR. J.M.A.

SHEET NO. 5 OF 12 SHEETS
JOB NO. 971038





Curve Table				
No.	Desc.	Radius	Delta	Length
C17	E.P.	1083.400m	40°29'12"	765.561m
C18	C.L.	1066.300m	25°05'50"	467.070m
C19	E.P.	1071.400m	25°05'37"	469.235m

METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

ENGINEER OF WORK
PLANS PREPARED UNDER THE DIRECTION OF:
PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)
7/9/99 DATE

Ruggeri - Jensen - Azar & Associates
CIVIL ENGINEERING SURVEYING PLANNING
4001 OWENS DRIVE, SUITE 125 PLEASANTON, CA 94588
PHONE: (925) 227-9100 FAX: (925) 227-9300

IMPROVEMENT PLAN
STA. 9+80.00 TO 13+40.00
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

DATE	MK	SHEET REVISIONS	BY	CK
4/21/99	1A	ADDED NOTE		

SCALE AS SHOWN
DATE 7-7-99
DRAWN A.F.C./A.W.
CHECKED
PROJ. MGR. J.M.J.

SHEET NO. 6 OF 12 SHEETS
JOB NO. 971038

123310

F:\RUBYHILL\971038\METRIC\Phase1\971038PL.dwg 8-25-99 3:46:31 pm PLS_DASH

STA. 13+40.00 MATCH LINE SEE SHEET 6

STA. 17+00.00 MATCH LINE SEE SHEET 8

BEFORE EXCAVATING
CALL U.S.A.
UNDERGROUND SERVICE ALERT
800-642-2444 TOLL FREE
48 HOURS BEFORE ALL
PLANNED WORK OPERATIONS

LOCATION AND ELEVATIONS OF ALL EXISTING UTILITIES ARE UNKNOWN. CONTRACTOR TO POTHOLE AND VERIFY LOCATIONS PRIOR TO STARTING CONSTRUCTION. CONTRACTOR SHALL CONTACT CIVIL ENGINEER IF THERE ARE CONFLICTS WITH THE DESIGN.

C.L. PAV. = PAVEMENT ELEVATION AT CENTERLINE
C.L. = FINISHED GRADE ELEVATION AT CONTROL LINE

PROFILE SCALES:
1:500 HORIZONTAL
1:50 VERTICAL

CAUTION
EXISTING 600mm GAS LINE

VINEYARD ESTATES

R U B Y H I L L

Curve Table				
No.	Desc.	Radius	Delta	Length
C20	E.P.	917.258m	38°42'24"	619.660m
C21	C.L.	922.356m	42°59'45"	686.520m
C22	E.P.	905.258m	42°59'45"	673.793m

METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

7/9/99
DATE

0 10 20 30
(IN METERS)
SCALE 1:500

IMPROVEMENT PLAN
STA. 13+40.00 TO STA. 17+00.00
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

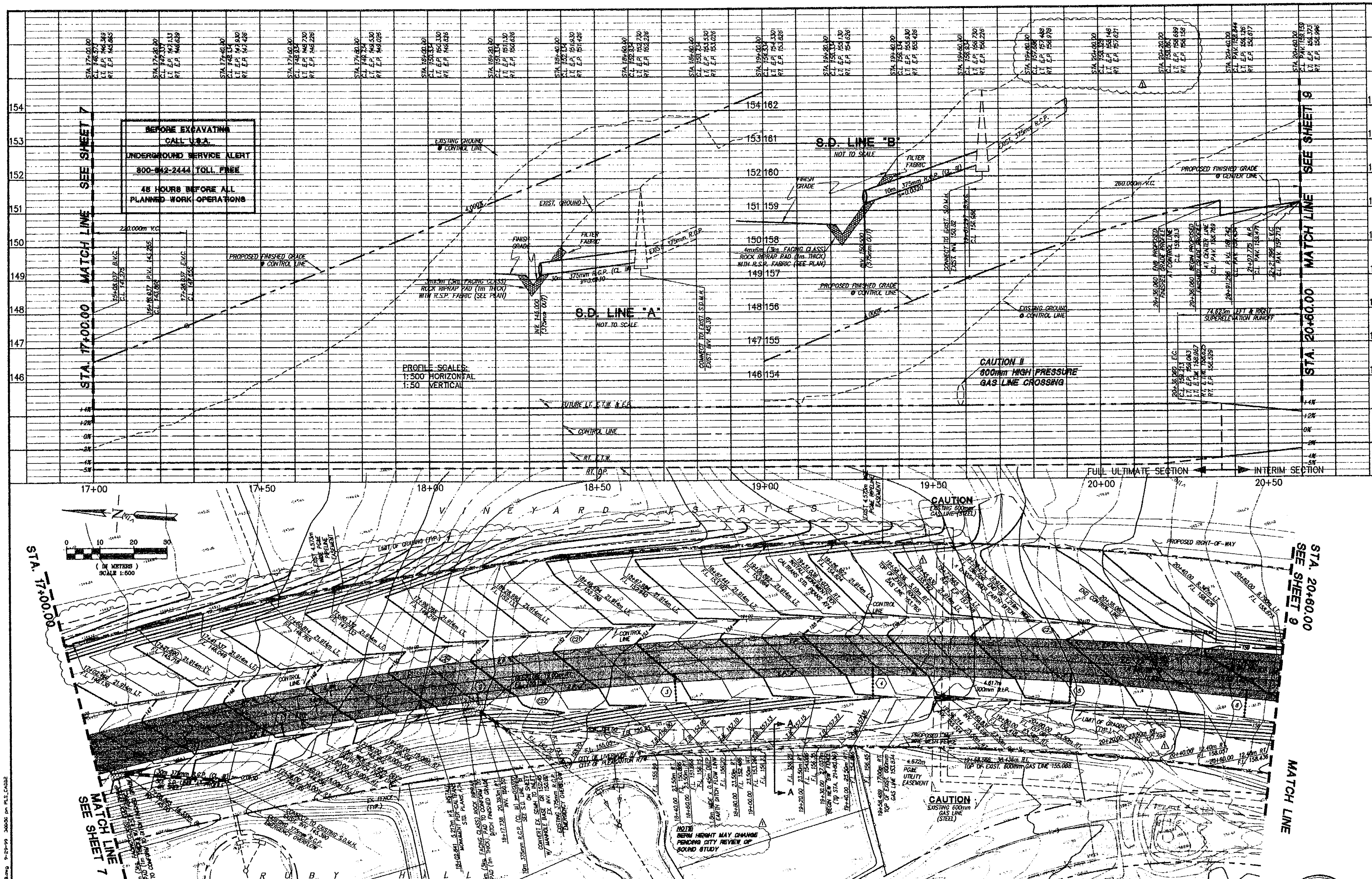
Ruggeri - Jensen - Azar & Associates
4690 CHABOT DRIVE, SUITE 150 • PLEASANTON, CA 94588
PHONE (925) 227-9100 • FAX: (925) 227-9300

DATE	MK	SHEET REVISIONS	CK	BY
5/28/99	A	REVISED MATCH SLOPE		BD

SCALE: AS SHOWN
DATE: 7-7-99
DESIGNED: R.C./R.V.
CHECKED:
PROJ. MGR.: D.A.A.

SHEET NO. 7 OF 12 SHEETS
JOB NO. 971038

123311



NOTE:

INSTALL TYPE 5 STRUCTURAL SECTION DRAINAGE SYSTEM & INTERMEDIATE TYPE EDGE DRAIN OUTLET SYSTEM WITH TYPE B OUTLET, TYPE C VENT (5% MIN.), & TYPE 2 CLEANOUT PER CALTRANS STD. PLANS D99A, D99B, & D99C AT THE FOLLOWING LOCATIONS:

1. STA. 17+57.54
2. STA. 18+17.54
3. STA. 18+77.54
4. STA. 19+37.54
5. STA. 19+97.54
6. STA. 20+50.683

Curve Table

No.	Desc.	Radius	Delta	Length
C20	E.P.	917.258m	38°42'24"	619.660m
C21	C.L.	922.358m	42°38'45"	686.520m
C22	E.P.	905.258m	42°38'45"	673.793m
C23	E.P.	917.251m	03°58'24"	63.074m

METRIC DIMENSIONS

Metric

DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

LOCATION AND ELEVATIONS OF ALL EXISTING UTILITIES ARE UNKNOWN. CONTRACTOR TO POTHOLE AND VERIFY LOCATIONS PRIOR TO STARTING CONSTRUCTION. CONTRACTOR SHALL CONTACT CIVIL ENGINEER IF THERE ARE CONFLICTS WITH THE DESIGN.

SECTION A-A
N.T.S.

0.6m — 0.6m — 2.44m (MIN.) — 1.2m WIDE x 0.3m DEEP DITCH

ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

7/9/99
DATE

REGISTERED PROFESSIONAL ENGINEER — PIERO P. RUGGERI — No. 25281 — Exp. 12-31-01 — CIVIL — STATE OF CALIFORNIA

123312

DATE	MK	SHEET REVISIONS	BY	CK
7/26/99	1	ADDED BERM NOTE, REVISED STREET GRADES	BV	
9/29/99	2	REVISED MATCH SLOPE	BV	

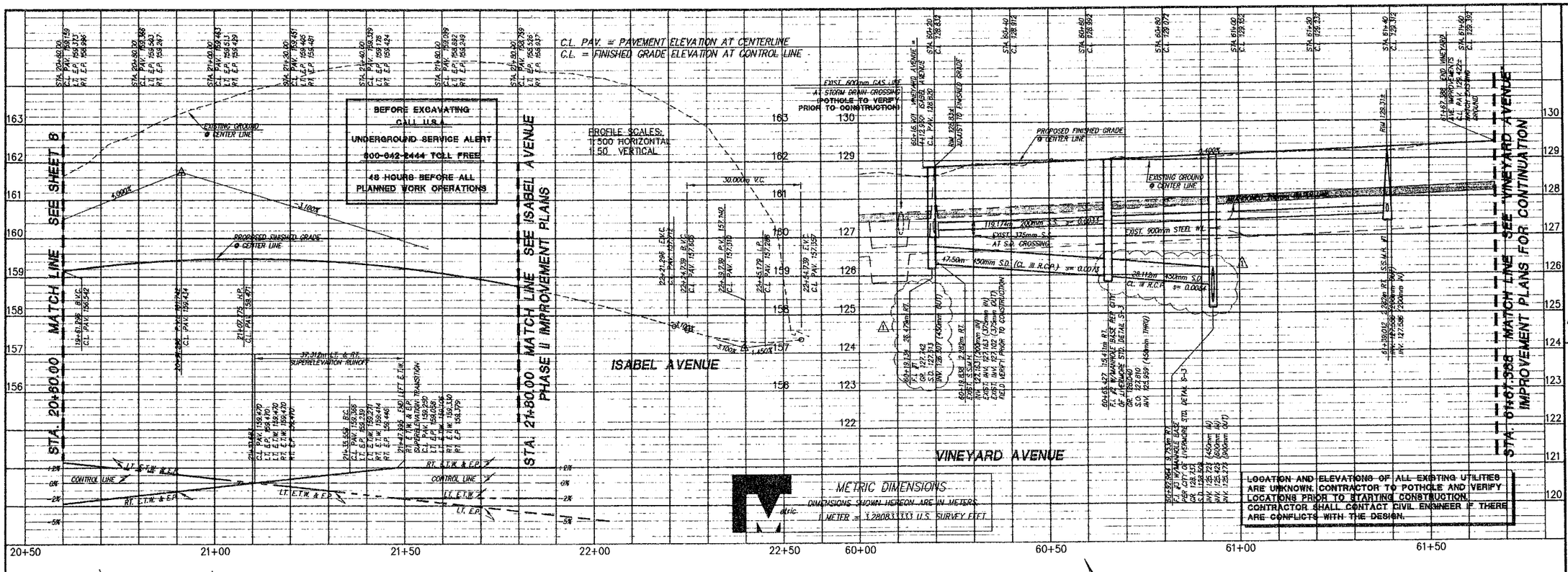
SCALE AS SHOWN
DATE 7-7-99
DRAWN R.F.C./B.V.
CHECKED
PROJ. MGR. J.M.A.

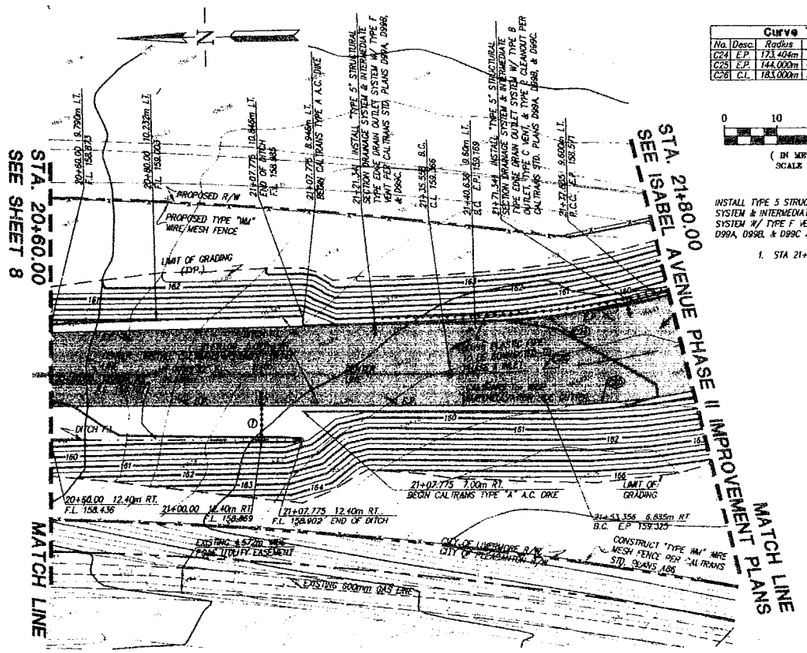
IMPROVEMENT PLAN
STA. 17+00.00 TO STA. 20+60.00
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

Ruggeri - Jensen - Azar & Associates
6601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

SHEET NO. 8 OF 12 SHEETS
JOB NO. 971038

F:\RUBYHILL\971038\METRIC\Phase1\M71038P8.dwg 9-29-99



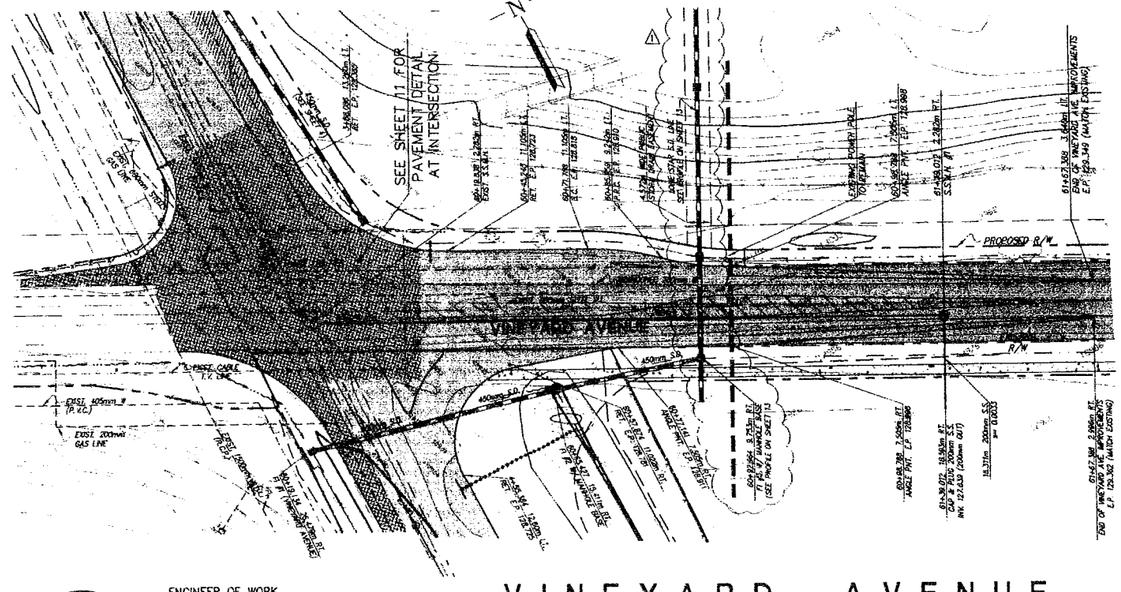


Curve Table			
No.	Desc.	Radius	Delta	Length
C24	E.P.	173.406m	11°58'44"	35.245m
C25	E.P.	144.000m	09°44'56"	24.501m
C26	C.L.	183.000m	35°49'06"	114.402m

0 10 20 30
(IN METERS)
SCALE 1:500

INSTALL TYPE 5 STRUCTURAL SECTION DRAINAGE SYSTEM & INTERMEDIATE TYPE EDGE DRAIN OUTLET SYSTEM W/ TYPE F HDNT PER CALTRANS STD. PLANS D99A, D99B, & D99C AT THE FOLLOWING LOCATIONS:

1. STA 21+00.00



ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

7/9/99
DATE

ISABEL AVENUE

VINEYARD AVENUE

Ruggeri-Jensen-Azar & Associates
6681 OWENS DRIVE, SUITE 150 - PLEASANTON, CA 94588
PHONE: (925) 227-9100 - FAX: (925) 227-9300

IMPROVEMENT PLAN
STA. 20+60.00 TO STA. 21+80.00
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

DATE	NO.	SHEET REVISIONS	BY	CK
7/26/99	1	REVISED SYSTEM LAYOUT & STORM	BV	
8/16/99	2	REVISED PAVEMENT SECTION & STORM DRAIN LINE, ADDED EARTH SWALE	BV	

SCALE: AS SHOWN
DATE: 7/9/99
DRAWN: A.F.C./B.V.
CHECKED:
PROJ. MGR.: J.A.C.

SHEET NO. 9 OF 12 SHEETS
JOB NO. 971038

123313 123314

I:\RUBYHILL\971038\ENGR\Phase1\M710B9.dwg 9-16-99 4:27:32 pm R.L.JABS2

METRIC DIMENSIONS

DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

STANDARD W17 SIGN (TYP.)
STANDARD G7 SIGN "ISABEL AVENUE"
END IMPROVEMENTS
DESIGN SPEED: 80 KpH
PROPOSED RIGHT-OF-WAY
VINEYARD AVENUE
DETAIL 22
DETAIL 27B (680.24m)
DETAIL 27B (497.21m)
DETAIL 29 (191.50m)
DETAIL 27B (608.24m)
DETAIL 27B (654.20m)
DETAIL 22 (671.35m)
DETAIL 38
DETAIL 27B (648.08m)
CLASS I TYPE F DELINEATOR (TYP.) @ 52.40m SPACING
CLASS I TYPE F DELINEATOR (TYP.) @ 48.50m SPACING
CLASS I TYPE F DELINEATOR (TYP.) @ 48.15m SPACING
CLASS I DELINEATOR (TYP.)
STANDARD G7 SIGN "VINEYARD AVENUE"
STANDARD W17 SIGN
INSTALL J5 PULL BOX EVERY 60m (TYPICAL)
INSTALL 53 C WITH 1 SIC (TYPICAL)
CITY OF LIVERMORE R/W
CITY OF PLEASANTON R/W
CITY OF LIVERMORE R/W
CITY OF PLEASANTON R/W
MATCH LINE
STA. 9+00.00 SEE BELOW
STA. 9+00.00 SEE ABOVE
STA. 15+50.00 SEE BELOW
STA. 15+50.00 SEE ABOVE
STA. 16+10.00
MATCH LINE SEE ABOVE
CONTROL LINE
LANE DROP TRANSITION 183.41m
STANDARD R2 SIGN (45mph)
STANDARD R4-3 SIGN
STANDARD W8 SIGN
CENTER LINE
STANDARD W1 SIGN
"SIGNAL AHEAD" PVMNT. MARKING (THERMOPLASTIC)
STANDARD G2B & G3S SIGNS
STANDARD G5 SIGN LIVERMORE / FREMONT
DETAIL 28
STANDARD W75 SIGN
TYPE W ARROW (THERMOPLASTIC)
DETAIL 10 (THERMOPLASTIC)
DETAIL 39
DETAIL 38 (THERMOPLASTIC)
VALLECITOS ROAD RTE. 84
CONNECT TO CONTROLLER PER SIGNAL PLANS PREPARED BY T.J.K.M.

NOTE:
SEE SHEET 11 FOR INTERIM STRIPING SCHEME AT ISABEL/VINEYARD INTERSECTION.

SEE SIGNAL AND LIGHTING PLAN & INTERCONNECT SYSTEM PLAN PREPARED BY T.J.K.M. FOR DETAILS

NOTE:
ALL PAVEMENT MARKINGS AND LIMIT LINES SHALL BE THERMOPLASTIC

DESIGN SPEED: 80 KpH (@ INTERSECTION)
DESIGN SPEED: 100 KpH (OTHER)

0 25 50 75
(IN METERS)
SCALE 1:1000

PERMIT #8428
6/9/00
AS-BUILT MARKING
Resident Engineer
Changes
Markings by:
Channel Wall in Road

ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI R.C.E. 25281 DATE
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

PROFESSIONAL ENGINEER PIERO P. RUGGERI No. 25281 EXP. 12-31-01 CIVIL STATE OF CALIFORNIA

Ruggeri-Jensen-Azar & Associates
5601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

IMPROVEMENT PLAN
SIGNING AND STRIPING PLAN
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

DATE	BY	CK	SHEET REVISIONS

SCALE: AS SHOWN
DATE: 7-12-99
DRAWN: E.P.C./A.M.
CHECKED:
PROJ. MGR.: A.M.

SHEET NO. 10 OF 12 SHEETS
JOB NO. 971038

F:\RUBYHILL\971038\METRIC\Phase1\M971038S10.dwg 7-12-99 JA56x pn PLS_CAD82

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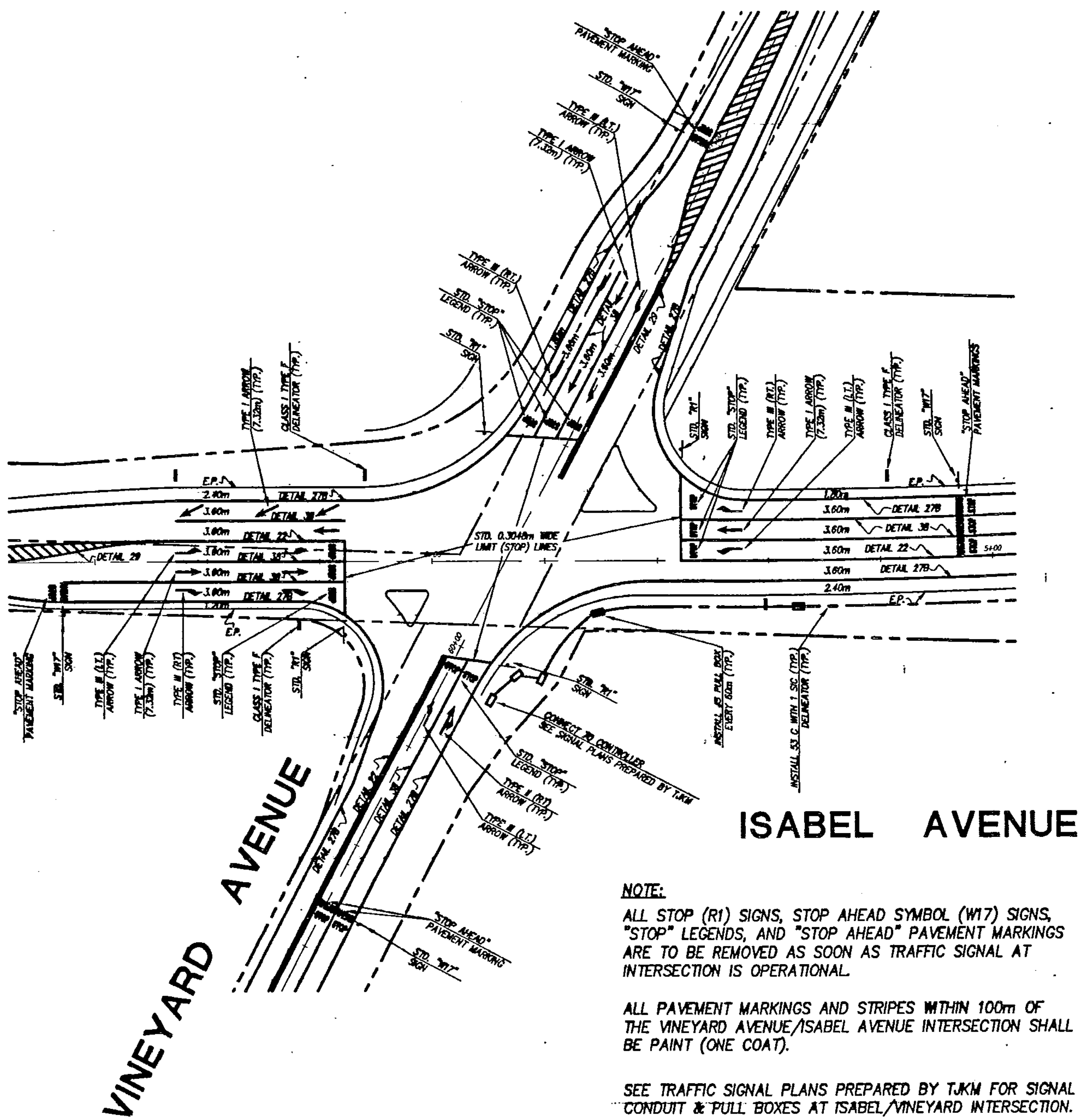
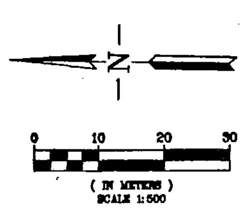


NOTE:

ALL STOP (R1) SIGNS, STOP AHEAD SYMBOL (W17) SIGNS, "STOP" LEGENDS, AND "STOP AHEAD" PAVEMENT MARKINGS ARE TO BE REMOVED AS SOON AS TRAFFIC SIGNAL AT INTERSECTION IS OPERATIONAL.

ALL PAVEMENT MARKINGS AND STRIPES WITHIN 100m OF THE VINEYARD AVENUE/ISABEL AVENUE INTERSECTION SHALL BE PAINT (ONE COAT).

SEE TRAFFIC SIGNAL PLANS PREPARED BY TJKM FOR SIGNAL CONDUIT & PULL BOXES AT ISABEL/VINEYARD INTERSECTION.



METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.2808333333 U.S. SURVEY FEET.

AS-BUILT DRAWING

ENGINEER OF WORK
PLANS PREPARED UNDER THE DIRECTION OF:

PIERO P. RUGGERI — R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)
7/9/99
DATE

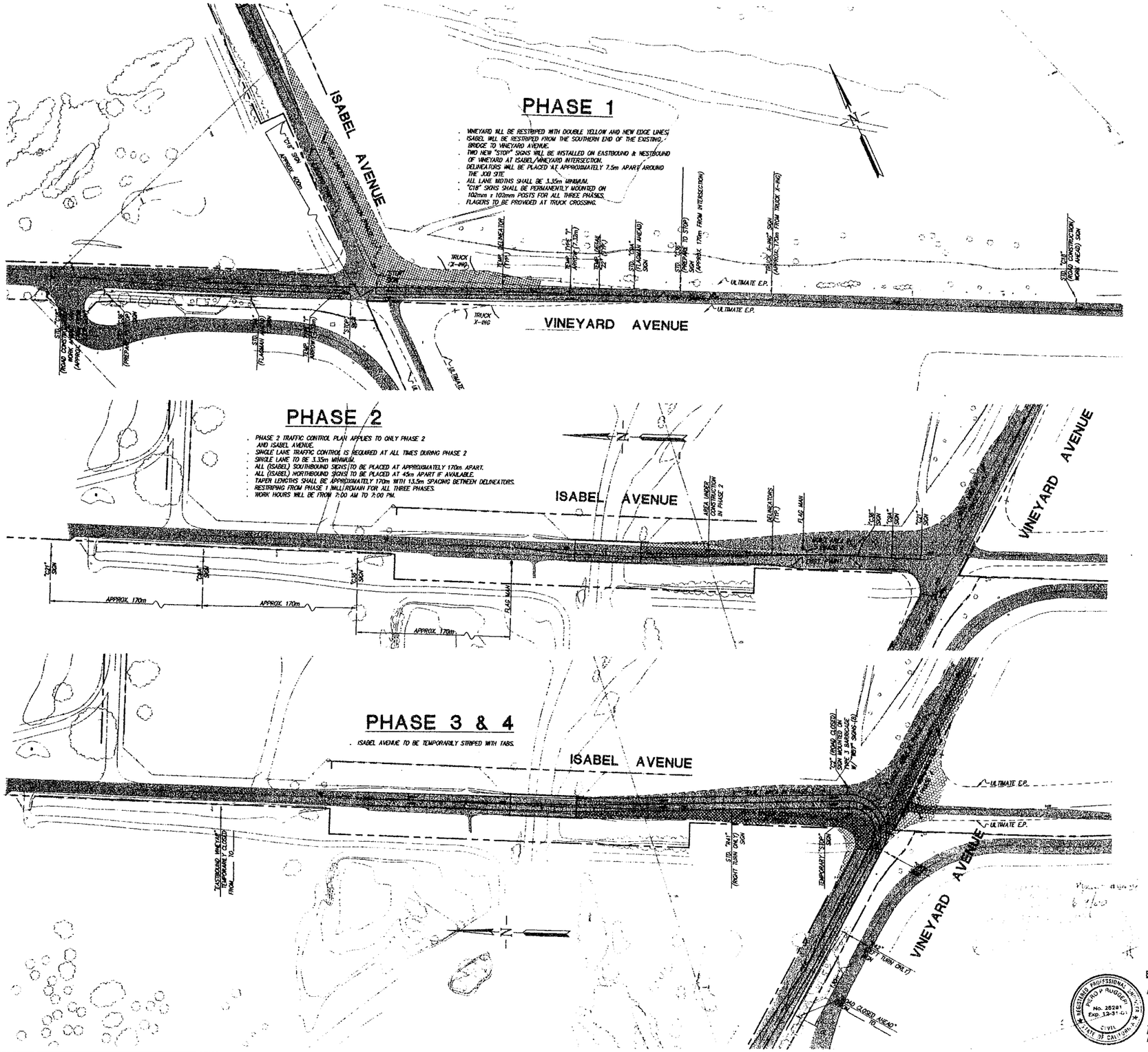
Ruggeri - Jensen - Azar & Associates
6601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

IMPROVEMENT PLAN
INTERIM ISABEL/VINEYARD INTERSECTION STRIPING PLAN
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

SCALE AS SHOWN
DATE 7-7-98
DRAWN A.T.C./R.V.
CHECKED
PROJ. MGR. J.N.A.

SHEET NO. 11 OF 12 SHEETS
JOB NO. 971038

123317 123318



ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

REGISTERED PROFESSIONAL ENGINEER PIERO P. RUGGERI No. 25281 Exp. 12-31-01 CIVIL STATE OF CALIFORNIA

PIERO P. RUGGERI R.C.E. 25281 — 7/9/99 DATE

RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

Ruggeri - Jensen - Azar & Associates
1600 DIMOND PRIVE, SUITE 155, PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

IMPROVEMENT PLANS
ISABEL/VINEYARD TRAFFIC CONTROL PLANS
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

DATE	MK	SHEET REVISIONS	BY	CK

SCALE AS SHOWN
DATE 7-7-99
DRAWN R.F.C./B.V.
CHECKED
PROJ. MGR. J.A.A.

SHEET NO. 12 OF 12 SHEETS

JOB NO. 971038

123319 123320

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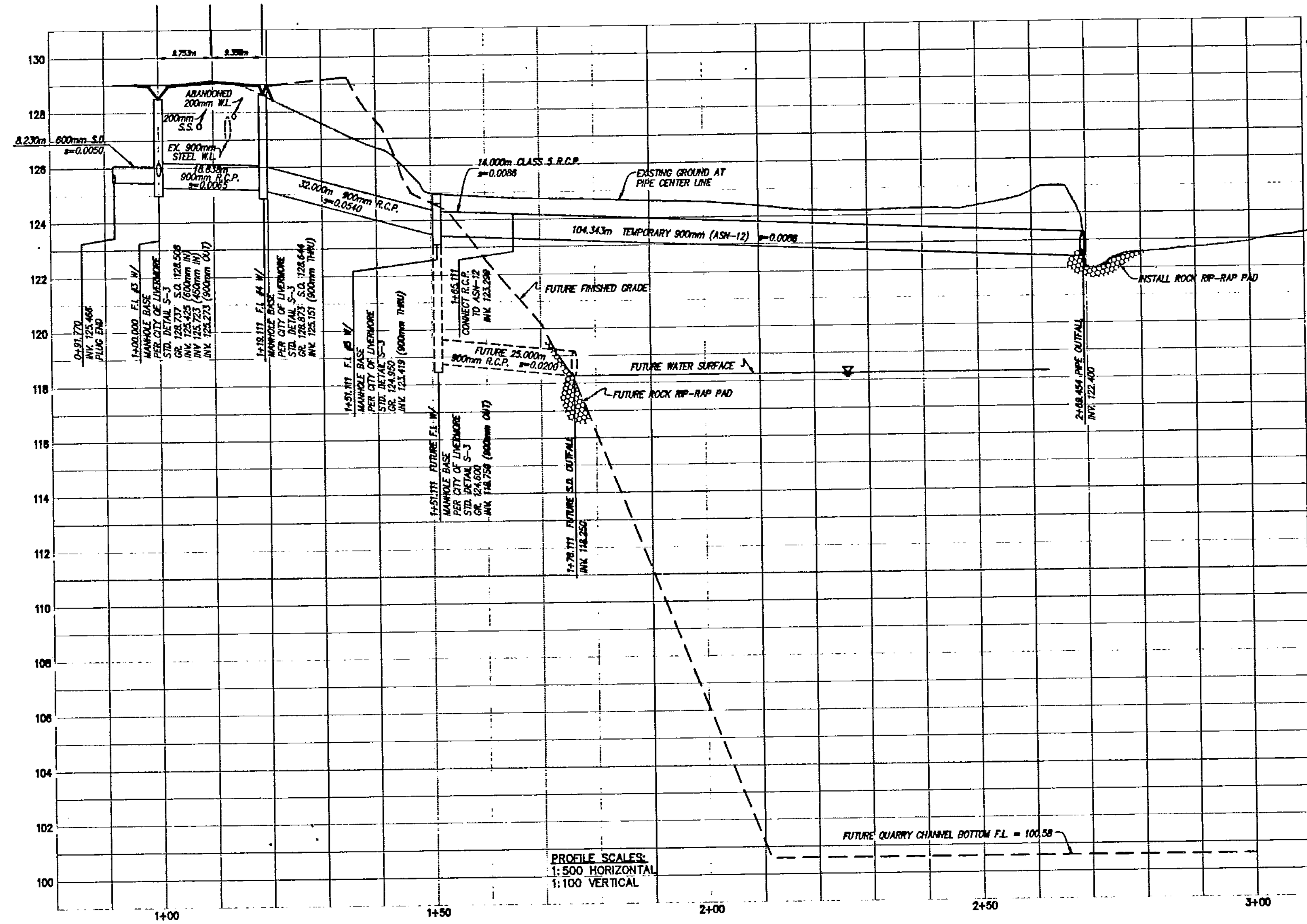
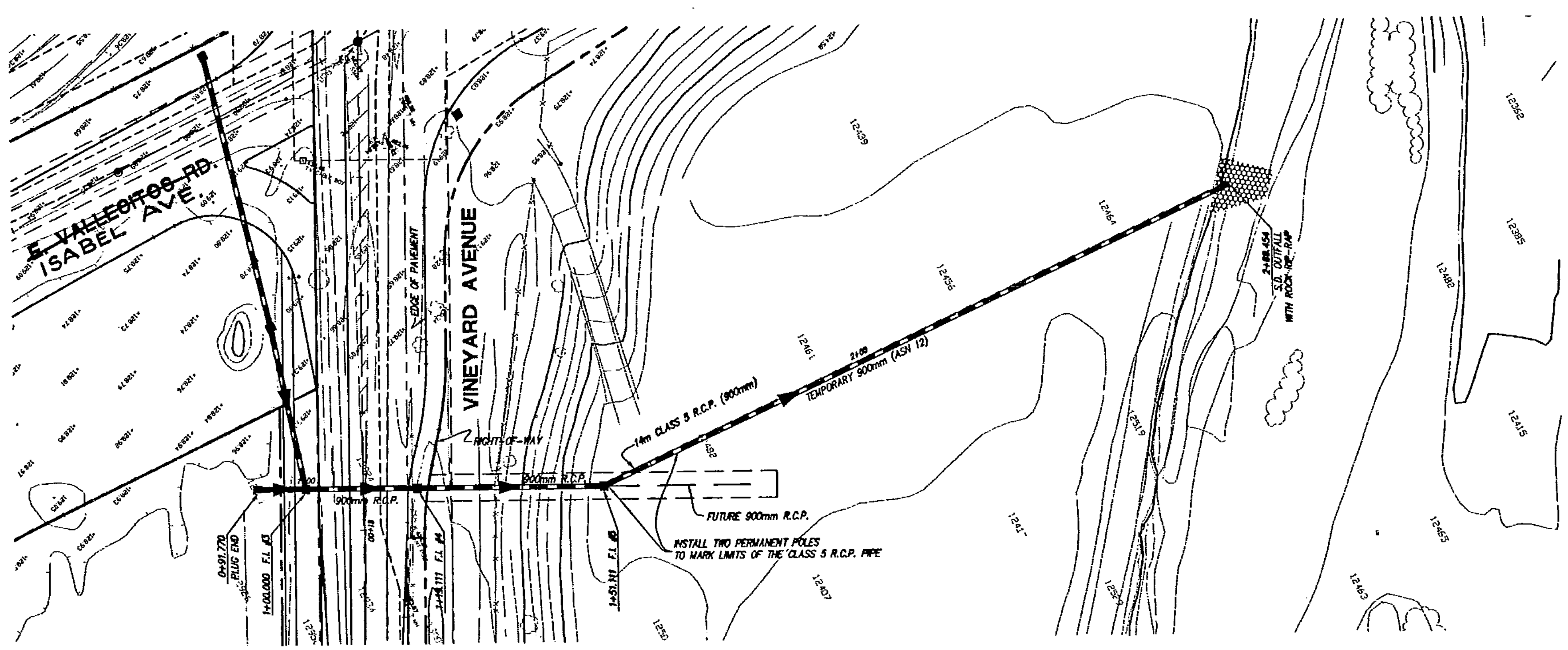




IMPROVEMENT PLAN

STORM DRAIN OUTFALL TO LONE STAR

ISABEL AVENUE - PHASE I

CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA

FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

Ruggeri - Jensen - Azar & Associates
6601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

SCALE AS SHOWN
DATE 7-7-99
DRAWN A.P.W.
CHECKED R.T.C.
PROJ. MGR. J.A.A.

DATE	MK	SHEET REVISIONS	BY	CK

SHEET NO. 13 OF 13 SHEETS

JOB NO. 971038

123321 123322

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		1A	407

OF SHEETS

	NAME	DESCRIPTION
1	X1-X10	TYPICAL CROSS SECTONS
2-14	-	STANDARD PLANS LIST
15	K1	KEY MAP AND LINE INDEX
16-32	L1-L17	LAYOUT
33-49	LD1-LD17	LAYOUT (DEMOLITION)
50-64	P1-P15	PROFILE
65-69	C1-C5	CONSTRUCTION DETAILS
70-86	G1-G17	CONTOUR GRADING AND
87-126	D1-D40	DRAINAGE PLANS, PROFILES, DETAILS AND QUANTITIES
127-141	ED1-ED15	EDGE DRAIN PLANS
142-153	CH1-CH12	ARROYO MOCHO RELOCATION
154-174	U1-U21	UTILITY
175-189	W1-W15	RECLAIMED WATER
190-199	SC1-SC10	STAGE CONSTRUCTION AND DETAILS AND QUANTITIES
200	CS1	CONSTRUCTION AREA SIGNS
201-205	TH1-TH5	TRAFFIC HANDLING
206-214	DE1-DE9	DETOUR LAYOUTS AND DETAILS
215-239	PD1-PD25	PAVEMENT DELINEATION
240-243	Q1-Q4	SUMMARY OF QUANTITIES
244-263	S1-S20	SIGN PLANS
264-297A	--	HIGHWAY PLANTING
298-322	E1-E25	ELECTRICAL PLANS

STRUCTURE PLANS

323-324	RW1-RW2	RETAINING WALL PLANS
325-327	RR1-RR3	RAILROAD SHOO-FLY PLANS
328-366	--	ISABEL PUMPING PLANT
367-382	--	ISABEL AVENUE UNDERCROSSING (BR NO 33C-0406)
383-395	--	ISABEL AVENUE UNDERPASS (BR NO 33C-0405)
396-407	--	ARROYO MOCHO (BR NO 33C-0407)

CITY OF LIVERMORE

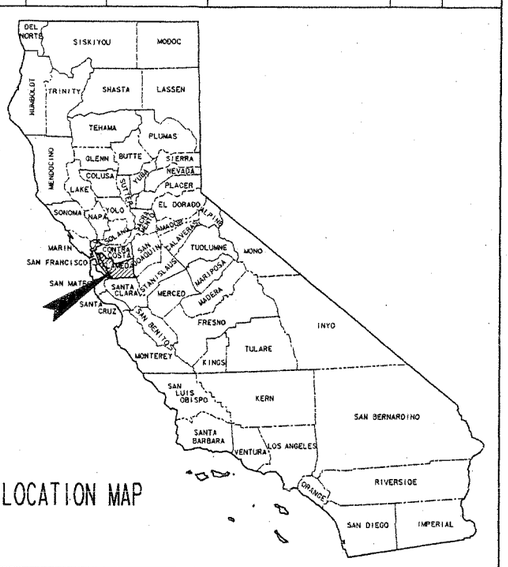
DEPARTMENT OF COMMUNITY DEVELOPMENT

PROJECT PLANS FOR CONSTRUCTION ON
ISABEL AVENUE EXTENSION - PHASE 2
IN ALAMEDA COUNTY IN LIVERMORE
FROM 1.0 km SOUTH OF CONCANNON BLVD TO AIRWAY BLVD

To be supplemented by Standard Plans dated July, 1997
and City of Livermore Standard Details dated March 8, 1999

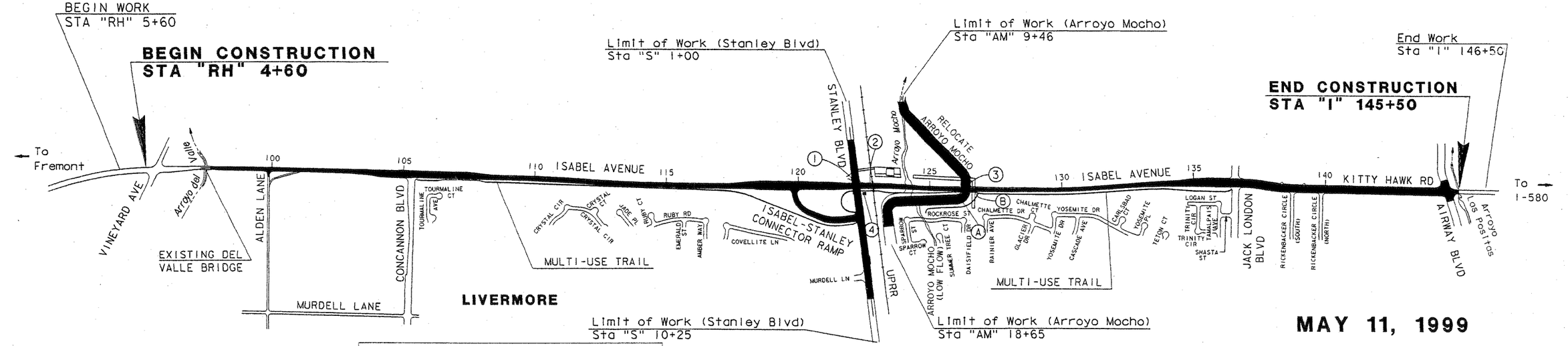
SET 1 OF 2

AS-BUILT SET



LOCATION MAP

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



MAY 11, 1999

STRUCTURES LIST	BRIDGE NO.
(A) RETAINING WALL NO. 1	
(B) RETAINING WALL NO. 2	
(1) ISABEL AVENUE UNDERCROSSING	33C-0406
(2) ISABEL AVENUE UNDERPASS	33C-0405
(3) ARROYO MOCHO	33C-0407
(4) PUMPING PLANT	

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes Revisions by: MPW (Initials)

☐ Changes As Noted

SCALE IN METERS

0 500 1000 1500

RECOMMENDED FOR APPROVAL

Kenneth E. Ross, Project Manager
City of Livermore

APPROVED BY: Philip E. Boydstun 5/6/99

Philip E. Boydstun, City Engineer, RCE 26867
City of Livermore

REGISTERED PROFESSIONAL ENGINEER
Philip E. Boydstun
No. 26867
Exp. 3-31-01
CIVIL
STATE OF CALIFORNIA

The plans contained herin have been prepared by or under the direction of:

Olga Angelica Rodriguez

5/11/99
Plans Approval Date

REGISTERED PROFESSIONAL ENGINEER
OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-99
CIVIL
STATE OF CALIFORNIA

The Contractor shall possess the Class (or classes) of license as specified in the ''Notice to Contractors''.

Contract No. 04-233054

PROJECT ENGINEER | DATE | PROJECT MANAGER | DATE

LAST REVISION 00-00-00

USERNAME => COUSE

TIME PLOTTED => Fri May 7 11:45:31 1999

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		1B	207

Caltrans Metric

CITY OF LIVERMORE

DEPARTMENT OF COMMUNITY DEVELOPMENT

PROJECT PLANS FOR CONSTRUCTION ON

ISABEL AVENUE EXTENSION - PHASE 2

IN ALAMEDA COUNTY IN LIVERMORE

FROM 1.0 km SOUTH OF CONCANNON BLVD

R/W

To be supplemented by Standard Plans dated July, 1997
and City of Livermore Standard Details dated March 8, 1999

PROJECT 1

CITY PROJECT #89-50

(FOR FUNDING INFORMATION PURPOSES)

LOCATION MAP

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

INDEX OF SHEETS

NO.	NAME	DESCRIPTION
2-11	XI-X10	TYPICAL CROSS SECTONS
12-14	-	STANDARD PLANS LIST
15	KI	KEY MAP AND LINE INDEX
16-32	LI-LI7	LAYOUT
33-49	LDI-LDI7	LAYOUT (DEMOLITION)
50-64	PI-PI5	PROFILE
65-69	CI-C5	CONSTRUCTION DETAILS
70-86	GI-GI7	CONTOUR GRADING AND
87-126	DI-D40	DRAINAGE PLANS, PROFILES, DETAILS AND QUANTITIES
127-141	EDI-EDI5	EDGE DRAIN PLANS
142-153	CHI-CHI2	ARROYO MOCHO RELOCATION
154-174	UI-U2I	UTILITY
175-189	WI-WI5	RECLAIMED WATER
190-199	SCI-SCI0	STAGE CONSTRUCTION AND DETAILS AND QUANTITIES
200	CSI	CONSTRUCTION AREA SIGNS
201-205	THI-TH5	TRAFFIC HANDLING
206-214	DEI-DE9	DETOUR LAYOUTS AND DETAILS
215-239	PDI-PD25	PAVEMENT DELINEATION
240-243	QI-Q4	SUMMARY OF QUANTITIES
244-263	SI-S20	SIGN PLANS
264-297	--	HIGHWAY PLANTING
298-322	EI-E25	ELECTRICAL PLANS

STRUCTURE PLANS

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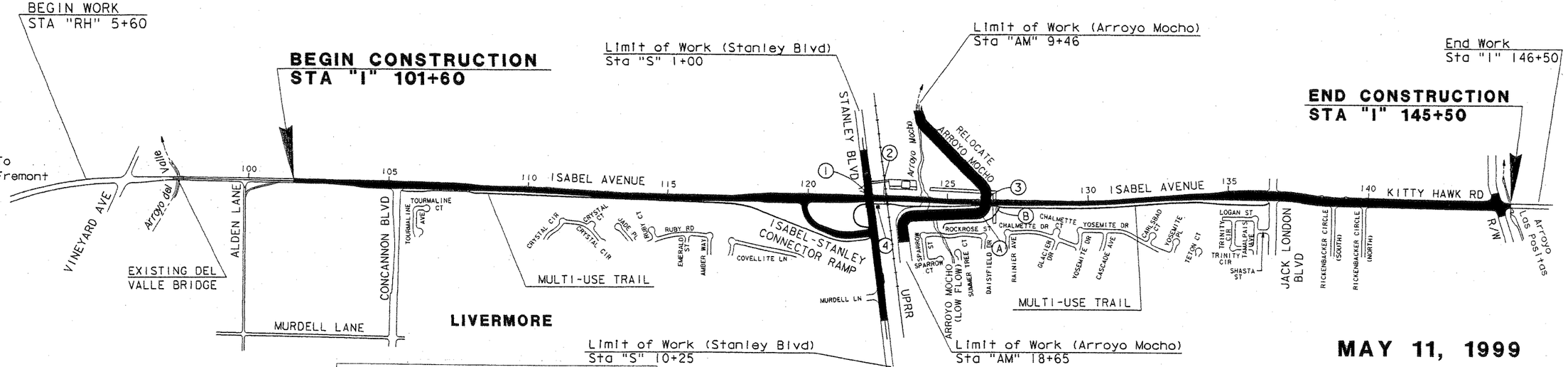
328-366	--	ISABEL PUMPING PLANT
367-382	--	ISABEL AVENUE UNDERCROSSING (BR NO 33C-0406)
383-395	--	ISABEL AVENUE UNDERPASS (BR NO 33C-0405)
396-407	--	ARROYO MOCHO (BR NO 33C-0407)



MAY 11, 1999

STRUCTURES LIST		BRIDGE NO.
(A)	RETAINING WALL NO. 1	
(B)	RETAINING WALL NO. 2	
(1)	ISABEL AVENUE UNDERCROSSING	33C-0406
(2)	ISABEL AVENUE UNDERPASS	33C-0405
(3)	ARROYO MOCHO	33C-0407
(4)	PUMPING PLANT	

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes
☐ Changes As Noted

Revisions by: MPW (Initials)

RECOMMENDED FOR APPROVAL:

Kenneth E. Ross, Project Manager
City of Livermore

APPROVED BY:

Philip E. Boydstun, City Engineer, RCE 26867
City of Livermore
5/6/99

REGISTERED PROFESSIONAL ENGINEER — Philip E. Boydstun — No. 26867 — Exp. 3-31-01 — CIVIL — STATE OF CALIFORNIA

The plans contained herin have been prepared by or under the direction of:

Olga Angelica Rodriguez

REGISTERED PROFESSIONAL ENGINEER — OLGA ANGELICA RODRIGUEZ — No. 53594 — Exp. 6-30-99 — CIVIL — STATE OF CALIFORNIA

5/11/99
Plans Approval Date

SCALE IN METERS
0 500 1000 1500

The Contractor shall possess the Class (or classes) of license as specified in the ''Notice to Contractors''.

Contract No. 04-233054

FOR REDUCED PLANS 0 20 40 60 80

USERNAME => pouser

LAST REVISION | DATE | PROJECT MANAGER | DATE | PROJECT ENGINEER

TIME PLOTTED => Fri May 7 11:46:53 1999

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		IC	207

INDEX OF SHEETS

NO.	NAME	DESCRIPTION
2-11	XI-X10	TYPICAL CROSS SECTONS
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323-324	RWI-RW2	RETAINING WALL PLANS
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328-366	--	ISABEL PUMPING PLANT
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383-395	--	ISABEL AVENUE UNDERPASS (BR NO 33C-0405)
396-407	--	ARROYO MOCHO (BR NO 33C-0407)

CITY OF LIVERMORE

DEPARTMENT OF COMMUNITY DEVELOPMENT

PROJECT PLANS FOR CONSTRUCTION ON

ISABEL AVENUE EXTENSION - PHASE 2

IN ALAMEDA COUNTY IN LIVERMORE

FROM 1.0 km SOUTH OF CONCANNON BLVD TO AIRWAY BLVD

To be supplemented by Standard Plans dated July, 1997 and City of Livermore Standard Details dated March 8, 1999

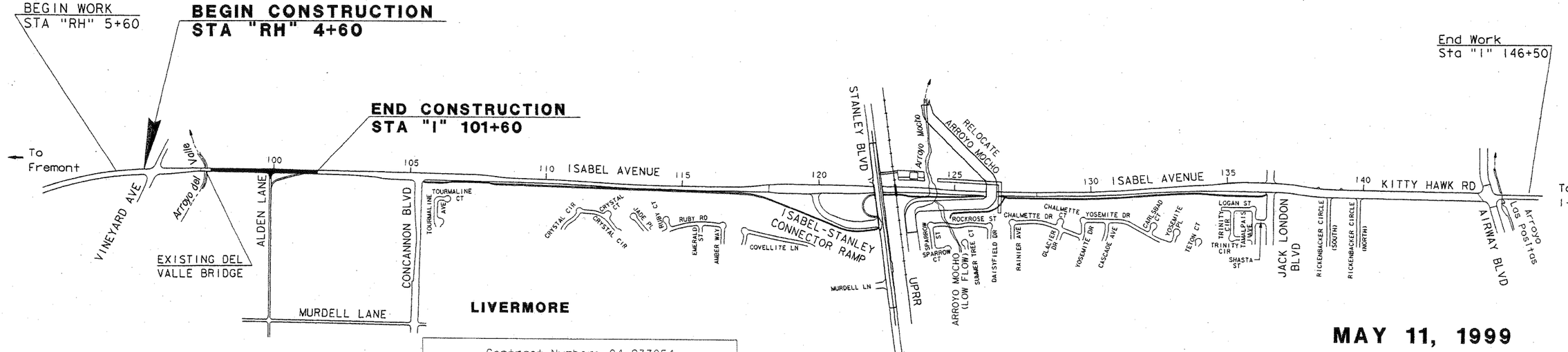
PROJECT 2

CITY PROJECT # 96-91

(FOR FUNDING INFORMATION PURPOSES)

LOCATION MAP

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



MAY 11, 1999

STRUCTURES LIST

		BRIDGE NO.
(A)	RETAINING WALL NO. 1	
(B)	RETAINING WALL NO. 2	
(1)	ISABEL AVENUE UNDERCROSSING	33C-0406
(2)	ISABEL AVENUE UNDERPASS	33C-0405
(3)	ARROYO MOCHO	33C-0407
(4)	PUMPING PLANT	

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes
☐ Changes As Noted

Revisions by: MPW (Initials)

RECOMMENDED FOR APPROVAL:

Kenneth E. Ross, Project Manager
City of Livermore

APPROVED BY:

Philip E. Boydstun, City Engineer, RCE 26867
City of Livermore

5/6/99

REGISTERED PROFESSIONAL ENGINEER
Philip E. Boydstun
No. 26867
Exp. 3-31-01
CIVIL
STATE OF CALIFORNIA

The plans contained herin have been prepared by or under the direction of:

Olga Angelica Rodriguez

5/11/99
Plans Approval Date

REGISTERED PROFESSIONAL ENGINEER
OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-99
CIVIL
STATE OF CALIFORNIA

SCALE IN METERS
0 500 1000 1500

The Contractor shall possess the Class (or classes) of license as specified in the ''Notice to Contractors''.

Contract No. 04-233054

PROJECT ENGINEER | DATE | PROJECT MANAGER | DATE

FOR REDUCED PLANS 0 20 40 60 80

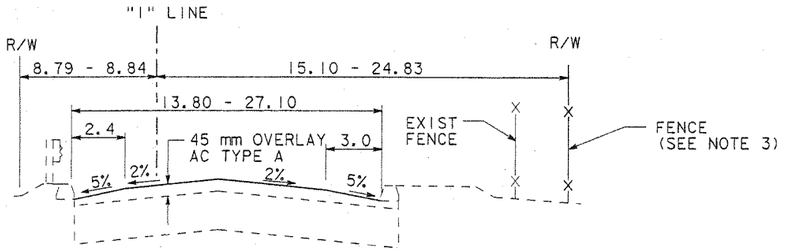
USERNAME => pouser

LAST REVISION 05-07-99

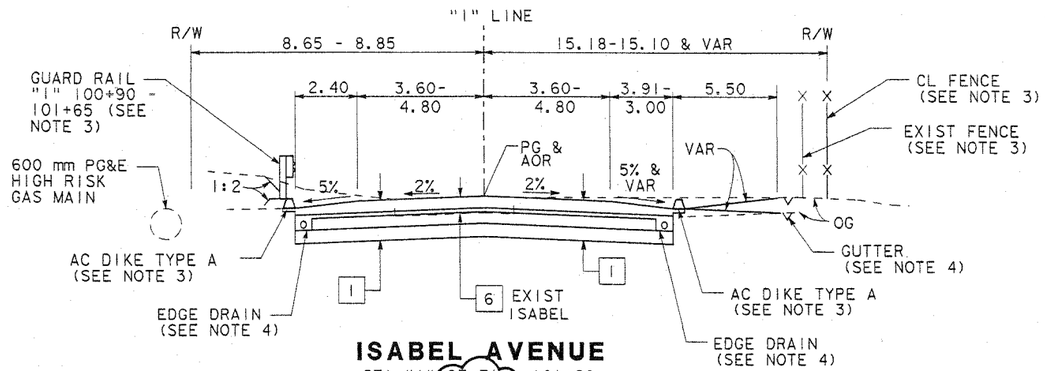
TIME PLOTTED => Fri May 7 11:39:36 1999

NOTES:

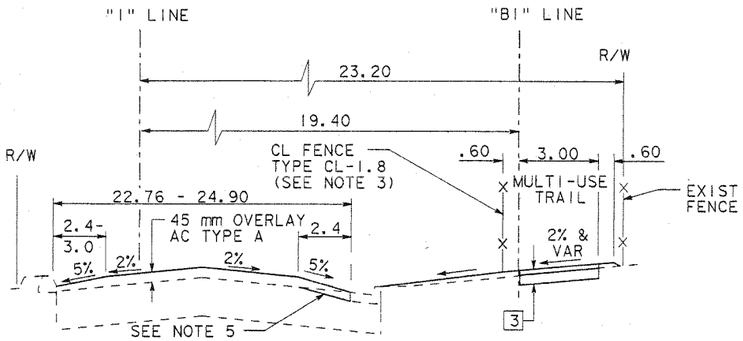
1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR LOCATION OF CURB & GUTTER, OVERLAY, COLD PLANE, FENCE, GUARD RAIL, K-RAIL, CONCRETE BARRIER, AND AC DIKE, SEE LAYOUT SHEETS.
4. FOR GUTTER LAYOUT, SEE DRAINAGE PLANS. FOR EDGE DRAIN AND UNDERDRAIN LAYOUT, SEE EDGE DRAIN PLANS. FOR GUTTER TYPICAL SECTION, SEE SHEET D-31. FOR UNDERDRAIN TYPICAL SECTION, SEE SHEET ED-1.
5. SEE CONSTRUCTION DETAILS.
6. SEE SHEET C-5 FOR DETAIL. SEE LAYOUT SHEETS FOR HORIZONTAL LOCATION OF AXIS OF ROTATION TO "I" LINE.
7. FOR BERM LAYOUT AND GRADING SEE CONTOUR GRADING PLANS. FOR BERM TYPICAL SECTION, SEE SHEET X-10.
8. FOR STRUCTURE, SEE BRIDGE PLANS. FOR PUMP STATION, SEE PUMP STATION PLANS. FOR RETAINING WALL, SEE RETAINING WALL PLANS
9. OVERHEAD UTILITY CORRIDOR, SEE UTILITY PLANS.
10. FOR LANDSCAPING & IRRIGATION, SEE LANDSCAPING & IRRIGATION PLANS.



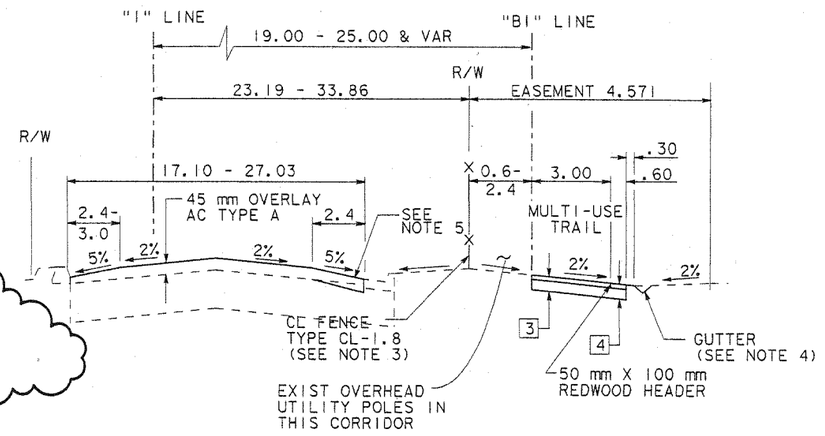
ISABEL AVENUE
"I" 101+60 - 105+49



ISABEL AVENUE
STA "I" 97+71 - 101+60



ISABEL AVENUE
"I" 106+62 - 107+82
"BI" 11+17 - 12+37



ISABEL AVENUE
"I" 105+49 - 106+62
"I" 107+82 - 109+07
"BI" 10+04 - 11+17
"BI" 12+37 - 13+63

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates

☐ No Changes
☒ Changes As Noted
Revisions by: MPW (Initials)

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84		2	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-03
CIVIL
STATE OF CALIFORNIA

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
Livermore, CA 94550

MK CENTENNIAL
5000 Hopyard Road, Suite 100
Pleasanton, CA 94588
TEL: 510-460-5050 FAX: 510-460-5064

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

TYPICAL STRUCTURAL SECTIONS

1 — 180 mm AC(TYPE A); 75 mm ATPB (OMIT FOR 1 MOD); 210 mm Cl 2 AB; 330 mm AS Cl 4
2 — 390 mm AC (TYPE A)
3 — 75 mm AC (TYPE A); 150 mm Cl 2 AB
4 — 75 mm DECOMPOSED GRANITE; 150 mm CL 2 AB
5 — 210 mm AC(TYPE A); 600 mm Cl 2 AB
6 — EXISTING SECTION; 50 mm AC; 76 mm AB
7 — EXISTING SECTION; 192 mm AC; 204 mm AB; 128 mm AS
8 — EXISTING SECTION; 192 mm AC; 204 mm AB; 253 mm AS
9 — EXISTING SECTION; 168 mm AC; 204 mm PCC
10 — EXISTING SECTION; 152 mm AC; 442 mm PCC
11 — 180 mm AC (TYPE A); 75 mm ATPB; 330 mm Cl 2 AB; 210 mm Cl 3 PERMEABLE MATERIAL
12 — 150 mm Cl 2 AB

ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-1

DESIGN OVERSIGHT | CALCULATED/DESIGNED BY | CHECKED BY | DATE 5/99 | OR | RA 5/99 | OR | REVISED BY | DATE REVISED | 6/99 | 6/99

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00

TIME PLOTTED => $$$$$$$SYSTIME$$$$$$

02:28:25 PM07/07/2002 I:\1611\phase2\1611bx01.dgn

FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$

NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
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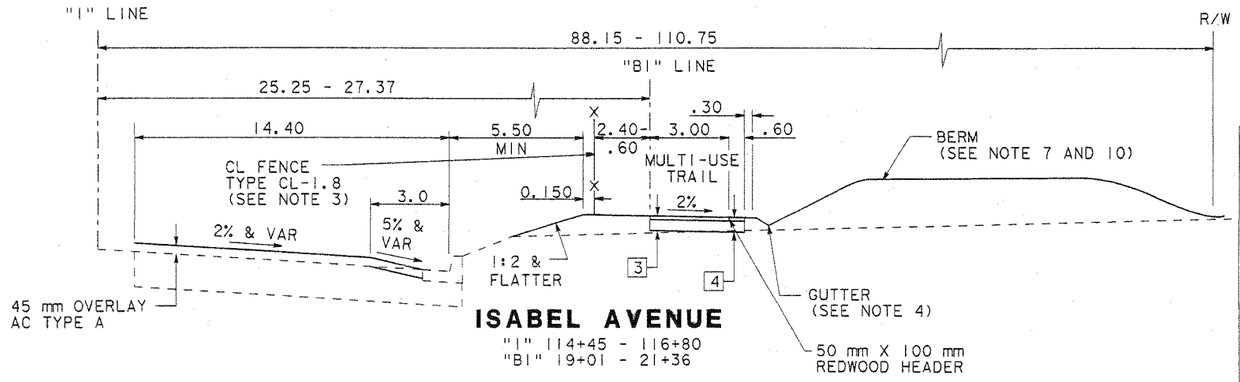
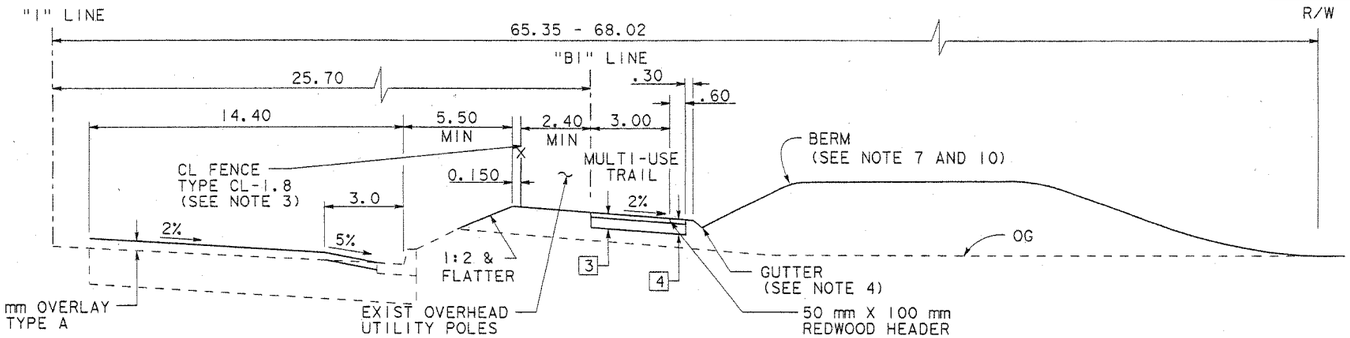
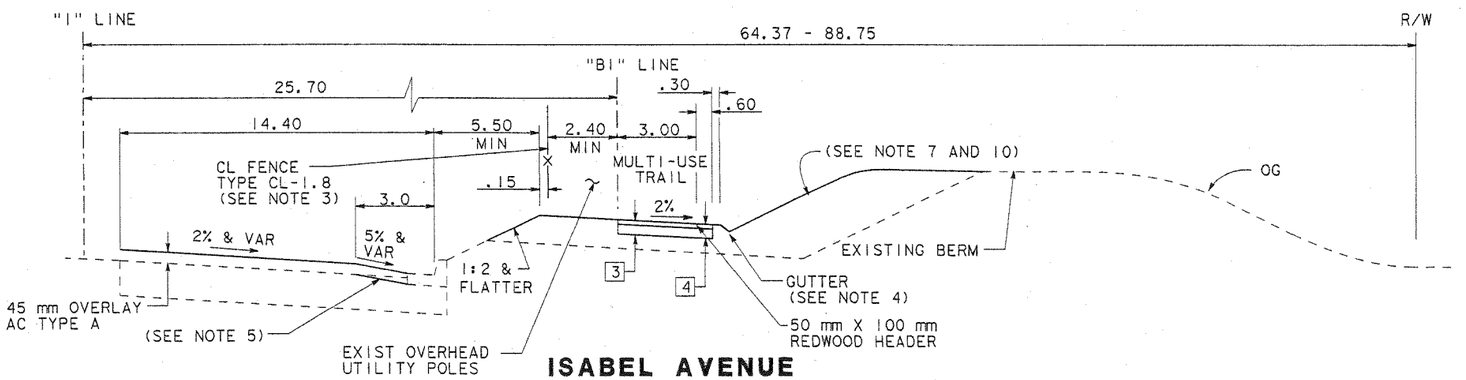


ISABEL AVENUE
"I" 114+45 - 116+80
"BI" 19+01 - 21+36



ISABEL AVENUE
"I" 109+75 - 110+43
"BI" 14+31 - 14+98



ISABEL AVENUE
"I" 109+07 - 109+75
"I" 110+43 - 114+45
"BI" 13+63 - 14+31
"BI" 14+98 - 19+01

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		3	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-03
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

5/11/99
PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
Livermore, CA 94550

MK CENTENNIAL
5000 Hopyard Road, Suite 100
Pleasanton, CA 94588
TEL: 510-460-5050 FAX: 510-460-5064

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Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING
Resident Engineer: Hank Doll
Vail Cooper & Associates
☒ No Changes
☐ Changes As Noted
Revisions by: MPW (Initials)

TYPICAL STRUCTURAL SECTIONS

1 — 180 mm AC(TYPE A)
75 mm ATPB (OMIT FOR 1 MOD)
210 mm Cl 2 AB
330 mm AS Cl 4

2 — 390 mm AC (TYPE A)

3 — 75 mm AC (TYPE A)
150 mm Cl 2 AB

4 — 75 mm DECOMPOSED GRANITE
150 mm CL 2 AB

5 — 210 mm AC(TYPE A)
600 mm Cl 2 AB

6 — EXISTING SECTION
50 mm AC
76 mm AB

7 — EXISTING SECTION
192 mm AC
204 mm AB
128 mm AS

8 — EXISTING SECTION
192 mm AC
204 mm AB
253 mm AS

9 — EXISTING SECTION
168 mm AC
204 mm PCC

10 — EXISTING SECTION
152 mm AC
442 mm PCC

11 — 180 mm AC (TYPE A)
75 mm ATPB
330 mm Cl 2 AB
210 mm Cl 3 PERMEABLE MATERIAL

12 — 150 mm Cl 2 AB

ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-2

REVISED BY	DATE REVISED
OR	6/99
OR	6/99

DATE 5/99 OR RA 5/99

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CHECKED BY

DESIGN OVERSIGHT

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00

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FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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DGN FILE => $$$$$$$$$$DGNSPEC$$$$$$$$$$

CU 04256

EA 233051

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84		4	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — OLGA ANGELICA RODRIGUEZ — No. 53594 — Exp. 6-30-03 — CIVIL — STATE OF CALIFORNIA

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
Livermore, CA 94550

MK CENTENNIAL
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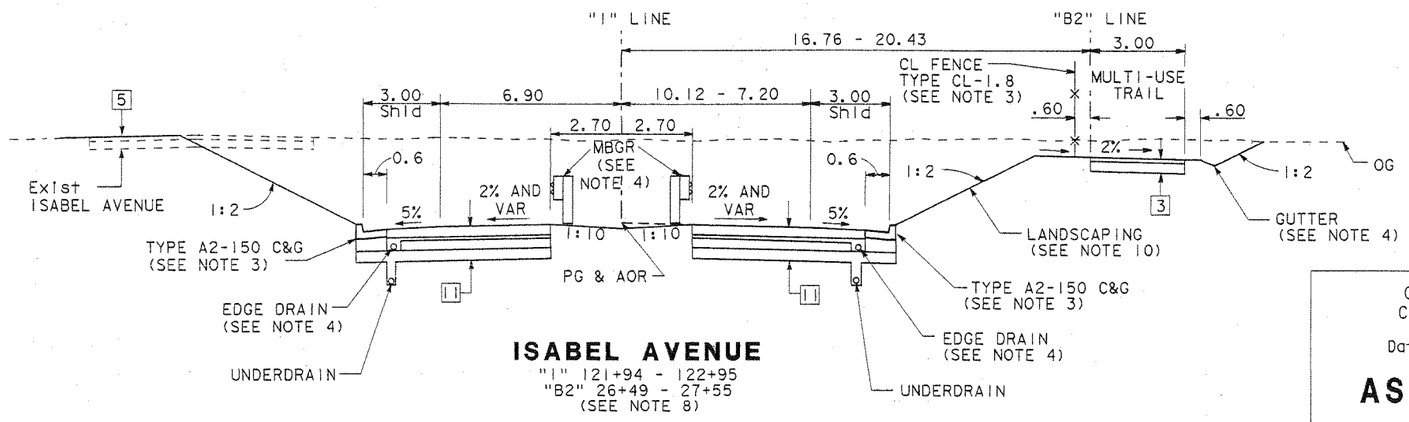
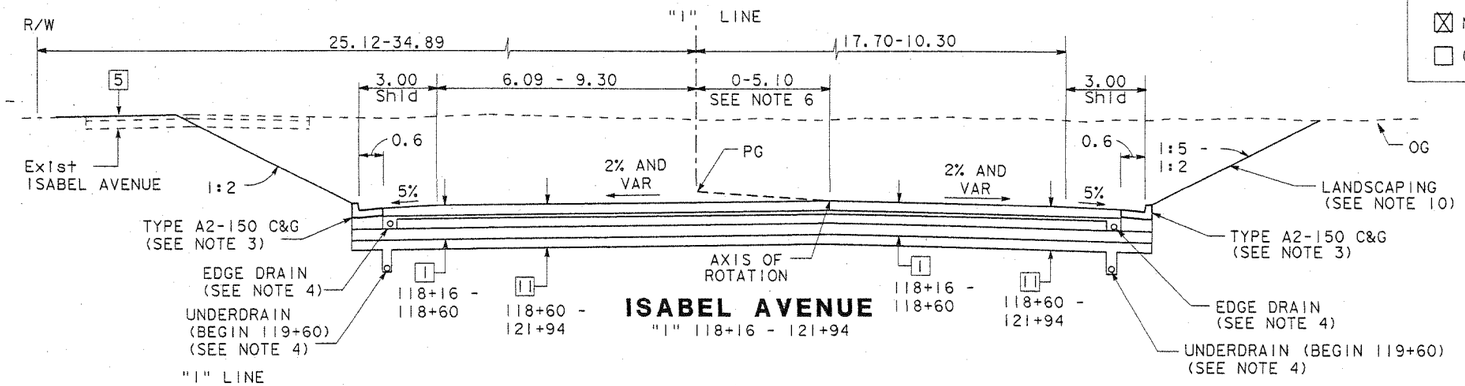
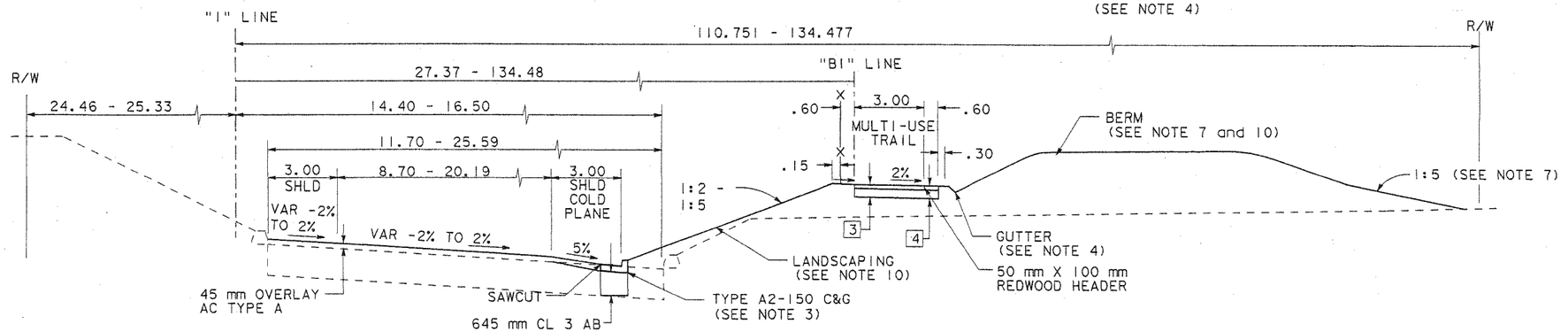


ISABEL AVENUE
"I" 121+94 - 122+95
"B2" 26+49 - 27+55
(SEE NOTE 8)



ISABEL AVENUE
"I" 118+16 - 121+94



ISABEL AVENUE
"I" 116+80 - 118+16
"B1" 21+36 - 22+75

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes
☐ Changes As Noted

Revisions by: MPW (Initials)

TYPICAL STRUCTURAL SECTIONS

1	180 mm AC(TYPE A) 75 mm ATPB (OMIT FOR 1 MOD) 210 mm Cl 2 AB 330 mm AS Cl 4
2	390 mm AC (TYPE A)
3	75 mm AC (TYPE A) 150 mm Cl 2 AB
4	75 mm DECOMPOSED GRANITE 150 mm CL 2 AB
5	210 mm AC(TYPE A) 600 mm Cl 2 AB
6	EXISTING SECTION 50 mm AC 76 mm AB
7	EXISTING SECTION 192 mm AC 204 mm AB 128 mm AS
8	EXISTING SECTION 192 mm AC 204 mm AB 253 mm AS
9	EXISTING SECTION 168 mm AC 204 mm PCC
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11	180 mm AC (TYPE A) 75 mm ATPB 330 mm Cl 2 AB 210 mm Cl 3 PERMEABLE MATERIAL
12	150 mm Cl 2 AB

ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-3

DATE	REVISED BY	DATE REVISED
	RA	2/00
	OR	6/99
	OR	6/99
5/99	RA	5/99

CALCULATED/DESIGNED BY
CHECKED BY

DESIGN OVERSIGHT

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00

TIME PLOTTED => $$$$$$SYSTIME$$$$$$

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FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		5	407

Olga A. T. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-03
CIVIL
STATE OF CALIFORNIA

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
Livermore, CA 94550

MK CENTENNIAL
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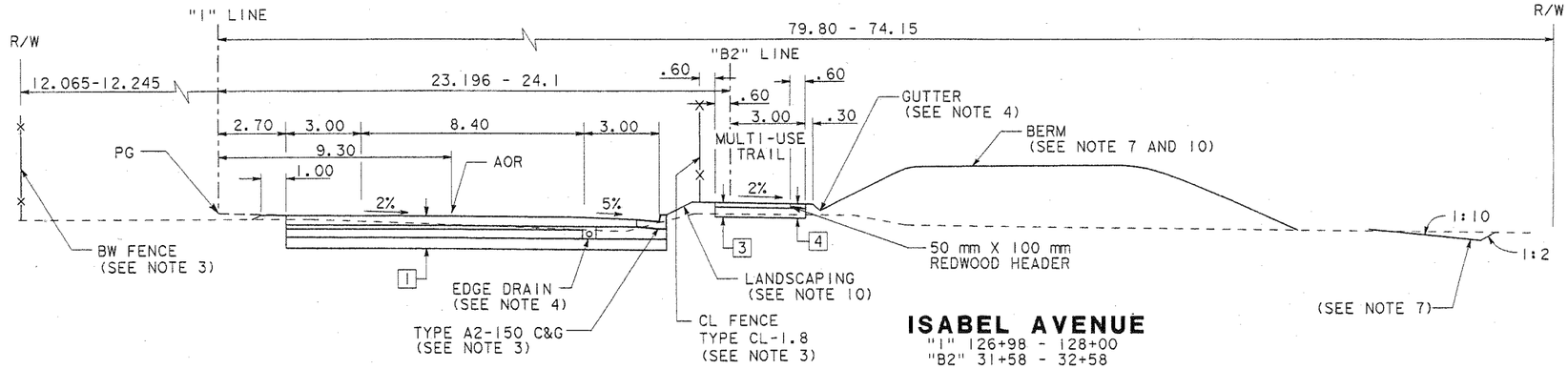
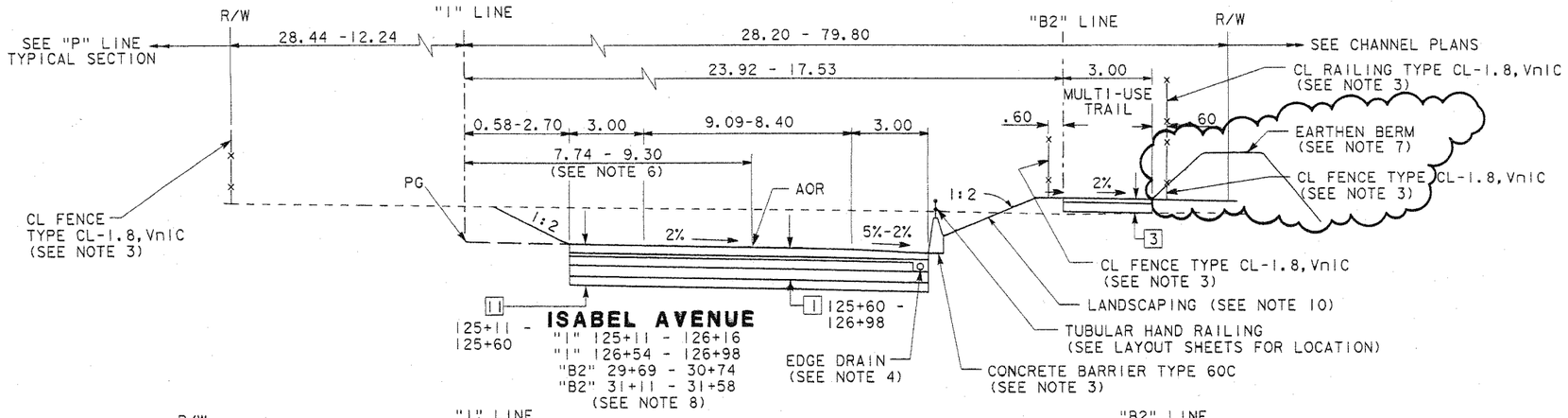
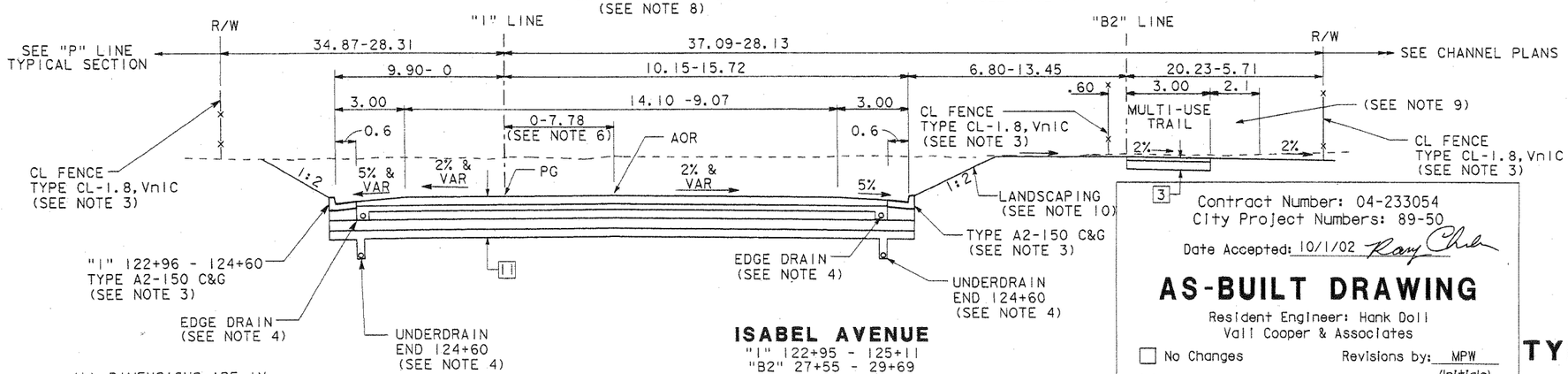


ISABEL AVENUE
"I" 126+98 - 128+00
"B2" 31+58 - 32+58



ISABEL AVENUE
"I" 125+11 - 126+16
"I" 126+54 - 126+98
"B2" 29+69 - 30+74
"B2" 31+11 - 31+58
(SEE NOTE 8)



ISABEL AVENUE
"I" 122+95 - 125+11
"B2" 27+55 - 29+69

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

TYPICAL STRUCTURAL SECTIONS

I	180 mm AC (TYPE A) 75 mm ATPB (OMIT FOR I MOD) 210 mm Cl 2 AB 330 mm AS Cl 4
2	390 mm AC (TYPE A)
3	75 mm AC (TYPE A) 150 mm Cl 2 AB
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ABBREVIATIONS

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EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

AS-BUILT DRAWING
Resident Engineer: Hank Doll
Vali Cooper & Associates
☐ No Changes
☒ Changes As Noted
Revisions by: MPW (Initials)

TYPICAL CROSS SECTIONS
NO SCALE

X-4

CALCULATED/ DESIGNED BY	CHECKED BY	DATE	REVISED BY	DATE REVISED
OR	RA	5/99	OR	6/99
			OR	6/99
			RA	2/00

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
DESIGN OVERSIGHT

LAST REVISION 00-00-00
TIME PLOTTED => $$$$$$SYTIME$$$$$$

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84		6	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-03
CIVIL
STATE OF CALIFORNIA

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
Livermore, CA 94550

MK CENTENNIAL
5000 Hopyard Road, Suite 100
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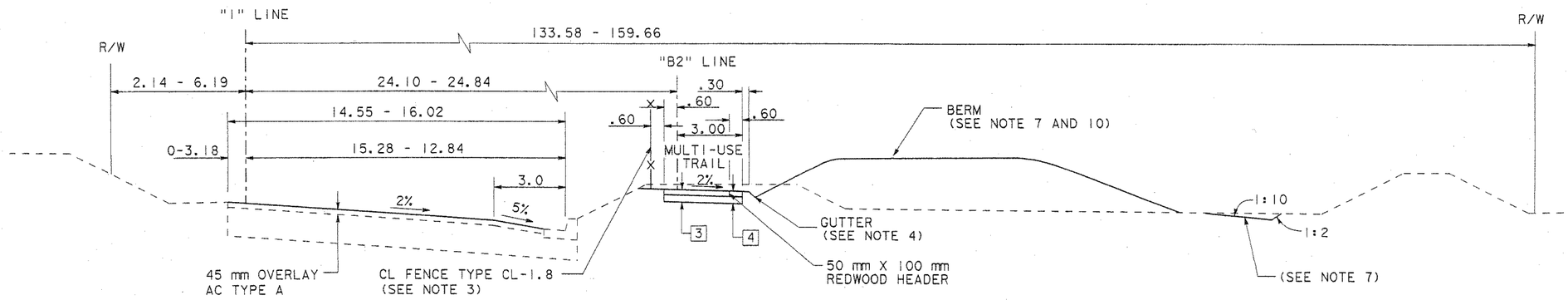
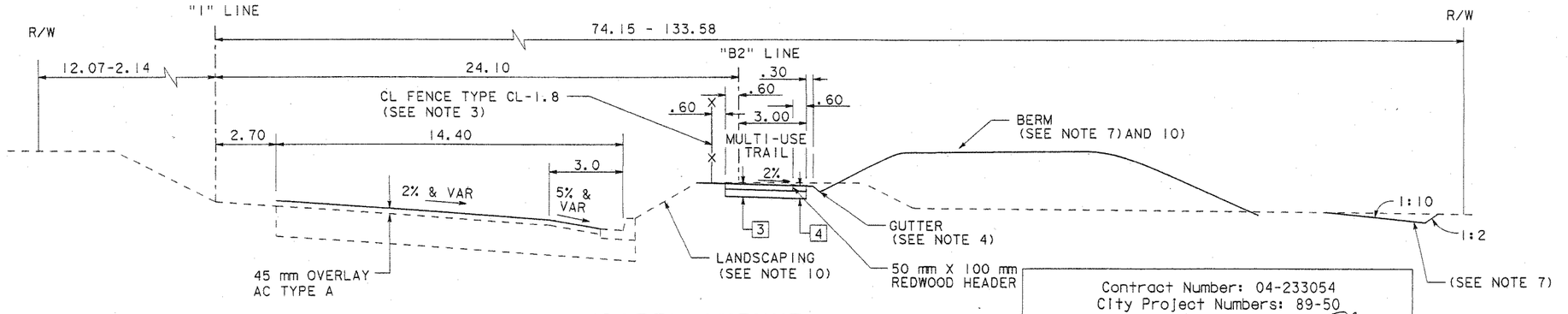


ISABEL AVENUE
"I" 133+40 - 134+00
"B2" 38+00 - 38+58



ISABEL AVENUE
"I" 128+00 - 133+40
"B2" 32+58 - 38+00

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING
Resident Engineer: Hank Doll
Vali Cooper & Associates
☒ No Changes
☐ Changes As Noted
Revisions by: MPW (Initials)

TYPICAL STRUCTURAL SECTIONS

1. 180 mm AC (TYPE A)
   75 mm ATPB (OMIT FOR 1 MOD)
   210 mm Cl 2 AB
   330 mm AS Cl 4
2. 390 mm AC (TYPE A)
3. 75 mm AC (TYPE A)
   150 mm Cl 2 AB
4. 75 mm DECOMPOSED GRANITE
   150 mm CL 2 AB
5. 210 mm AC (TYPE A)
   600 mm Cl 2 AB
6. EXISTING SECTION
   50 mm AC
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7. EXISTING SECTION
   192 mm AC
   204 mm AB
   128 mm AS
8. EXISTING SECTION
   192 mm AC
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ABBREVIATIONS

VAR	VARIABLE
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TYPICAL CROSS SECTIONS

NO SCALE

X-5

DESIGN OVERSIGHT | STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | Caltrans

CALCULATED/ DESIGNED BY	DATE	REVISED BY	DATE REVISED
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OR	RA	5/99	OR 6/99

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FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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DGN FILE => $$$$$$$$$$DGNSPEC$$$$$$$$$$

CU 04256 | EA 233051

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — OLGA ANGELICA RODRIGUEZ — No. 53594 — Exp. 6-30-03 — CIVIL — STATE OF CALIFORNIA

CITY OF LIVERMORE
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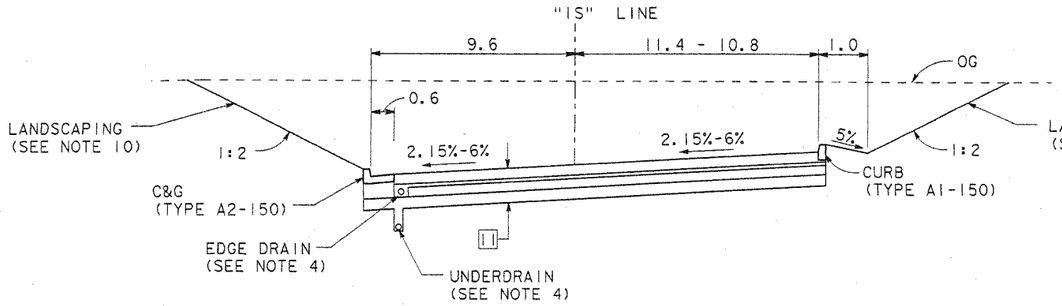
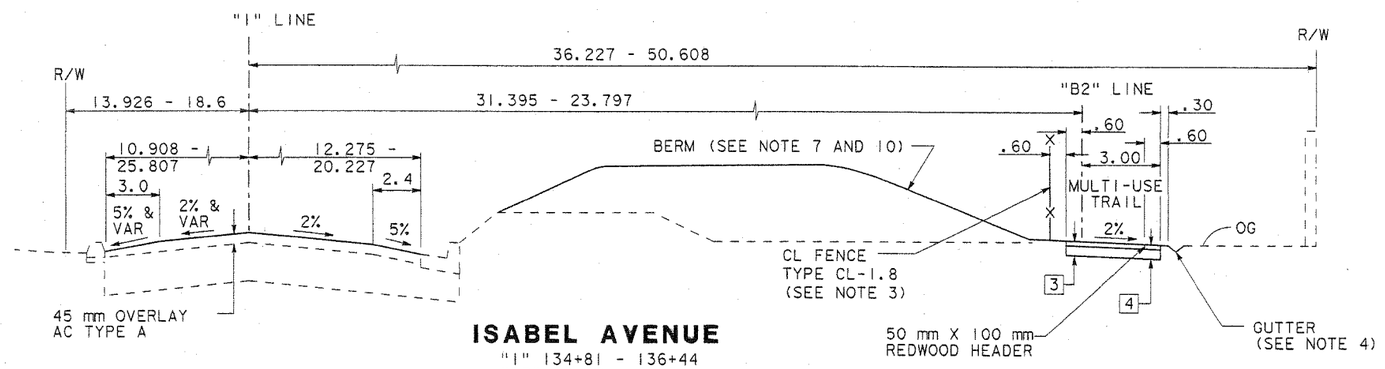
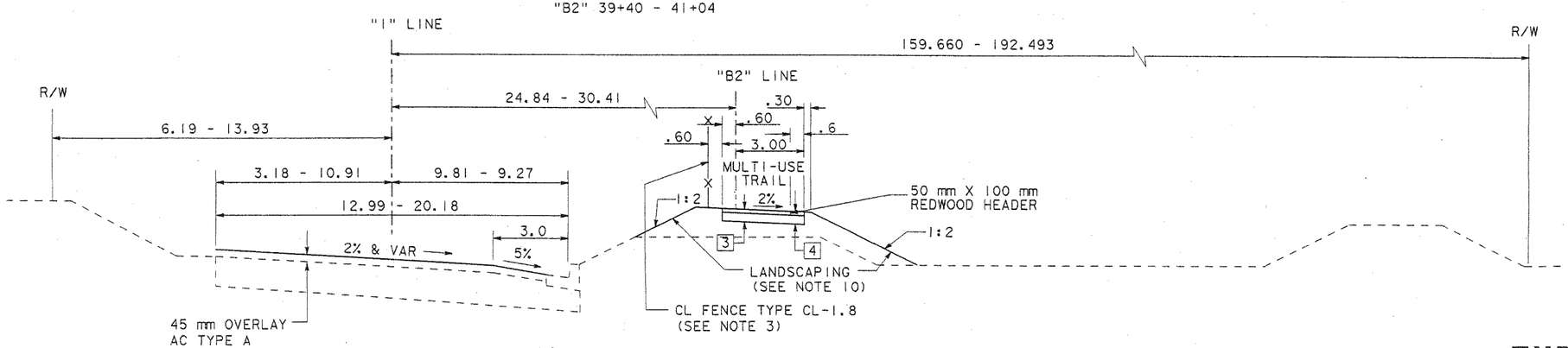


ISABEL AVENUE CONNECTOR
"IS" 20+12 - 20+76



ISABEL AVENUE
"I" 134+81 - 136+44
"B2" 39+40 - 41+04



ISABEL AVENUE
"I" 134+00 - 134+81
"B2" 38+58 -39+40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING
Resident Engineer: Hank Doll
Vail Cooper & Associates
☒ No Changes
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TYPICAL STRUCTURAL SECTIONS

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9	EXISTING SECTION 168 mm AC 204 mm PCC
10	EXISTING SECTION 152 mm AC 442 mm PCC
11	180 mm AC (TYPE A) 75 mm ATPB 330 mm CI 2 AB 210 mm CI 3 PERMEABLE MATERIAL
12	150 mm CI 2 AB

ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-6

CALCULATED/ DESIGNED BY	DATE	REVISED BY	DATE REVISED
CHECKED BY	5/99	OR	6/99
RA	5/99	OR	6/99

DESIGN OVERSIGHT

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 00-00-00

TIME PLOTTED => $$$$$$SYTIME$$$$$$

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FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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NOTES:

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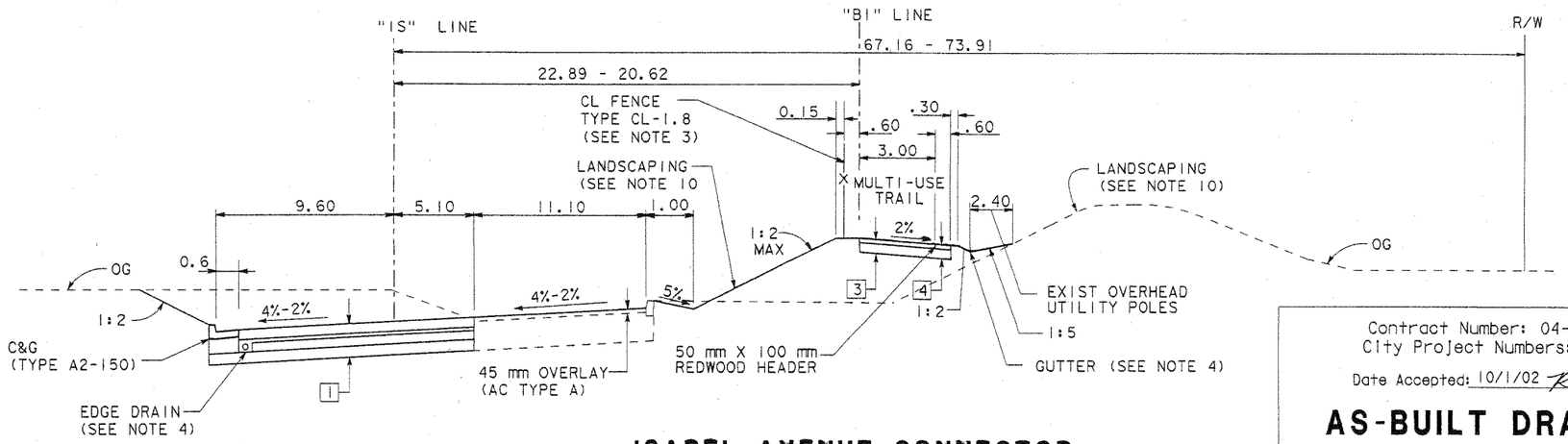
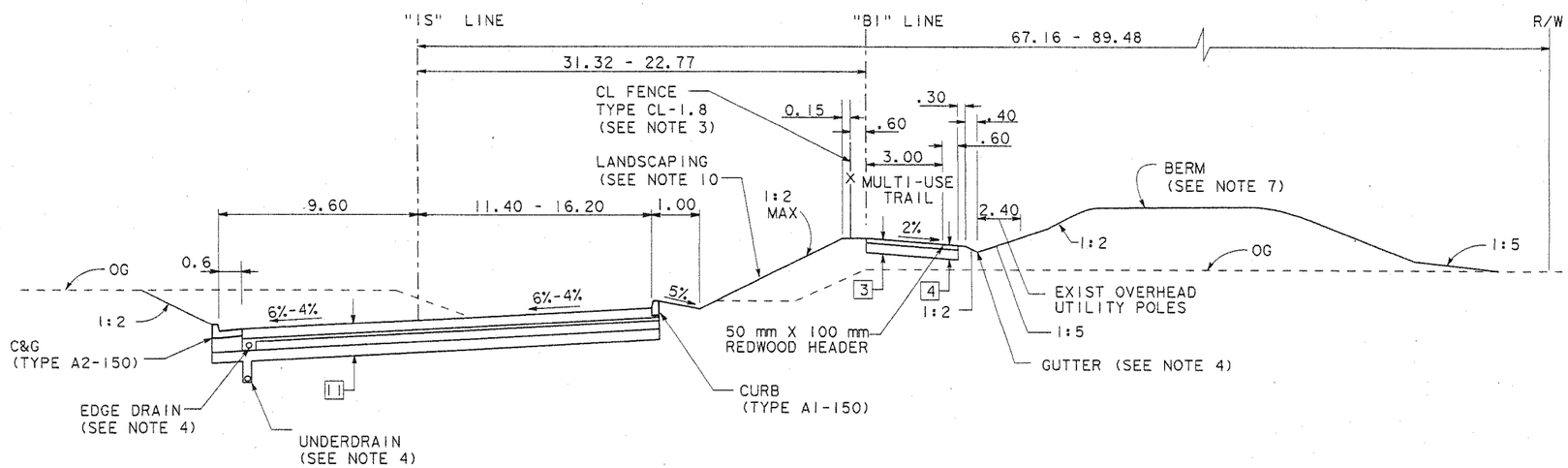


ISABEL AVENUE CONNECTOR
"IS" 21+85 - 23+00
"BI" 25+81 - 26+95



ISABEL AVENUE CONNECTOR
"IS" 20+76 - 21+85
"BI" 24+65 - 25+81

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84		8	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — OLGA ANGELICA RODRIGUEZ — No. 53594 — Exp. 6-30-03 — CIVIL — STATE OF CALIFORNIA

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
Livermore, CA 94550

MK CENTENNIAL
5000 Hopyard Road, Suite 100
Pleasanton, CA 94588
TEL: 510-460-5050 FAX: 510-460-5064

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Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING
Resident Engineer: Hank Doll
Vail Cooper & Associates
☒ No Changes
☐ Changes As Noted
Revisions by: MPW (Initials)

TYPICAL STRUCTURAL SECTIONS

1 — 180 mm AC(TYPE A)
75 mm ATPB (OMIT FOR 1 MOD)
210 mm Cl 2 AB
330 mm AS Cl 4

2 — 390 mm AC (TYPE A)

3 — 75 mm AC (TYPE A)
150 mm Cl 2 AB

4 — 75 mm DECOMPOSED GRANITE
150 mm CL 2 AB

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600 mm Cl 2 AB

6 — EXISTING SECTION
50 mm AC
76 mm AB

7 — EXISTING SECTION
192 mm AC
204 mm AB
128 mm AS

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192 mm AC
204 mm AB
253 mm AS

9 — EXISTING SECTION
168 mm AC
204 mm PCC

10 — EXISTING SECTION
152 mm AC
442 mm PCC

11 — 180 mm AC (TYPE A)
75 mm ATPB
330 mm Cl 2 AB
210 mm Cl 3 PERMEABLE MATERIAL

12 — 150 mm Cl 2 AB

ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-7

DESIGN OVERSIGHT	CALCULATED/ DESIGNED BY	DATE	REVISED BY	DATE REVISED
	CHECKED BY	5/99	OR	6/99
	RA	5/99	OR	6/99

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00 TIME PLOTTED => $$$$$$SYSTIME$$$$$$

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FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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DGN FILE => $$$$$$$$$$DGNSPEC$$$$$$$$$$

CU 04256 EA 233051

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84		9	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-03
CIVIL
STATE OF CALIFORNIA

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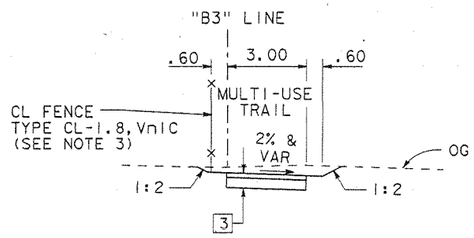
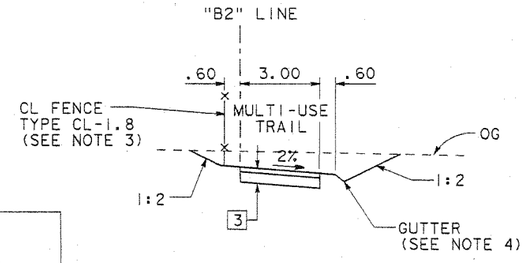


MULTI-USE TRAIL
"B3" 10+00 - 12+33



MULTI-USE TRAIL
"B2" 25+22 - 26+48

Contract Number: 04-233054
City Project Numbers: 89-50

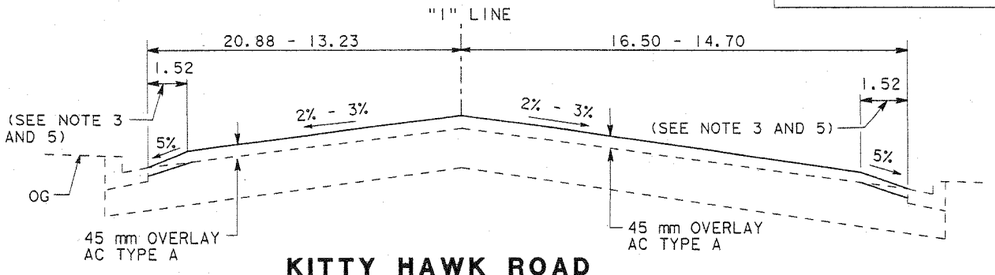
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

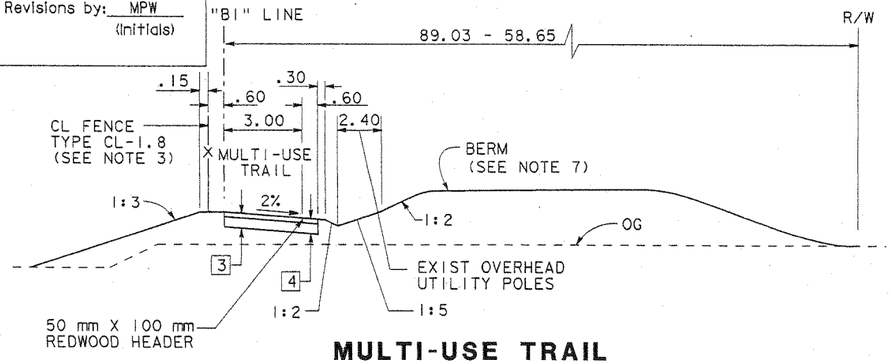
Resident Engineer: Hank Doll
Vali Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)



KITTY HAWK ROAD
"1" 136+83 - 136+90



MULTI-USE TRAIL
"B1" 22+75 - 24+65

TYPICAL STRUCTURAL SECTIONS

- 1 — 180 mm AC (TYPE A); 75 mm ATPB (OMIT FOR 1 MOD); 210 mm Cl 2 AB; 330 mm AS Cl 4
- 2 — 390 mm AC (TYPE A)
- 3 — 75 mm AC (TYPE A); 150 mm Cl 2 AB
- 4 — 75 mm DECOMPOSED GRANITE; 150 mm CL 2 AB
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- 12 — 150 mm Cl 2 AB

ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-8

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DATE	REVISED BY	DATE REVISED
5/99	OR	6/99
	OR	6/99

CALCULATED/DESIGNED BY OR 5/99
CHECKED BY RA

DESIGN OVERSIGHT

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00
TIME PLOTTED => $$$$$$$SYTIME$$$$$$

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84		10	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

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OLGA ANGELICA RODRIGUEZ
No. 53594
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CIVIL
STATE OF CALIFORNIA

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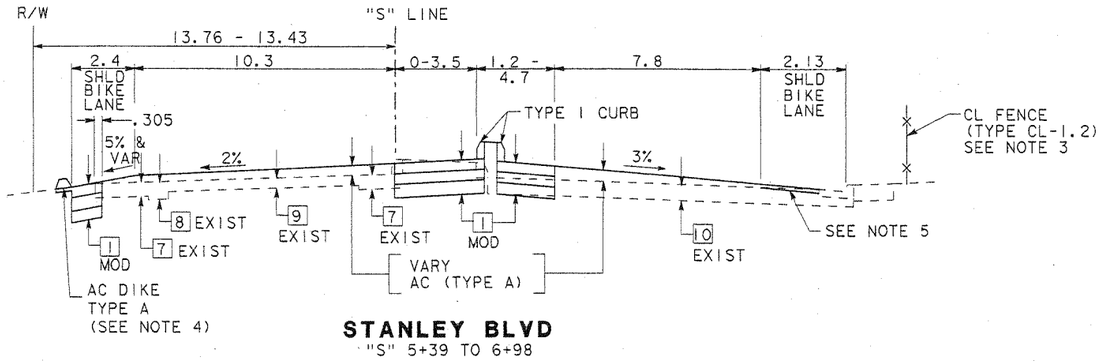
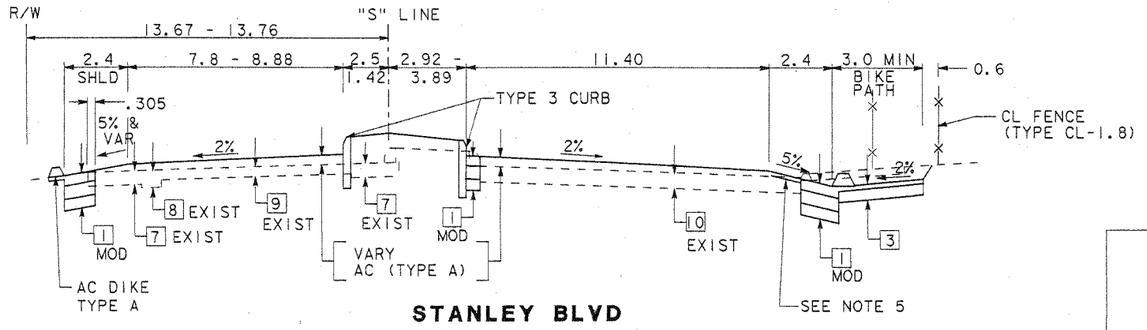
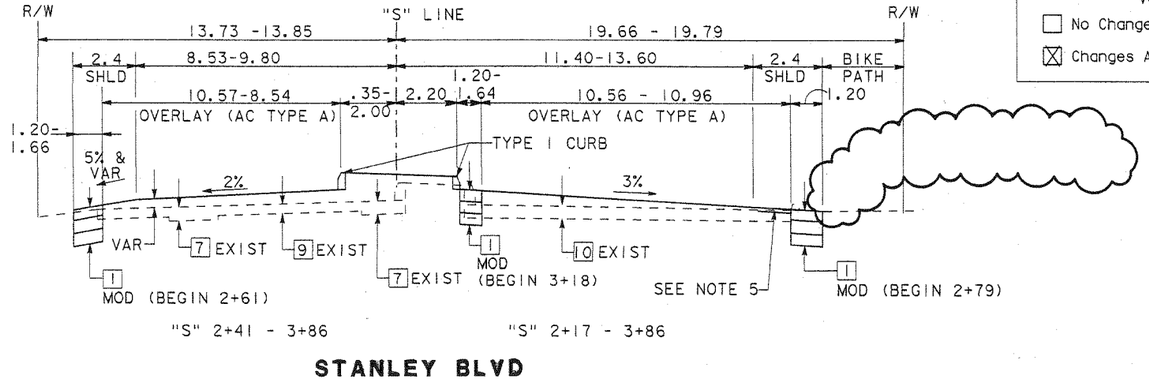


STANLEY BLVD
"S" 5+39 TO 6+98



STANLEY BLVD
"S" 4+53 TO 5+39



"S" 2+41 - 3+86 "S" 2+17 - 3+86

STANLEY BLVD

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (initials)

TYPICAL STRUCTURAL SECTIONS

1	180 mm AC(TYPE A) 75 mm ATPB (OMIT FOR 1 MOD) 210 mm Cl 2 AB 330 mm AS Cl 4
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12	150 mm Cl 2 AB

ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
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TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

TYPICAL CROSS SECTIONS

NO SCALE

X-9

REVISED BY	DATE REVISED
OR	6/99
OR	6/99
DATE 5/99	5/99
OR	RA
CALCULATED/ DESIGNED BY	CHECKED BY

DESIGN OVERSIGHT

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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CU 04256 EA 233051

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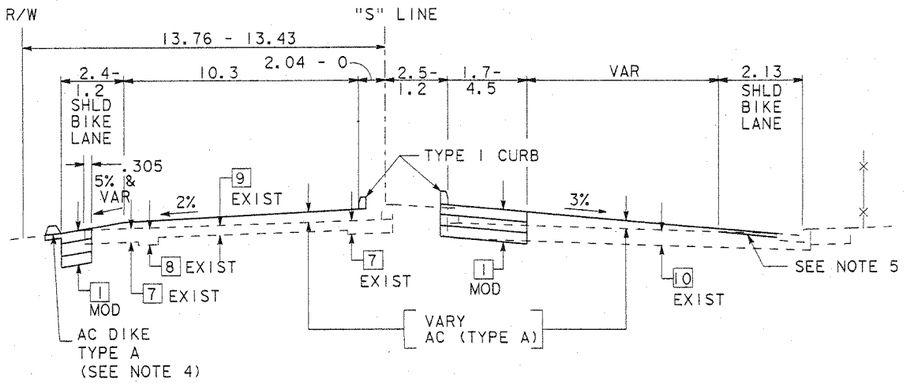
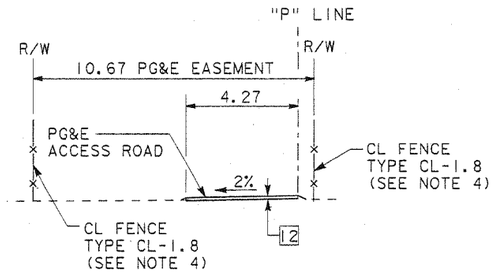
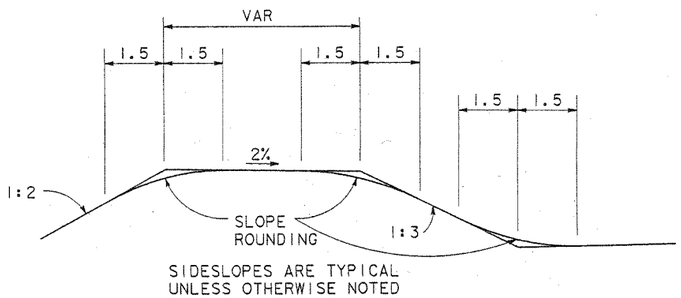


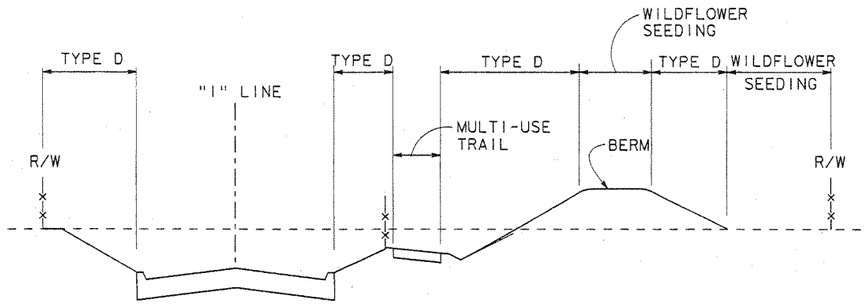
STANLEY BLVD
"S" 6+98 TO 7+49



PG&E ACCESS ROAD
"P" 10+05 - 12+31



TYPICAL BERM
(SEE NOTE 7)



TYPICAL EROSION CONTROL

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
OLGA ANGELICA RODRIGUEZ
No. 53594
Exp. 6-30-03
CIVIL
STATE OF CALIFORNIA

5/11/99
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Contract Number: 04-233054
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Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING
Resident Engineer: Hank Doll
Vail Cooper & Associates
☒ No Changes Revisions by: MPW (Initials)
☐ Changes As Noted

TYPICAL CROSS SECTIONS

NO SCALE

X-10

DESIGNED BY	CHECKED BY	DRAWN BY	CALCULATED/ CHECKED BY
OR	RA	OR	

DATE	REVISED BY	DATE REVISED
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	OR	6/99

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — DESIGN OVERSIGHT
Caltrans

LAST REVISION 00-00-00 TIME PLOTTED => $$$$$$SYSTIME$$$$$$

DIST	COUNTY	ROUTE	MILE POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	26.6/26.9	1	25

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — DAVID E. MELIS No. 54383 12/31/09 CIVIL ENGINEER — STATE OF CALIFORNIA

MARK THOMAS & COMPANY, INC.
5000 HOPYARD ROAD, SUITE 315
PLEASANTON, CA 94588

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OAKS BUSINESS PARK - TRACT 7300

CONSTRUCTION PLANS FOR ISABEL AVENUE (SR 84) WIDENING

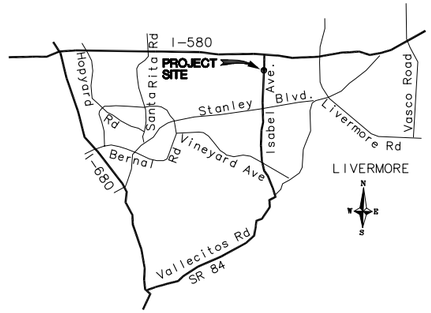
IN ALAMEDA COUNTY

IN LIVERMORE

FROM ARROYO MOCHO BRIDGE

TO 300M SOUTH OF JACK LONDON BOULEVARD

AND AT JACK LONDON BOULEVARD



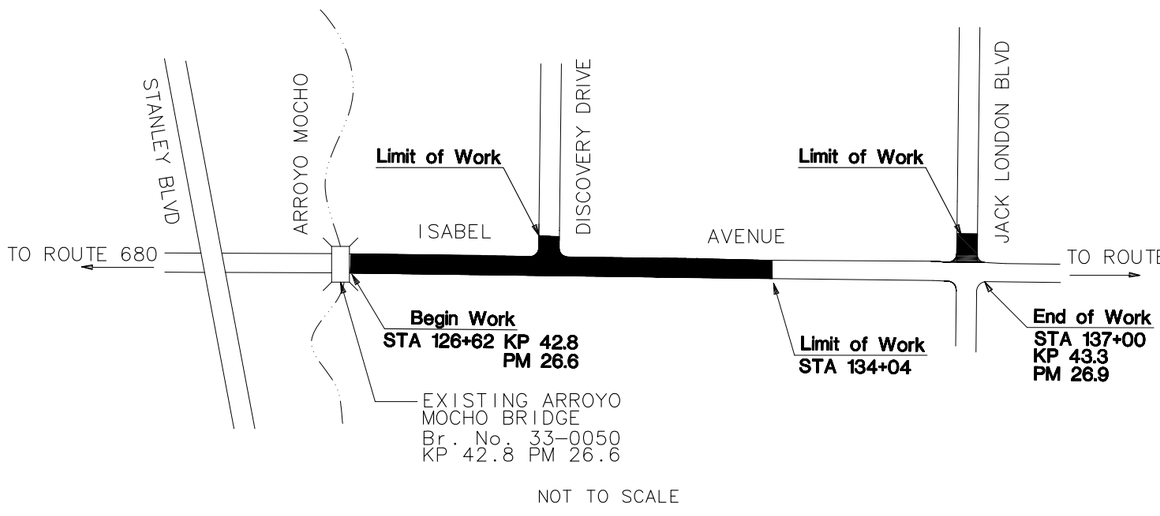
VICINITY MAP
No Scale

INDEX OF SHEETS

No.	Title
1	TITLE SHEET
2	TYPICAL CROSS SECTIONS
3–4	LAYOUT
5–8	CONSTRUCTION DETAILS
9–10	DRAINAGE PLANS AND PROFILES
11	EDGE DRAINS
12–14	PAVEMENT DELINEATION
15–16	SIGNING
17	STAGE CONSTRUCTION
18–25	SIGNAL & LIGHTING

GENERAL NOTES:

1. ALL CONSTRUCTION SHALL CONFORM TO THESE PLANS, CALTRANS' STANDARD DETAILS AND SPECIFICATION, DATED JULY 2004, THE STANDARD DETAILS AND SPECIFICATIONS OF THE CITY OF LIVERMORE, DATED MAY 2001, THE COUNTY OF ALAMEDA METRIC DESIGN GUIDELINES, DATED JULY 1995 AND THE STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION, DATED 1994,WHERE APPLICABLE.
2. THE ENGINEER SHALL PROVIDE STAKING TO ESTABLISH GRADE AS PROVIDED FOR IN THE PROJECT SPECIFICATIONS.
3. THE CONTRACTOR SHALL NOTIFY THE CITY ENGINEER 48 HOURS PRIOR TO REQUIRED INSPECTIONS AND CONSTRUCTION STAKING.
4. CONTRACTOR SHALL KEEP THE CITY POLICE, FIRE DEPARTMENT, AND ENGINEER INFORMED DAILY REGARDING EXCAVATIONS, BARRICADES, AND DETOURS.
5. CONTRACTOR SHALL LEAVE EMERGENCY TELEPHONE NUMBERS WITH THE ABOVE DEPARTMENTS AND ENGINEER.
6. IT SHALL BE CONTRACTOR'S RESPONSIBILITY TO VERIFY FIELD LOCATIONS, ELEVATIONS, ETC. OF EXISTING FACILITIES AND TO IMMEDIATELY NOTIFY THE ENGINEER OF ANY FIELD CONFLICTS OR OMISSIONS.
7. THE CONTRACTOR SHALL KEEP EXISTING STREETS FREE FROM DIRT AND DEBRIS DURING ALL PHASES OF CONSTRUCTION.
8. THE CONTRACTOR SHALL PROVIDE DUST CONTROL AT ALL TIMES. PRIOR TO OBTAINING WATER FROM FIRE HYDRANTS, THE CONTRACTOR SHALL OBTAIN A HYDRANT WATER METER FROM THE CALIFORNIA WATER SERVICE COMPANY (OR CITY WATER RESOURCES DIVISION, WHERE APPROPRIATE).
9. THE CONTRACTOR SHALL MAINTAIN ACCESS TO PLACES OF RESIDENCE AND BUSINESS ALONG THE STREETS TO BE REPAIRED THROUGHOUT THE LIFE OF THE CONTRACT. ALL STREETS SHALL BE FULLY OPEN TO THROUGH TRAFFIC BETWEEN THE HOURS OF 3:30 PM AND 7:00 AM, EXCEPT MAJOR STREETS AND CORE COMMERCIAL STREETS WHICH SHALL REMAIN OPEN PER SUB-SECTION 01110-1.12, "MAINTAINING TRAFFIC" OF THE CONTRACT SPECIFICATIONS.
10. THE CONTRACTOR SHALL NOTIFY UNDERGROUND SERVICE ALERT (U.S.A.) 800-227-2600, 48 HOURS PRIOR TO START OF EXCAVATION OR DEMOLITION OF IMPROVEMENTS SO THAT UTILITIES MAY BE NOTIFIED AND LINES MARKED.
11. THE CONTRACTOR WILL BE REQUIRED TO PAY ANY ADDITIONAL FEES FOR INSPECTION OF ANY WORK PERFORMED OUTSIDE OF THE CITY'S NORMAL WORKING HOURS. SAID FEE WILL BE IN ACCORDANCE WITH THE LATEST PUBLIC WORKS OVERTIME INSPECTION FEE POLICY AND ARRANGEMENTS FOR INSPECTIONS SERVICES DETERMINED PRIOR TO THE WORK.
12. ANY DAMAGE TO THE EXISTING FACILITIES, INCLUDING LANDSCAPING, IRRIGATION, FENCES, WALLS, SIDEWALK AND OTHER PAVEMENT SURFACES, SHALL BE REPAIRED AT CONTRACTOR'S EXPENSE.
13. COMPACTION TESTING WILL BE PERFORMED ON ALL STREET WORK TO VERIFY THAT COMPACTION CONFORMS TO CITY STANDARDS. THE INITIAL TEST AND ONE RETEST WILL BE PERFORMED BY THE CITY (24 HOURS NOTICE REQUIRED). ALL ADDITIONAL TESTING WILL BE AT THE CONTRACTOR'S EXPENSE.
14. ALL RETURN RADII AND CURVE DATA ARE TO FACE OF CURB OR TO CONTROL LINES.



NOT TO SCALE

RECORD DRAWING

BASED UPON A SINGLE SITE OBSERVATION (NOT CONTINUOUS OR EXHAUSTIVE INSPECTIONS) AND INFORMATION PROVIDED BY OTHERS. IT IS OUR OPINIONS THAT THIS DRAWING INDICATES, TO THE BEST OF OUR KNOWLEDGE, AN ACTUAL RECORD OF CONSTRUCTION. MARK THOMAS & COMPANY, HAS NOT PERFORMED CONSTRUCTION INSPECTION OR FIELD SURVEYS TO CHECK AS-CONSTRUCTED CONDITIONS, OR DETAILED FIELD REVIEWS TO VERIFY THE ACCURACY AND COMPLETENESS OF THIS DRAWING. MARK THOMAS & COMPANY CANNOT AND DOES NOT WARRANT ITS ACCURACY AND COMPLETENESS AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS AND OMISSIONS WHICH MAY BE INCORPORATED HEREIN AS A RESULT.

MARK THOMAS & COMPANY — 1-25-08 DATE

RECOMMENDED FOR APPROVAL:

DATE

APPROVED BY:

DATE

DATE

APPROVED BY TRAFFIC SECTION — DATE

BENCHMARK

MON NO. 31 FOUND 3.175 mm (1/8") IRON PIN SET IN CONCRETE IN A STANDARD CITY WELL MONUMENT BOX AT THE INTERSECTION OF KITTY HAWK ROAD AND RICKENBACKER CIRCLE 3.601m LEFT OF CENTER LINE STATION "I" 139 + 82.625. THE ELEVATION IS 122.796

BASIS OF BEARING

ALL COORDINATES, DISTANCES AND BEARINGS ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM NAD 23, ZONE 3, HPGN, EPOCH 1991.254

CALL U.S.A.
UNDERGROUND SERVICE ALERT
TOLL FREE
800-227-2600
48 HOURS BEFORE YOU DIG

Metric

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying, and Planning Services
6920 Koll Center Parkway, Suite 219
Pleasanton, CA 94566 925/417-8000

SHEET NO. 1 OF 25 SHEETS

ISABEL AVENUE WIDENING

TITLE AND LOCATION MAP

COVER SHEET

PROJECT NO. 54-0095B

NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATIONS AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR LOCATION AND TYPE OF AC DIKE SEE LAYOUT PLANS.
4. FOR EDGE DRAIN SEE EDGE DRAIN PLANS
5. MATCH THE ELEVATION OF EXISTING AND PROPOSED ATPB LAYERS.

RECORD DRAWING

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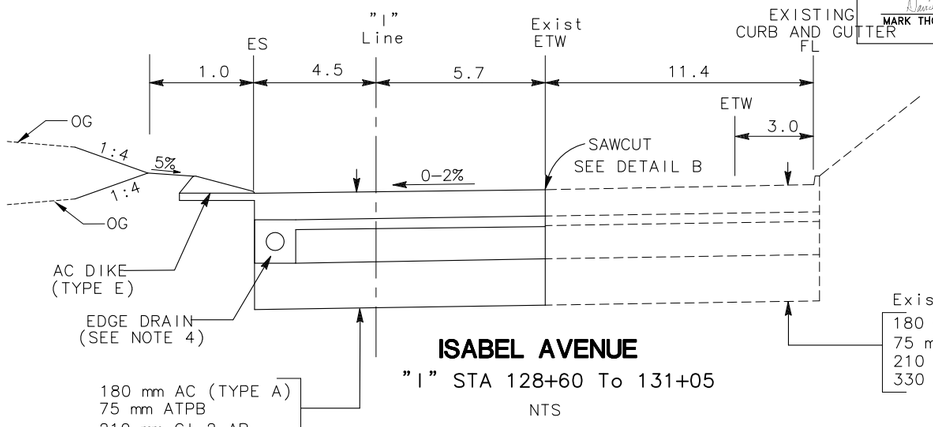
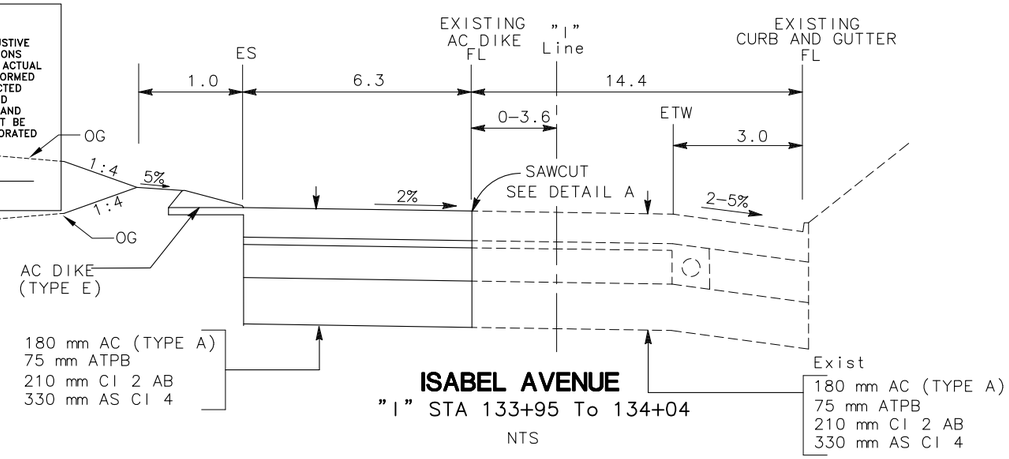
David E. Melis — MARK THOMAS & COMPANY

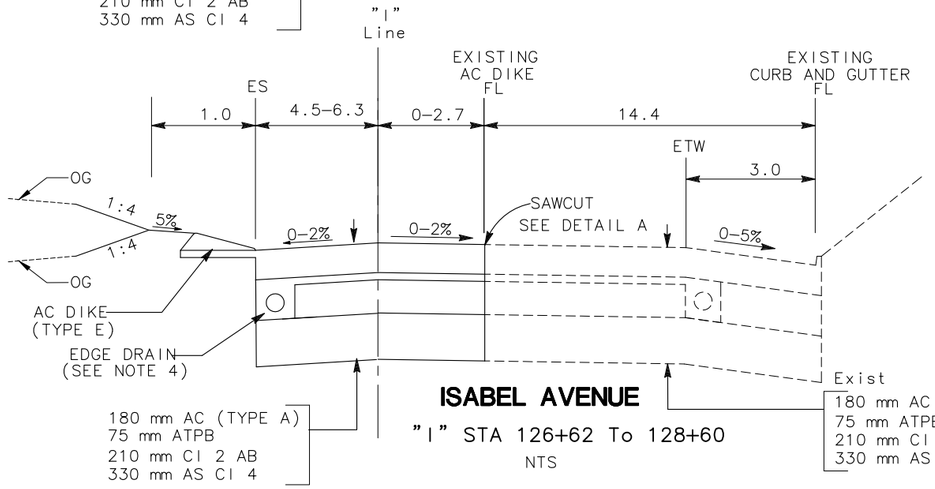
1-25-08 — DATE



ISABEL AVENUE
"I" STA 128+60 To 131+05
NTS

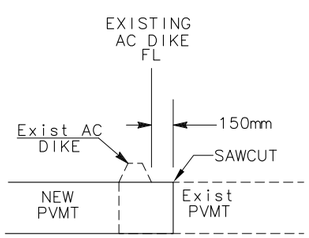


ISABEL AVENUE
"I" STA 133+95 To 134+04
NTS

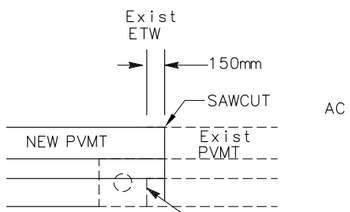


ISABEL AVENUE
"I" STA 126+62 To 128+60
NTS

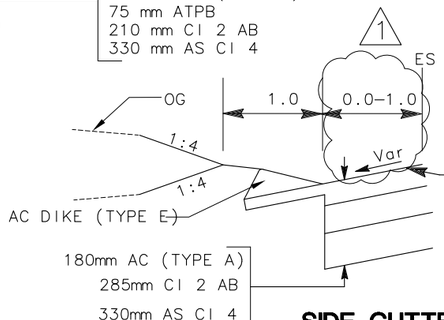
ISABEL AVENUE
"I" STA 131+95 To 133+49
NTS



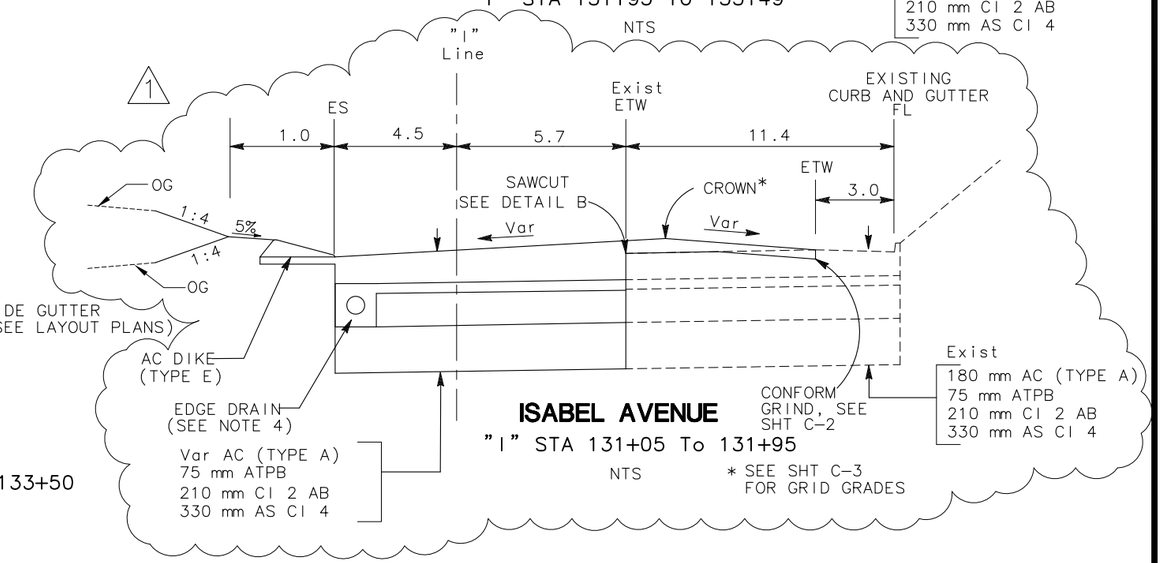
DETAIL A
NTS



DETAIL B
NTS



SIDE GUTTER
"I" STA 131+60 To 133+50
NTS



ISABEL AVENUE
"I" STA 131+05 To 131+95
NTS

* SEE SHT C-3 FOR GRID GRADES

Metric

REGISTERED PROFESSIONAL ENGINEER — DAVID E. MELIS — No. 54383 — Exp. 12/31/09 — CIVIL — STATE OF CALIFORNIA

APPROVED BY: David E. Melis
DAVID E. MELIS
RCE #54383
SCALE: NTS DRAWN BY: TM
DATE: 8-01-05 CHECKED BY: SM

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying, and Planning Services
5000 Hopyard Road, Suite 315
Pleasanton, CA 94588 925/417-8000

NO.	BY	DATE	REVISIONS
1	DM	10/07	PROFILE CORRECTION

CITY OF LIVERMORE, CALIFORNIA · INCORPORATED 1876 · COUNTY OF ALAMEDA

ISABEL AVENUE WIDENING
TYPICAL CROSS SECTIONS

X-1

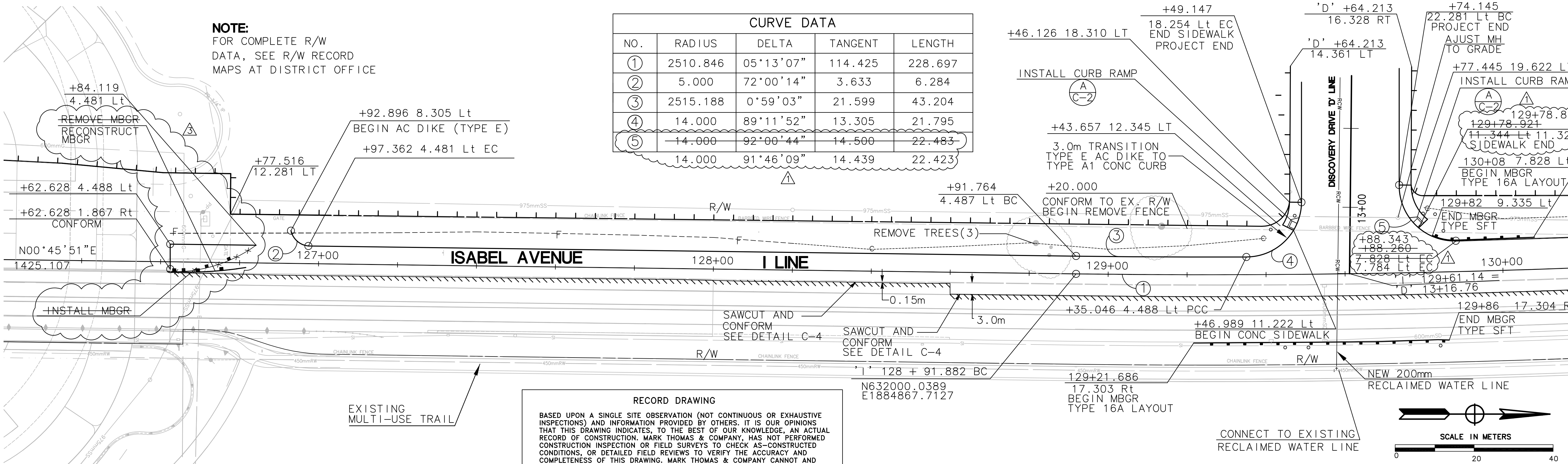
CITY OF LIVERMORE — CALIFORNIA

SHEET 2 OF 25 SHEETS

JOB NO. 54-0095B

NOTE:
FOR COMPLETE R/W
DATA, SEE R/W RECORD
MAPS AT DISTRICT OFFICE

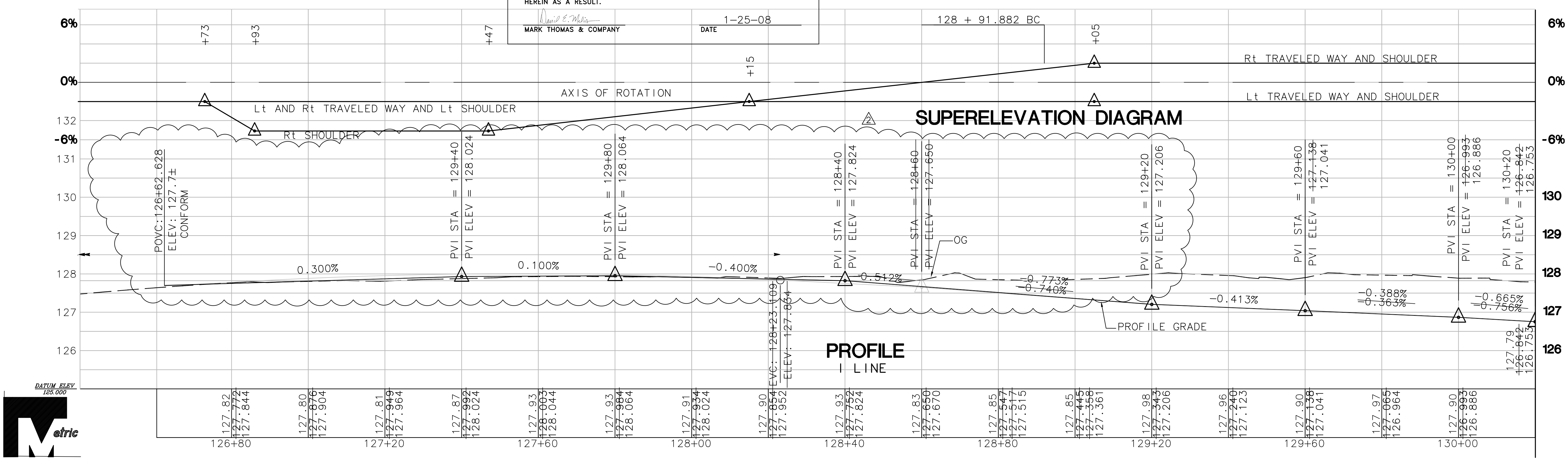
CURVE DATA				
NO.	RADIUS	DELTA	TANGENT	LENGTH
1	2510.846	05°13'07"	114.425	228.697
2	5.000	72°00'14"	3.633	6.284
3	2515.188	0°59'03"	21.599	43.204
4	14.000	89°11'52"	13.305	21.795
5	~~14.000~~	~~92°00'44"~~	~~14.500~~	~~22.483~~
	14.000	91°46'09"	14.439	22.423



RECORD DRAWING

BASED UPON A SINGLE SITE OBSERVATION (NOT CONTINUOUS OR EXHAUSTIVE INSPECTIONS) AND INFORMATION PROVIDED BY OTHERS. IT IS OUR OPINIONS THAT THIS DRAWING INDICATES, TO THE BEST OF OUR KNOWLEDGE, AN ACTUAL RECORD OF CONSTRUCTION. MARK THOMAS & COMPANY, HAS NOT PERFORMED CONSTRUCTION INSPECTION OR FIELD SURVEYS TO CHECK AS-CONSTRUCTED CONDITIONS, OR DETAILED FIELD REVIEWS TO VERIFY THE ACCURACY AND COMPLETENESS OF THIS DRAWING. MARK THOMAS & COMPANY CANNOT AND DOES NOT WARRANT ITS ACCURACY AND COMPLETENESS AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS AND OMISSIONS WHICH MAY BE INCORPORATED HEREIN AS A RESULT.

MARK THOMAS & COMPANY — DATE 1-25-08



1	TM	10/05	MODIFIED CURVE DATA
2	RC	1/07	MODIFIED PROFILE DATA
3	TM	4/07	AMENDED MBGR CONSTRUCTION
NO.	BY	DATE	REVISIONS

REGISTERED PROFESSIONAL ENGINEER — DAVID E. MELIS — No. 54383 — Exp. 12/31/09 — CIVIL — STATE OF CALIFORNIA

APPROVED BY: DAVID E. MELIS
RCE #54383
SCALE: H 1:500; V 1:50 DRAWN BY: TM
DATE: 8-01-05 CHECKED BY: SM

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying, and Planning Services
5000 Hopyard Road, Suite 315
Pleasanton, CA 94588 925/417-8000

CITY OF LIVERMORE, CALIFORNIA — INCORPORATED 1876 — COUNTY OF ALAMEDA

ISABEL AVENUE WIDENING
PROPOSED GEOMETRIC LAYOUT

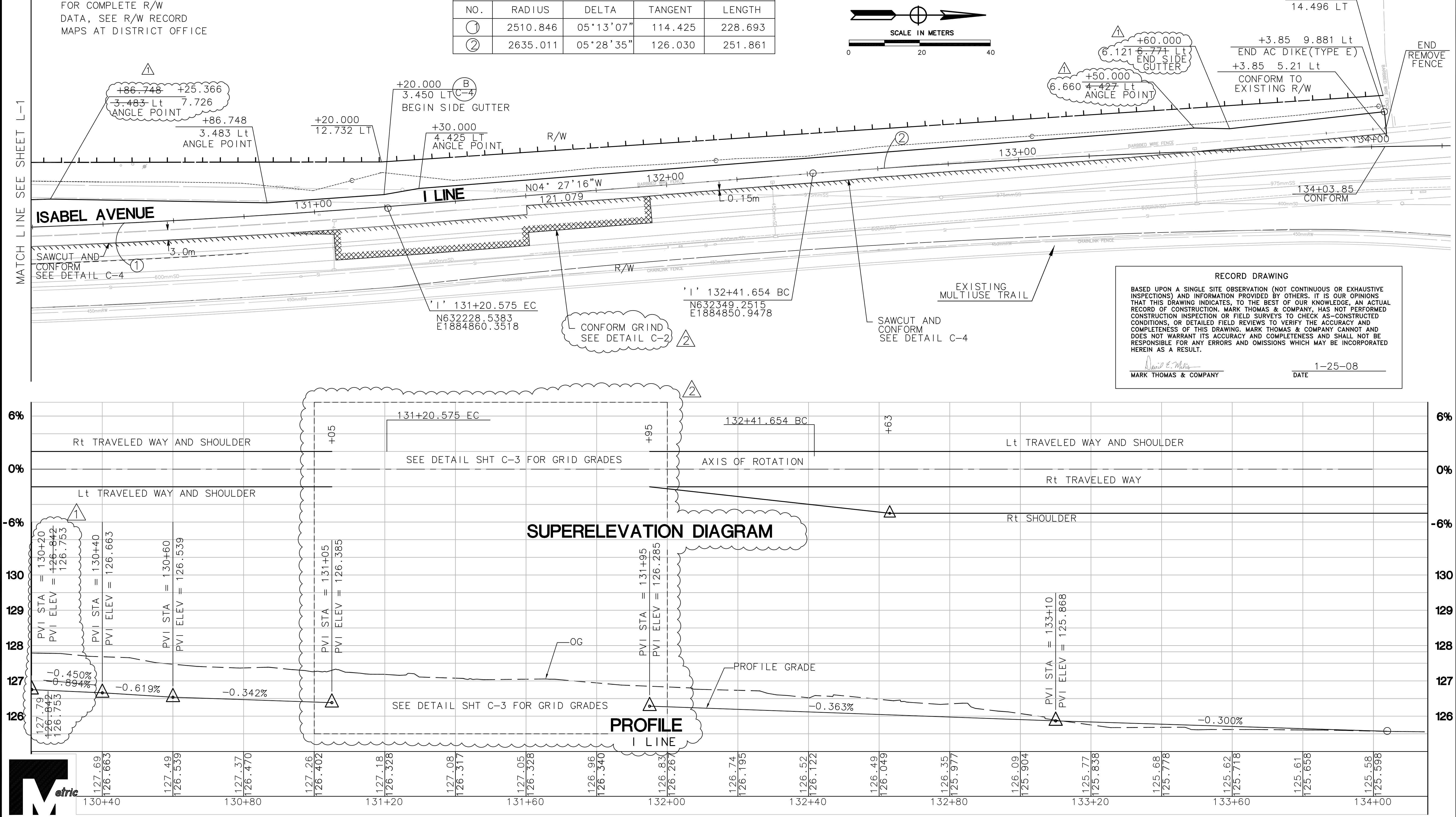
L-1

CITY OF LIVERMORE CALIFORNIA

SHEET 3 OF 25 SHEETS
JOB NO. 54-0095B

NOTE:
FOR COMPLETE R/W DATA, SEE R/W RECORD MAPS AT DISTRICT OFFICE

CURVE DATA				
NO.	RADIUS	DELTA	TANGENT	LENGTH
1	2510.846	05°13'07"	114.425	228.693
2	2635.011	05°28'35"	126.030	251.861



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MARK THOMAS & COMPANY — DATE 1-25-08

REGISTERED PROFESSIONAL ENGINEER DAVID E. MELIS No. 54383 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

APPROVED BY: DAVID E. MELIS RCE #54383
SCALE: H 1:500; V 1:50 DRAWN BY: TM
DATE: 8-01-05 CHECKED BY: SM

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying, and Planning Services
5000 Hopyard Road, Suite 315
Pleasanton, CA 94588 925/417-8000

NO.	BY	DATE	REVISIONS
1	TM	10/05	MODIFIED LT ETW CALLOUT
2	DM	10/07	PROFILE CORRECTION

CITY OF LIVERMORE, CALIFORNIA — INCORPORATED 1876 — COUNTY OF ALAMEDA

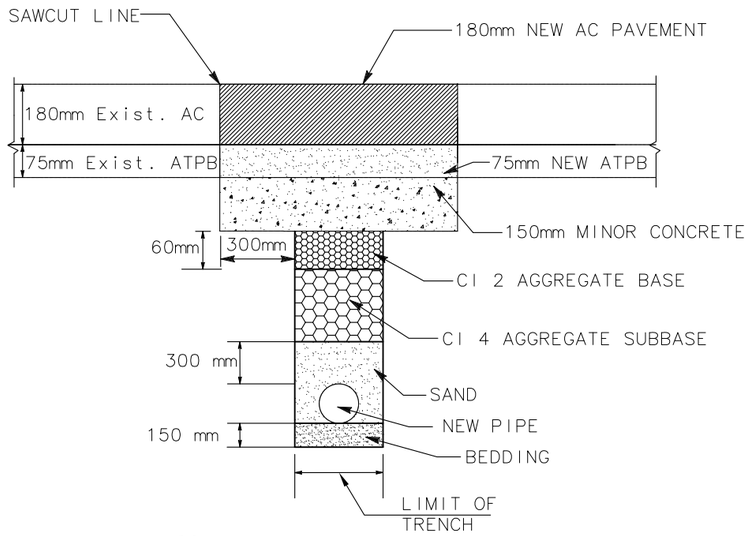
ISABEL AVENUE WIDENING
PROPOSED GEOMETRIC LAYOUT

L-2

CITY OF LIVERMORE CALIFORNIA

SHEET 4 OF 25 SHEETS

JOB NO. 54-0095B

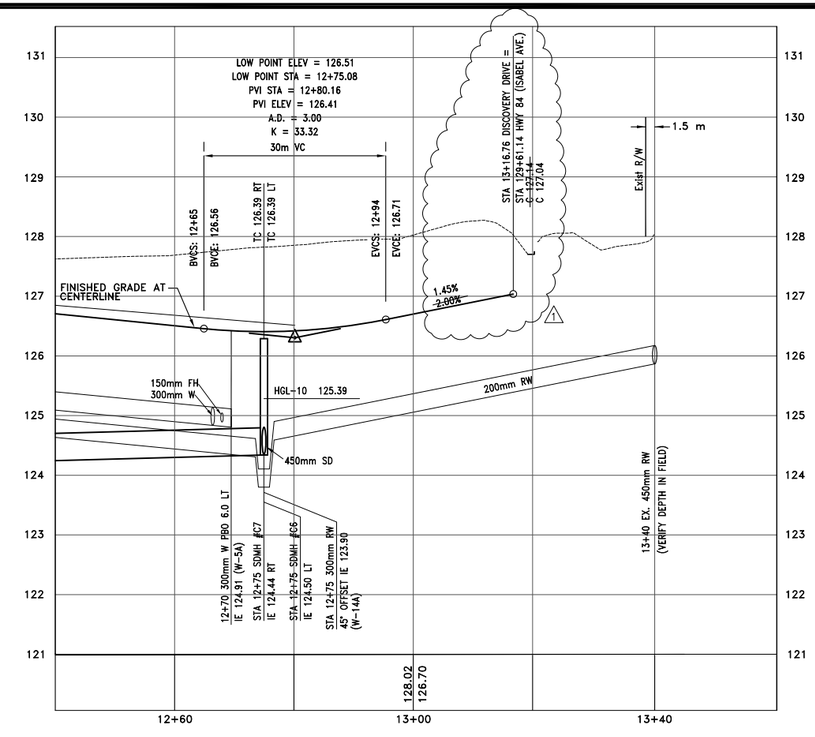


A TRENCH DETAIL —PER CITY OF LIVERMORE STD

NTS

NOTES:

1. MINOR CONCRETE MAY BE RAPID SET PCC.
2. AGGREGATE BASE & AGGREGATE SUBBASE MAY BE REPLACED WITH SLURRY CEMENT BACKFILL.



B RECLAIMED WATER LINE PROFILE

NTS

RECORD DRAWING

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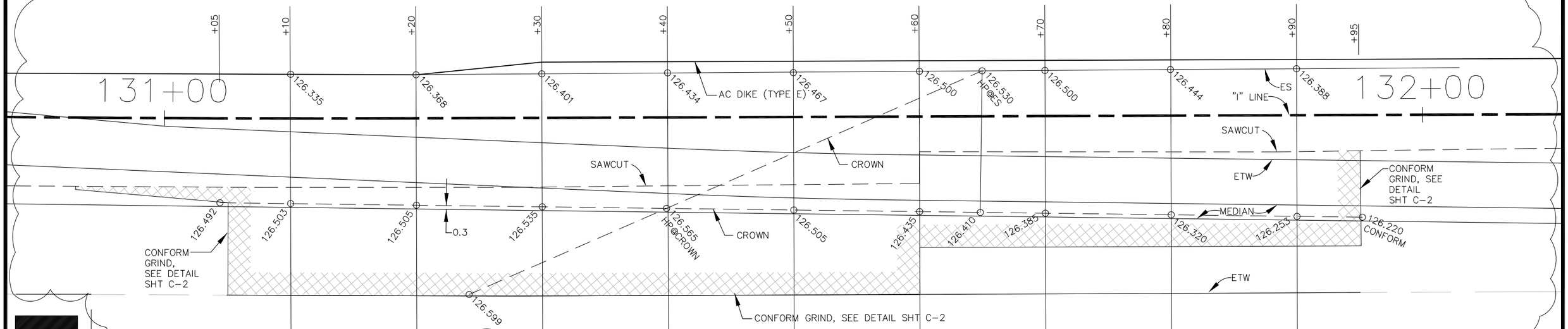
David E. Melis — MARK THOMAS & COMPANY

1-25-08 — DATE

△2



C GRID GRADES - 131+05 to 131+95

1:250

Metric

DAVID E. MELIS No. 54383 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

APPROVED BY: David E. Melis
DAVID E. MELIS
RCE #54383

SCALE: AS SHOWN DRAWN BY: TM
DATE: 8-01-05 CHECKED BY: SM

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying, and Planning Services
5000 Hopyard Road, Suite 315
Pleasanton, CA 94588 925/417-8000

NO.	BY	DATE	REVISIONS
1	TM	10/05	
2	DM	10/07	GRIDGRADES TO CORRECT
			PROFILE CROSS SLOPE

CITY OF LIVERMORE, CALIFORNIA, INCORPORATED 1876, COUNTY OF ALAMEDA

ISABEL AVENUE WIDENING
CONSTRUCTION DETAILS

C-3

CITY OF LIVERMORE CALIFORNIA

SHEET 7 OF 25 SHEETS

JOB NO. 54-0095B

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		382	407

REGISTERED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — G. NEELAKANTAN — No. 2391 — Exp. 9/30/01 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

Caltrans Metric

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chiba

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

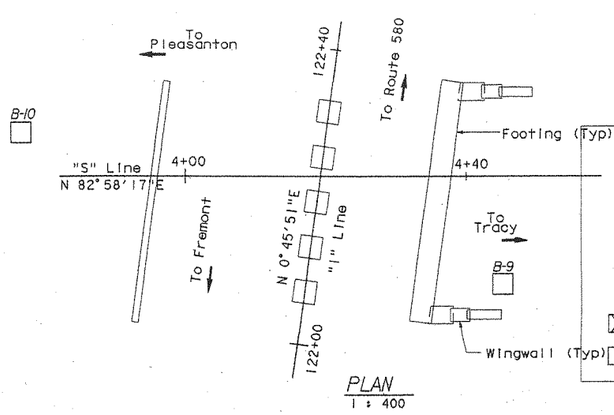
☒ No Changes Revisions by: MPW (Initials)
☐ Changes As Noted

NOTES:

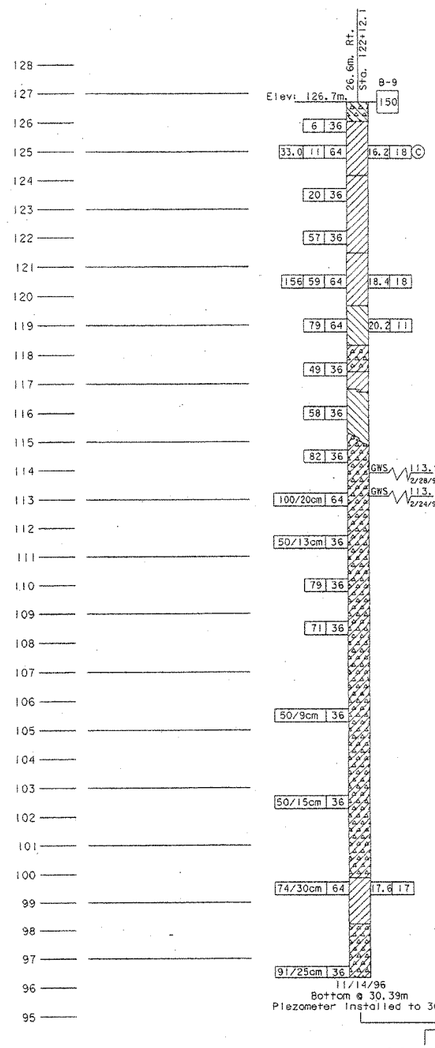
1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

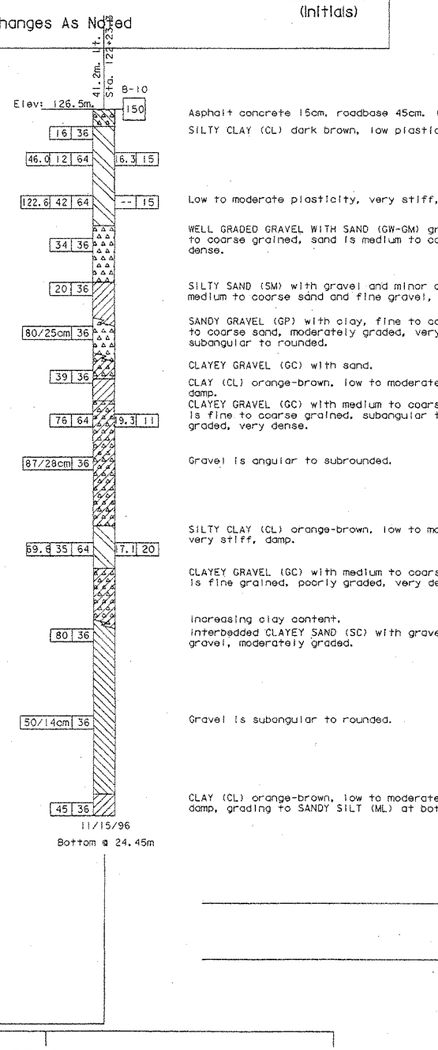
2. Soil classification and description conform to ASTM D2487.

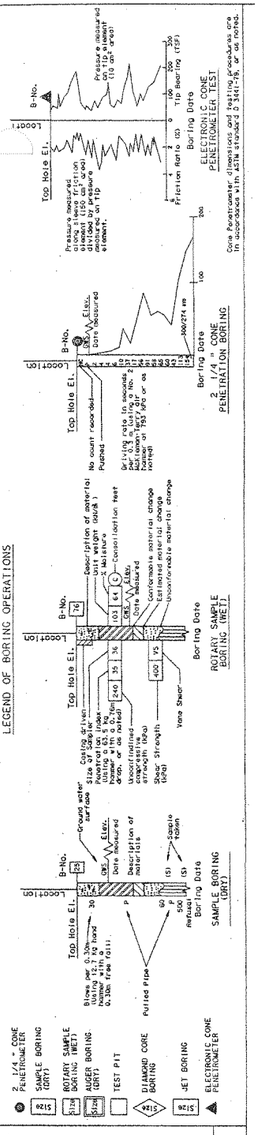
BENCHMARK:
All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).
TBM No. 2: Mon. No. 220
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.004 meters right of Center Line Station "15" 122+19.529. The elevation is 126.311 meters (414.41 feet).



PLAN
1 : 400







DESIGN OVERSIGHT	DRAWN BY	J. HULSE	N. Mace	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	O. RODRIGUEZ
SIGN OFF DATE	CHECKED BY	T. HUBER	FIELD INVESTIGATION BY: DATE:		PROJECT ENGINEER

BRIDGE NO. 33C-0406
KILOMETER POST

ISABEL AVENUE UNDERCROSSING

LOG OF TEST BORINGS

REV. DATE: 6-2-97

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 16 OF 16

TIME PLOTTED => $$$$$$$SYTIME$$$$$$

NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

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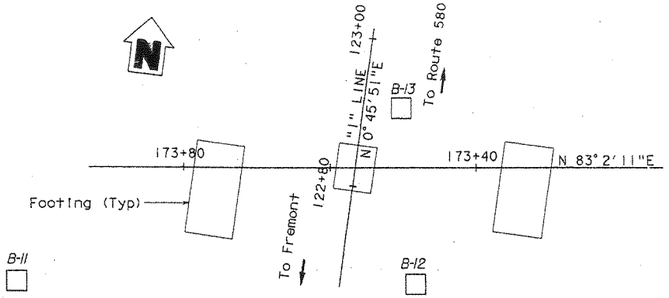
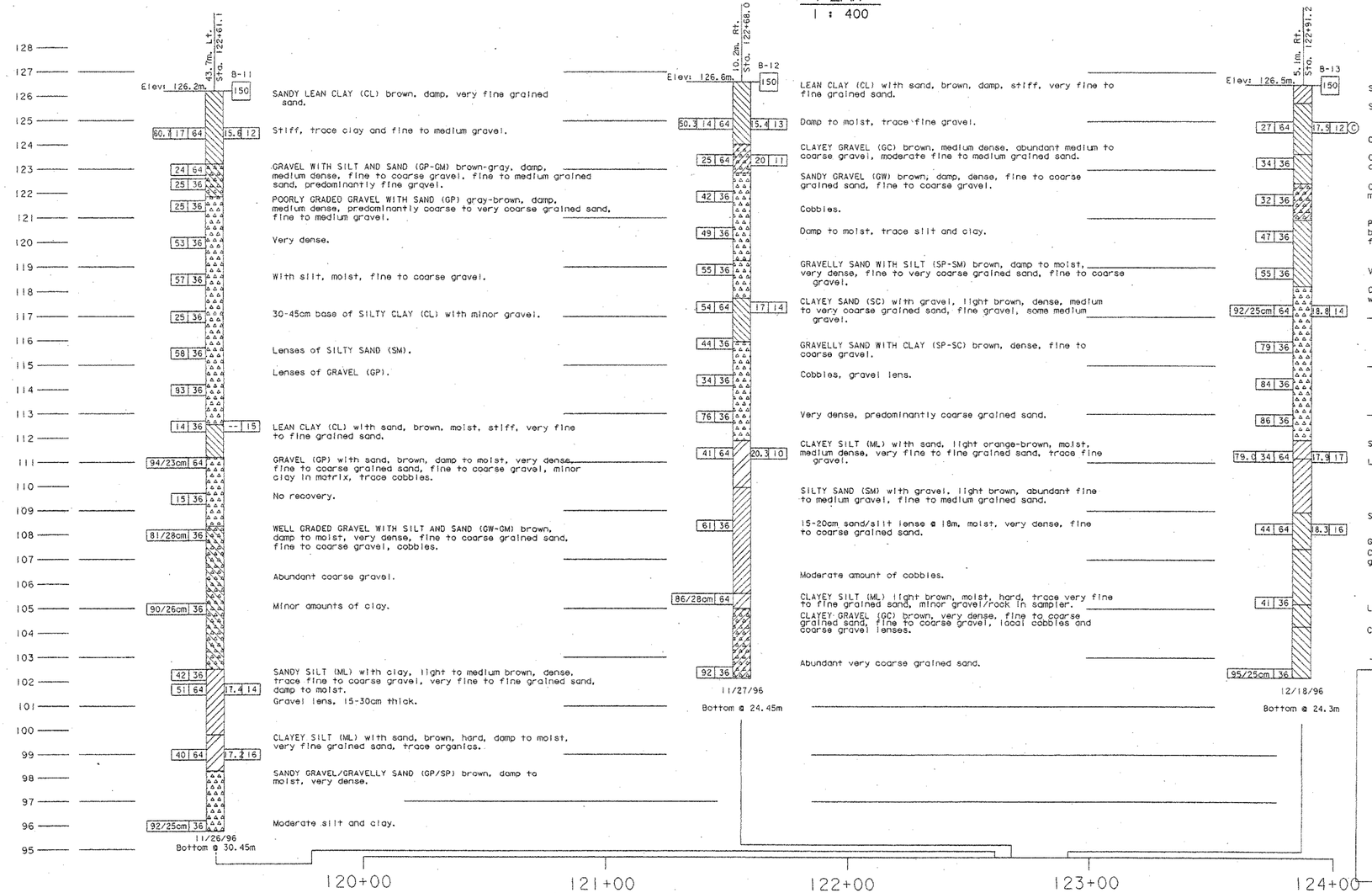
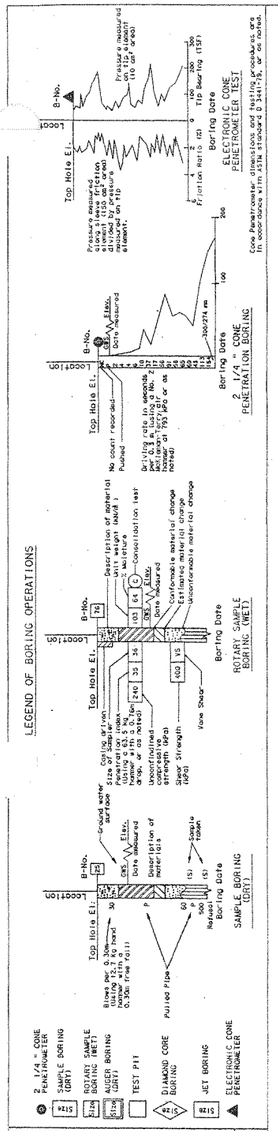


PLAN
1 : 400



LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SANDY SILT or SILTY SAND · SILTY CLAY · PEAT and/or ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK

CONSISTENCY OF SOIL FOR SAMPLES
According to the Standard Penetration Test

SPT N-Value (Blows/0.3m)	Granular	SPT N-Value (Blows/0.3m)	Cohesive
0-4	Very Loose	<2	Very Soft
5-10	Loose	2-4	Soft
11-30	Medium Dense	5-8	Medium Stiff
31-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

NOTE: Visual classification of materials based on field inspection is confirmed or revised with laboratory test results.

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		395	407

REGISTERED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER · G. NEELAKANTAN · No. 2391 · Exp. 9/30/01 · GEOTECHNICAL · STATE OF CALIFORNIA

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes
☐ Changes As Noted

Revisions by: MPW (Initials)

DESIGN OVERSIGHT	DRAWN BY	J. HULSE	A. PATTERSON, V. THILAKARATNE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	O. RODRIGUEZ
SIGN OFF DATE	CHECKED BY	T. HUBER	FIELD INVESTIGATION BY: DATE:		PROJECT ENGINEER

BRIDGE NO. 33C-0405
KILOMETER POST

ISABEL AVENUE UNDERPASS
LOG OF TEST BORINGS

REV. DATE: 6-2-97

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 13 OF 13

TIME PLOTTED => $$$$$$$SYTIME$$$$$$$

NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

2. Soil classification and description conform to ASTM D2487.

BENCHMARK:
All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).
TBM No. 2: Mon. No. 220
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.064 meters right of Center Line Station "15" 122+19.529. The elevation is 126.311 meters (414.41 feet).

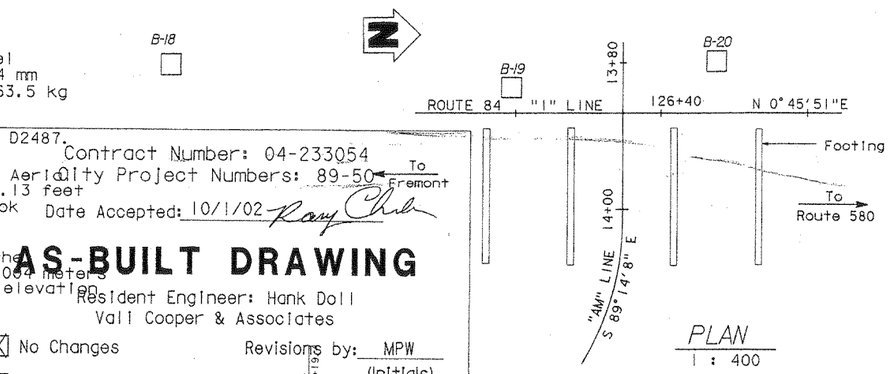
Contract Number: 04-233054
City Project Numbers: 89-50
To Fremont
Date Accepted: 10/1/02

AS-BUILT DRAWING

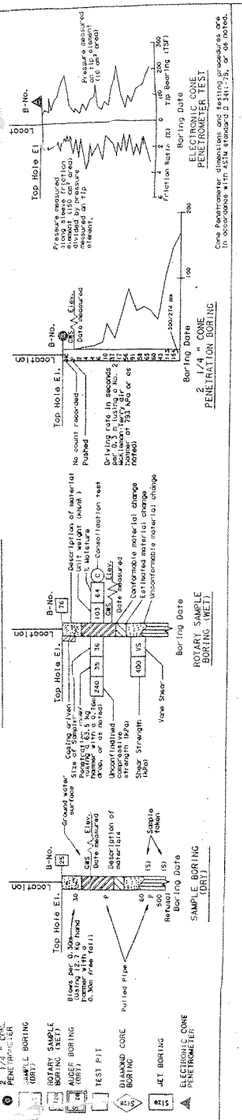
Resident Engineer: Hank Doll
Vali Cooper & Associates

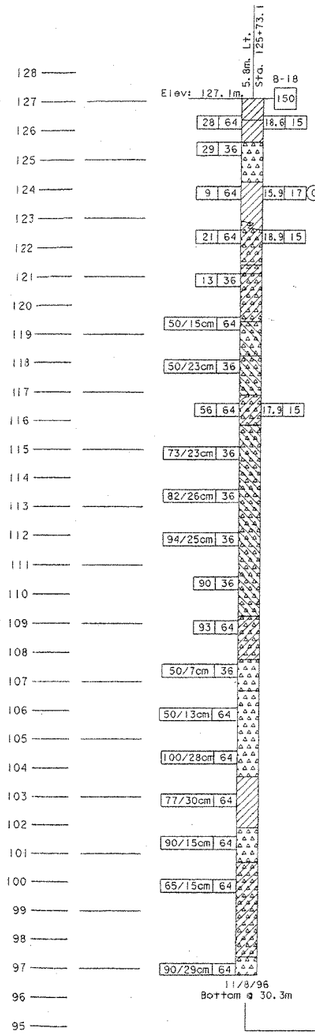
☒ No Changes
☐ Changes As Noted

Revisions by: MPW (Initials)



PLAN
1 : 400





SILTY SAND (SM) medium brown, very fine grained, poorly graded, medium dense, dry.
SANDY SILT (ML) with gravel, light to medium brown, gap graded, medium dense, moist.
SANDY GRAVEL/GRAVELLY SAND (GP/SP) medium brown to light gray @ 1.65m, gap graded, medium dense, dry, gravel is fine to coarse grained, sand is primarily fine grained.

SANDY SILT (ML) with minor gravel, medium brown, loose, non plastic, moist, grading to CLAY (CL) with minor sand and gravel.

GRAVELLY LEAN CLAY (CL) brown, stiff, low to moderate plasticity, fine to coarse gravel, subrounded to rounded.

CLAYEY GRAVEL (GC) lens.

Local sandy layers.

GRAVEL AND COBBLES (GC) with silty clay matrix, fine to coarse gravel and small cobbles, gap graded, very dense.

SILTY GRAVEL (GM) brown, medium to coarse grained sand, primarily fine gravel, moderately graded, very dense.

CLAYEY GRAVEL (GC) medium brown, coarse grained, poorly graded, dense, subrounded to rounded gravel, clay is low to medium plasticity.
SILTY GRAVEL (GM) with sand, brown to gray, fine to coarse grained, moderately graded, very dense, primarily fine gravel.

Local lenses of fine to coarse grained, very dense, SANDY GRAVEL (GP).

Fine to coarse gravel, moderately gap graded.

CLAYEY GRAVEL (GC) brown, low to moderate plasticity clay matrix, gravel is coarse grained, subrounded to rounded, very dense.

GRAVELLY SAND (SP) fine to coarse sand, fine gravel, moderately graded, very dense.

SANDY GRAVEL (GW) light brown, moist, very dense, sand, silt and minor clay matrix, coarse gravel is subangular.

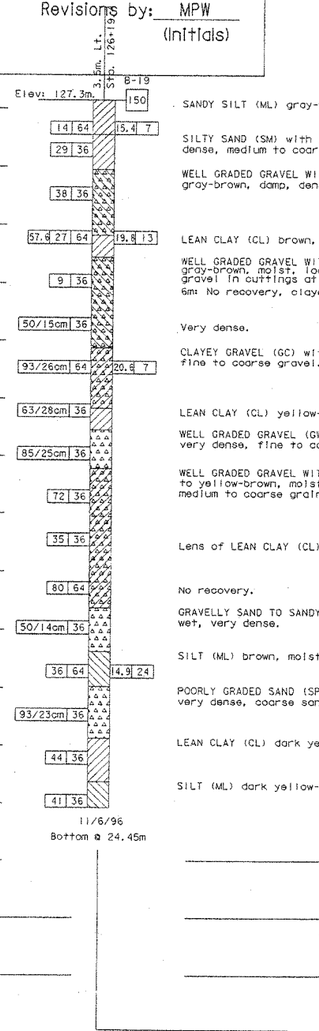
5-7.5cm layers of Gravelly Sand (SP).

CLAY (CL) brown, hard.
No recovery.

SANDY GRAVEL (GM) with clay, brown, moist to wet, very dense.

CLAYEY GRAVEL (GC) brown, moist, very dense.

Scattered cobbles.
SANDY CLAYEY GRAVEL (GM/GC) brown, damp, very dense, medium to coarse gravel, subangular to angular.



SANDY SILT (ML) gray-brown, damp, loose.

SILTY SAND (SM) with gravel, gray-brown, damp, medium dense, medium to coarse sand, fine gravel.

WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, damp, dense, fine to coarse gravel.

LEAN CLAY (CL) brown, moist, stiff.

WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, moist, loose, rounded fine to coarse gravel in cuttings at 5.7m.
6m: No recovery, clayey sand to clayey gravel cuttings.

Very dense.

CLAYEY GRAVEL (GC) with sand, brown, moist, very dense, fine to coarse gravel.

LEAN CLAY (CL) yellow-brown, moist, very stiff.

WELL GRADED GRAVEL (GW) with sand, brown, moist to wet, very dense, fine to coarse gravel, medium to coarse sand.

WELL GRADED GRAVEL WITH CLAY AND SAND (GW-GC) brown to yellow-brown, moist, very dense, fine to coarse gravel, medium to coarse grained sand.

Lens of LEAN CLAY (CL) from 15.3 to 15.45m.

No recovery.

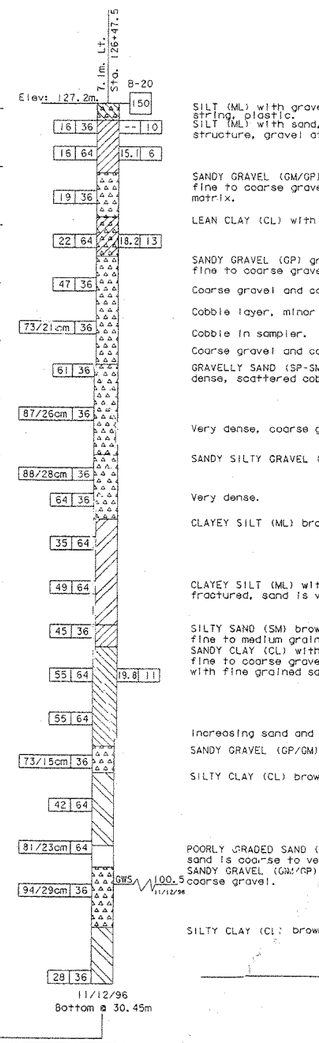
GRAVELLY SAND TO SANDY GRAVEL (SW/GW) gray-brown, wet, very dense.

SILT (ML) brown, moist to wet, very stiff, slightly plastic.

POORLY GRADED SAND (SP) with gravel, gray-brown, wet, very dense, coarse sand and gravel.

LEAN CLAY (CL) dark yellow-brown, moist, hard.

SILT (ML) dark yellow-brown, moist, hard.



SILT (ML) with gravel, dark brown, damp, stiff, minor string, plastic.
SILT (ML) with sand, dark brown, damp, stiff, open-pore structure, gravel at 1m.

SANDY GRAVEL (GM/GP) brown, damp, medium dense, fine to coarse gravel, moderate amount of sand and silt matrix.

LEAN CLAY (CL) with gravel, brown, damp to moist, stiff.

SANDY GRAVEL (GP) gray-brown, moist, dense, minor silt, fine to coarse gravel.

Coarse gravel and cobbles.

Cobble layer, minor caving.

Cobble in sampler.

Coarse gravel and cobbles.

GRAVELLY SAND (SP-SM) moderate sand and silt matrix, dense, scattered cobbles.

Very dense, coarse gravel and cobbles, local clay lens.

SANDY SILTY GRAVEL (GM) brown, damp, very dense.

Very dense.

CLAYEY SILT (ML) brown, damp, very stiff.

CLAYEY SILT (ML) with sand, brown, moist, very stiff, fractured, sand is very fine to fine grained.

SILTY SAND (SM) brown, moist, dense, sand is very fine to medium grained.
SANDY CLAY (CL) with gravel, brown, moist, hard, minor fine to coarse gravel throughout. Layers of Clayey Silt (ML) with fine grained sand.

Increasing sand and gravel.

SANDY GRAVEL (GP/GM) green-brown, moist, very dense.

SILTY CLAY (CL) brown, moist, very stiff.

POORLY GRADED SAND (SP) gray-brown, moist, very dense, sand is coarse to very coarse grained, minor silt.
SANDY GRAVEL (GM/GP) brown, moist to wet, very dense, coarse gravel.

SILTY CLAY (CL) brown, moist, very stiff, slightly plastic.

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		407	407

REGISTERED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
C. NEELAKANTAN
No. 2391
Exp. 9/30/01
GEOTECHNICAL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. HULSE
CHECKED BY: T. HUBER

N. MACE, V. THILAKARATNE
J. THURBER
FIELD INVESTIGATION BY:
DATE:

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

O. RODRIGUEZ
PROJECT ENGINEER

BRIDGE NO. 33C-0107
KILOMETER POST

ARROYO MOCHO BRIDGE
LOG OF TEST BORINGS

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 12 OF 12

REV. DATE: 6-2-97

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS
0 10 20 30 40 50 60 70 80 90 100

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

TIME PLOTTED => $$$$$$$SYSTIME$$$$$$$

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	3-7-08	3-7-08	2055630.6 ft / 6184601.3 ft NAD83	NB01
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			~ 65.5' Lt Sta ~ 235+62.1 A1	575 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Solid-Stem Auger			Steep Hillside Portable Rig	4 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			20 ft	25.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		Lean CLAY with GRAVEL (CL); stiff; brown to dark brown; moist; FILL.												
	1				1	8 10 18	28			10	123				
573.00	2														
	3														
571.00	4														
	5				2	17 34 38	72								
569.00	6		SANDY lean CLAY (CL); very stiff; brown.												
	7		SILTY SAND with GRAVEL (SM); very dense; reddish brown; moist; fine GRAVEL.												
567.00	8		SANDY lean CLAY with GRAVEL (CL); hard; brown; moist.												
	9														
565.00	10				3	12 19 33	52			12					
	11														
563.00	12														
	13		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist; coarse GRAVEL.												
561.00	14														
	15				4	31 47 50/5"	97/ 11"								
559.00	16														Sampler advanced 17 in.
	17														
557.00	18														
	19														
555.00	20				5	33 21 50/5"	71/ 11"								
	21														Sampler advanced 17 in.
553.00	22		CLAYEY SAND with GRAVEL (SC/CL); brown; moist; some GRAVEL.												Cave-in to 22' - could not clean
	23														
551.00	24														
	25		Bottom of Borehole at 25.0 ft.												

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB01
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		3-10-08	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	3-7-08	3-7-08	2056087.4 ft / 6184642.6 ft NAD83	NB02
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			~ 64.4' Lt Sta ~ 240+01.8 A1	573 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Solid-Stem Auger			Steep Hillside Portable Rig	4 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	30.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		Lean CLAY with GRAVEL (CL); stiff; brown; moist to wet [FILL].												
	1														
571.00	2				1	7 7 10	17			14	116				Hand auger to 2'
	3														
569.00	4		At EL. 569.5 ft, becomes brown mottled with yellowish brown.												
	5		At EL. 568.0 ft, becomes hard.		2	19 21 26	47			11					LL=27 PI=10 PI
567.00	6														
	7														
565.00	8														
	9														
563.00	10		Lean CLAY with GRAVEL (CL); hard; dark gray and dark grayish brown; moist to wet [FILL].		3	19 20 41	61			9	125				
	11														
561.00	12														
	13														
559.00	14														
	15		At EL. 558.0 ft, with brown.		4	14 21 45	66								
557.00	16														
	17														
555.00	18														
	19														
553.00	20				5	17 13 10	23								
	21		At EL. 552.0 ft, with very stiff; multicolored.												
551.00	22														
	23														
549.00	24														
	25														

(continued)

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB02
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		3-10-08	1 of 2

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Lean CLAY with GRAVEL (CL) *(continued)*.		6	8	60								
			Lean CLAY (CL); reddish brown; moist.			18									
547.00	26		SANDY lean CLAY (CL); very stiff; reddish brown; moist.			42									
	27														
			Increase in sand.												
545.00	28														
	29		CLAYEY SAND (SC); very dense; brown.		7	50/3"	REF								No recovery Sampler advanced 3 in.
543.00	30		Boring dry ATD. Bottom of Borehole at 30.0 ft.												
541.00	31														
	32														
539.00	33														
	34														
537.00	35														
	36														
535.00	37														
	38														
533.00	39														
	40														
531.00	41														
	42														
529.00	43														
	44														
527.00	45														
	46														
525.00	47														
	48														
523.00	49														
	50														
521.00	51														
	52														
519.00	53														
	54														
	55														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE **BORING RECORD**				HOLE ID **NB02**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **L.Phillips**		DATE **3-10-08**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-14-07	12-14-07	37° 38' 8.67" / -121° 48' 3.12" NAD83	NB03
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 27.8' Lt Sta ~ 245+90.1 A1	539.30 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Not measured	80.0 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0	GRAVELLY SILT (ML); stiff; brown; moist; with asphalt concrete chunks (FILL).											
	1			1	13 19 22	41	55						4" solid flight augered to 7 feet.
537.30	2												
	3	Lean CLAY with GRAVEL (CL); brown; moist.											
535.30	4												
	5	At EL. 534.3 ft, with increase in sand content.		2	6 11 17	28	65		6	123			
533.30	6	CLAYEY SAND with GRAVEL (SC); dense; brown; moist.											
	7	At EL. 532.3 ft, with cobbles.											Dry to 7 feet; began rotary wash.
531.30	8												
	9												
529.30	10	At EL. 529.3 ft, becomes very dense.		3	26 44 40	84	70						
	11												
527.30	12	SILT (ML); very stiff; brown; moist; trace GRAVEL.											
	13												
525.30	14												
	15			4	11 23 31	54	80		18	114	UC =3.6		PI
523.30	16												
	17												
521.30	18												
	19												
519.30	20	At EL. 519.3 ft, becomes hard; brown to grayish brown with balck speckling; black speckling.		5	12 21 29	50	85		19	112	UC =5.9		
	21												
517.30	22												
	23												
515.30	24												
	25												

(continued)

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB03
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-14-07	1 of 3

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		At EL. 514.3 ft, grades to silty clay (CL-ML).		6	12 23 33	56	85		18	113	UC =5.7		
513.30	26													
	27													
511.30	28													
	29													
509.30	30				7	15 26 35	61	65		18	114	UC =9.9		
	31													
507.30	32													
	33													Drilling fluid seeped through casing annulas to ground surface.
505.30	34		SANDY lean CLAY (CL); hard; dark brown; moist; trace fine GRAVEL; gray mottling and some black speckling.											
	35				8	15 28 38	66	80		16	117	UC =8.1		Extra casing added.
503.30	36													
	37		At EL. 502.3 ft, with increase in gravel content.											
501.30	38													
	39													
499.30	40		CLAYEY SAND with GRAVEL (SC); very dense; reddish brown; moist; fine GRAVEL.		9	39 65 88/3"	153/ 9"	50						
	41													Sampler advanced 15 in.
497.30	42													
	43													
495.30	44													
	45				10	44 57 121	178	35						
493.30	46													
	47													
491.30	48													
	49													
489.30	50				11	54 50/2"	50/ 2"	45						
	51													Sampler advanced 8 in.
487.30	52													
	53													
485.30	54													
	55													

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: **BORING RECORD**

HOLE ID: **NB03**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-14-07	2 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		CLAYEY SAND with GRAVEL (SC) *(continued)*.		12	82/5"	REF	35						Sampler advanced 5 in.
483.30	56													
	57													
481.30	58													
	59													
479.30	60				13	53 75 66	141	85						
	61													
477.30	62		At EL. 477.8 ft, with decrease in gravel content.											
	63		Lean CLAY (CL); hard; brown; moist; with black speckling.											
475.30	64													
	65				14	25 49 65	114	100		14	121	UC =5.3		
473.30	66													
	67													
471.30	68													
	69													
469.30	70		CLAYEY GRAVEL with SAND (GC); very dense; brown; moist.		15	69 50/1"	50/ 1"	35						
	71													Sampler advanced 7 in.
467.30	72													
	73													
465.30	74		SANDY lean CLAY (CL); hard; dark reddish brown; moist; trace GRAVEL.											
	75				16	32 51 92	143	70						
463.30	76													
	77		At EL. 462.3 ft, with increase in gravel content.											
461.30	78		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.											
	79				17	68 50/1"	50/ 1"							Sampler advanced 7 in.
459.30	80		Bottom of Borehole at 80.0 ft.											
	81													
457.30	82													
	83													
455.30	84													
	85													

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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55 S. Market St, Ste 1500
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REPORT TITLE **BORING RECORD**				HOLE ID **NB03**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **12-14-07**	SHEET **3 of 3**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	**11-27-07**	**11-27-07**	**37° 38' 9.78" / -121° 48' 0.09" NAD83**	**NB04**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			**~ 51.4' Rt Sta ~ 248+46.5 A1**	**527.70 ft NAVD 88**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			**Mobile B53**	**8 inch**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			**140lb/30in - Wirewinch**	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			**Dry**	**25.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SANDY SILT with GRAVEL (ML); very dense; dark yellowish brown; moist; - FILL.												
	1				1	17 29 38	67	75							
525.70	2														
	3														
523.70	4		Lean CLAY with GRAVEL (CL); hard; grayish brown; moist.		2	17 20 27	47	90		10	120	UC =6.8			PI
	5		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; light yellowish brown; moist.		3	32 79 50/2"	129/ 8"	80							
521.70	6														Sampler advanced 14 in.
	7														
519.70	8		Lean CLAY (CL); hard; light brownish gray to brownish yellow; moist.		4	32 35 49	84	100		16	113	UC =3			
	9														
517.70	10														
	11														
515.70	12														
	13														
513.70	14		At EL. 514.2 ft, becomes brown to yellowish red.		5	27 39 45	84	90		16	119	UC =10.6			
	15														
511.70	16														
	17														
509.70	18														Hard drilling.
	19		At EL. 509.2 ft, with gravel.		6	33 62 72/4"	134/ 10"								
507.70	20														Sampler advanced 16 in.
	21														
505.70	22		CLAYEY SAND with GRAVEL (SC); very dense; browinsh red; moist.		7	80 50/2"	50/ 2"								
	23														Sampler advanced 8 in.
503.70	24		CLAYEY GRAVEL with SAND (GC); very dense; browinsh red; moist.		8	69 50/2"	50/ 2"								
	25														Sampler advanced 8 in.

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				**NB04**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**12-3-07**	**1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Boring dry ATD.												Refusal at 25 feet.
501.70	26		Bottom of Borehole at 25.0 ft.												
	27														
499.70	28														
	29														
497.70	30														
	31														
495.70	32														
	33														
493.70	34														
	35														
491.70	36														
	37														
489.70	38														
	39														
487.70	40														
	41														
485.70	42														
	43														
483.70	44														
	45														
481.70	46														
	47														
479.70	48														
	49														
477.70	50														
	51														
475.70	52														
	53														
473.70	54														
	55														

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REPORT TITLE **BORING RECORD**				HOLE ID **NB04**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **12-3-07**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-13-07	12-13-07	37° 38' 13.2" / -121° 47' 56.78" NAD83	NB05
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 10.2' Rt Sta ~ 252+76.0 A1	527.30 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Not measured	56.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0	9 inches Asphalt Concrete over 9 inches AB.											
	1												4" solid flight augered to 7 feet.
525.30	2	SILTY SAND with GRAVEL (SM); very dense; gray; moist; with asphalt concrete chunks - FILL.		1	29 33 40	73	60						
	3												
523.30	4	SANDY lean CLAY with GRAVEL (CL); stiff; black; moist.											
	5	CLAYEY SILT (ML/CL); stiff; brownish yellow to brown; moist.		2	17 26 35	61	70		4	124			
521.30	6	SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; brown; moist.											
	7												Dry to 7 feet; began rotary wash.
519.30	8												
	9												
517.30	10	SILTY SAND with GRAVEL (SM); very dense; brown; moist.		3	20 43 54	97	70						
	11												
515.30	12												
	13												Some fluid loss.
513.30	14	CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.											
	15			4	16 27 38	65	85						
511.30	16												
	17												
509.30	18	Lean CLAY (CL); hard; gray; moist; trace GRAVEL; brown mottling with some black speckling.											
	19												
507.30	20			5	22 30 42	72	80		14	121	UC =9.9		
	21												
505.30	22												
	23												
503.30	24												
	25												

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB05
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-13-07	1 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		Lean CLAY (CL) *(continued)*.		6	17 29 47	76	80		15	118	UC =7.1		
501.30	26													
	27													
499.30	28													
	29													
497.30	30				7	17 34 43	77	85		16	117	UC =7.8		
	31													
495.30	32													
	33													
493.30	34													
	35				8	18 29 45	74	85		20	110	UC =6.4		
491.30	36													
	37													
489.30	38													
	39													
487.30	40				9	21 40 50	90	80		15	119	UC =7.9		
	41													
485.30	42													
	43													
483.30	44													
	45				10	19 41 58	99	70		16	116	UC =7.9		
481.30	46													
	47													
479.30	48													
	49													
477.30	50		At EL. 477.3 ft, becomes (Lean CLAY) (CL); dark reddish brown.		11	24 41 50	91	50		18	113	UC =7.5		
	51													
475.30	52													
	53													
473.30	54		At EL. 473.3 ft, with (Lean CLAY) (CL); gravel.											
	55													

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				**NB05**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **12-13-07**	SHEET **2 of 3**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	55		Lean CLAY (CL) *(continued)*.		12	21 38 80	118	70							
471.30	56														
	57		Bottom of Borehole at 56.5 ft.												
469.30	58														
	59														
467.30	60														
	61														
465.30	62														
	63														
463.30	64														
	65														
461.30	66														
	67														
459.30	68														
	69														
457.30	70														
	71														
455.30	72														
	73														
453.30	74														
	75														
451.30	76														
	77														
449.30	78														
	79														
447.30	80														
	81														
445.30	82														
	83														
443.30	84														
	85														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB05**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**12-13-07**	**3 of 3**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	3-6-08	3-6-08	2057046.5 ft / 6185473.2 ft NAD83	NB05A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			~ 44.4' Lt Sta ~ 256.67 A1	546 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Solid-Stem Auger			Steep Hillside Portable Rig	4 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	35.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		Lean CLAY with GRAVEL (CL); hard; brown mottled with dark brown; moist; gravel at the top.												
	1				1	14 16 20	36			12	113				LL=28 PI=13 PI
544.00	2														
	3														
542.00	4														
	5				2	34 28 28	56								
540.00	6		SANDY lean CLAY (CL); very stiff; black; moist.												
	7		SILTY SAND with GRAVEL (SM); dense; reddish brown; moist; fine GRAVEL.												
538.00	8														
	9		SANDY lean CLAY (CL); hard; brown; moist.												
536.00	10				3	14 19 29	48			16	114				LL=37 PI=20 PI
	11														
534.00	12														
	13														
532.00	14		Gravel layer 3".												
	15		SILTY SAND (SM); dense; brown; fine GRAVEL.		4	31 34 23	57								
530.00	16		SANDY lean CLAY (CL); very stiff; brown; moist.												
	17														
528.00	18														
	19														
526.00	20		SILTY SAND with GRAVEL (SM); very dense; reddish brown.		5	34 25 46	71								
	21		SILTY SAND (SM); very dense; reddish brown; moist.												
524.00	22														
	23		Gravel.												
522.00	24		SANDY SILT (ML); hard; brown; moist.												
	25														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB05A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		3-10-08	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SANDY SILT (ML) *(continued)*.		6	25 37 50/4"	87/ 10"								
520.00	26		SILTY SAND (SM); very dense; moist; coarse SAND.												Sampler advanced 16 in.
	27														
518.00	28														
	29		SANDY SILT (ML); brown.												
516.00	30				7	41 55/6"	55/ 6"								Samples disturbed
	31		SILTY SAND (SM); very dense; reddish brown; fine GRAVEL.												Sampler advanced 12 in.
514.00	32														
	33														
512.00	34				8	38 18 32	50								
			SANDY lean CLAY (CL); hard; brown.												
	35		CLAYEY SAND (SC); very dense; brown.												
			Boring dry ATD. Bottom of Borehole at 35.0 ft.												
510.00	36														
	37														
508.00	38														
	39														
506.00	40														
	41														
504.00	42														
	43														
502.00	44														
	45														
500.00	46														
	47														
498.00	48														
	49														
496.00	50														
	51														
494.00	52														
	53														
492.00	54														
	55														

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REPORT TITLE **BORING RECORD**				HOLE ID **NB05A**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **L.Phillips**		DATE **3-10-08**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-17-07	12-17-07	37° 38' 18.98" / -121° 47' 55.34" NAD83	NB06
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 38' Lt Sta ~ 258+83.4 A1	527.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Not measured	80.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.												
	1				1	14 27 28	55	95		6	132				4" solid flight augered to 7 feet.
525.80	2														
	3														
523.80	4														
	5				2	25 40 29	69	85		8	130				
521.80	6														
	7														Dry to 7 feet; began rotary wash.
519.80	8		CLAYEY GRAVEL with SAND (GC); very dense; brown; moist.												
	9														
517.80	10				3	28 36 45	81	50		7	136				PA
	11														
515.80	12														
	13														
513.80	14														
	15				4	27 48 58	106	100							
511.80	16														
	17														
509.80	18														
	19														
507.80	20				5	35 62 64	126	90							
	21														
505.80	22														
	23														
503.80	24														
	25														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB06
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-17-07	1 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		CLAYEY GRAVEL with SAND (GC) *(continued)*.		6	32 64 85	149	85						
501.80	26													
	27		At EL. 500.8 ft, with (CLAYEY GRAVEL with SAND) (GC); increase in gravel content.											
499.80	28													
	29													
497.80	30				7	59/3"	REF	0						Sampler advanced 3 in.
	31		At EL. 496.8 ft, with (CLAYEY GRAVEL with SAND) (GC); cobbles.											Very hard drilling from 31 to 34 feet.
495.80	32													
	33		Poorly graded GRAVEL (GP); very dense; with interbedded clayey sand lenses.											
493.80	34		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.											
	35				8	30 45 58	103	70		11	127	UC =3.7		
491.80	36													
	37													
489.80	38		At EL. 490.3 ft, with decrease in gravel content.											
	39		Lean CLAY (CL); hard; reddish brown; moist; with black speckling.											
487.80	40				9	16 26 38	64	90		20	109	UC =6.8		
	41													
485.80	42													
	43													
483.80	44													
	45		At EL. 482.8 ft, with (Lean CLAY) (CL); some fine SAND.		10	23 40 56	96	90		15	118	UC =7.5		
481.80	46													
	47													
479.80	48													
	49													
477.80	50		At EL. 477.8 ft, with gray mottling.		11	25 48 52	100	90		16	116	UC =9		
	51													
475.80	52													
	53													
473.80	54													
	55													

(continued)

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San Jose Office

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB06**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-17-07	2 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		At EL. 472.8 ft, with (Lean CLAY) (CL); no gray mottling.		12	25 41 50	91	80		16	117	UC =11.1		
471.80	56		Lean CLAY (CL) *(continued)*.											
	57													
469.80	58													
	59													
467.80	60				13	22 37 47	84	95		15	121			
	61		CLAYEY SAND with GRAVEL (SC); very dense; reddish brown; moist.											
465.80	62													
	63													
463.80	64													
	65				14	55 119 50/2"	169/ 8"	90						
461.80	66		CLAYEY GRAVEL (GC); very dense; reddish brown; moist.											Sampler advanced 14 in.
	67													
459.80	68													
	69		CLAYEY SAND with GRAVEL (SC); very dense; reddish brown; moist.											
457.80	70				15	36 41 55	96	100						
	71													
455.80	72													
	73													
453.80	74													
	75				16	71 50/2"	50/ 2"	60						
451.80	76													Sampler advanced 8 in.
	77													
449.80	78													
	79				17	57 83 82	165							
447.80	80		Bottom of Borehole at 80.0 ft.											
	81													
445.80	82													
	83													
443.80	84													
	85													

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE **BORING RECORD**				HOLE ID **NB06**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **12-17-07**	SHEET **3 of 3**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	12-10-07	12-10-07	37° 38' 48.21" / -121° 48' 13.41" NAD83	NB07
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 53.8' Lt Sta ~ 293+10.8 A1	443.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	20.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY lean CLAY with SAND (CL); hard; brown; moist; some GRAVEL.												
	1				1	18 30 34	64	90		7	126	UC =4.4			
441.00	2														
	3		SANDY lean CLAY (CL); hard; reddish brown; moist; some GRAVEL.		2	16 18 20	38	90		13	120	UC =5.3			
439.00	4														
	5				3	19 26 38	64	90		15	118	UC =5.3			CP
437.00	6														
	7														
435.00	8														
	9				4	18 18 23	41	90		16	117	UC =6.5			
433.00	10														
	11														
431.00	12		Poorly graded SAND with GRAVEL (SP); very dense; reddish brown; moist.												
	13														
429.00	14		Well-graded GRAVEL with SAND (GW); very dense; light gray; moist; angular GRAVEL.		5	41 64 57	121	70							
	15														
427.00	16														
	17		At EL. 426.5 ft, becomes reddish brown.												
425.00	18														
	19				6	32 52 38	90	75							
423.00	20		At EL. 423.5 ft, becomes light gray.												
			Boring dry ATD. Bottom of Borehole at 20.0 ft.												
421.00	21														
	22														
	23														
419.00	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB07
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-10-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	3-5-08	3-5-08	37° 38' 52.38" / -121° 48' 16.77" NAD83	NB07A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clearheart Drilling			~ 81.9' Lt Sta ~ 298+02.6 A1	437.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			DR10K-1	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	20.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		Lean CLAY with GRAVEL (CL); medium stiff; reddish brown; moist; trace fine roots and topsoil.												
	1				1	5 5 8	13	80							
435.00	2		CLAYEY SAND with GRAVEL (SC); loose; yellowish brown; moist.												
	3		At 3 ft, same as above except very dense.		2	19 31 36	67	90							
433.00	4														
	5				3	29 15 8	23	80							
431.00	6		Lean CLAY (CL); soft; yellowish brown; moist; trace fine gravel.												
	7														
429.00	8														
	9		At 8.5 ft, same as above except with gravel.		4	7 6 9	15	60							
427.00	10														
	11														
425.00	12														
	13														
423.00	14				5	9 9 15	24	10							
	15														
421.00	16		CLAYEY GRAVEL with SAND (GC); very dense; brownish yellow; moist.												
	17														
419.00	18														
	19				6	40 116 80/4"	196/ 10"								
417.00	20														Sampler advanced 16 in.
	21		Bottom of Boring @ 20 feet Boring dry at ATD. Bottom of Borehole at 20.0 ft.												
415.00	22														
	23														
413.00	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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REPORT TITLE				HOLE ID
BORING RECORD				NB07A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		3-9-08	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	**3-5-08**	**3-5-08**	**37° 38' 55.35" / -121° 48' 18.23" NAD83**	**NB08**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clearheart drilling			**~ 73.6' Lt Sta ~ 301+18.4 A1**	**434.90 ft NAVD 88**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			**DR10K-1**	**8 inch**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			**140lb/30in - Wirewinch**	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			**Dry**	**31.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY SAND with GRAVEL (SC); medium dense; yellowish brown; moist.												
	1				1	6 11 15	26	70							
432.90	2														
	3		SANDY SILTY CLAY (CL-ML); very stiff; yellowish brown; moist.		2	19 19 66	85	75							
430.90	4		SANDY lean CLAY with GRAVEL (CL); very stiff; yellowish brown; moist.												
	5		SANDY lean CLAY (CL); At 5 ft, same as above except trace fine gravel.		3	19 15 15	30	65							
428.90	6														
	7														
426.90	8														
	9				4	8 11 14	25	50							
424.90	10														
	11														
422.90	12		Poorly graded SAND with SILT (SP-SM); very dense; reddish brown; moist.												
	13														
420.90	14				5	19 38 44	82	90							
	15		Poorly graded GRAVEL with SILT and SAND (GP-GM); very dense; dark yellowish brown; moist.												
418.90	16														
	17														
416.90	18														
	19				6	114		0							Sampler advanced 6 in. Big cobble in shoe
414.90	20														
	21														
412.90	22														
	23														
410.90	24				7	66 127		0							
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				**NB08**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**3-9-08**	**1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Poorly graded GRAVEL with SILT and SAND (GP-GM) *(continued).*												Sampler advanced 12 in.
408.90	26														
	27														
406.90	28														
	29				8	90/3"	REF	0							Sampler advanced 3 in.
404.90	30		CLAYEY GRAVEL with SAND (GC); very dense; light yellowish brown; moist.		9	88 78 98	176	70							
	31														
402.90	32		End of Boring @ 31.5 ft Boring dry ATD. Bottom of Borehole at 31.5 ft.												
	33														
400.90	34														
	35														
398.90	36														
	37														
396.90	38														
	39														
394.90	40														
	41														
392.90	42														
	43														
390.90	44														
	45														
388.90	46														
	47														
386.90	48														
	49														
384.90	50														
	51														
382.90	52														
	53														
380.90	54														
	55														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB08**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**3-9-08**	**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	**11-26-07**	**11-26-07**	**37° 39' 8.53" / -121° 48' 19.38" NAD83**	**NB09**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			**~ 63.7' Rt Sta ~ 314+51.4 A1**	**425.10 ft NAVD 88**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			**Mobile B53**	**8 inch**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			**140lb/30in - Wirewinch**	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			**Dry**	**30.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY SILT (ML); hard; brown; moist.												
	1				1	62 53 41	94	70		5					LL=22 PI=3 PI
423.10	2														
	3														
421.10	4		SILTY GRAVEL (GM); very dense; brown to light gray; moist.		2	45 40 28	68	55							
	5														
419.10	6														
	7														
417.10	8														
	9				3	32 32 30	62	50							
415.10	10														
	11														
413.10	12														
	13														
411.10	14				4	22 39 33	72	70							
	15														
409.10	16														
	17														
407.10	18														
	19				5	18 41 48	89	80							
405.10	20														
	21														
403.10	22														
	23														
401.10	24		At EL. 401.1 ft, becomes (SILTY GRAVEL) (GM); wet.		6	26 37 50	87	55							
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				**NB09**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**12-3-07**	**1 of 2**

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SILTY GRAVEL (GM) *(continued)*.												
399.10	26														
	27														
397.10	28														
	29				7	39 42 45	87	85							
395.10	30		Boring dry ATD. Bottom of Borehole at 30.0 ft.												
393.10	32														
391.10	34														
389.10	36														
387.10	38														
385.10	40														
383.10	42														
381.10	44														
379.10	46														
377.10	48														
375.10	50														
373.10	52														
371.10	54														
	55														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB09**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-3-07	2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	**3-4-08**	**3-4-08**	**37° 39' 11.62" / -121° 48' 20.65" NAD83**	**NB10**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clearheart Drilling			**~ 37.3' Lt Sta ~ 317+64.8 A1**	**421.90 ft NAVD 88**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			**DR10K-1**	**8 inch**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44"), CA (2.44")			**140lb/30in - Wirewinch**	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			**23.5 ft**	**30.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY GRAVEL with SAND (GC); dense; dark brown; moist; subrounded GRAVEL.												
	1				1	14 16 19	35	70							
419.90	2														
	3				2	15 22 24	46	75							
417.90	4														
	5		Lean CLAY (CL); medium stiff; dark grayish brown; moist.		3	6 9 11	20	35							
415.90	6														
	7														
413.90	8														
	9		SANDY lean CLAY with GRAVEL (CL); medium stiff; dark grayish brown; moist.		4	7 8 8	16	50							
411.90	10														
	11														
409.90	12														
	13														
407.90	14		Poorly graded GRAVEL with SILT and SAND (GP-GM); very dense; light yellowish brown; moist.		5	46 114 63	177	25							
	15														
405.90	16														
	17														
403.90	18														
	19		At 18.5 ft, same as above except Poorly Graded Sand with Clay and Sand (GP-GC).		6	50 28 28	56	60							
401.90	20														
	21		At 21 ft, same as above except Poorly Graded Gravel with Silt and Sand (GP-GM).												
399.90	22														
	23		At 23 ft, same as above except Poorly Graded Sand with Silt (GP-GM), wet.												
397.90	24				7	45 27 34	61	90							
	25														

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

55 S. Market St, Ste 1500
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REPORT TITLE				HOLE ID
BORING RECORD				**NB10**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**3-9-08**	**1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		*(continued).*												
395.90	26														
	27		CLAYEY GRAVEL with SAND (GC); very dense; light brown; wet.												
393.90	28														
	29				8	29 34 38	72								
391.90	30		At 29.5 ft, same as above except increase in sand content. End of Boring @ 30 ft. Bottom of Borehole at 30.0 ft.												
389.90	31														
	32														
387.90	33														
	34														
385.90	35														
	36														
383.90	37														
	38														
381.90	39														
	40														
379.90	41														
	42														
377.90	43														
	44														
375.90	45														
	46														
373.90	47														
	48														
371.90	49														
	50														
369.90	51														
	52														
367.90	53														
	54														
	55														

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REPORT TITLE **BORING RECORD**					HOLE ID **NB10**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**		EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**					
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **3-9-08**		SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	1-2-08	1-3-08	37° 39' 12.42" / -121° 48' 18.8" NAD83	NB11
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 111.8' Rt Sta ~ 318+45.8 A1	412 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE) / TOTAL DEPTH OF BORING
Cement			Not measured	5 ft on 1-3-08 / 60.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		SANDY lean CLAY with GRAVEL (CL); brownish gray; moist.											
	1				1	14 23 28	51	85						4" solid flight augered to 7 feet.
410.00	2		CLAYEY SAND with GRAVEL (SC); very dense; grayish brown; moist to wet.											
	3		Cobbles from 2.5 to 4.5 feet.											
408.00	4													
	5				2	13 20 19	39	85		14	118			PA Drilling fluid measured at 5 feet upon completion of drilling.
406.00	6		At EL. 406.5 ft, becomes dense; light brown.											
	7													Began rotary wash.
404.00	8													
	9													
402.00	10		At EL. 402.0 ft, becomes very dense.		3	19 28 24	52	80						
	11													
400.00	12													
	13													
398.00	14													
	15				4	16 37 40	77	65						
396.00	16													
	17													Suspended drilling on 01/02/08; resumed on 01/03/08.
394.00	18		CLAYEY SAND with GRAVEL (SC); gravel layer from 18 to 18.5 feet.											
	19													
392.00	20				5	19 31 39	70	85						
	21													
390.00	22													
	23													
388.00	24													
	25													

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB11
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		1-4-08	1 of 3

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		CLAYEY SAND with GRAVEL (SC) *(continued)*.		6	14 21 26	47	80		9	134			
386.00	26													
	27													
384.00	28													
	29													
382.00	30				7	21 31 44	75	85						
	31													
380.00	32													
	33													
378.00	34													
	35				8	38 48 49	97	80						
376.00	36													
	37													
374.00	38													
	39		CLAYEY SAND with GRAVEL (SC); very dense; brown to reddish brown; moist.											
372.00	40				9	21 40 43	83	85						
	41													
370.00	42													
	43													
368.00	44													
	45				10	21 29 31	60	65		11	130			
366.00	46													
	47													
364.00	48		SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; brown; moist; trace GRAVEL; with clay.											
	49													
362.00	50				11	40 40 51	91	25						
	51													
360.00	52													
	53													
358.00	54													
	55													

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: **BORING RECORD**

HOLE ID: **NB11**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**1-4-08**	**2 of 3**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	55		SILTY, CLAYEY SAND with GRAVEL (SC-SM) *(continued).*		12	32 45 59	104	80							
356.00	56														
	57														
354.00	58														
	59				13	29 46 45	91	65							
352.00	60		Bottom of Borehole at 60.0 ft.												
350.00	61														
	62														
348.00	63														
	64														
346.00	65														
	66														
344.00	67														
	68														
342.00	69														
	70														
340.00	71														
	72														
338.00	73														
	74														
336.00	75														
	76														
334.00	77														
	78														
332.00	79														
	80														
330.00	81														
	82														
328.00	83														
	84														
	85														

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San Jose Office

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**NB11**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**1-4-08**	**3 of 3**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-19-07	12-20-07	37° 39' 12.87" / -121° 48' 19.94" NAD83	NB12
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 19.4' Rt Sta ~ 318+90.0 A1	422 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44"), CA (2.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE) / TOTAL DEPTH OF BORING
Cement			Not measured	8 ft on 12-20-07 / 71.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		SANDY SILT (ML); dark grayish brown; moist; trace GRAVEL.											
	1				1	15 16 10	26	60						4" Solid Flight Auger to 3.5 feet
420.00	2													
	3													
418.00	4		CLAYEY SAND with GRAVEL (SC); very dense; dark grayish brown; moist.											Dry to 3.5 feet. Began rotary wash.
	5				2	18 31 31	62	60						
416.00	6													
	7													
414.00	8													Water level observed at 8 ft prior to start of drilling on 12/20/08.
	9													
412.00	10				3	13 59 45	104	45						
	11													
410.00	12													
	13													
408.00	14													
	15				4	13 48 49	97	35						
406.00	16													
	17		SANDY lean CLAY with GRAVEL (CL); brown.											
404.00	18													
	19													
402.00	20		SILTY SAND with GRAVEL (SM); very dense; brown.		5	9 34 25	59	45						
	21													
400.00	22													
	23													
398.00	24													
	25													

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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REPORT TITLE				HOLE ID
BORING RECORD				NB12
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-21-07	1 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		SILTY SAND with GRAVEL (SM) *(continued)*.		6	7 35 40	75	90						
396.00	26													
	27													Suspended drilling on 12/19/07; resumed on 12/20/07.
394.00	28													
	29													
392.00	30				7	7 20 37	57	40						
	31													
390.00	32		CLAYEY GRAVEL with SAND (GC); dense; brown; moist.											
	33													
388.00	34													
	35				8	9 16 20	36	0						
386.00	36													
	37				9	30 18 27	45	35						
384.00	38													
	39													
382.00	40		At EL. 382.0 ft, becomes (CLAYEY GRAVEL with SAND) (GC); very dense.		10	8 23 31	54	35						
	41													
380.00	42													
	43													
378.00	44													
	45				11	27 31 44	75	70						
376.00	46													
	47													
374.00	48													
	49													
372.00	50				12	28 42 78	120	80						
	51													
370.00	52													
	53													
368.00	54													
	55													

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				**NB12**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**12-21-07**	**2 of 3**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		CLAYEY GRAVEL with SAND (GC) *(continued)*.											
366.00	56													
	57													
364.00	58													
	59													
362.00	60				13	24 42 46	88	70						
	61													
360.00	62													
	63													
358.00	64													
	65													
356.00	66													
	67													
354.00	68													
	69													
352.00	70				14	26 43 55	98	40						
	71													
350.00	72		Bottom of Borehole at 71.5 ft.											
	73													
348.00	74													
	75													
346.00	76													
	77													
344.00	78													
	79													
342.00	80													
	81													
340.00	82													
	83													
338.00	84													
	85													

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San Jose Office

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB12**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-21-07	3 of 3

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-18-07	12-19-07	37° 39' 14.82" / -121° 48' 19.99" NAD83	NB13
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 15.7' Rt Sta ~ 320+87.3 A1	421 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE) / TOTAL DEPTH OF BORING
Cement			Not measured	14 ft on 12-19-07 / 80.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SANDY SILT (ML); medium stiff; dark brown; moist; trace GRAVEL; (FILL).												
	1				1	6 4 4	8	80							4" solid flight augered to 12 feet.
419.00	2														
	3														
417.00	4		SILTY SAND with GRAVEL (SM); dense; brown; moist; (FILL).												
	5				2	14 20 22	42	80		5	143				
415.00	6														
	7														
413.00	8														
	9														
411.00	10		CLAYEY SAND with GRAVEL (SC); dense; brown; moist; (FILL).		3	10 17 32	49	100							
	11		2 inches asphalt concrete.												
409.00	12		Very dense; Boulders and cobbles.												Dry to 12 feet; began rotary wash. Very hard drilling.
	13														
407.00	14														
	15		CLAYEY SAND with GRAVEL (SC); medium dense; light brown; moist.		4	13 13 16	29	100		12					PA Water level measured at 14 ft prior to resuming drilling on 12/20/07.
405.00	16														
	17														
403.00	18														
	19														
401.00	20		SANDY fat CLAY (CH); medium stiff; light brown; moist.		5	11 4 6	10	25		18	109				PA No recovery at first attempt; disturbed sample retrieved in second attempt.
	21														
399.00	22														
	23														
397.00	24														
	25		SILTY GRAVEL with SAND (GM); very dense; brown;												Hard drilling

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB13
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-21-07	1 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		moist.		6	21 35 42	77	60						
395.00	26													
	27													
393.00	28													
	29													
391.00	30				7	32 34 36	70	60						
	31													
389.00	32													
	33													Hard drilling
387.00	34													
	35		At EL. 386.0 ft, becomes dense.		8	15 21 26	47	100						
385.00	36													
	37													
383.00	38													
	39													
381.00	40				9	20 19 26	45	65						
	41													
379.00	42													
	43													
377.00	44													
	45		At EL. 376.0 ft, becomes very dense.		10	28 29 26	55	100						
375.00	46													
	47													
373.00	48													
	49													
371.00	50				11	32 37 60	97	100						
	51													
369.00	52													
	53													
367.00	54													
	55													

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: **BORING RECORD**

HOLE ID: **NB13**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**12-21-07**	**2 of 3**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		SILTY SAND with GRAVEL (SM); very dense; brown; moist.		12	21 24 36	60							
365.00	56													
	57													
363.00	58													
	59													
361.00	60		SILTY GRAVEL with SAND (GM); very dense; brown; moist.		13	35 48 75	123							
	61													
359.00	62													
	63		SILTY SAND (SM); dense; brown; moist.											
357.00	64													
	65				14	9 17 46	63			11	135			
355.00	66		SILTY SAND with GRAVEL (SM); very dense; brown; moist.											Suspended drilling on 12/18/07; resumed on 12/19/07.
	67													
353.00	68													
	69													
351.00	70				15	33 87 135	222	90						
	71													
349.00	72													
	73													
347.00	74													
	75				16	31 58 69	127	55						
345.00	76													
	77													
343.00	78													
	79				17	47 74 81/3"	155/ 9"	35						
341.00	80		Bottom of Borehole at 80.0 ft.											Sampler advanced 15 in.
	81													
339.00	82													
	83													
337.00	84													
	85													

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: **BORING RECORD**

HOLE ID: **NB13**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-21-07	3 of 3

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	1-18-08	1-18-08	37° 39' 14.66" / -121° 48' 19.38" NAD83	NB14
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 65.7' Rt Sta ~ 320+72.1 A1	415 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Not measured	60.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILT with GRAVEL (ML); stiff; brown; moist.												
	1				1	10 15 25	40	75		9	122				LL=21 PI=1 PI PI
413.00	2														
	3														4" solid flight augered to 11.5 feet.
411.00	4		SILTY GRAVEL (GM); very dense; brown; moist.												
	5				2	22 31 36	67	65							
409.00	6														
	7														
407.00	8		CLAYEY GRAVEL with SAND (GC); medium dense; grayish brown; moist.												
	9														
405.00	10				3	10 14 12	26	60		5					PA
	11														
403.00	12														Dry to 11.5 feet; began rotary wash.
	13														
401.00	14		Lean CLAY (CL); stiff; brown with grayish brown mottles; moist.												
	15				4	4 5 8	13	50		27	99	PP = 1.5			LL=33 PI=11 PI
399.00	16														
	17														
397.00	18		CLAYEY SAND with GRAVEL (SC); very dense; brown.												
	19														
395.00	20				5	19 28 36	64	55							
	21														
393.00	22														
	23														
391.00	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB14
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		1-21-08	1 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		CLAYEY SAND with GRAVEL (SC) *(continued)*.		6	15 39 32	71	65						
389.00	26													
	27													
387.00	28													
	29													
385.00	30				7	9 25 30	55	65		9	133			
	31													
383.00	32													
	33													Slight fluid loss
381.00	34													
	35				8	26 43 44	87	65						
379.00	36													
	37													
377.00	38													
	39													
375.00	40				9	19 27 27	54	65		8	143			
	41													
373.00	42													
	43													
371.00	44													
	45		At EL. 370.0 ft, becomes dense.		10	6 11 29	40	35						
369.00	46													
	47													
367.00	48													
	49													
365.00	50		At EL. 365.0 ft, becomes very dense.		11	15 42/1"	42/ 1"	50						
	51													Sampler advanced 7 in.
363.00	52													
	53													
361.00	54													
	55													

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San Jose Office

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB14**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**1-21-08**	**2 of 3**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	55														
359.00	56		Lean CLAY with SAND (CL); brown.		12	13 18 16	34	0							
	57														
357.00	58		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.												
	59				13	12 26 39	65	50		12	126				
355.00	60		Bottom of Borehole at 60.0 ft.												
	61														
353.00	62														
	63														
351.00	64														
	65														
349.00	66														
	67														
347.00	68														
	69														
345.00	70														
	71														
343.00	72														
	73														
341.00	74														
	75														
339.00	76														
	77														
337.00	78														
	79														
335.00	80														
	81														
333.00	82														
	83														
331.00	84														
	85														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE **BORING RECORD**				HOLE ID **NB14**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **1-21-08**	SHEET **3 of 3**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	**11-27-07**	**11-27-07**	**37° 39' 31.22" / -121° 48' 19.75" NAD83**	**NB15**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			**~ 24.1' Rt Sta ~ 337+46.9 A1**	**419.00 ft NAVD 88**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			**Mobile B53**	**8 inch**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			**140lb/30in - Wirewinch**	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			**Dry**	**14.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY lean CLAY (CL); very stiff; grayish brown to black; moist.												
	1				1	11 14 12	26	60							
417.00	2														
	3														
415.00	4		SILTY, CLAYEY GRAVEL with SAND (GC-GM); dense; yellowish brown; moist.		2	13 13 29	42	80							Cobble in shoe.
	5		At EL. 414.0 ft, grades to very dense; Clayey GRAVEL (GC).		3	38 52 54	106	95							
413.00	6														
	7														
411.00	8														Hard drilling.
	9		At EL. 410.5 ft, with sand.		4	25 31 31	62	90							
409.00	10														
	11														
407.00	12														
	13				5	42 50/1.5"	50/ 1.5"								Sampler advanced 7.5 in.
405.00	14		Boring dry ATD. Bottom of Borehole at 14.0 ft.												Refusal at 14 feet.
403.00	15														
	16														
401.00	17														
	18														
399.00	19														
	20														
397.00	21														
	22														
395.00	23														
	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**NB15**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**12-3-07**	**1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-26-07	11-26-07	37° 39' 41.81" / -121° 48' 19.4" NAD83	NB16
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 52.1' Rt Sta ~ 348+17.7 A2	420.90 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	15.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7 inches Asphalt Concrete over 17 inches AB.												
	1				1	64 50/1"	50/ 1"	40							Bag sample 1 to 5 feet.
418.90	2		SILTY GRAVEL (GM); very dense; brown mottled with gray red; moist.												Sampler advanced 7 in.
	3														
416.90	4				2	22 24 30	54	70							
	5														
414.90	6														
	7														
412.90	8														
	9				3	35 21 28	49	85							
410.90	10		SILTY SAND with GRAVEL (SM); very dense; brown; moist.												
	11														
408.90	12														
	13														
406.90	14		SILTY GRAVEL (GM); very dense; brown; moist.		4	23 28 106	134	70							
	15														Tried SPT at 15.5 feet; blow count = 50 for < 1 inch.
404.90	16		Boring dry ATD. Bottom of Borehole at 15.5 ft.												Refusal at 15.5 feet.
	17														
402.90	18														
	19														
400.90	20														
	21														
398.90	22														
	23														
396.90	24														
	25														

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB16
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-26-07	11-26-07	37° 39' 47.68" / -121° 48' 19.34" NAD83	NB17
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 51.5' Rt Sta ~ 354+11.8 A2	419.60 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	20.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7 inches Asphalt Concrete over 17 inches AB.												
	1				1	63 35 32	67	30							Bag sample 1 to 5 feet.
417.60	2		CLAYEY GRAVEL (GC); very dense; dark gray; moist.												
	3														
415.60	4		SILTY GRAVEL (GM); dense; brown; moist.		2	20 23 24	47	55							
	5														
413.60	6		CLAYEY GRAVEL with SAND (GC); very dense; brown; moist.												
	7														
411.60	8														
	9				3	32 36 36	72	65							PA
409.60	10														
	11														
407.60	12														
	13														
405.60	14				4	35 44 59	103	100							
	15														
403.60	16														
	17														
401.60	18														
	19				5	30 41 79	120	95							
399.60	20		Boring dry ATD. Bottom of Borehole at 20.0 ft.												
	21														
397.60	22														
	23														
395.60	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB17
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-26-07	11-26-07	37° 39' 52.9" / -121° 48' 19.27" NAD83	NB18
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 51.3' Rt Sta ~ 359+40.0 A2	414.50 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	20.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete over 16 inches AB.												
	1				1	25 16 12	28	15		9	124				Bag sample 1 to 5 feet.
412.50	2		Lean CLAY (CL); stiff; reddish brown; moist.												
	3														
410.50	4		SILTY GRAVEL (GM); very dense; brown; moist.		2	10 26 37	63	65							
	5														
408.50	6														
	7														
406.50	8														
	9				3	49 37 41	78	90							
404.50	10														
	11														
402.50	12														
	13														
400.50	14				4	57 54 58	112	65							
	15														
398.50	16														
	17														
396.50	18														
	19				5	44 40 43	83								
394.50	20		Boring dry ATD. Bottom of Borehole at 20.0 ft.												
	21														
392.50	22														
	23														
390.50	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB18
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-21-07	11-21-07	37° 40' 24.96" / -121° 48' 20.14" NAD83	NB19
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 76.1' Lt Sta ~ 391+83.6 A2	420.60 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	30.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY CLAY (CL-ML); medium stiff; dark brown; moist; trace GRAVEL.												
	1														
418.60	2				1	4 6 6	12	65		13	113	UC =0.9			
	3														
416.60	4				2	3 3 5	8	95		15	112	UC =0.5			PI
	5														
414.60	6														
	7														
412.60	8														
	9		Lean CLAY (CL); very stiff; light brown; moist.		3	5 12 13	25	50		11	120	UC =1.7			PI
410.60	10														
	11														
408.60	12														
	13														
406.60	14				4	11 16 18	34	55							
	15		CLAYEY SAND with GRAVEL (SC); medium dense to dense; brown; moist.												
404.60	16														
	17														
402.60	18														
	19		SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; brown; moist.		5	34 40 42	82	70							
400.60	20														
	21														
398.60	22														
	23														
396.60	24		SILT (ML); stiff; brown; moist.		6	9 8 9	17	100							
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB19
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SILTY SAND with GRAVEL (SM); very dense; brown; moist.												
394.60	26														
	27														
392.60	28														
	29				7	21 34 36	70	55							
390.60	30		Boring dry ATD. Bottom of Borehole at 30.0 ft.												
388.60	32														
386.60	34														
384.60	36														
382.60	38														
380.60	40														
378.60	42														
376.60	44														
374.60	46														
372.60	48														
370.60	50														
368.60	52														
366.60	54														
	55														

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**NB19**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**11-30-07**	**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-21-07	11-21-07	37° 40' 28.56" / -121° 48' 20.13" NAD83	NB20
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 63.8' Lt Sta ~ 395+45.2 A3	421.40 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY CLAY (CL-ML); very stiff; brown; moist; trace GRAVEL.												
	1				1	11 14 6	20	40							
419.40	2														
	3														
417.40	4		At EL. 417.4 ft, becomes light brown.		2	6 9 9	18	55		6	114	UC =1.4			PI
	5														
415.40	6														
	7														
413.40	8														
	9		At EL. 412.9 ft, becomes hard.		3	9 22 28	50	80		9	125	UC =5.9			
411.40	10														
	11														
409.40	12														
	13														
407.40	14				4	15 18 19	37	50		9	126	UC =7.6			
	15														
405.40	16														
	17														
403.40	18														
	19				5	16 20 24	44	45		13	122	UC =9.7			
401.40	20														
	21														
399.40	22														
	23														
397.40	24		At EL. 397.9 ft, becomes very stiff to hard; fine sand lenses.		6	14 15 20	35	60		12	114	UC =4			
	25														

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San Jose Office

55 S. Market St, Ste 1500
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REPORT TITLE				HOLE ID
BORING RECORD				NB20
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SILTY CLAY (CL-ML) *(continued)*.												
395.40	26														
	27														
393.40	28														
	29				7	23 36 47	83	75							
391.40	30		At EL. 391.4 ft, with (SILTY CLAY) (CL-ML); some GRAVEL.												
	31		SILTY GRAVEL with SAND (GM); very dense; brown; moist.												
389.40	32														
	33														
387.40	34				8	30 34 42	76	100							
	35														
385.40	36														
	37														
383.40	38														
	39				9	50 48 81/3.5"	129/ 9.5"	95							
381.40	40		Boring dry ATD. Bottom of Borehole at 40.0 ft.												Sampler advanced 15.5 in.
	41														
379.40	42														
	43														
377.40	44														
	45														
375.40	46														
	47														
373.40	48														
	49														
371.40	50														
	51														
369.40	52														
	53														
367.40	54														
	55														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB20**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**11-30-07**	**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-21-07	11-21-07	37° 40' 40.98" / -121° 48' 19.77" NAD83	NB21
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 34.2' Lt Sta ~ 408+03.9 A3	417.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SANDY lean CLAY with GRAVEL (CL); very stiff; dark brown; moist.												
	1				1	9 22 40	62	85		8	123	UC =3.9			
415.80	2														
	3				2	28 36 34	70	65							
413.80	4														
	5		At EL. 412.8 ft, with increase in gravel content.												
411.80	6														
	7		CLAYEY SAND with GRAVEL (SC); medium dense; moist.												
409.80	8														
	9				3	4 7 7	14	60		6					PA
407.80	10														
	11														
405.80	12		SANDY lean CLAY with GRAVEL (CL); hard; brown; moist.												
	13														
403.80	14				4	17 21 27	48	75		9	128	UC =8.2			
	15														
401.80	16		At EL. 402.3 ft, with increase in gravel content.												
	17		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; tan brown; dry.												
399.80	18														
	19				5	20 51 45	96	85							
397.80	20														
	21														
395.80	22														
	23														
393.80	24				6	41 69/1.5"	69/ 1.5"	50							Sampler advanced 7.5 in.
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB21
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 2

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Poorly graded SAND with SILT and GRAVEL (SP-SM) *(continued)*.												
391.80	26														
	27														
389.80	28														
	29		At EL. 389.3 ft, becomes wet.		7	27 32 38	70	100							
387.80	30														
	31														
385.80	32														
	33		Lean CLAY (CL); hard; brown.												
383.80	34				8	7 11 22	33	90		16	117	UC =3			PI
	35														
381.80	36		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; tan brown; moist to wet.												
	37														
379.80	38														
	39				9	40 51 53	104	75							
377.80	40		Boring dry ATD. Bottom of Borehole at 40.0 ft.												
	41														
375.80	42														
	43														
373.80	44														
	45														
371.80	46														
	47														
369.80	48														
	49														
367.80	50														
	51														
365.80	52														
	53														
363.80	54														
	55														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE **BORING RECORD**				HOLE ID **NB21**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **11-30-07**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-4-07	12-4-07	37° 40' 40.91" / -121° 48' 18.74" NAD83	NB22
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 48.5' Rt Sta ~ 407+96.2 A3	407.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	30.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		5 inches AC over 7 inches AB.												
	1		SILTY GRAVEL (GM); dense; brown; moist; trace fine GRAVEL; (FILL).		1	21 28 24	52	55							
405.80	2														
	3														
403.80	4		At EL. 404.3 ft, becomes medium dense.		2	11 10 7	17	30							
	5														
401.80	6														
	7														
399.80	8														
	9				3	7 7 23	30	55							
397.80	10		CLAYEY GRAVEL with SAND (GC); medium dense; moist to wet.												
	11														
395.80	12														
	13		SANDY lean CLAY (CL); very stiff; brown; moist to wet.												
393.80	14		At EL. 393.8 ft, with some fine GRAVEL; increase in sand content.		4	13 18 21	39	65							
	15														
391.80	16		SILTY SAND with GRAVEL (SM); very dense; brown; moist.												
	17														
389.80	18														
	19				5	36 43 31	74	45		6	127				
387.80	20														
	21														
385.80	22														
	23														
383.80	24				6	43 78 91	169	80							
	25														

Plastic shavings in gravel cuttings; might have trimmed an underdrain pipe.

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB22
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-4-07	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SILTY SAND with GRAVEL (SM) *(continued)*.												
381.80	26														
	27														
379.80	28														
	29				7	76 50/2"	50/ 2"								Sampler advanced 8 in. Rock fragment at 29 feet.
377.80	30		Boring dry ATD. Bottom of Borehole at 30.0 ft.												
375.80	32														
373.80	34														
371.80	36														
369.80	38														
367.80	40														
365.80	42														
363.80	44														
361.80	46														
359.80	48														
357.80	50														
355.80	52														
353.80	54														
	55														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**NB22**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**12-4-07**	**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-7-07	12-7-07	37° 40' 40.82" / -121° 48' 18.21" NAD83	NB22A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 91.1' Rt Sta ~ 407+87.4 A3	421.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			24.7 ft	30.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		3 inches asphalt concrete.												
	1		SANDY lean CLAY with GRAVEL (CL); stiff; brown; moist.												
419.00	2														
	3														
417.00	4				1	9 10 7	17	35							
	5		SILTY SAND (SM); yellowish brown.												
415.00	6														
	7														
413.00	8		SANDY SILTY CLAY with GRAVEL (CL-ML); medium stiff; brown; moist.		2	5 3 5	8	35		11					PI
411.00	10														
	11														
409.00	12														
	13														
407.00	14		At EL. 407.0 ft, becomes (SANDY lean CLAY with GRAVEL) (CL); very stiff.		3	8 11 19	30	50							
	15														
405.00	16		CLAYEY SAND with GRAVEL (SC); dense; brown; moist.												
	17														
403.00	18														
	19				4	14 18 20	38	65		6	126				
401.00	20														
	21														
399.00	22														
	23														
397.00	24		At EL. 397.5 ft, becomes (CLAYEY SAND with GRAVEL) (SC); very dense; wet.		5	23 26 30	56	65		7	136				
	25														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB22A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-7-07	1 of 2

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		CLAYEY SAND with GRAVEL (SC) *(continued)*.												
395.00	26														
	27														
393.00	28														
	29		At EL. 392.5 ft, becomes dense.		6	15 23 25	48	65							
391.00	30		Bottom of Borehole at 30.0 ft.												
389.00	31														
	32														
387.00	33														
	34														
385.00	35														
	36														
383.00	37														
	38														
381.00	39														
	40														
379.00	41														
	42														
377.00	43														
	44														
375.00	45														
	46														
373.00	47														
	48														
371.00	49														
	50														
369.00	51														
	52														
367.00	53														
	54														
	55														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB22A**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-7-07	2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-27-07	1-2-08	37° 40' 46.51" / -121° 48' 19.37" NAD83	NB23
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 94.8' Lt Sta ~ 413+63.2 A3	417 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE) / TOTAL DEPTH OF BORING
Cement			Not measured	42.5 ft on 1-2-08 / 101.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		6 inches Aggregate.											
	1		CLAYEY SAND with GRAVEL (SC); dense to very dense; brown; moist.		1	15 27 23	50	65		4	143			4" solid flight augered to 8 feet.
415.00	2													
	3		Cobbles.											
413.00	4		CLAYEY SAND with GRAVEL (SC); medium dense; dark grayish brown; moist to wet.											
	5				2	6 7 6	13	55						
411.00	6													
	7													
409.00	8													Dry to 8 feet; began rotary wash.
	9		Lean CLAY (CL); stiff; dark brown; moist; trace fine GRAVEL.											
407.00	10				3	3 4 9	13	65		12	127	UC =3.3		
	11		At EL. 406.0 ft, with coarse sand.											
405.00	12													
	13													
403.00	14		CLAYEY SAND with GRAVEL (SC); very dense; dark brown; moist.											
	15				4	10 28 26	54	70						
401.00	16													
	17													
399.00	18													Fluid loss from 17 to 19 feet.
	19		CLAYEY GRAVEL with SAND (GC); dense; dark brown; moist.											
397.00	20				5	19 29 39	68	65						
	21													
395.00	22													
	23													
393.00	24		CLAYEY SAND with GRAVEL (SC); dense; brown.											
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				NB23
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		1-4-08	1 of 4

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		CLAYEY SAND with GRAVEL (SC) *(continued)*.		6	21 32 31	63	80						
391.00	26													
	27													
389.00	28													
	29		Lean CLAY (CL); stiff; light brown; moist.											
387.00	30				7	5 5 5	10	35		22	103	UC =1		PI
	31													
385.00	32													
	33													
383.00	34													
	35				8	5 6 6	12	40		21	99	UC =1		PI
381.00	36													
	37		SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; grayish brown.											
379.00	38													
	39													
377.00	40				9	35 40 80	120	80						
	41													
375.00	42													
	43													Water level observed at 42.5 ft prior to resuming drilling 01/02/08.
373.00	44													
	45				10	41 57 62	119	85						
371.00	46													
	47													
369.00	48													
	49													
367.00	50		At EL. 367.0 ft, becomes dense.		11	27 30 16	46	65		7	136			PA
	51													
365.00	52		At EL. 365.0 ft, with less gravel.											
	53													
363.00	54		SILTY CLAY (CL-ML); very stiff; light brown.											
	55													

(continued)

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB23**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	1-4-08	2 of 4

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		SILTY CLAY (CL-ML) *(continued)*.		12	9 12 16	28	80		17	116	UC =1.4		PI
361.00	56													
	57													
359.00	58													
	59													
357.00	60		Lean CLAY (CL); very stiff; brown; moist; trace GRAVEL.		13	10 13 14	27	95		14	121	UC =1.7		
	61													
355.00	62													
	63													
353.00	64													
	65		At EL. 352.0 ft, with sand lenses.		14	11 24 31	55	50		14	125	UC =1.2		
351.00	66													
	67													
349.00	68		SILTY GRAVEL with SAND (GM); very dense; brown.											
	69													
347.00	70				15	48 88 115	203	50						
	71													
345.00	72													Suspended drilling 12/27/07; resumed 01/02/08.
	73													
343.00	74													
	75		Lean CLAY (CL); very stiff to hard; brown; moist.		16	18 27 32	59	100						
341.00	76													
	77													
339.00	78													
	79													
337.00	80				17	15 26 31	57	100		17	110	UC =2.8		
	81													
335.00	82		At EL. 335.0 ft, with some sand.											
	83													
333.00	84		SANDY lean CLAY with GRAVEL (CL); very stiff; reddish brown; moist.											
	85													

(continued)

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB23**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**1-4-08**	**3 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	85		SANDY lean CLAY with GRAVEL (CL) *(continued)*.		18	12 16 43	59	100		12	127	UC =2.8			
331.00	86														
	87														
329.00	88														
	89														
327.00	90		CLAYEY SAND with GRAVEL (SC); very dense; brown.		19	35 58 108	166	90							
	91														
325.00	92														
	93														
323.00	94														
	95				20	39 56 59	115	90							
321.00	96														
	97														
319.00	98														
	99														
317.00	100				21	56 67 55	122	90							
	101														
315.00	102		Bottom of Borehole at 101.5 ft.												
	103														
313.00	104														
	105														
311.00	106														
	107														
309.00	108														
	109														
307.00	110														
	111														
305.00	112														
	113														
303.00	114														
	115														

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55 S. Market St, Ste 1500
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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB23**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	1-4-08	4 of 4

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-26-07	12-27-07	37° 40' 48.04" / -121° 48' 21.29" NAD83	NB24
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling			~ 155.2' Lt Sta ~ 415+18.7 A3	418 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE) / TOTAL DEPTH OF BORING
Cement			Not measured	26.5 ft on 12-27-07 / 101.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches Aggregate.												
			GRAVELLY SILT (ML); brown.												
	1		SANDY SILT (ML); medium stiff; dark brown; moist; trace fine GRAVEL.		1	3 3 3	6	55		8	106	UC =0.6			4" solid flight augered to 8 feet.
415.50	2														
	3		SILTY GRAVEL (GM); medium dense; grayish brown; dry; with some cobbles up to 6 inches.												
413.50	4														
	5				2	12 12 12	24	25							
411.50	6														
	7														
409.50	8		CLAYEY SAND with GRAVEL (SC); medium dense; dark brown; moist.												Dry to 8 feet; began rotary wash.
	9														
407.50	10				3	7 6 10	16	25							
	11														
405.50	12														
	13														
403.50	14		CLAYEY GRAVEL with SAND (GC); medium dense; grayish brown; moist.												
	15				4	9 11 16	27	35		7	132				PA
401.50	16														
	17														
399.50	18														
	19														
397.50	20		At EL. 397.5 ft, becomes dense.		5	7 18 34	52	80							
	21														
395.50	22														
	23														
393.50	24														
	25														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB24
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		1-2-08	1 of 4

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		At EL. 392.5 ft, becomes very dense. CLAYEY GRAVEL with SAND (GC) *(continued)*.		6	39 60 66	126	50						
391.50	26													
	27		At EL. 390.5 ft, with some gravel layers upto 6 inches thick.											Water level measured at 26.5 ft prior to resuming drilling on 12/27/07.
389.50	28													
	29													
387.50	30				7	13 27 39	66	65						
	31													
385.50	32													
	33													
383.50	34		Lean CLAY (CL); hard; dark brown; moist; trace coarse SAND.											
	35				8	10 16 23	39	80		13	126	UC =4.8		
381.50	36													
	37		CLAYEY SAND with GRAVEL (SC); very dense; brown with gray mottling; moist.											
379.50	38													
	39													
377.50	40				9	32 72 89	161	90						
	41													
375.50	42													
	43													
373.50	44													
	45				10	40 46 30	76	60						
371.50	46													
	47													
369.50	48		At EL. 369.5 ft, with (CLAYEY SAND with GRAVEL) (SC); decrease in gravel content.											
	49		Lean CLAY (CL); hard; dark brown; moist; trace GRAVEL.											
367.50	50				11	21 25 23	48	75		8	137	UC =1.6		
	51													
365.50	52													
	53													
363.50	54													
	55													

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

55 S. Market St, Ste 1500
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REPORT TITLE **BORING RECORD**				HOLE ID **NB24**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **1-2-08**	SHEET **2 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	55		At EL. 362.5 ft, becomes very stiff. Lean CLAY (CL) *(continued)*.		12	9 13 17	30	80		25	101	UC =2.7			
361.50	56														
	57														
359.50	58		CLAYEY GRAVEL (GC); brown.												
	59														
357.50	60		Lean CLAY (CL); stiff; dark brown; moist.		13	7 9 10	19	80		21	106	UC =1.6			PI
	61														
355.50	62														
	63														
353.50	64														
	65		At EL. 352.5 ft, becomes hard.		14	16 21 25	46	35		14	123	UC =6.4			
351.50	66														
	67														
349.50	68														
	69														
347.50	70		At EL. 347.5 ft, becomes stiff.		15	11 15 26	41	65		18	114	UC =1.6			
	71		SILTY SAND (SM); dense; dark brown; moist.												
345.50	72		At EL. 345.5 ft, with gravel.												
	73														
343.50	74		Lean CLAY with SAND (CL); dark brown.												
	75				16	34 35 31	66	90							
341.50	76		Poorly graded SAND with SILT (SP-SM); very dense; dark brown; moist; trace fine GRAVEL.												
	77														
339.50	78		Lean CLAY (CL); stiff; dark brown; moist.												
	79														
337.50	80				17	11 15 22	37	90		20	108	UC =1.9			PI
	81														
335.50	82														
	83														
333.50	84														
	85														

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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REPORT TITLE **BORING RECORD**				HOLE ID **NB24**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **1-2-08**	SHEET **3 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	85		At EL. 332.5 ft, becomes very stiff. Lean CLAY (CL) *(continued)*.		18	13 22 28	50	85		19	110	UC =3.2			
331.50	86														
	87														
329.50	88														
	89														
327.50	90		At EL. 327.5 ft, becomes hard.		19	18 31 54	85	65							
	91														Suspended drilling on 12/26/07; resumed on 12/27/07.
325.50	92														
	93														
323.50	94														
	95				20	17 25 38	63	100		16	117	UC =4.9			
321.50	96														
	97														
319.50	98														
	99														
317.50	100		At EL. 317.5 ft, becomes light brown.		21	13 20 25	45	65		22	104	UC =3.6			
	101														
315.50	102		Bottom of Borehole at 101.5 ft.												
	103														
313.50	104														
	105														
311.50	106														
	107														
309.50	108														
	109														
307.50	110														
	111														
305.50	112														
	113														
303.50	114														
	115														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**NB24**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**1-2-08**	**4 of 4**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-5-07	12-5-07	37° 41' 8.56" / -121° 48' 19.63" NAD83	NB25
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 61.8' Rt Sta ~ 435+92.1 A3	416.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	22.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches Asphalt Concrete over 12 inches AB.												
	1				1	57 42 25	67	65							
414.00	2		SILTY SAND with GRAVEL (SM); very dense; dark grayish brown; moist.												
	3														
412.00	4		SILTY, CLAYEY SAND (SC-SM); medium dense; dark brown; moist; trace fine GRAVEL.		2	8 9 9	18	65		7	128				
	5														
410.00	6														
	7														
408.00	8														
	9		Lean CLAY (CL); stiff to very stiff; dark brown; moist.		3	11 10 14	24	80		15	117	UC =2.1			
406.00	10														
	11														
404.00	12														
	13														
402.00	14		CLAYEY SAND with GRAVEL (SC); medium dense; dark brown; moist to wet; trace GRAVEL.		4	7 7 5	12	65		7	129				PI
	15														
400.00	16		SILTY SAND with GRAVEL (SM); very dense; brown to brownish gray; moist.												
	17														
398.00	18														
	19				5	67 44 50	94	55		4	138				
396.00	20														
	21														Hard drilling.
394.00	22		Boring dry ATD. Bottom of Borehole at 22.0 ft.												Refusal at 22 feet.
392.00	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB25
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-5-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-7-07	12-7-07	37° 41' 8.59" / -121° 48' 19.63" NAD83	NB25A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 92.4' Rt Sta ~ 435+92.0 A3	425.30 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	25.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SANDY lean CLAY with GRAVEL (CL); stiff; dark brown mottled with gray pockets; moist; (FILL).												
423.30	2														Hand augered to 3.5 feet.
	3														
421.30	4				1	14 14 8	22	65							
	5														
419.30	6														
	7														
417.30	8														
	9		Well-graded SAND with GRAVEL (SW); dense; brown; (FILL).		2	17 17 26	43	80							
415.30	10														
	11														
413.30	12														
	13														
411.30	14		Lean CLAY (CL); very stiff; brown; moist; trace fine GRAVEL; (FILL).		3	21 14 12	26	65		18	111	PP = 2 UC =1.5			
	15														
409.30	16														
	17														
407.30	18														
	19		At EL. 406.3 ft, becomes hard; brown mottled with gray pockets; increase in gravel content.		4	12 14 17	31	100		14	120	PP = 4.5 UC =2.2			
405.30	20		3 inches asphalt concrete.												
	21		SANDY lean CLAY with GRAVEL (CL); stiff; brown; moist.												
403.30	22														
	23														
401.30	24				5	9 23 29	52	80							
	25		CLAYEY SAND with GRAVEL (SC); dense; brown;												

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB25A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-7-07	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		moist.												
			Boring dry ATD.												
399.30	26		Bottom of Borehole at 25.0 ft.												
	27														
397.30	28														
	29														
395.30	30														
	31														
393.30	32														
	33														
391.30	34														
	35														
389.30	36														
	37														
387.30	38														
	39														
385.30	40														
	41														
383.30	42														
	43														
381.30	44														
	45														
379.30	46														
	47														
377.30	48														
	49														
375.30	50														
	51														
373.30	52														
	53														
371.30	54														
	55														

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REPORT TITLE **BORING RECORD**					HOLE ID **NB25A**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**		EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**					
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **12-7-07**		SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-20-07	11-20-07	37° 41' 19.71" / -121° 48' 19.7" NAD83	NB26
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 77.5' Rt Sta ~ 447+24.4 A3	410.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	30.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY lean CLAY (CL); stiff; yellowish brown; moist.												
	1				1	9 8 9	17	75		6	116				
408.20	2														
	3		At EL. 407.2 ft, with sand, gravel up to 2 inches.		2	5 6 8	14	70							
406.20	4														
	5		At EL. 405.2 ft, with (GRAVELLY lean CLAY) (CL); trace SAND.		3	8 7 7	14	75							
404.20	6														
	7														
402.20	8		Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; light brownish yellow to grayish brown; moist.												
	9				4	9 12 14	26	85		3	124				
400.20	10														
	11														
398.20	12														
	13														
396.20	14		Lean CLAY with GRAVEL (CL); stiff; dark reddish brown; moist.		5	30 12 14	26								2-inch gravel in shoe; sample disturbed.
	15														
394.20	16														
	17														
392.20	18														
	19		SILT (ML); medium stiff to stiff; brownish gray; moist; trace GRAVEL; trace SAND; orange and black mottling.		6	9 10 12	22	95		19	112	PP = 1.5 UC =0.7			PI
390.20	20														
	21														
388.20	22		CLAYEY SAND with GRAVEL (SC); very dense; olive brown to grayish brown; wet.												
	23														
386.20	24				7	31 36 50/6"	86/ 12"	90							
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB26
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 2

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		CLAYEY SAND with GRAVEL (SC) *(continued)*.												Sampler advanced 18 in.
384.20	26														
	27														
382.20	28														
	29				8	50/6"	REF	35		8	119				Sampler advanced 6 in.
380.20	30		Boring dry ATD. Bottom of Borehole at 30.0 ft.												
378.20	32														
376.20	34														
374.20	36														
372.20	38														
370.20	40														
368.20	42														
366.20	44														
364.20	46														
362.20	48														
360.20	50														
358.20	52														
356.20	54														
	55														

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REPORT TITLE **BORING RECORD**				HOLE ID **NB26**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **11-30-07**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-9-08	12-9-08	2056829.7 ft / 6185489.5 ft NAD83	NB30
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 34' Rt Sta ~ 51+26 VEX	527 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			24 ft	24 ft on 12-9-08	50.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY SILT (ML); very stiff; reddish brown; moist.												
	1				1	25 50/6"	50/ 6"	65							
525.00	2														Sampler advanced 12 in.
	3														
523.00	4		SILTY CLAY with SAND (CL-ML); hard; dark gray; moist; some GRAVEL.		2	18 29 32	61	50		6	123				
	5				3	10 11 13	24	60		10	127				LL=21 PI=5
521.00	6		Less sand.												PI
	7														
519.00	8		Lean CLAY with GRAVEL (CL); very stiff; brown mottled with gray; moist.												
	9				4	23 36 50	86	65		17	116	PP = >4.5 UC =7.27			
517.00	10														
	11														
515.00	12														
	13		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.												
513.00	14				5	50/6"	REF	35		8					Sampler advanced 6 in.
	15														
511.00	16														
	17														
509.00	18														
	19		Lean CLAY (CL); hard; brown mottled with grayish brown; moist.		6	13 15 14	29	100		21					
507.00	20														
	21														
505.00	22														
	23														
503.00	24		SILTY SAND with GRAVEL (SM); very dense; wet.		7	33 50/5"	50/ 5"	65		11	127				Sampler advanced 11 in.
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB30
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		12-11-08	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Lean CLAY (CL); hard; brown; moist.												
501.00	26														
	27														
499.00	28														
	29		CLAYEY SAND with GRAVEL (SC); brown.		8	50/5"	REF	80		13	121				Sampler advanced 5 in.
497.00	30														
	31														
495.00	32														
	33														
493.00	34				9	55 89 50/2"	139/ 8"	85		11					
	35														Sampler advanced 14 in.
491.00	36														
	37														
489.00	38														
	39		Lean CLAY (CL); very stiff to hard; brown; moist; with black speckling.		10	20 31 37	68	100		19					
487.00	40														
	41														
485.00	42														
	43														
483.00	44				11	50/6"	REF	35		14	122	PP = >4.5 UC =8.45			Sampler advanced 6 in.
	45														
481.00	46														
	47														
479.00	48														
	49				12	28 22 25	47	70		17	117	PP = >4.5 UC =7.255			
477.00	50		Bottom of Borehole at 50.0 ft.												
	51														
475.00	52														
	53														
473.00	54														
	55														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB30**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	L.Phillips	**12-11-08**	**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-9-08	12-9-08	2056994.7 ft / 6185748.5 ft NAD83	NB31
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 45.4' Rt Sta ~ 54+34 VEX	518 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			28 ft	28 ft on 12-9-08	50.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY SILT (ML); very stiff; brown; moist.												
	1				1	21 20 24	44	50		4					
516.00	2														
	3														
514.00	4				2	8 12 21	33	80		6	115				
	5		SANDY SILT (ML); very stiff; brown; moist.		3	25 34 22	56	35		8	123	PP = >4.5			
512.00	6														
	7														
510.00	8		SILTY SAND with GRAVEL (SM); very dense; brown; with GRAVEL.												
	9				4	33 50/5"	50/ 5"	50		5	125				Sampler advanced 11 in.
508.00	10														
	11		At EL. 507.0 ft, becomes reddish brown.												
506.00	12		Lean CLAY (CL); hard; reddish brown mottled with gray; moist.												
	13														
504.00	14				5	15 19 28	47	70		19	111	PP = >4.5			
	15														
502.00	16														
	17														
500.00	18		SILTY SAND (SM); very dense; brown; some GRAVEL; trace fines.												
	19				6	50/4"	REF	50		7	110				Sampler advanced 4 in.
498.00	20														
	21														
496.00	22		CLAYEY SAND (SC); very dense; brown; moist; with GRAVEL.												
	23														
494.00	24				7	54 82 77	159	75		11					
	25														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB31
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		12-11-08	1 of 2

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		CLAYEY SAND (SC) *(continued)*.												
492.00	26														
	27														
490.00	28				8	42 82 109	191	70		11					
	29														
488.00	30														
	31														
486.00	32														
	33														
484.00	34				9	62 50/2"	50/ 2"	65		14					Sampler advanced 8 in.
	35														
482.00	36														
	37														
480.00	38														
	39				10	42 129		50		11					
478.00	40														Sampler advanced 12 in.
	41														
476.00	42														
	43														
474.00	44				11	55 80 93	173	80							
	45		Lean CLAY (CL); hard; reddish brown; moist.												
472.00	46														
	47														
470.00	48														
	49		At EL. 469.5 ft, becomes reddish brown mottled with gray; and some black speckling.		12	22 33 50	83	100		20	110	PP = >4.5 UC =4.83			
468.00	50		Bottom of Borehole at 50.0 ft.												
	51														
466.00	52														
	53														
464.00	54														
	55														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB31**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	L.Phillips	**12-11-08**	**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	1-5-09	1-5-09	2057200.5 ft / 6185955.1 ft NAD83	NB32
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 21.3' Rt Sta ~ 103+77 V1	520 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	50.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8" Asphalt Concrete.												Bag sample 2 to 5'
	1		Aggregate Base.		1	50/3"	REF	15							
518.00	2														Sampler advanced 3 in.
	3														
516.00	4				2	50/4"	REF	20		7					Sampler advanced 4 in.
	5		SILTY SAND with GRAVEL (SM); reddish brown; trace GRAVEL; with fines.												
514.00	6														
	7														
512.00	8														
	9				3	50/6"	REF	20		9					Sampler advanced 6 in.
510.00	10														
	11														
508.00	12														
	13		SILTY GRAVEL with SAND (GM); very dense; brown.												
506.00	14				4	27 36 41	77	20							
	15														
504.00	16														
	17														
502.00	18														
	19		Lean CLAY (CL); hard; brown; moist; black speckling.		5	11 18 23	41	100		21					LL=31 PI=11 PI
500.00	20														
	21														
498.00	22														
	23														
496.00	24				6	13 16 21	37	100		24	106	UC =4.7			
	25		Brown mottled with grayish brown.												

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REPORT TITLE				HOLE ID
BORING RECORD				NB32
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		1-6-09	1 of 2

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Lean CLAY (CL) *(continued)*.												
494.00	26														
	27														
492.00	28														
	29				7	22 31 32	63	50		15	119	UC =5.5			
490.00	30														
	31														
488.00	32														
	33														
486.00	34				8	26 37 50	87	75		18	109				
	35		With GRAVEL.												
484.00	36														
	37		SANDY lean CLAY (CL); stiff; grayish brown; moist.												
482.00	38														
	39				9	15 18 31	49	100		20	109	UC =1.5			
480.00	40														
	41														
478.00	42		Lean CLAY with SAND (CL); stiff; grayish brown; moist.												
	43														
476.00	44				10	17 34 43	77	80		20	108	UC =2.0			
	45														
474.00	46														
	47		Lean CLAY (CL); stiff; grayish brown mottled with reddish brown; moist.												
472.00	48														
	49				11	10 10 13	23	50		31	90	UC =1.6			
470.00	50		Bottom of Borehole at 50.0 ft.												
	51														
468.00	52														
	53														
466.00	54														
	55														

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REPORT TITLE **BORING RECORD**				HOLE ID **NB32**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **L.Phillips**		DATE **1-6-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-10-08	12-10-08	2057427.5 ft / 6186227.6 ft NAD83	NB33
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 68.2' Rt Sta ~ 107+16 V1	517 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	30.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY SILT (ML); very dense; brown; moist.												Bag sample 0-5 feet
	1				1	50/4"	REF	0							
515.00	2														Sampler advanced 4 in.
	3		Less gravel.												
513.00	4		SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; brown; moist; with GRAVEL.		2	50/5"	REF	0							Sampler advanced 5 in.
	5				3	50/5"	REF	25		5					LL=23 PI=6
511.00	6														Sampler advanced 5 in. PI
	7														
509.00	8		SILTY SAND with GRAVEL (SM); dense; dark brown; moist; with GRAVEL.												
	9				4	23 21 17	38	75		5					
507.00	10														
	11														
505.00	12		Lean CLAY with SAND (CL); hard; brown; moist; trace GRAVEL.												
	13														
503.00	14				5	20 36 51	87	65		10					+#4=1% -#200=60% PA
	15														
501.00	16														
	17		CLAYEY SAND (SC); brown; trace GRAVEL.												
499.00	18														
	19				6	35 60 87	147	100		10					
497.00	20		Increase gravel.												
	21														
495.00	22		SILT with SAND (ML); hard; brown; moist; with fine SAND.												
	23														
493.00	24				7	52 67 79	146	80		13					
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB33
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		12-11-08	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SILT with SAND (ML) *(continued)*.												
491.00	26														
	27														
489.00	28		Lean CLAY (CL); hard; brown; moist.												
	29				8	20 29 48	77	100		20					
487.00	30		Bottom of Borehole at 30.0 ft.												
485.00	31														
	32														
	33														
483.00	34														
	35														
481.00	36														
	37														
479.00	38														
	39														
477.00	40														
	41														
475.00	42														
	43														
473.00	44														
	45														
471.00	46														
	47														
469.00	48														
	49														
467.00	50														
	51														
465.00	52														
	53														
463.00	54														
	55														

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REPORT TITLE **BORING RECORD**				HOLE ID **NB33**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **L.Phillips**		DATE **12-11-08**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Selvendran	12-10-08	12-10-08	2057536.5 ft / 6186234.0 ft NAD83	NB34
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 41.2' Rt Sta ~ 108+22 V1	508 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	35.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY GRAVEL (GM); dense; dark brown; moist.												Bag sample 0-5 feet
	1				1	17 22 16	38	65		6					
506.00	2														
	3				2	21 24 45	69	50		11					
504.00	4		With AC chunks.												
	5		SANDY lean CLAY with GRAVEL (CL); hard; reddish brown; moist; with GRAVEL.		3	19 28 30	58	65		10	125	PP = >4.5			LL=29 PI=14 PI
502.00	6														
	7														
500.00	8		SILTY SAND with GRAVEL (SM); dense; reddish brown; moist.		4	21 28 20	48	80		10	111	PP = >4.5			
	9		SILT with SAND (ML); hard; reddish brown; moist; with fine SAND.												
498.00	10														
	11														
496.00	12														
	13														
494.00	14				5	16 50/6"	50/ 6"	65							
	15		SILTY SAND with GRAVEL (SM); very dense; reddish brown; moist; with GRAVEL.												Sampler advanced 12 in.
492.00	16														
	17														
490.00	18		At EL. 490.0 ft, becomes brown; increasing gravel.												
	19				6	37 50/6"	50/ 6"	65		7	131				Sampler advanced 12 in.
488.00	20														
	21														
486.00	22		Lean CLAY (CL); very stiff to hard; reddish brown; moist; with black speckling and light gray streaking.												
	23														
484.00	24				7	26 50/6"	50/ 6"	65		15	119	PP = >4.5 UC =7.4			Sampler advanced 12 in.
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				NB34
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		12-11-08	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Lean CLAY (CL) *(continued)*.												
482.00	26														
	27														
480.00	28														
	29				8	30 50/4"	50/ 4"	65		16	117	PP = >4.5 UC =9.8			Sampler advanced 10 in.
478.00	30														
	31														
476.00	32														
	33														
474.00	34				9	31 41 50/5"	91/ 11"	100		16	120	UC =6.6			
	35		Bottom of Borehole at 35.0 ft.												Sampler advanced 17 in.
472.00	36														
	37														
470.00	38														
	39														
468.00	40														
	41														
466.00	42														
	43														
464.00	44														
	45														
462.00	46														
	47														
460.00	48														
	49														
458.00	50														
	51														
456.00	52														
	53														
454.00	54														
	55														

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REPORT TITLE **BORING RECORD**					HOLE ID **NB34**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**		EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**					
BRIDGE NUMBER	PREPARED BY **L.Phillips**		DATE **12-11-08**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	1-6-09	1-6-09	2057863.2 ft / 6186276.4 ft NAD83	NB35
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 12.6' Lt Sta ~ 111+44 V1	487 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			14.5 ft		50.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		4" Asphalt Concrete.												
	1		Aggregate base.												
485.00	2														
	3		SANDY lean CLAY with GRAVEL (CL); very stiff; reddish brown; moist.		1	30 50/6"	50/ 6"	50		7	116				Bag sample 2-1/2 - 5' Sampler advanced 12 in.
483.00	4														
	5				2	20 50/2"	50/ 2"	20							Sampler advanced 8 in.
481.00	6		Poorly graded SAND with GRAVEL (SP); very dense; dark gray; layer.												
	7		SILTY SAND with GRAVEL (SM); dense; reddish brown; moist.												
479.00	8														
	9				3	15 17 17	34	50		5					+#4=30% -#200=27% PA
477.00	10														
	11														
475.00	12														
	13														
473.00	14		SANDY lean CLAY (CL); medium stiff; dark grayish brown; moist to wet; trace GRAVEL.		4	5 3 4	7	100		17	117				LL=25 PI=10 PI
	15														HSA sealed off first aquifer at 19' Hit second one at 49'. H_2O quickly up to 15'
471.00	16														
	17														
469.00	18														
	19		Lean CLAY (CL); hard; reddish brown; trace GRAVEL.		5	10 19 44	63	80							
467.00	20														
	21														
465.00	22		CLAYEY SAND (SC); very dense; reddish brown; moist.												
	23														
463.00	24				6	21 33 50	83	75		9	134				
	25														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				NB35
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		1-7-09	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		CLAYEY SAND (SC) *(continued)*.												
461.00	26														
	27														
459.00	28														
	29				7	22 31 27	58	80		9	129				
457.00	30		Lean CLAY (CL); hard; reddish brown mottled with light brown; moist; trace GRAVEL.												
	31														
455.00	32														
	33														
453.00	34				8	17 27 50	77	80		14	121	UC =5.1			
	35														
451.00	36														
	37		CLAYEY SAND (SC); very dense; reddish brown; moist.												
449.00	38														
	39				9	33 50/5"	50/ 5"	40		11	127				Sampler advanced 11 in.
447.00	40														
	41														
445.00	42														
	43														
443.00	44				10	23 44 50	94	65		12	124				
	45														
441.00	46														
	47														
439.00	48														
	49				11	50/6"	REF	35							Sampler advanced 6 in. Aquifer
437.00	50		Bottom of Borehole at 50.0 ft.												
	51														
435.00	52														
	53														
433.00	54														
	55														

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: **BORING RECORD**

HOLE ID: **NB35**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	L.Phillips	**1-7-09**	**2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	1-5-09	1-5-09	2058228.7 ft / 6186575.8 ft NAD83	NB36
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 13.7' Lt Sta ~ 116+12 V1	492 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	50.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		4" Asphalt Concrete.												Bag sample 2.5 to 5'
	1		Aggregate Base.		1	50/4"	REF	30							
490.00	2														Sampler advanced 4 in.
	3		SILTY SAND with GRAVEL (SM); very dense; reddish brown; moist.												
488.00	4				2	37 50/6"	50/ 6"	65		5					Sampler advanced 12 in.
	5														
486.00	6														
	7														
484.00	8														
	9				3	26 29 31	60	65		8					
482.00	10														
	11														
480.00	12														
	13														
478.00	14				4	50/6"	REF	35							Sampler advanced 6 in.
	15		Browner color.												
476.00	16														
	17														
474.00	18														
	19		Lean CLAY (CL); very stiff; brown; moist.		5	13 24 50	74			17					
472.00	20		GRAVELLY lean CLAY with SAND (CL); very stiff; brown.												
	21														
470.00	22														
	23		Lean CLAY with SAND (CL); hard; reddish brown; moist.												
468.00	24				6	19 35 50	85	100		13	122	UC =4.7			
	25														

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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REPORT TITLE				HOLE ID
BORING RECORD				NB36
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		1-6-09	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Lean CLAY with SAND (CL) *(continued)*.												
466.00	26														
	27														
464.00	28		With black speckling.												
	29				7	16 19 24	43	100		16	120	UC =4.2			
462.00	30														
	31														
460.00	32														
	33														
458.00	34				8	15 19 36	55	100		18	116	UC =6.2			
	35		Mottled with gray.												
456.00	36														
	37														
454.00	38														
	39		Hard; some black speckling.		9	15 32 47	79	100		13	126	UC =9.3			
452.00	40														
	41														
450.00	42		CLAYEY SAND (SC); very dense; reddish brown; moist; trace GRAVEL.												
	43														
448.00	44				10	26 35 50	85	100		14	124				
	45														
446.00	46														
	47														
444.00	48														
	49				11	20 31 50	81	100		13	127				Dry ATD
442.00	50		Bottom of Borehole at 50.0 ft.												
	51														
440.00	52														
	53														
438.00	54														
	55														

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REPORT TITLE **BORING RECORD**				HOLE ID **NB36**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **L.Phillips**		DATE **1-6-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Selvendran	**12-12-08**	**12-15-08**	**2063189.1 ft / 6183749.7 ft NAD83**	**NB37**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling Co.			**~ 23.1' Rt Sta ~ 319+95.6 A1**	**404 ft NAVD 88**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			**Failing 1500**	**4-7/8 inch**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			**140lb/30in - Auto**	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			**Dry**	**3.5 ft on 12-15-08**	**90.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY SAND with GRAVEL (SM); dense; grayish brown; moist.												
	1				1	34 32 26	58	100							4" solid flight auger to 5 feet
402.00	2														
	3		CLAYEY GRAVEL with SAND (GC); reddish brown; moist.												
400.00	4														
	5		Lean CLAY with SAND (CL); stiff; brown; with orange mottles.		2	5 7 11	18	100		23	104	UC =0.48			began rotary wash
398.00	6		SANDY lean CLAY (CL); stiff; brown; moist.												
	7		CLAYEY GRAVEL (GC); brown.												
396.00	8														
	9		CLAYEY SAND with GRAVEL (SC); dense; brown; moist.												
394.00	10				3	19 24 28	52	80							
	11														
392.00	12														
	13														slight fluid loss
390.00	14														
	15		At 15 ft, becomes very dense.		4	23 35 35	70	35							
388.00	16														
	17														
386.00	18														
	19														
384.00	20		At 20 ft, becomes dense.		5	22 26 25	51	80		8	133				
	21														
382.00	22														
	23														
380.00	24														
	25														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				**NB37**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**12-16-08**	**1 of 4**

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		CLAYEY SAND with GRAVEL (SC) *(continued)*.		6	15 22 38	60	85		10	124			
378.00	26													
	27													
376.00	28													
	29													
374.00	30				7	19 20 23	43	80		12				+#4=40% -#200=12% PA
	31													
372.00	32													
	33													
370.00	34													
	35		At 35 ft, becomes very dense.		8	31 34 44	78	80		8	133			
368.00	36													
	37													
366.00	38													
	39													
364.00	40				9	14 53 47	100	75						
	41													
362.00	42													
	43		SANDY SILT (ML); medium dense; brown; moist; trace GRAVEL; fine SAND.											
360.00	44													
	45				10	6 6 11	17	100		27				Non-plastic
358.00	46													
	47													stop drilling 12/12/2008 resme drilling 12/15/2008
356.00	48		CLAYEY SAND with GRAVEL (SC); dense; brown; moist.											
	49													
354.00	50				11	18 24 35	59	80		11	125			
	51													
352.00	52													
	53													
350.00	54													
	55													

(continued)

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB37**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**12-16-08**	**2 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		At 55 ft, becomes very dense. CLAYEY SAND with GRAVEL (SC) *(continued)*.		12	14 27 39	66	75						
348.00	56													
	57													
346.00	58													
	59													
344.00	60		CLAYEY GRAVEL with SAND (GC); very dense; brown; moist.		13	28 42 56	98	90		9	136			+#4=48% -#200=15% PA
	61													
342.00	62													
	63													
340.00	64													
	65		At 65 ft, same as above except dark brown mottles.		14	37 38 39	77	75						
338.00	66													
	67													
336.00	68													
	69													
334.00	70		At 70 ft, same as above except reddish brown mottles.		15	25 48 73	121	95						
	71													
332.00	72													
	73													
330.00	74													
	75				16	29 41 43	84	90						
328.00	76													
	77													
326.00	78													
	79													
324.00	80				17	37 51 68	119	95						
	81													
322.00	82													
	83													
320.00	84													
	85													

(continued)

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB37**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-16-08	3 of 4

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	85		CLAYEY GRAVEL with SAND (GC) *(continued)*.		18	32 40 63	103	70							
318.00	86														
	87														
316.00	88														
	89				19	30 51 59	110	95							
314.00	90		Bottom of Borehole at 90.0 ft.												
312.00	91														
	92														
310.00	93														
	94														
308.00	95														
	96														
306.00	97														
	98														
304.00	99														
	100														
302.00	101														
	102														
300.00	103														
	104														
298.00	105														
	106														
296.00	107														
	108														
294.00	109														
	110														
292.00	111														
	112														
290.00	113														
	114														
	115														

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB37**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	12-16-08	4 of 4

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-11-08	12-11-08	2063196.5 ft / 6183662.3 ft NAD83	NB38
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Pitcher Drilling Co.			~ 64.5' Lt Sta ~ 320+02 A1	404 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Failing 1500	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Auto	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE) / TOTAL DEPTH OF BORING
Cement			Dry	3 ft on 12-11-08 / 90.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		SILTY SAND with GRAVEL (SM); dense; grayish brown; moist.											
	1				1	13 19 21	40	50						4" solid flight auger to 5 feet
402.00	2													
	3													
400.00	4		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.											
	5		At 4.5 ft, 3 inch gravel lense.		2	11 28 59	87	70						began rotary wash
398.00	6													
	7													
396.00	8													
	9													
394.00	10		At 10 ft, becomes dense.		3	16 15 22	37	60						
	11													
392.00	12													
	13													
390.00	14													
	15				4	24 21 22	43	50		9	130			
388.00	16													
	17													
386.00	18													
	19													
384.00	20		At 20 ft, becomes very dense.		5	14 24 32	56	50						
	21													
382.00	22													
	23													
380.00	24													
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				NB38
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-16-08	1 of 4

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		CLAYEY SAND with GRAVEL (SC) *(continued)*.		6	29 56 58	114	70		4	136			
378.00	26													
	27													
376.00	28													
	29													
374.00	30		At 30 ft, becomes dense.		7	13 21 20	41	75						
	31													
372.00	32													
	33													
370.00	34													
	35				8	24 70 50/3"	120/ 9"	25						
368.00	36													Sampler advanced 15 in.
	37													
366.00	38													
	39													
364.00	40				9	17 30 32	62	60		12				+#4=42% -#200=13% PA
	41													
362.00	42													
	43													
360.00	44													
	45				10	27 39 45	84	70						
358.00	46													
	47													
356.00	48													
	49													
354.00	50				11	31 28 27	55	60						
	51													
352.00	52													
	53													
350.00	54													
	55													

(continued)

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB38**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**12-16-08**	**2 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55				12	53 56 58	114	55						
348.00	56													
	57													
346.00	58													
	59													
344.00	60				13	21 29 37	66	100						
	61													
342.00	62													
	63													
340.00	64													
	65		CLAYEY GRAVEL with SAND (GC); very dense; brown; moist; At 35 ft, becomes very dense.		14	40 45 47	92	85		9	133			+#4=43% -#200=18% PA
338.00	66													
	67													
336.00	68													
	69													
334.00	70				15	32 38 55	93	15						
	71													
332.00	72													
	73													
330.00	74													
	75				16	36 48 65	113	65						
328.00	76													
	77													
326.00	78													
	79													
324.00	80				17	24 55 74	129	80						
	81													
322.00	82													
	83													
320.00	84													
	85													

(continued)

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REPORT TITLE: **BORING RECORD**

HOLE ID: **NB38**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**

PROJECT OR BRIDGE NAME: **SR 84 Expy Widen (URS 28649640)**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	M.Thummaluru	**12-16-08**	**3 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	85		CLAYEY GRAVEL with SAND (GC) *(continued)*.		18	42 44 48	92	65							
318.00	86														
	87														
316.00	88														
	89				19	35 48 44	92	90							
314.00	90		Bottom of Borehole at 90.0 ft.												
312.00	91														
	92														
310.00	93														
	94														
308.00	95														
	96														
306.00	97														
	98														
304.00	99														
	100														
302.00	101														
	102														
300.00	103														
	104														
298.00	105														
	106														
296.00	107														
	108														
294.00	109														
	110														
292.00	111														
	112														
290.00	113														
	114														
	115														

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REPORT TITLE **BORING RECORD**				HOLE ID **NB38**
DIST. **04**	COUNTY **Alameda**	ROUTE **84**	POSTMILE **22.9/27.1**	EA **04-297601**
PROJECT OR BRIDGE NAME **SR 84 Expy Widen (URS 28649640)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**		DATE **12-16-08**	SHEET **4 of 4**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-4-07	12-4-07	37° 37' 54.46" / -121° 48' 6.91" NAD83	RB01
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 5.6' Lt Sta ~ 230+68.3 A1	574.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete over 6.5 inches AB.												
	1		SANDY lean CLAY (CL); very stiff; brown; moist; trace fine GRAVEL; (FILL).		1	11 15 19	34	65		14	119	UC =3.9			Bag sample 1 to 5 feet. PA, PI, R
572.00	2														
	3				2	14 21 36	57	45		13	121				
570.00	4		GRAVELLY lean CLAY with SAND (CL); hard; brown; moist.												
	5				3	24 23 33	56	80		12	127				
568.00	6														
	7														
566.00	8		CLAYEY SAND with GRAVEL (SC); dense; brown; moist.												
	9				4	3 22 30	52	80							
564.00	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
562.00	11														
	12														
560.00	13														
	14														
558.00	15														
	16														
556.00	17														
	18														
554.00	19														
	20														
552.00	21														
	22														
550.00	23														
	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB01
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-4-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-4-07	12-4-07	37° 38' 1.71" / -121° 48' 6.3" NAD83	RB02
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 75.9' Rt Sta ~ 238+09.6 A1	554.10 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete over 9 inches AB.												
	1				1	25 23 18	41	30							
552.10	2		SILTY, CLAYEY SAND with GRAVEL (SC-SM); medium dense; brown; moist.												
	3		At EL. 551.6 ft, with decrease in gravel content.												
					2	13 16 11	27	55							
550.10	4		SANDY lean CLAY (CL); stiff; grayish brown; moist.												Large gravel; disturbed sample.
	5				3	12 7 5	12			13	124	UC =0.7			LL=30 PI=15 PI
548.10	6														
	7														
546.10	8		SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; brown; moist.												
	9				4	34 55 53	108	65							
544.10	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
542.10	11														
	12														
	13														
540.10	14														
	15														
538.10	16														
	17														
536.10	18														
	19														
534.10	20														
	21														
532.10	22														
	23														
530.10	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB02
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-4-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-27-07	11-27-07	37° 38' 6.51" / -121° 48' 4.68" NAD83	RB03
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 27.6' Rt Sta ~ 243+42.4 A1	547.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SANDY lean CLAY (CL); very stiff; yellowish brown; moist.												
	1				1	9 12 14	26	90		11	116	UC =2.1			Bag sample 1 to 5 feet. R
545.80	2														
	3														
543.80	4				2	7 13 15	28	90		7	120				
	5		SILTY GRAVEL with SAND (GM); very dense; light brownish yellow; moist.		3	32 77/4"	77/ 4"	56							
541.80	6														Sampler advanced 10 in.
	7		CLAYEY GRAVEL with SAND (GC); very dense; light brownish yellow; moist.												
539.80	8														
	9				4	33 42 108	150	95							
537.80	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
535.80	12														
	13														
533.80	14														
	15														LL=31 PI=10
531.80	16														
	17														
529.80	18														
	19														
527.80	20														
	21														
525.80	22														
	23														
523.80	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB03
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	12-10-07	12-10-07	37° 38' 13.76" / -121° 47' 55.55" NAD83	RB04
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 68' Rt Sta ~ 253+70.5 A1	531.70 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		9 inches Asphalt Concrete.												
	1		Poorly graded SAND with GRAVEL (SP); very dense; brown; moist; trace fines.		1	43 47 36	83	60							Bag sample 1 to 5 feet. R
529.70	2		Poorly graded SAND (SP); dense; yellowish brown; moist.												
	3				2	34 52 62	114	65							
527.70	4														
	5		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; yellowish brown; moist.		3	54 86/4"	86/ 4"	65							
525.70	6														Sampler advanced 10 in.
	7														
523.70	8														
	9				4	43 50/2"	50/ 2"	60							Sampler advanced 8 in.
521.70	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
519.70	12														
	13														
517.70	14														
	15														
515.70	16														
	17														
513.70	18														
	19														
511.70	20														
	21														
509.70	22														
	23														
507.70	24														
	25														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB04
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-10-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-19-07	11-19-07	37° 38' 20.22" / -121° 47' 54.76" NAD83	RB05
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 4.1' Rt Sta ~ 260+11.3 A1	527.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0														
	1		SILTY SAND with GRAVEL (SM); dense; dark reddish brown; moist.												
525.20	2				1	20 21 18	39	70		7	121	UC =1.4			LL=21 PI=5 PI, R Bag sample 1 to 5 feet.
	3														
	4		SANDY lean CLAY (CL); very stiff; dark reddish brown; moist.		2	11 15 28	43	70		10	114	UC =4.4			
	5														
521.20	6		Poorly graded GRAVEL with SILT and SAND (GP-GM); very dense; light yellowish brown to white; moist.		3	25 38 29	67	75		9	122				
	7														
519.20	8														
	9		At EL. 518.2 ft, becomes medium dense.		4	13 15 14	29	75		8	123				
517.20	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
515.20	12														
	13														
513.20	14														
	15														
511.20	16														
	17														
509.20	18														
	19														
507.20	20														
	21														
505.20	22														
	23														
503.20	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB05
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

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LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-19-07	11-19-07	37° 38' 24.78" / -121° 47' 55.15" NAD83	RB06
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 5' Rt Sta ~ 264+70 A1	506.30 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		5 inches Asphalt Concrete over 4 inches AB.												
	1		Poorly graded GRAVEL with SILT and SAND (GP-GM); medium dense; light yellowish brown; moist.		1	21 8 10	18	45							
504.30	2														
	3		At EL. 503.1 ft, grades to (Poorly graded GRAVEL with CLAY and SAND) (GP-GC); dense; Poorly Graded GRAVEL with CLAY and SAND (GP-GC); light yellowish brown to olive brown.		2	10 19 21	40	60							
502.30	4														
	5				3	15 25 43	68	95							
500.30	6														
	7														
498.30	8		CLAYEY SAND (SC); medium dense; dark reddish brown; moist; trace GRAVEL.												
	9				4	9 16 18	34	85		14	117	UC =3.5			
496.30	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
494.30	11														
	12														
492.30	13														
	14														
490.30	15														
	16														
488.30	17														
	18														
486.30	19														
	20														
484.30	21														
	22														
482.30	23														
	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB06
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-19-07	11-19-07	37° 38' 29.97" / -121° 47' 56.84" NAD83	RB07
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 7.8' Lt Sta ~ 270+16.4 A1	489.10 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	13.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches Asphalt Concrete over 4 inches AB.												
	1		Poorly graded GRAVEL with SILT and SAND (GP-GM); medium dense; brownish yellow; moist.		1	13 15 8	23	0							R
487.10	2														No recovery.
	3				2	15 12 13	25	0							
485.10	4														
	5				3	7 6 5	11	0							
483.10	6														No recovery.
	7														
481.10	8														
	9		Elastic SILT (MH); soft; grayish brown; moist to wet; trace fine GRAVEL.		4	4 3 3	6	90		12	115	UC =0.8			LL=17 PI=1 PI
479.10	10														
	11														
477.10	12		SANDY lean CLAY (CL); very stiff; reddish brown with black mottling; moist.		5	10 13 15	28	90		15	116	UC =5			
	13														
475.10	14		Boring dry ATD. Bottom of Borehole at 13.5 ft.												
	15														
473.10	16														
	17														
471.10	18														
	19														
469.10	20														
	21														
467.10	22														
	23														
465.10	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB07
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-27-07	11-27-07	37° 38' 36.85" / -121° 48' 1.42" NAD83	RB08
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 33.1' Lt Sta ~ 278+11.0 A1	460.40 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	15.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		5 inches of Asphalt Concrete over 4 inches AB.												
	1		CLAYEY GRAVEL with SAND (GC); dense; dark reddish brown; moist.		1	19 17 26	43	75							Bag sample 1 to 5 feet.
458.40	2														
	3														
456.40	4		CLAYEY SAND (SC); medium dense; dark reddish brown; moist; trace GRAVEL.		2	13 12 11	23	90		10	125	UC =1.1			
	5														
454.40	6		At EL. 454.4 ft, with some GRAVEL.												
	7														
452.40	8														
	9				3	12 14 25	39	90		11	123				
450.40	10		Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; reddish brown; moist.												
	11														
448.40	12														
	13														
446.40	14				4	14 14 12	26	90		1					
	15		Boring dry ATD. Bottom of Borehole at 15.0 ft.												
444.40	16														
	17														
442.40	18														
	19														
440.40	20														
	21														
438.40	22														
	23														
436.40	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB08
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-27-07	11-27-07	37° 38' 38.64" / -121° 48' 3.02" NAD83	RB09
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 33' Lt Sta ~ 280+36.2 A1	461.70 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	15.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		5.5 inches of Asphalt Concrete over 6.5 inches of AB.												
	1		CLAYEY GRAVEL with SAND (GC); dense; dark reddish brown; moist.		1	26 30 32	62	95		8	126	UC =2.5			Bag sample 1 to 5 feet.
459.70	2														
	3		CLAYEY SAND with GRAVEL (SC); medium dense; reddish brown; moist.												
457.70	4				2	25 18 16	34	95		7	124				
	5														
455.70	6		Lean CLAY (CL); very stiff; reddish brown; moist.												
	7														
453.70	8														
	9				3	11 17 27	44	90		24	108				
451.70	10		SILTY SAND (SM); dense; reddish brown to yellowish brown; moist.												
	11														
449.70	12														
	13														
447.70	14		At EL. 448.2 ft, becomes medium dense.		4	6 8 16	24	90		13	112	UC =1.2			
	15		Boring dry ATD. Bottom of Borehole at 15.0 ft.												
445.70	16														
	17														
443.70	18														
	19														
441.70	20														
	21														
439.70	22														
	23														
437.70	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB09
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-19-07	11-19-07	37° 38' 42.23" / -121° 48' 6.48" NAD83	RB10
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 3.2' Lt Sta ~ 284+94.3 A1	451.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		5.5 inches Asphalt Concrete over 5 inches AB.												
449.80	2		Poorly graded GRAVEL with SILT and SAND (GP-GM); medium dense; brownish yellow; moist.		1	10 14 7	21	60							Bag sample 1 to 5 feet. R
447.80	4		SANDY lean CLAY (CL); stiff; dark reddish brown; moist; trace GRAVEL.		2	6 9 10	19	90		16					LL=32 PI=15 PI
445.80	6		At EL. 446.8 ft, becomes very stiff.		3	4 8 13	21	90		15	117				
443.80	8														
441.80	10		Poorly graded SAND with GRAVEL (SP); medium dense; reddish brown to orange red; moist.		4	18 17 18	35	85		7	116				
			Boring dry ATD. Bottom of Borehole at 10.0 ft.												
439.80	12														
437.80	14														
435.80	16														
433.80	18														
431.80	20														
429.80	22														
427.80	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB10
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-19-07	11-19-07	37° 38' 45.92" / -121° 48' 10.61" NAD83	RB11
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 6.1' Lt Sta ~ 289+94.0 A1	447.40 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	11.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6.5 inches Asphalt Concrete over 2 inches AB.												
	1		CLAYEY SAND with GRAVEL (SC); loose; yellowish brown; moist; FILL.		1	7 5 3	8	35							Bag sample 1 to 5 feet. R
445.40	2														
	3		SANDY lean CLAY (CL); stiff; reddish brown; moist; some GRAVEL.		2	4 7 10	17	60							
443.40	4														
	5		CLAYEY SAND with GRAVEL (SC); loose to medium dense; reddish brown; moist.		3	8 5 6	11	90		15	116				
441.40	6														
	7														
439.40	8														
	9		SANDY lean CLAY (CL/SC); stiff; reddish brown; moist.		4	5 5 5	10	0							No recovery.
437.40	10				5	3 5 10	15	90		15					Sample disturbed; used catcher.
	11														
435.40	12		Boring dry ATD. Bottom of Borehole at 11.5 ft.												
	13														
433.40	14														
	15														
431.40	16														
	17														
429.40	18														
	19														
427.40	20														
	21														
425.40	22														
	23														
423.40	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB11
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-20-07	11-20-07	37° 38' 50.38" / -121° 48' 14.76" NAD83	RB12
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 32.7' Lt Sta ~ 295+52.0 A1	440.50 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BORE HOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7 inches of Asphalt Concrete over 10 inches of AB.												
	1				1	17 16 21	37	50		8					R
438.50	2		SANDY lean CLAY with GRAVEL (CL); very stiff; dark brown; moist.												
	3		SILTY GRAVEL (GM); medium dense; tan; moist.												
	4				2	16 13 12	25	40							
436.50	5														
	6		SANDY lean CLAY with GRAVEL (CL); very stiff; dark brown; moist.		3	7 8 9	17	30							
434.50	7														
	8		CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist.												
	9				4	9 9 9	18	55		11	124				
432.50	10														
430.50	11		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
428.50	12														
	13														
426.50	14														
	15														
424.50	16														
	17														
422.50	18														
	19														
420.50	20														
	21														
418.50	22														
	23														
416.50	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB12
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-19-07	11-19-07	37° 38' 54.98" / -121° 48' 17.2" NAD83	RB13
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 10.1' Lt Sta ~ 300+54.3 A1	434.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches of Asphalt Concrete over 4 inches of AB.												
	1		CLAYEY SAND (SC); loose; yellowish brown; moist; trace GRAVEL.		1	10 6 6	12	0							Bag sample 1 to 5 feet. No recovery.
432.00	2														
	3		Fat CLAY (CH); stiff; brownish gray; moist.		2	8 11 13	24	90		12	122				LL=26 PI=9 PI
430.00	4														
	5				3	5 6 9	15	90		22	104				LL=43 PI=23 PI
428.00	6														
	7														
426.00	8														
	9		At EL. 425.5 ft, with trace GRAVEL.		4	4 6 11	17	90		15	113				
424.00	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
422.00	12														
	13														
420.00	14														
	15														
418.00	16														
	17														
416.00	18														
	19														
414.00	20														
	21														
412.00	22														
	23														
410.00	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB13
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-19-07	11-19-07	37° 39' 0.19" / -121° 48' 18.94" NAD83	RB14
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 10.8' Rt Sta ~ 305+98.7 A1	431.50 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches Asphalt Concrete over 12 inches AB.												
429.50	2		SILTY SAND (SM); medium dense; tan brown.		1	18 13 5	18	30							Bag sample 1 to 5 feet. R
427.50	4		Fat CLAY with GRAVEL (CH); stiff; black; moist.		2	4 8 9	17	65		12	114				
425.50	6		Poorly graded GRAVEL (GP); medium dense; tan/brown.		3	8 9 10	19	0							
423.50	8		At EL. 423.0 ft, becomes dense.		4	18 24 18	42	40							
421.50	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
419.50	12														
417.50	14														
415.50	16														
413.50	18														
411.50	20														
409.50	22														
407.50	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB14
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	12-10-07	12-10-07	37° 39' 6.69" / -121° 48' 20.17" NAD83	RB15
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 3' Lt Sta ~ 312+65.8 A1	423.70 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	9.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches Asphalt Concrete.												
	1		SILT (ML); soft; brown; moist; trace GRAVEL; trace SAND.		1	5 3 3	6	25		12					Bag sample 1 to 5 feet.
421.70	2														
	3				2	3 2 3	5	0							No recovery.
419.70	4		Poorly graded SAND with GRAVEL (SP); very loose to loose; brown; moist.												
	5		At EL. 418.7 ft, becomes medium dense.		3	4 6 12	18	25							Used catcher; disturbed sample.
417.70	6														
	7		At EL. 417.2 ft, becomes very dense.												
415.70	8														
	9				4	50/0.5"	REF	3							Sampler advanced 0.5 in.
413.70	10		Boring dry ATD. Bottom of Borehole at 9.5 ft.												
	11														
411.70	12														
	13														
409.70	14														
	15														
407.70	16														
	17														
405.70	18														
	19														
403.70	20														
	21														
401.70	22														
	23														
399.70	24														
	25														

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55 S. Market St, Ste 1500
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REPORT TITLE				HOLE ID
BORING RECORD				RB15
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-10-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	12-10-07	12-10-07	37° 39' 18.29" / -121° 48' 20.56" NAD83	RB16
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 30' Lt Sta ~ 324+38.9 A1	424.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches Asphalt Concrete.												
	1		Well-graded GRAVEL with SILT and SAND (GW-GM); very dense; light gray; moist.		1	33 92 69	161	75							Bag sample 1 to 5 feet. R
422.20	2														
	3		At EL. 421.2 ft, becomes dense.		2	26 29 28	57	35							
420.20	4														
	5				3	13 10 9	19	75		12	125				
418.20	6		SANDY lean CLAY with GRAVEL (CL); very stiff; brown; moist.												
	7														
416.20	8														
	9		Well-graded GRAVEL with SILT and SAND (GW-GM); medium dense; brown; moist.		4	12 20 14	34	45							
414.20	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
412.20	11														
	12														
410.20	13														
	14														
408.20	15														
	16														
406.20	17														
	18														
404.20	19														
	20														
402.20	21														
	22														
400.20	23														
	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB16
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-10-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-19-07	11-19-07	37° 39' 22.1" / -121° 48' 19.45" NAD83	RB17
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 56.6' Rt Sta ~ 328+24.4 A1	425.90 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY GRAVEL with SAND (GM); dense; tan; moist.												
	1				1	28 24 25	49	35							Bag sample 1 to 5 feet.
423.90	2														
	3				2	23 25 24	49	65							
421.90	4														
	5				3	26 23 24	47	50							
419.90	6														
	7														
417.90	8														
	9		At EL. 417.4 ft, becomes medium dense.		4	12 8 10	18	35		6					+#4=46% -#200=15% PA
415.90	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
413.90	12														
	13														
411.90	14														
	15														
409.90	16														
	17														
407.90	18														
	19														
405.90	20														
	21														
403.90	22														
	23														
401.90	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB17
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-5-07	12-5-07	37° 39' 26.77" / -121° 48' 20.49" NAD83	RB18
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 31.1' Lt Sta ~ 332+96.7 A1	421.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		5.5 inches Asphalt Concrete over 6.5 inches AB.												
419.20	2		SILTY SAND with GRAVEL (SM); dense; dark grayish brown; moist.		1	22 22 23	45	45							Bag sample 1 to 5 feet. R
417.20	4		At EL. 418.2 ft, becomes medium dense.		2	8 17 19	36	0							No recovery.
415.20	6		SILTY SAND with GRAVEL (SM); dense; light brown; moist.		3	18 22 22	44	55							
411.20	9		At EL. 412.7 ft, becomes dark brown.		4	21 24 22	46	100		7					
	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
409.20	12														
407.20	14														
405.20	16														
403.20	18														
401.20	20														
399.20	22														
397.20	24														
	25														

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB18
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-5-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-3-07	12-3-07	37° 39' 35.39" / -121° 48' 20.14" NAD83	RB19
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 11.3' Lt Sta ~ 341+68.3 A1	415.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches asphalt concrete over 10 inches AB.												
	1				1	17 25 21	46	65							Bag sample 1 to 5 feet.
413.20	2		SILTY SAND with GRAVEL (SM); dense; brown; moist.												
	3				2	33 35 33	68	85							
411.20	4														
	5		At EL. 410.2 ft, becomes very dense.		3	39 40 41	81	65							
409.20	6														
	7														
407.20	8														
	9		At EL. 406.7 ft, becomes dense; with less gravel.		4	24 33 28	61	67		21	102				
405.20	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
403.20	12														
	13														
401.20	14														
	15														
399.20	16														
	17														
397.20	18														
	19														
395.20	20														
	21														
393.20	22														
	23														
391.20	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB19
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-5-07	12-5-07	37° 39' 52.5" / -121° 48' 19.77" NAD83	RB20
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 11.9' Rt Sta ~ 358+99.5 A2	415.60 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete.												
	1		SILTY SAND with GRAVEL (SM); dense; gray.		1	70 32 13	45	45		20	97				Bag sample 1 to 5 feet.
413.60	2														
	3		SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; brown; moist.		2	25 43 84	127	78							
411.60	4														
	5		SILTY GRAVEL with SAND (GM); very dense; grayish brown.		3	32 43 39	82	65							
409.60	6														
	7		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.												
407.60	8														
	9				4	35 35 35	70	78							
405.60	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
403.60	12														
	13														
401.60	14														
	15														
399.60	16														
	17														
397.60	18														
	19														
395.60	20														
	21														
393.60	22														
	23														
391.60	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB20
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-5-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-19-07	11-19-07	37° 39' 50.04" / -121° 48' 20.1" NAD83	RB21
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 11.8' Lt Sta ~ 356+49.4 A2	418.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY GRAVEL (GM); medium dense to dense; brown; moist.												
	1				1	23 21 20	41	45							Bag sample 1 to 5 feet. R
416.80	2														
	3				2	24 23 25	48	60							
414.80	4														
	5		SILTY, CLAYEY GRAVEL (GC-GM); very dense; reddish to yellowish brown; moist.		3	44 39 46	85	55							
412.80	6														
	7														
410.80	8														
	9		At EL. 410.3 ft, becomes dense.		4	33 29 31	60	45							
408.80	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
406.80	12														
	13														
404.80	14														
	15														
402.80	16														
	17														
400.80	18														
	19														
398.80	20														
	21														
396.80	22														
	23														
394.80	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB21
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-19-07	11-19-07	37° 39' 55.52" / -121° 48' 20.03" NAD83	RB22
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 16.2' Lt Sta ~ 362+04.1 A2	422.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B61	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY GRAVEL (GM); very dense; tan; dry.												
	1				1	46 50/4"	50/ 4"	75							Bag sample 1 to 5 feet.
420.20	2														Sampler advanced 10 in.
	3		SANDY SILT (ML); very stiff; dark brown; dry.		2	12 13 17	30	35							
418.20	4														Sample disturbed.
	5		At EL. 417.2 ft, becomes hard.		3	13 19 23	42	50							
416.20	6														Sample disturbed.
	7		At EL. 415.2 ft, with trace GRAVEL.												
414.20	8														
	9				4	50/6"	REF	22							Sampler advanced 6 in. Sample disturbed.
412.20	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
410.20	12														
	13														
408.20	14														
	15														
406.20	16														
	17														
404.20	18														
	19														
402.20	20														
	21														
400.20	22														
	23														
398.20	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB22
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	12-10-07	12-10-07	37° 39' 58.36" / -121° 48' 19.06" NAD83	RB23
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 49.5' Rt Sta ~ 364+94.7 A2	411.30 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7 inches Asphalt Concrete over 26 inches AB.												
	1				1	56 75 18	93	78		21	99				Bag sample 1 to 5 feet.
409.30	2														
	3		SANDY lean CLAY (CL); very stiff; brown; moist; trace GRAVEL.		2	8 9 11	20	78		14	120				
407.30	4														
	5				3	8 12 16	28	78		13	124				
405.30	6														
	7														
403.30	8		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; brown; moist.												
	9				4	22 36 29	65	78		3	131				
401.30	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
399.30	12														
	13														
397.30	14														
	15														
395.30	16														
	17														
393.30	18														
	19														
391.30	20														
	21														
389.30	22														
	23														
387.30	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB23
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-10-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-20-07	11-20-07	37° 40' 2.99" / -121° 48' 19.98" NAD83	RB24
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 49.2' Lt Sta ~ 369+58.3 A2	417.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILT (ML); very stiff; dark brown; moist; trace GRAVEL.												
	1														
415.00	2				1	17 19 19	38	35		10	130				Bag sample 1 to 5 feet. R
	3		At EL. 414.0 ft, observed increase in sand content.												
413.00	4				2	11 10 11	21	35		6	124				
	5														
411.00	6				3	7 9 11	20	45							
	7														
409.00	8														
	9				4	7 10 10	20	50		11	121				
407.00	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
405.00	12														
	13														
403.00	14														
	15														
401.00	16														
	17														
399.00	18														
	19														
397.00	20														
	21														
395.00	22														
	23														
393.00	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB24
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-20-07	11-20-07	37° 40' 7.71" / -121° 48' 19.08" NAD83	RB25
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 9.5' Rt Sta ~ 374+38.4 A2	410.60 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8.5 inches of Aspahalt Concrete over 8 inches AB.												
	1				1	39 16 8	24	55							Bag sample 1 to 5 feet. R
408.60	2		SILTY SAND (SM); medium dense; brown; moist.												
	3														
	3		Lean CLAY with GRAVEL (CL); very stiff; brown; moist.		2	6 9 11	20	40		7	125				
406.60	4														
	5														
	5				3	10 11 12	23	35							
404.60	6		SILTY GRAVEL (GM); medium dense; brown; moist.												
	7														
402.60	8		CLAYEY GRAVEL (GC); medium dense; dark brown; moist.												
	9				4	11 16 17	33	40							
400.60	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
398.60	11														
	12														
396.60	13														
	14														
394.60	15														
	16														
392.60	17														
	18														
390.60	19														
	20														
388.60	21														
	22														
386.60	23														
	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB25
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-20-07	11-20-07	37° 40' 13.11" / -121° 48' 20.02" NAD83	RB26
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 67.3' Lt Sta ~ 379+84.3 A2	423.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY GRAVEL (GC); medium dense; dark gray to brown; moist.												
	1				1	17 15 16	31	25							
421.20	2														
	3				2	13 18 19	37	35							
419.20	4														
	5				3	18 12 18	30	60							
417.20	6														
	7														
415.20	8		Lean CLAY (CL); very stiff; dark brown; moist; trace GRAVEL.		4	11 12 11	23	60		10	127				
413.20	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
411.20	12														
409.20	14														
407.20	16														
405.20	18														
403.20	20														
401.20	22														
399.20	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB26
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-5-07	12-5-07	37° 40' 21.46" / -121° 48' 18.55" NAD83	RB27
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 52.3' Rt Sta ~ 388+29.9 A2	414.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7.5 inches Asphalt Concrete over 7.5 inches AB.												
	1				1	13 14 15	29	55							Bag sample 1 to 5 feet.
412.20	2		SANDY lean CLAY with GRAVEL (CL); very stiff; brown; moist.												
	3				2	15 15 21	36	55		8	128				
410.20	4		At EL. 411.2 ft, becomes grayish brown.												
	5				3	18 16 19	35	65							
408.20	6														Metal shavings on top of sample liner 3; probably fill.
	7														
406.20	8														
	9				4	14 12 14	26	65		10	118				
404.20	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
402.20	12														
	13														
400.20	14														
	15														
398.20	16														
	17														
396.20	18														
	19														
394.20	20														
	21														
392.20	22														
	23														
390.20	24														
	25														

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB27
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-5-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-3-07	12-3-07	37° 40' 26.17" / -121° 48' 17.64" NAD83	RB28
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 125.3' Rt Sta ~ 393+05.8 A2	409.40 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete.												
	1		SILTY SAND with GRAVEL (SM); very dense; moist.		1	33 38 58	96	65							Bag sample 1 to 5 feet. R
407.40	2														
	3				2	71 51 39	90	55							
405.40	4														
	5		At EL. 404.4 ft, becomes dense.		3	24 27 24	51	60							
403.40	6														
	7														
401.40	8														
	9		At EL. 400.9 ft, with increase in gravel size.		4	31 26 31	57	70							
399.40	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
397.40	12														
	13														
395.40	14														
	15														
393.40	16														
	17														
391.40	18														
	19														
389.40	20														
	21														
387.40	22														
	23														
385.40	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB28
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-3-07	12-3-07	37° 40' 28.88" / -121° 48' 14.07" NAD83	RB29
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 422.9' Rt Sta ~ 395+79.7 A3	410.00 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete over 10 inches AB.												
	1				1	34 81/4"	81/ 4"	55							
408.00	2		SILTY SAND with GRAVEL (SM); medium dense; brown.												Sampler advanced 10 in.
	3				2	17 17 19	36	100		15	115				
406.00	4		Lean CLAY (CL); very stiff; brown; moist.												
	5				3	5 9 10	19	78		15	116				LL=28 PI=10 PI
404.00	6														
	7														
402.00	8														
	9		At EL. 401.0 ft, becomes hard.		4	18 26 33	59	85		16	117				
400.00	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
398.00	11														
	12														
396.00	13														
	14														
394.00	15														
	16														
392.00	17														
	18														
390.00	19														
	20														
388.00	21														
	22														
386.00	23														
	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB29
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-3-07	12-3-07	37° 40' 30.01" / -121° 48' 18.62" NAD83	RB30
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 57.9' Rt Sta ~ 396+95.1 A3	400.10 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7.5 inches of Asphalt Concrete over 8.5 inches AB.												
	1				1	19 19 19	38	55							Filter fabric at 1.5 feet. Probably storm drain trench backfill.
398.10	2		Poorly graded GRAVEL (GP); dense.												
	3		At EL. 397.1 ft, becomes medium dense.		2	10 9 8	17	65							
396.10	4														
	5		Lean CLAY (CL); stiff; brown; moist.		3	4 4 6	10	65		12	125				
394.10	6														
	7														
392.10	8														
	9		At EL. 391.1 ft, becomes very stiff.		4	15 17 19	36	55							
390.10	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
388.10	12														
	13														
386.10	14														
	15														
384.10	16														
	17														
382.10	18														
	19														
380.10	20														
	21														
378.10	22														
	23														
376.10	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB30
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-3-07	12-3-07	37° 40' 33.75" / -121° 48' 14.21" NAD83	RB31
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 412.8' Rt Sta ~ 400+72.6 A3	416.10 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8.5 inches Asphalt Concrete over 6 inches AB.												
414.10	2		Lean CLAY (CL); stiff; brown; moist; trace GRAVEL.		1	6 6 8	14	55		15	117				Bag sample 1 to 5 feet. PI, R LL=29 PI=10
412.10	4				2	4 5 10	15	65		76	76				
410.10	6		SILTY SAND (SM); dense; brown; moist.		3	15 18 21	39	90		7	117				
406.10	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.		4	30 35 24	59	78							
404.10	12														
402.10	14														
400.10	16														
398.10	18														
396.10	20														
394.10	22														
392.10	24														

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REPORT TITLE				HOLE ID
BORING RECORD				RB31
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-4-07	12-4-07	37° 40' 38.41" / -121° 48' 19.21" NAD83	RB32
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 11' Rt Sta ~ 405+43.1 A3	402.90 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete over 6 inches AB.												
	1				1	82 50/2"	50/ 2"	35							
400.90	2		SILTY SAND (SM); very dense; brown.												Sampler advanced 8 in.
	3		At EL. 399.9 ft, becomes dense.		2	18 17 25	42	65		6	106				
398.90	4		At EL. 398.9 ft, with gravel.												
	5				3	29 29 30	59	65							
396.90	6														
	7														
394.90	8		At EL. 394.9 ft, becomes very dense.												
	9				4	35 33 31	64	65		7	135				
392.90	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
390.90	12														
	13														
388.90	14														
	15														
386.90	16														
	17														
384.90	18														
	19														
382.90	20														
	21														
380.90	22														
	23														
378.90	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB32
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-4-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-4-07	12-4-07	37° 40' 41.61" / -121° 48' 18.89" NAD83	RB33
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 36.8' Rt Sta ~ 408+67.3 A3	411.10 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6.5 inches Asphalt Concrete over 11.5 inches AB.												
	1				1	25 20 21	41	65		9	124				Bag sample 1 to 5 feet. R
409.10	2		SILTY SAND with GRAVEL (SM); dense; brown.												
	3				2	13 15 22	37	45		49	93				
407.10	4		SILT (ML); very stiff; brown; moist.												
	5				3	40 69/4"	69/ 4"	70							
405.10	6		SILTY SAND with GRAVEL (SM); very dense; brown; moist.												Sampler advanced 10 in.
	7														
403.10	8														
	9				4	21 33 33	66	90		2	135				
401.10	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
399.10	11														
	12														
397.10	13														
	14														
395.10	15														
	16														
393.10	17														
	18														
391.10	19														
	20														
389.10	21														
	22														
387.10	23														
	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB33
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-4-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	11-20-07	11-20-07	37° 40' 49.31" / -121° 48' 19.23" NAD83	RB34
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 9.7' Rt Sta ~ 416+46.1 A3	420.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8 inches Asphalt Concrete.												
	1		SILTY, CLAYEY GRAVEL (GC-GM); dense; dark brown; moist.		1	18 25 26	51	55							Bag sample 1 to 5 feet.
418.80	2														
	3		At EL. 417.8 ft, becomes very dense.		2	22 38 39	77	90							
416.80	4														
	5				3	28 50/6"	50/ 6"	50							
414.80	6														Sampler advanced 12 in.
	7														
412.80	8														
	9		At EL. 412.3 ft, becomes dense.		4	14 19 28	47	80							
410.80	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
408.80	11														
	12														
406.80	13														
	14														
404.80	15														
	16														
402.80	17														
	18														
400.80	19														
	20														
398.80	21														
	22														
396.80	23														
	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB34
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	**11-20-07**	**11-20-07**	**37° 40' 54.82" / -121° 48' 19.51" NAD83**	**RB35**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			**~ 12.6' Lt Sta ~ 422+03.4 A3**	**422.80 ft NAVD 88**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			**Mobile B53**	**8 inch**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			**140lb/30in - Wirewinch**	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			**Dry**	**10.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SANDY lean CLAY (CL); stiff; grayish brown; moist.												
	1				1	3 5 7	12	75		14	114				Bag sample 1 to 5 feet. R
420.80	2														
	3		At EL. 419.8 ft, becomes very stiff; some GRAVEL.		2	8 11 9	20	75							
418.80	4														
	5				3	9 11 13	24	75		7	116				
416.80	6														
	7														
414.80	8		SANDY SILT (ML); very stiff; brownish yellow; dry to moist.		4	7 10 11	21	65		4	109				
	9														
412.80	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
410.80	12														
	13														
408.80	14														
	15														
406.80	16														
	17														
404.80	18														
	19														
402.80	20														
	21														
400.80	22														
	23														
398.80	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				**RB35**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Alameda**	**84**	**22.9/27.1**	**04-297601**
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		**11-30-07**	**1 of 1**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-20-07	11-20-07	37° 40' 54.8" / -121° 48' 19.33" NAD83	RB35A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 1.6' Rt Sta ~ 422+01.1 A3	422.20 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	5.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		10 inches asphalt concrete over 20 inches AB.												
420.20	2		SANDY lean CLAY (CL); hard; grayish brown; dry to moist.		1	19 28 18	46								
418.20	4														
	5		Boring dry ATD. Bottom of Borehole at 5.0 ft.												
416.20	6														
414.20	8														
412.20	10														
410.20	12														
408.20	14														
406.20	16														
404.20	18														
402.20	20														
400.20	22														
398.20	24														
	25														

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB35A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-20-07	11-20-07	37° 40' 59.76" / -121° 48' 19.21" NAD83	RB36A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 22.2' Rt Sta ~ 427+01.8 A3	420.50 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	5.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
420.50	0		9 inches asphalt concrete over 29 inches AB.												
418.50	2		GRAVELLY lean CLAY (CL); very stiff; brownish yellow; moist.		1	19 26 15	41								
416.50	4		Boring dry ATD. Bottom of Borehole at 5.0 ft.												
414.50	6														
412.50	8														
410.50	10														
408.50	12														
406.50	14														
404.50	16														
402.50	18														
400.50	20														
398.50	22														
396.50	24														

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB36A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-20-07	11-20-07	37° 41' 5.4" / -121° 48' 20.12" NAD83	RB37
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 5.7' Lt Sta ~ 432+76.2 A3	416.90 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILT (ML); very stiff; grayish brown; moist; with mulch.												
	1				1	6 9 10	19	70		16		PP = 2.5			LL=24 PI=5 PI, R Bag sample 1 to 5 feet.
414.90	2														
	3		At EL. 413.9 ft, grades to SANDY SILT (ML), with fine roots.		2	7 9 12	21	90		5	112				
412.90	4														
	5		Lean CLAY (CL); very stiff; yellowish brown; moist.		3	6 9 9	18	75		11					LL=28 PI=9 PI
410.90	6														
	7														
408.90	8														
	9				4	9 13 15	28	80		11	122				
406.90	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
404.90	12														
	13														
402.90	14														
	15														
400.90	16														
	17														
398.90	18														
	19														
396.90	20														
	21														
394.90	22														
	23														
392.90	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB37
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-20-07	11-20-07	37° 41' 55.01" / -121° 48' 20.01" NAD83	RB37A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 4.1' Rt Sta ~ 432+85.3 A3	419.90 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	5.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		10 inches Asphalt Concrete over 18 inches AB.												
	1				1	19 50/4.5"	50/ 4.5"								
417.90	2														Sampler advanced 10.5 in.
	3		Poorly graded SAND with GRAVEL (SP); very dense; grayish brown to brownish yellow; moist.												
	3				2	50/5"	REF								
415.90	4														Sampler advanced 5 in.
	5		Boring dry ATD. Bottom of Borehole at 5.0 ft.												
413.90	6														
	7														
411.90	8														
	9														
409.90	10														
	11														
407.90	12														
	13														
405.90	14														
	15														
403.90	16														
	17														
401.90	18														
	19														
399.90	20														
	21														
397.90	22														
	23														
395.90	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB37A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-20-07	11-20-07	37° 41' 10.24" / -121° 48' 20.07" NAD83	RB38
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 14' Lt Sta ~ 437+67.8 A3	414.80 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY GRAVEL with SAND (GC); medium dense; yellowish brown; wet.												
	1				1	6 8 8	16	70							Bag sample 1 to 5 feet.
412.80	2														
	3		Poorly graded GRAVEL with SILT and SAND (GP-GM); medium dense; reddish brown; moist.		2	13 16 18	34	78							
410.80	4														
	5		At EL. 409.8 ft, grades to wet; Poorly graded GRAVEL with CLAY and SAND (GP-GC).		3	15 17 14	31	75							
408.80	6														
	7														
406.80	8		Lean CLAY (CL); stiff; grayish brown; moist.												
	9				4	9 10 13	23	90		15	120	PP = 1.8			
404.80	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
402.80	11														
	12														
400.80	13														
	14														
398.80	15														
	16														
396.80	17														
	18														
394.80	19														
	20														
392.80	21														
	22														
390.80	23														
	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB38
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-20-07	11-20-07	37° 41' 10.24" / -121° 48' 20.36" NAD83	RB38A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 13.7' Rt Sta ~ 437+66.2 A3	413.10 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	5.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
413.10	0		8.5 inches asphalt concrete over 21.5 inches AB.												
411.10	2		Poorly graded GRAVEL with CLAY and SAND (GP-GC); medium dense; reddish brown to grayish brown; moist.		1	16 19 16	35	75							
409.10	4														
	5		Boring dry ATD.												
407.10	6		Bottom of Borehole at 5.0 ft.												
405.10	8														
403.10	10														
401.10	12														
399.10	14														
397.10	16														
395.10	18														
393.10	20														
391.10	22														
389.10	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				RB38A
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		11-30-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	12-5-07	12-5-07	37° 41' 13.89" / -121° 48' 20.59" NAD83	RB39
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 7.6' Rt Sta ~ 441+35.9 A3	413.50 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), CA (2.44")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		6 inches asphalt concrete over 12 inches AB.												
	1				1	15 20 20	40	78		4	123				Bag sample 1 to 5 feet.
411.50	2		SILTY, CLAYEY SAND with GRAVEL (SC-SM); medium dense to dense; brown.												
	3				2	14 10 9	19	45							
409.50	4														
	5		Lean CLAY (CL); very stiff; brown; moist.		3	12 15 17	32	65		13	119				
407.50	6														
	7														
405.50	8														
	9		SILTY SAND (SM); dense; brown; moist.		4	19 19 20	39	78							
403.50	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
401.50	12														
	13														
399.50	14														
	15														
397.50	16														
	17														
395.50	18														
	19														
393.50	20														
	21														
391.50	22														
	23														
389.50	24														
	25														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB39
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-5-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	12-10-07	12-10-07	37° 41' 19.71" / -121° 48' 20.7" NAD83	RB40
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 2.4' Lt Sta ~ 447+24.5 A3	413.30 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7.5 inches Asphalt Concrete.												
	1		Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; brown; moist; gravel up to 1/4 inch.		1	24 17 19	36	70							Bag sample 1 to 5 feet. R
411.30	2		At EL. 411.3 ft, with fine gravel, light gray.												
	3		At EL. 410.3 ft, becomes loose; moist to wet.		2	8 6 4	10	10							
409.30	4														
	5		SANDY lean CLAY with GRAVEL (CL); stiff; brown; moist to wet.		3	3 5 6	11	78		16	120				LL=26 PI=9 PI
407.30	6														
	7														
405.30	8														
	9				4	3 4 7	11	85							
403.30	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
401.30	11														
	12														
399.30	13														
	14														
397.30	15														
	16														
395.30	17														
	18														
393.30	19														
	20														
391.30	21														
	22														
389.30	23														
	24														
	25														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB40
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-10-07	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	1-6-09	1-6-09	2055088.7 ft / 6184696.3 ft NAD83	RB41
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 0' Rt Sta ~ 230+21 A1	575 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Bulk			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	5.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		8-1/2" Asphalt Concrete.												Bag sample 2 - 5'
	1		Aggregate Base.												
573.00	2		Lean CLAY (CL); brown; moist.							13					LL=30 PI=15 PI
571.00	4														
	5		Bottom of Borehole at 5.0 ft.												
569.00	6														
567.00	8														
565.00	10														
563.00	12														
561.00	14														
559.00	16														
557.00	18														
555.00	20														
553.00	22														
551.00	24														
	25														

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB41
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		1-7-09	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	1-6-09	1-6-09	2055859.8 ft / 6184655.6 ft NAD83	RB42
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 30.5' Rt Sta ~ 237+41 A1	558 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Bulk			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	5.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		7" Asphalt Concrete.												
	1		Aggregate Base.												
556.00	2		Lean CLAY (CL); grayish brown; moist.												Bag sample 2 - 4'
554.00	4														
	5		Bottom of Borehole at 5.0 ft.												
552.00	6														
550.00	8														
548.00	10														
	11														
546.00	12														
	13														
544.00	14														
	15														
542.00	16														
	17														
540.00	18														
	19														
538.00	20														
	21														
536.00	22														
	23														
534.00	24														
	25														

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55 S. Market St, Ste 1500
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REPORT TITLE				HOLE ID
BORING RECORD				RB42
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		1-7-09	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C.Rambo	1-6-09	1-6-09	2056674.6 ft / 6185156.2 ft NAD83	RB43
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			~ 30' Rt Sta ~ 247+57 A1	534 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Mobile B53	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Bulk			140lb/30in - Wirewinch	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry	5.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		4" Asphalt Concrete.												
	1		Aggregate Base.												
532.00	2														Bag sample
	3														
530.00	4														
	5		Bottom of Borehole at 5.0 ft.												
528.00	6														
	7														
526.00	8														
	9														
524.00	10														
	11														
522.00	12														
	13														
520.00	14														
	15														
518.00	16														
	17														
516.00	18														
	19														
514.00	20														
	21														
512.00	22														
	23														
510.00	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

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San Jose Office

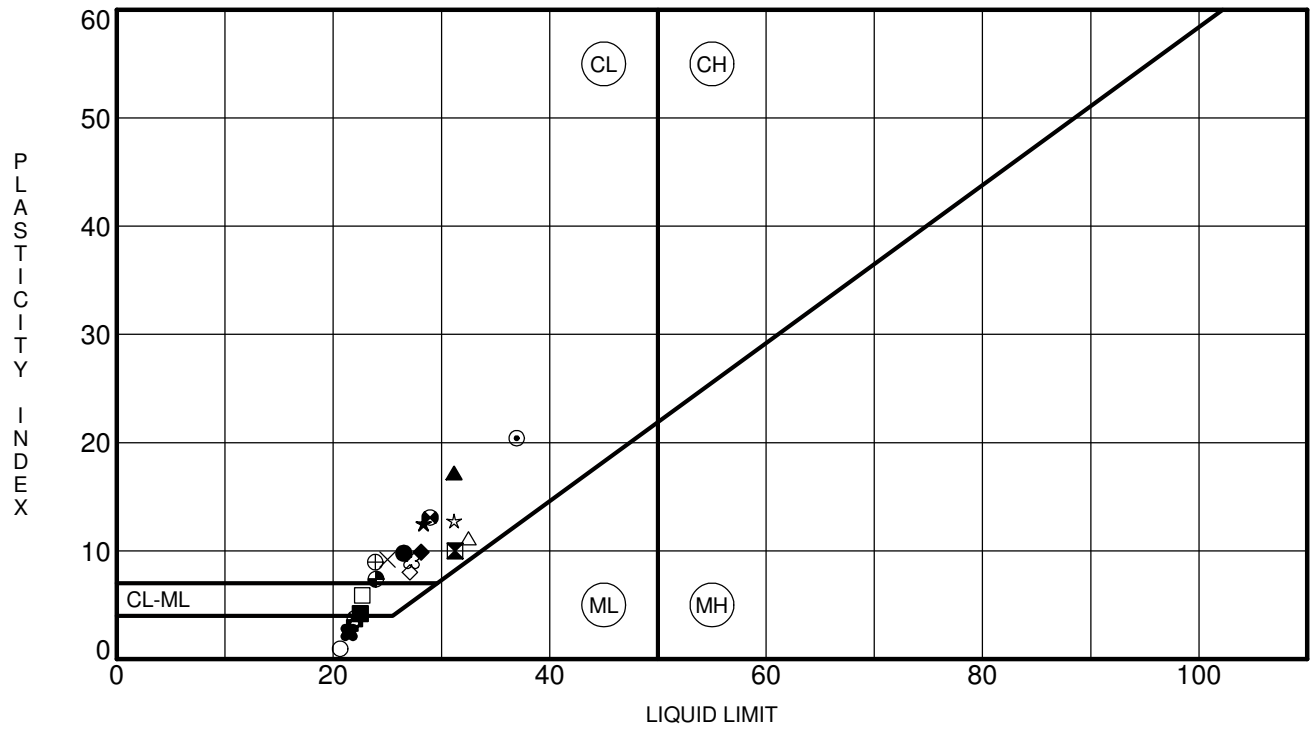
55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB43
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.9/27.1	04-297601
PROJECT OR BRIDGE NAME				
SR 84 Expy Widen (URS 28649640)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		1-7-09	1 of 1

The water content, dry density and unconfined compressive strength were determined for selected samples to estimate the strength and compressibility of the underlying soils. The results of these tests, together with the resistance to penetration of the sampler are shown at the corresponding sample location on the Boring Records, Appendix C.

Atterberg limit tests were performed on cohesive samples to determine the plasticity characteristics. The results of these tests are presented in this appendix.

Gradations were performed on granular samples to determine the grain size distributions; the results of these tests are presented in this appendix.



Specimen Identification			LL	PL	PI	Fines	Classification
●	NB02	5.0	27	17	10		Clayey SAND (SC) with gravel
⊠	NB03	15.0	31	21	10		Lean CLAY (CL)
▲	NB04	3.5	31	14	17		Sandy lean CLAY (CL) with gravel
★	NB05A	1.0	28	16	12		Lean CLAY (CL) with sand
⊙	NB05A	10.0	37	17	20		Lean CLAY (CL)
✿	NB09	1.0	22	19	3		Silty SAND (SM/GM) with gravel
○	NB14	1.0	21	20	1		Silty SAND (SM) with gravel
△	NB14	15.0	33	21	12		Lean CLAY (CL) with sand
⊗	NB19	3.0	22	18	4		SILT (ML) with sand
⊕	NB19	8.5	24	15	9		Sandy lean CLAY (CL) with gravel
□	NB20	3.5	23	17	6		Silty CLAY (CL-ML)
❁	NB21	33.5	29	16	13		Lean CLAY (CL)
◕	NB22A	8.5	24	17	7		Sandy, silty CLAY (CL-ML) with gravel
☆	NB23	30.0	31	18	13		Lean CLAY (CL)
⊠	NB23	35.0	27	18	9		Lean CLAY (CL)
■	NB23	55.0	23	18	5		Sandy, silty CLAY (CL-ML)
◆	NB24	60.0	28	18	10		Lean CLAY (CL)
◇	NB24	80.0	27	19	8		Lean CLAY (CL)
╳	NB25	13.5	25	16	9		Clayey SAND (SC/GC) with gravel
✖	NB26	18.5	21	19	2		Sandy SILT (ML)

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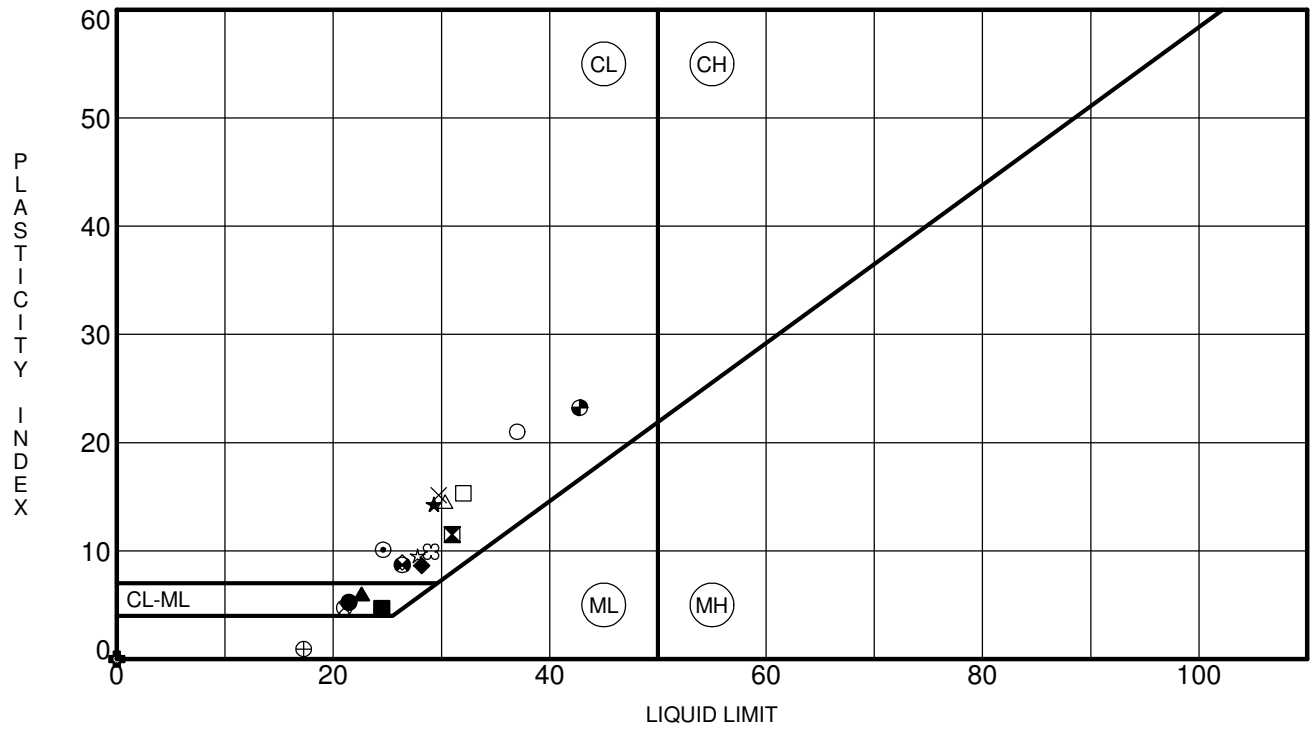
55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS ATTERBERG LIMITS 28649640-ROUTE84.GPJ SNJ CT.GLB 9/16/10



	Specimen Identification		LL	PL	PI	Fines	Classification
●	NB30	5.0	21	16	5		Silty, clayey SAND (SC-SM) with gravel
⊠	NB32	18.5	31	20	11		Lean CLAY (CL)
▲	NB33	5.0	23	17	6		Silty, clayey SAND (SC-SM) with gravel
★	NB34	5.0	29	15	14		Clayey SAND (SC) with gravel
⊙	NB35	13.5	25	15	10		Lean CLAY (CL) with sand
✿	NB37	45.0	NP	NP	NP		Sandy SILT (ML)
○	RB01	1.0	37	16	21	56	Sandy lean CLAY (CL)
△	RB02	5.0	30	16	14		Clayey SAND (SC) with gravel
⊗	RB05	1.0	21	16	5		Silty, clayey SAND (SC)
⊕	RB07	8.5	17	16	1		Silty SAND (SM)
□	RB10	3.0	32	17	15		Lean CLAY (CL) with sand
⊛	RB13	3.0	26	18	8		Clayey SAND (SC) with gravel
◕	RB13	5.0	43	20	23		Lean CLAY (CL) with sand
☆	RB29	5.0	28	18	10		Sandy lean CLAY (CL)
⊠	RB31	1.0	29	19	10		Sandy lean CLAY (CL)
■	RB37	1.0	24	20	4		Silty CLAY (CL-ML) with sand
◆	RB37	5.0	28	20	8		Lean CLAY (CL)
◇	RB40	5.0	26	17	9		Lean CLAY (CL/SC) with gravel
×	RB41	2.0	30	15	15		Sandy lean CLAY (CL)

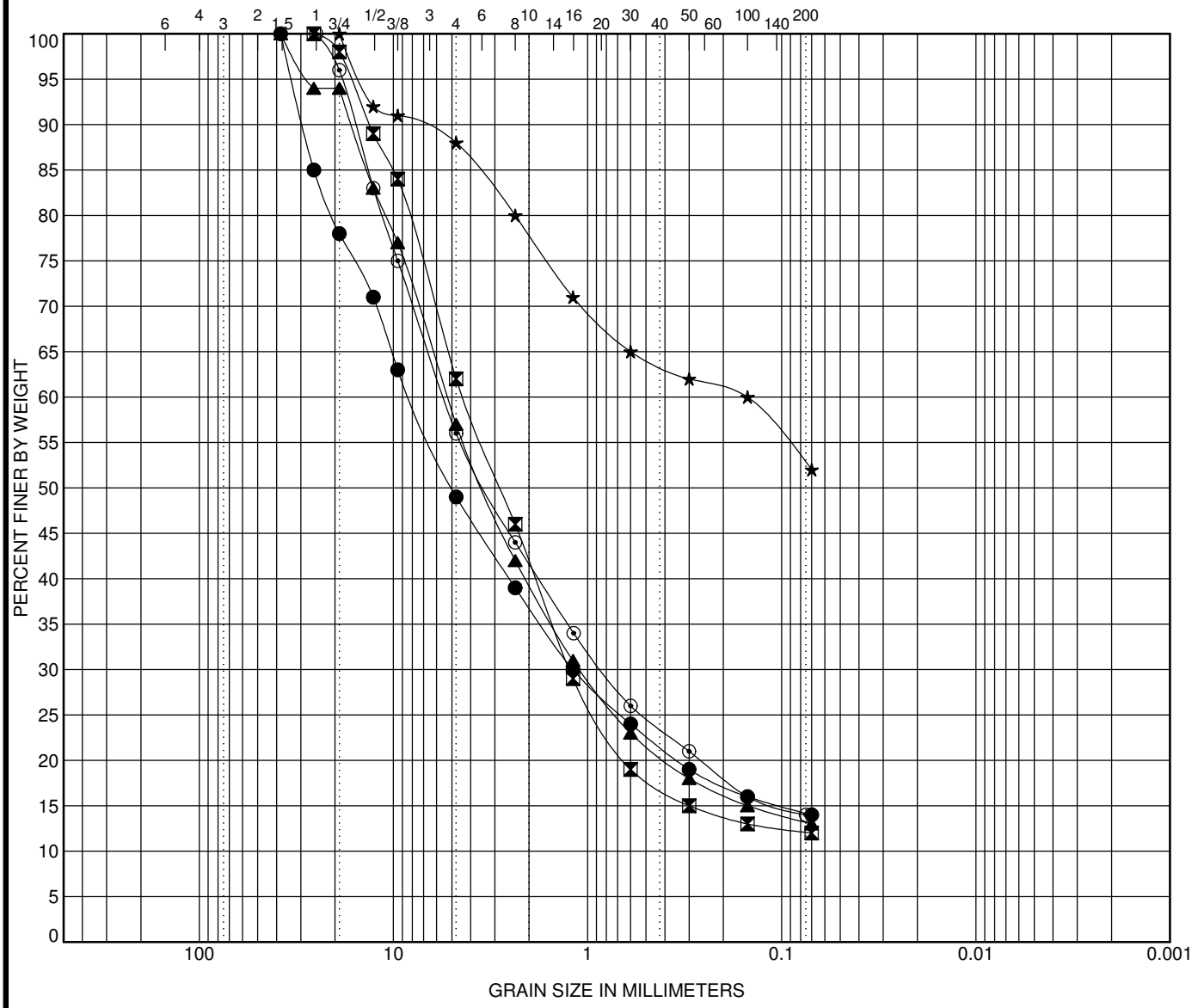
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS ATTERBERG LIMITS 28649640-ROUTE84.GPJ SNJ CT.GLB 9/16/10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	NB06	10.0	Clayey GRAVEL (GC) with sand					
⊠	NB11	5.0	Clayey SAND (SC) with gravel					
▲	NB13	15.0	Clayey SAND (SC) with gravel					
★	NB13	20.0	Sandy fat CLAY (CH)					
⊙	NB14	10.0	Clayey GRAVEL (GC) with sand					

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	NB06	10.0	38.1	8.196	1.19		51.0	34.8	14.2	
⊠	NB11	5.0	25.7	4.352	1.239		38.0	49.9	12.1	
▲	NB13	15.0	38.1	5.271	1.092		43.0	43.8	13.2	
★	NB13	20.0	19	0.15			12.0	35.3	52.7	
⊙	NB14	10.0	25	5.496	0.841		44.0	42.0	14.0	

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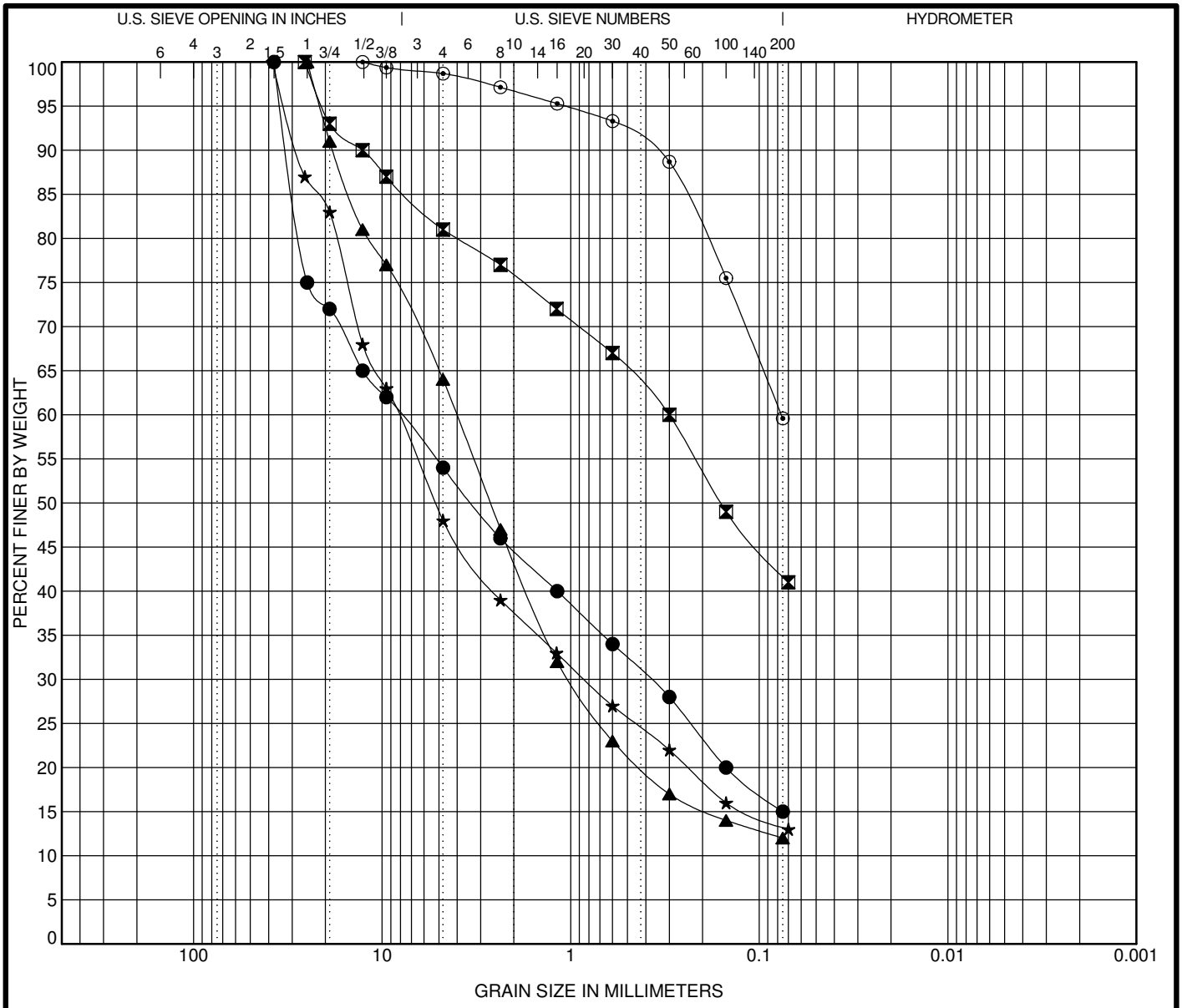
55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	NB17	8.5						
⊠	NB21	8.5	Clayey SAND (SC) with gravel					
▲	NB23	50.0	Poorly graded SAND (SP-SC) with clay and gravel				6.82	107.44
★	NB24	15.0	Clayey GRAVEL (GC) with sand					
⊙	NB33	13.5	Sandy lean CLAY (CL)					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	NB17	8.5	37.5	7.989	0.378		46.0	39.0	15.0	
⊠	NB21	8.5	25.7	0.3			19.0	39.3	41.7	
▲	NB23	50.0	25	4.029	1.015		36.0	52.0	12.0	
★	NB24	15.0	38.1	8.277	0.845		52.0	34.7	13.3	
⊙	NB33	13.5	12.7	0.076			1.3	39.1	59.6	

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55 S. Market St, Ste 1500
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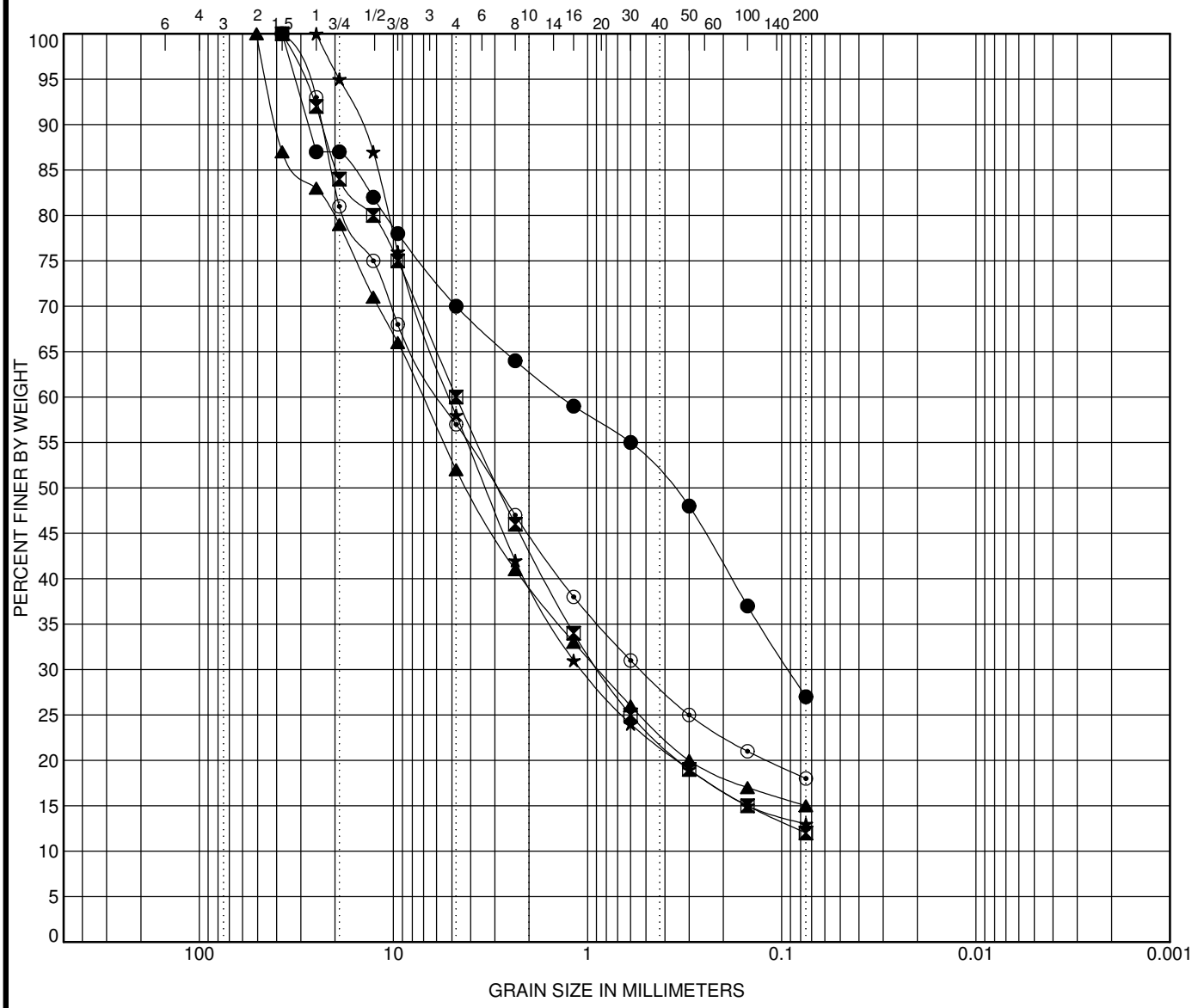
GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	NB35	8.5	Clayey SAND (SC) with gravel					
⊠	NB37	30.0	Clayey SAND (SC) with gravel				3.40	100.54
▲	NB37	60.0	Clayey GRAVEL (GC) with sand					
★	NB38	40.0	Clayey SAND (SC) with gravel					
⊙	NB38	65.0	Clayey GRAVEL (GC) with sand					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	NB35	8.5	37.5	1.355	0.092		30.0	43.0	27.0	
⊠	NB37	30.0	37.5	4.75	0.874		40.0	48.0	12.0	
▲	NB37	60.0	50.8	7.058	0.883		48.0	37.0	15.0	
★	NB38	40.0	25	5.13	1.071		42.0	45.0	13.0	
⊙	NB38	65.0	37.5	5.738	0.535		43.0	39.0	18.0	

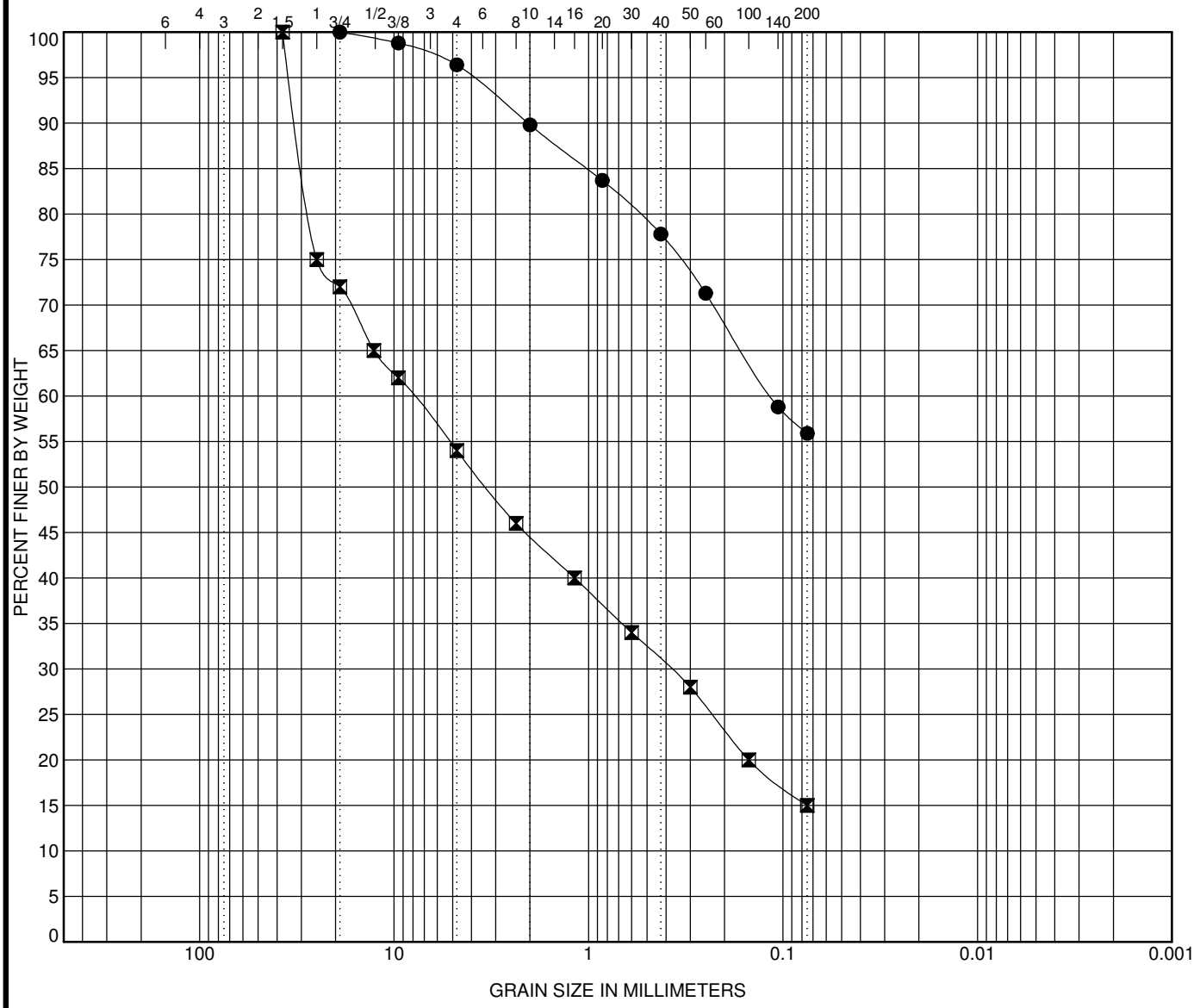
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**RB01**	**1.0**	**Sandy lean CLAY (CL)**	**37**	**16**	**21**		
⊠	**RB17**	**8.5**						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RB01**	**1.0**	**19**	**0.115**			**3.6**	**40.5**	**55.9**	
⊠	**RB17**	**8.5**	**37.5**	**7.989**	**0.378**		**46.0**	**39.0**	**15.0**	

URS

55 S. Market St, Ste 1500
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GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

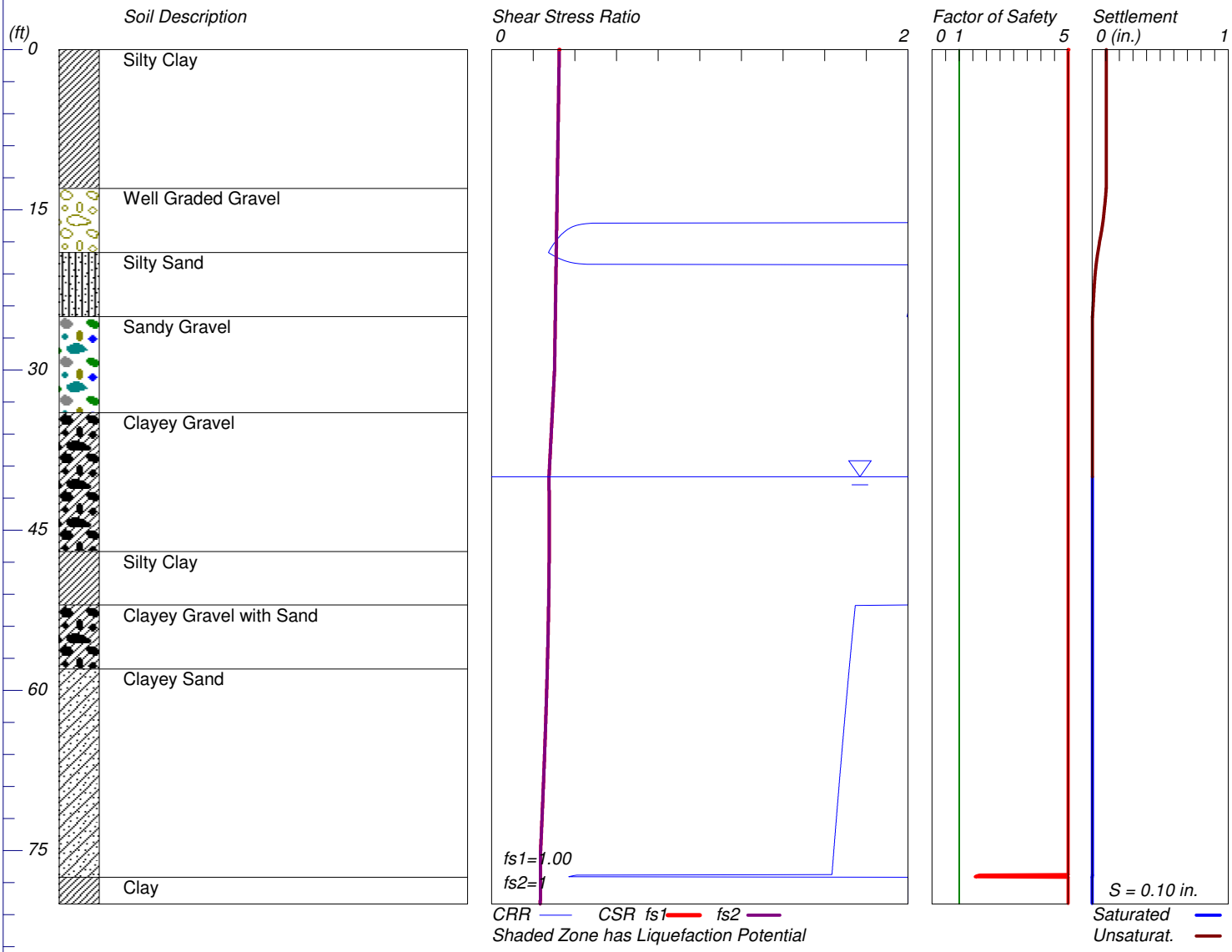
URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 9/16/10

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=B-10 Water Depth=40 ft Surface Elev.=415

Magnitude=7.5
Acceleration=0.5g



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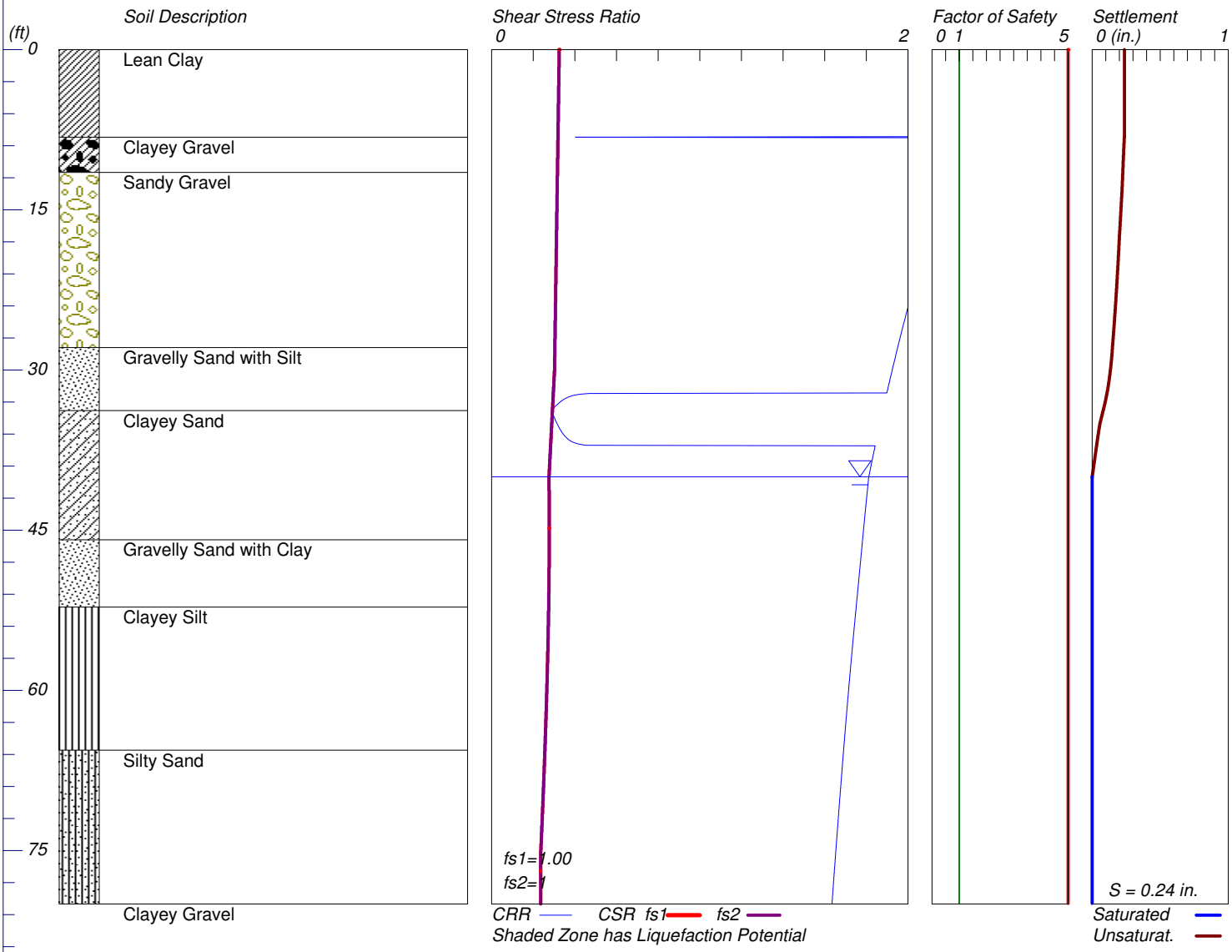
LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=B-12 Water Depth=40 ft Surface Elev.=415

Magnitude=7.5
Acceleration=0.5g



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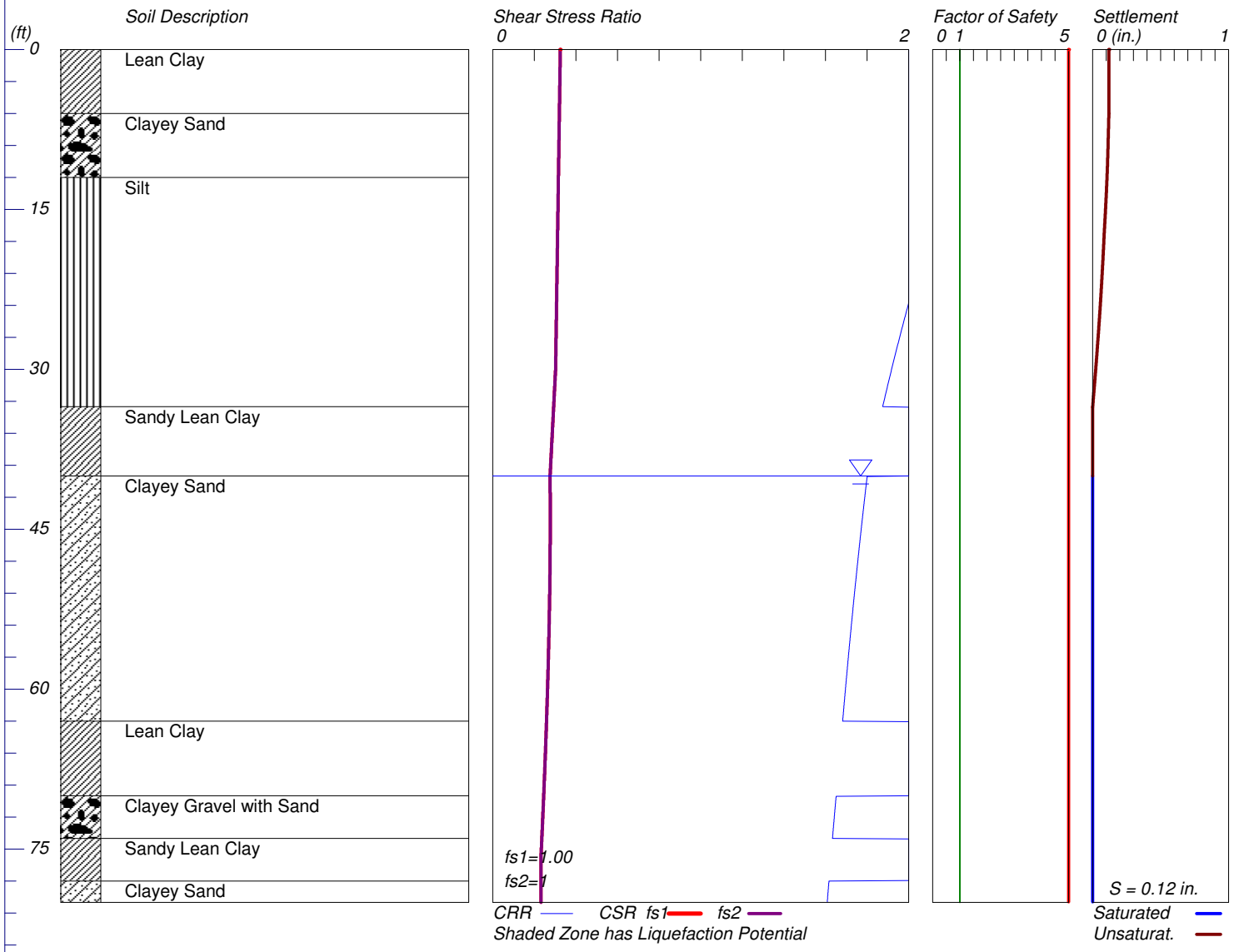
LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB03 Water Depth=40 ft Surface Elev.=539

Magnitude=7.5
Acceleration=0.5g



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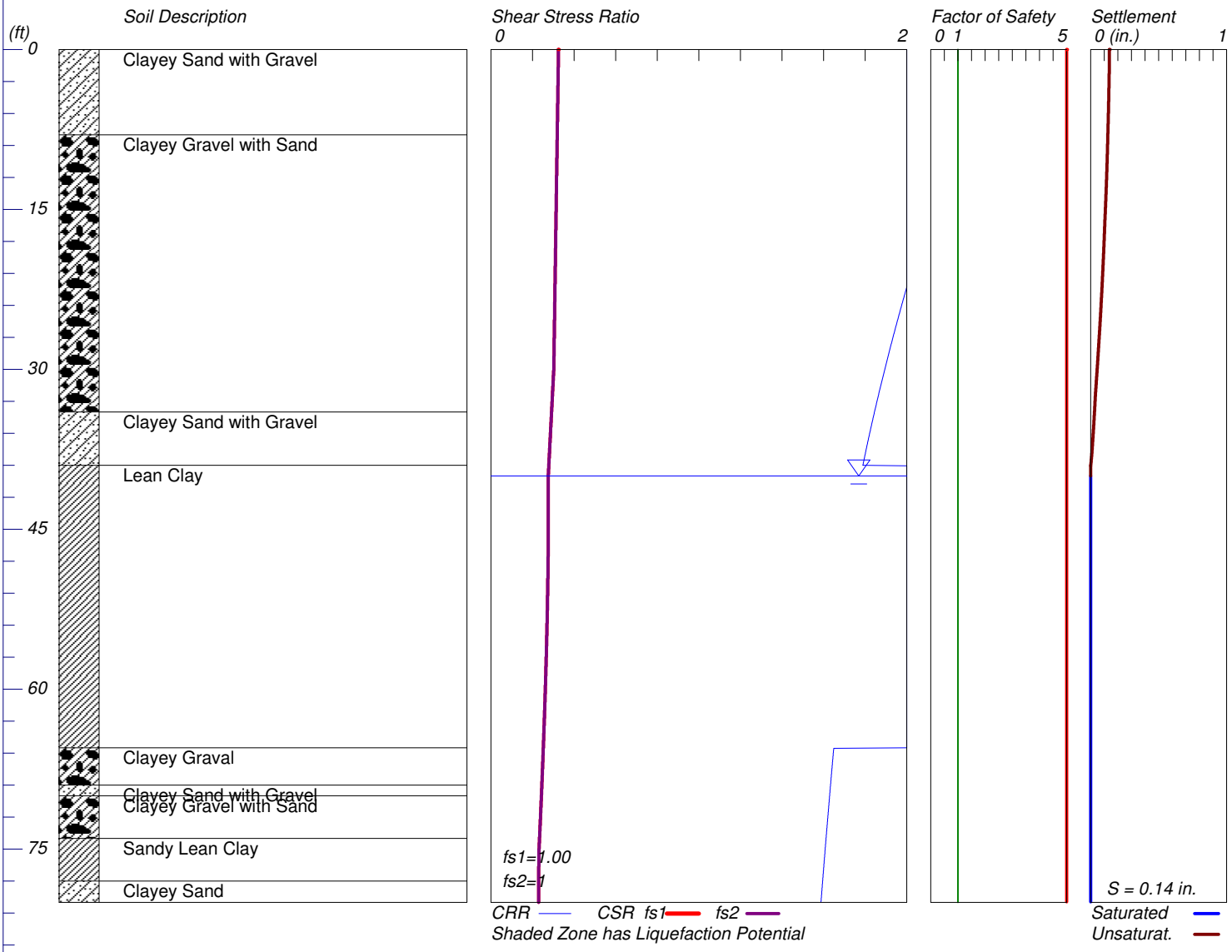
LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB06 Water Depth=40 ft Surface Elev.=528

Magnitude=7.5
Acceleration=0.5g



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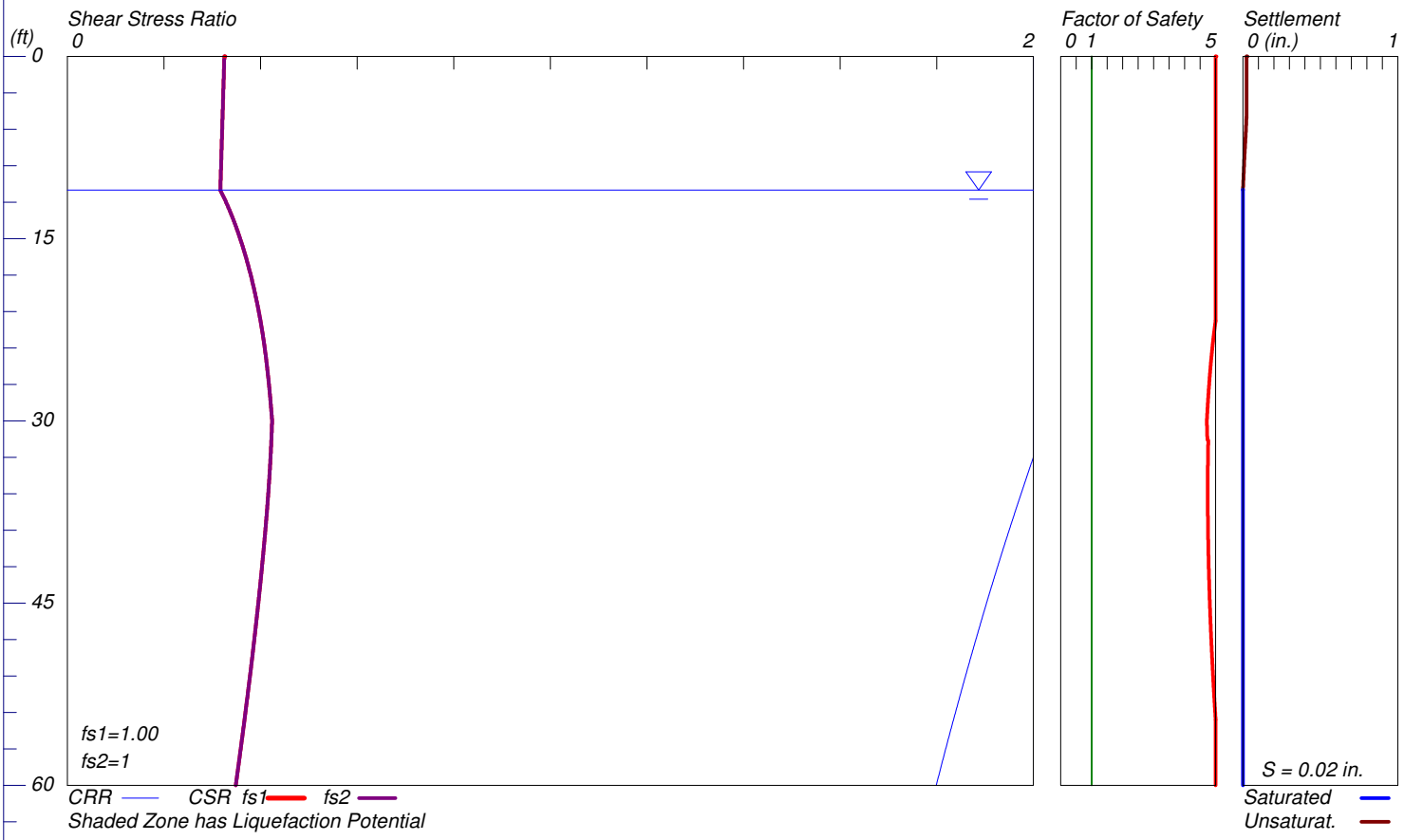
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB11 Water Depth=11 ft Surface Elev.=412

Magnitude=7.5
Acceleration=0.5g



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URS

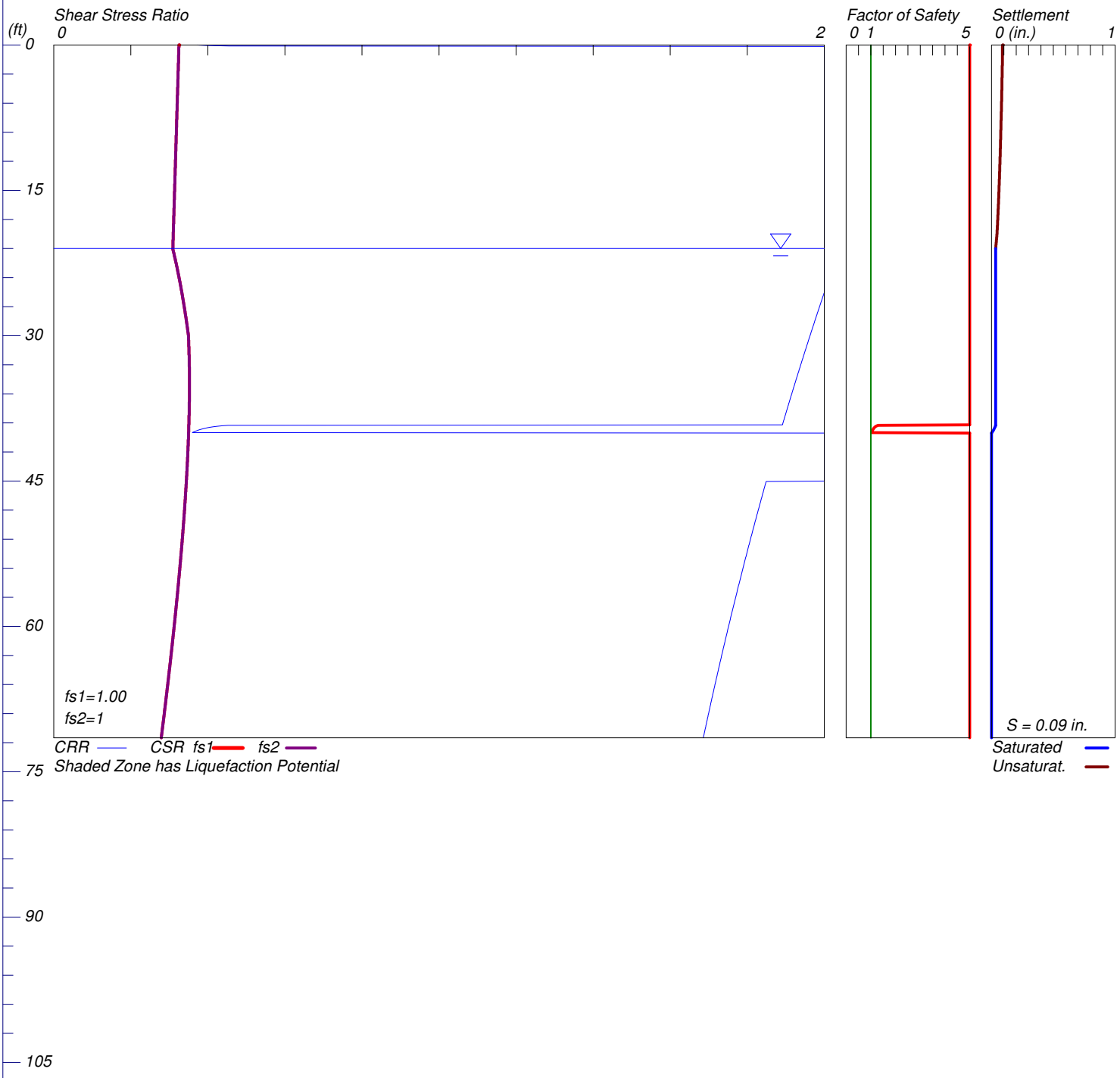
Plate

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB12 Water Depth=21 ft Surface Elev.=422

Magnitude=7.5
Acceleration=0.5g



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URS

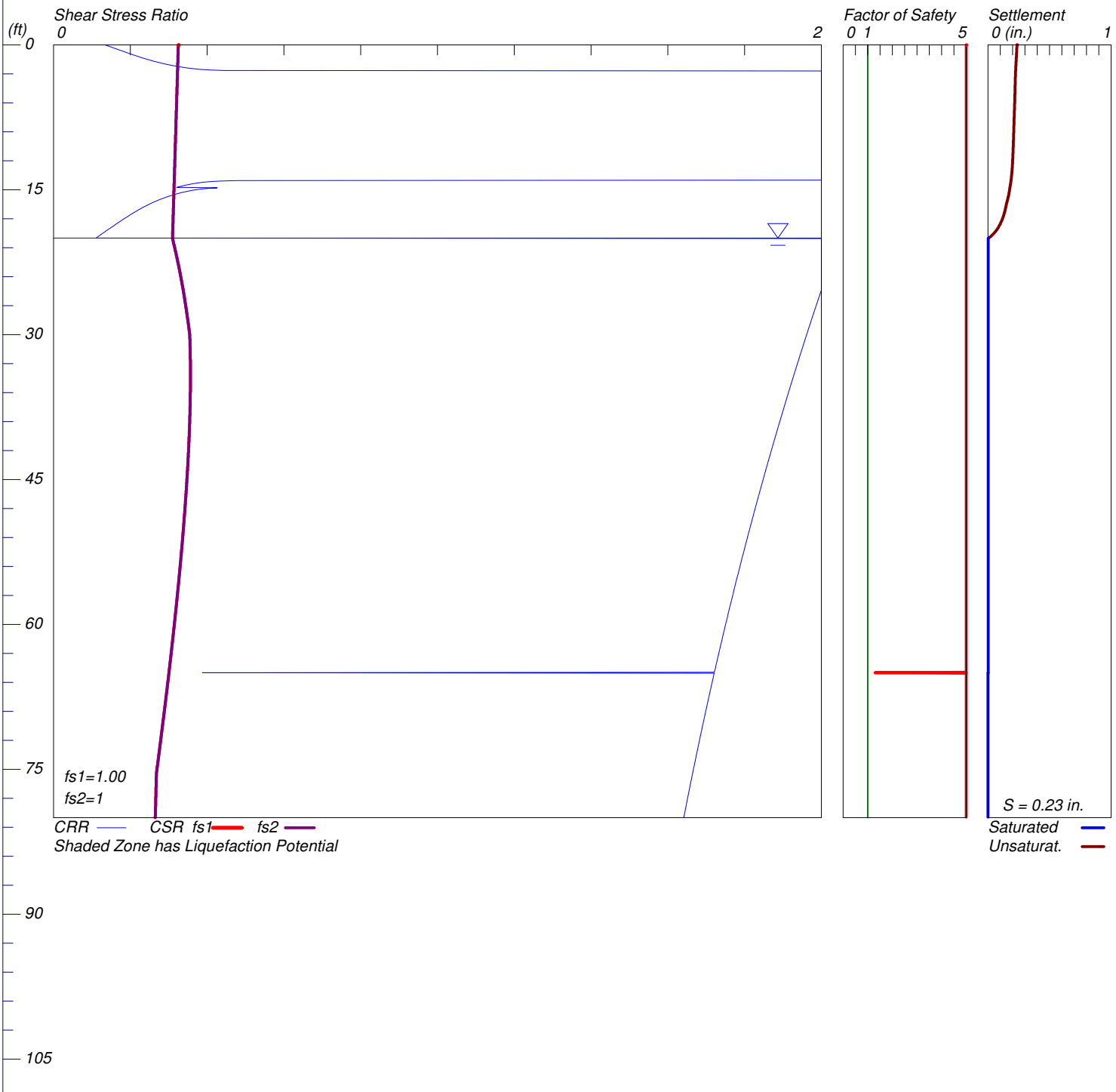
Plate

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB13 Water Depth=20 ft Surface Elev.=421

Magnitude=7.5
Acceleration=0.5g



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URS

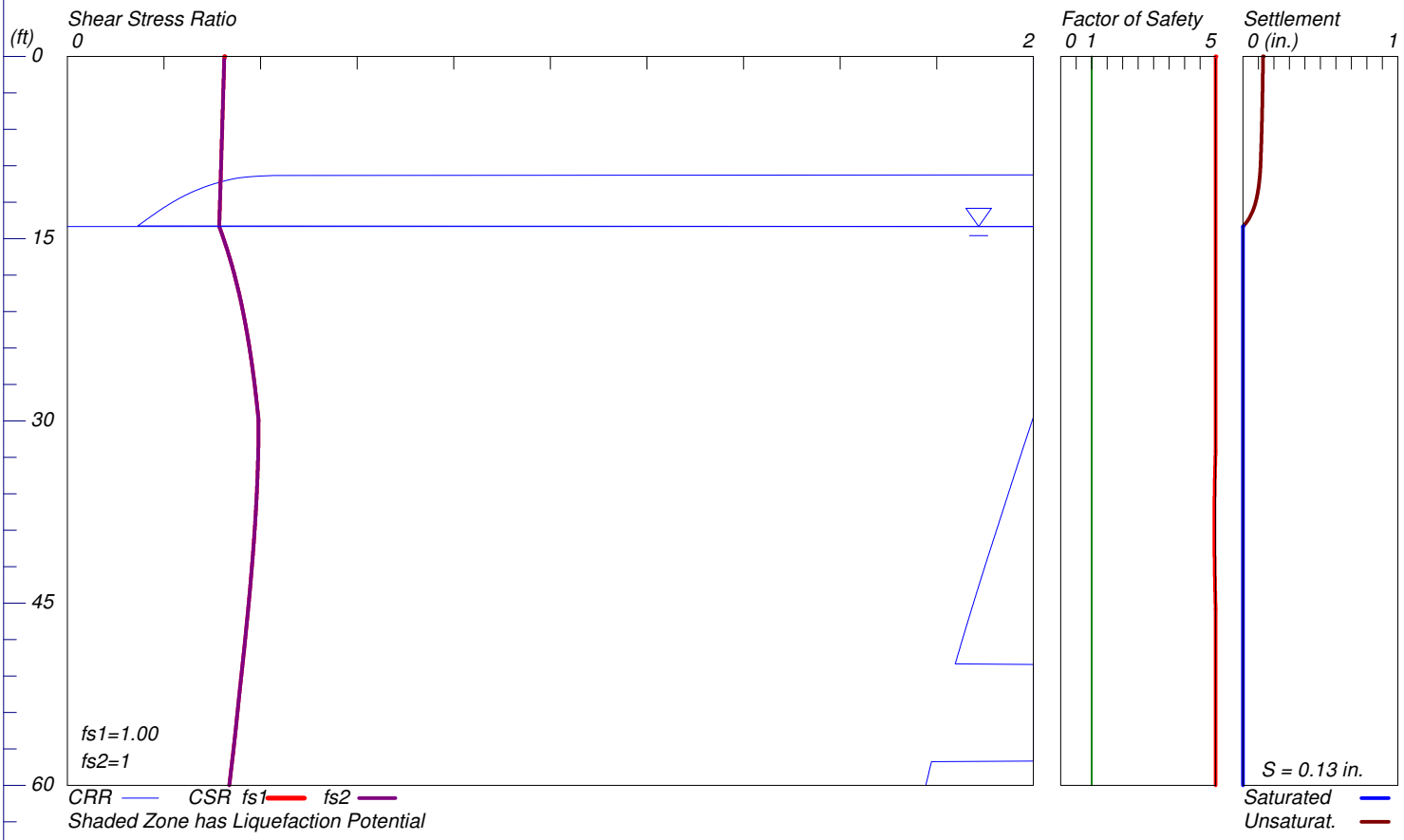
Plate

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB14 Water Depth=14 ft Surface Elev.=415

Magnitude=7.5
Acceleration=0.5g



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URS

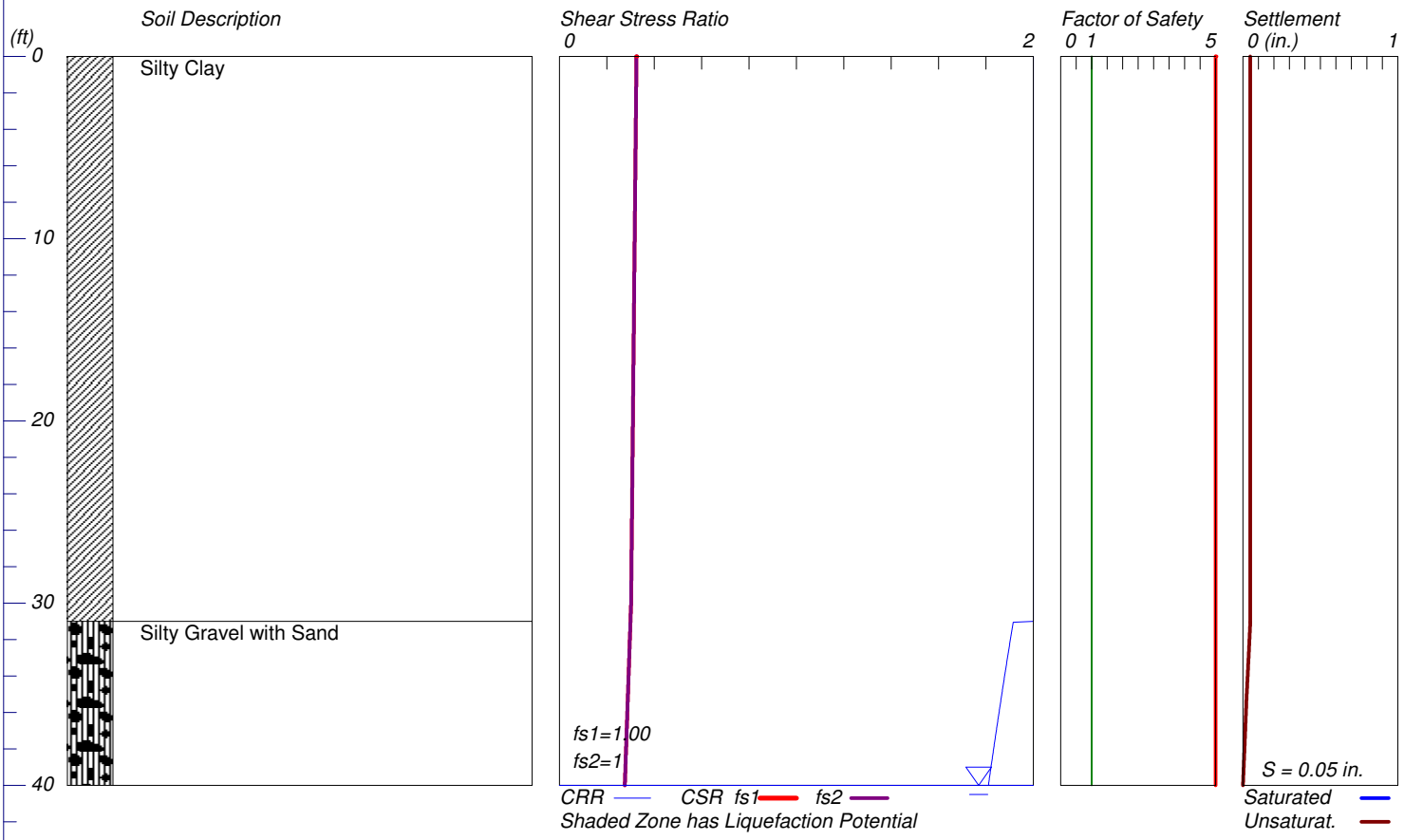
Plate

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB20 Water Depth=40 ft Surface Elev.=421

Magnitude=7.5
Acceleration=0.5g



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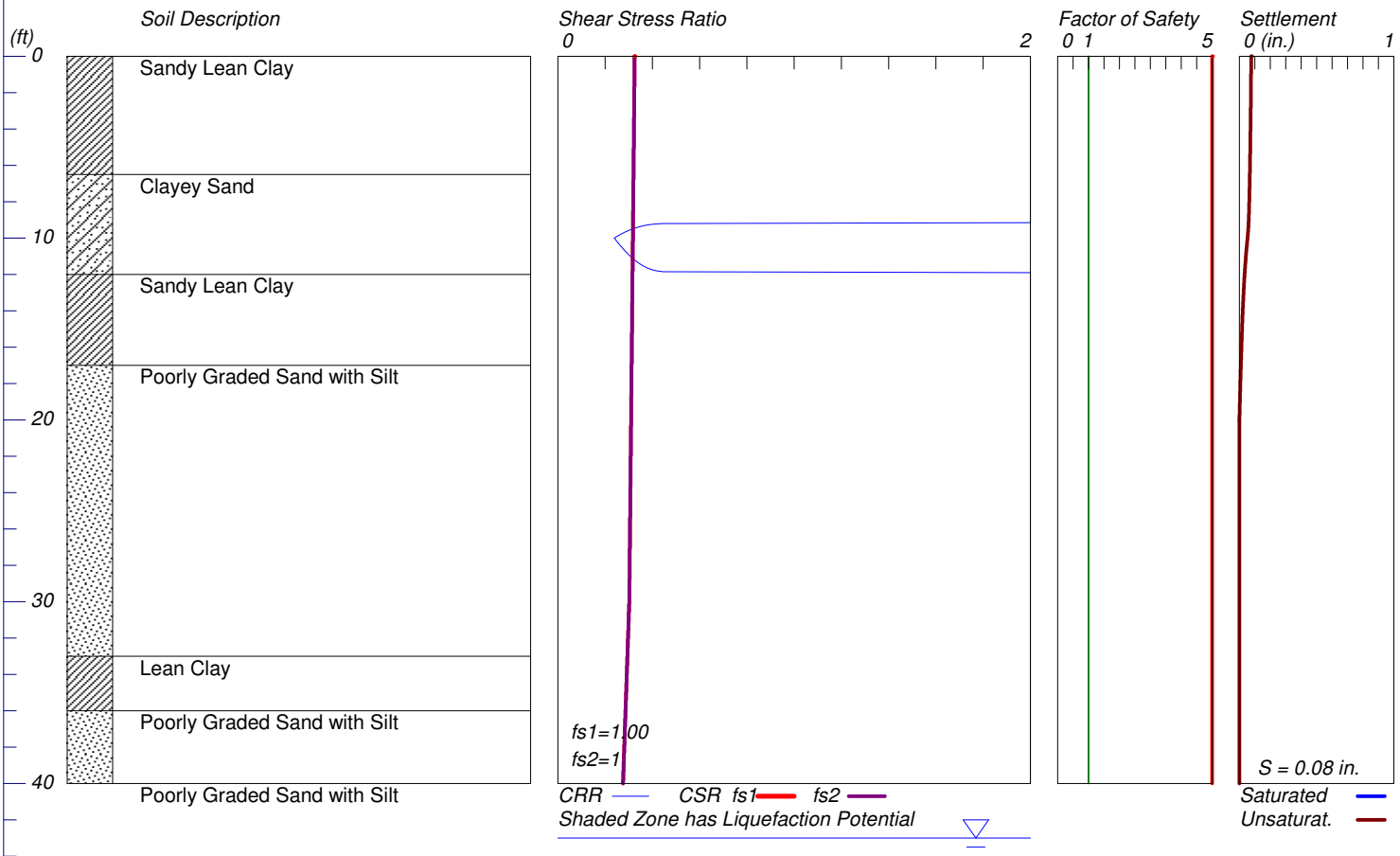
LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB21 Water Depth=43 ft Surface Elev.=418

Magnitude=7.5
Acceleration=0.5g



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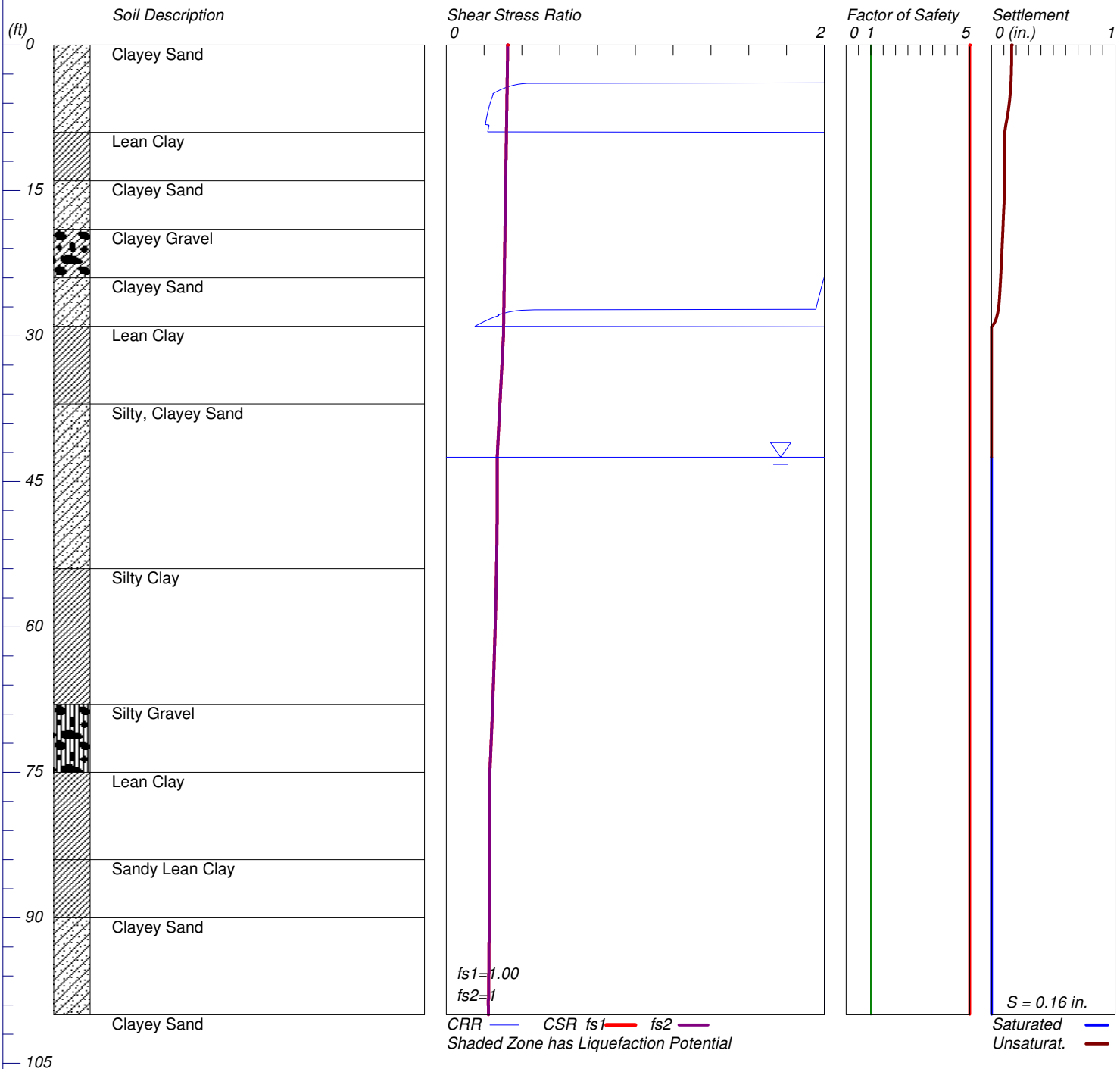
LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB23 Water Depth=42.5 ft Surface Elev.=417

Magnitude=7.5
Acceleration=0.5g



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LIQUEFACTION ANALYSIS

Project: Route 84 Widening
Project No.: 28649640
Boring No.: NB37

PGA = 0.5
M_w = 7.5
GWT during EQ = 3.0 ft

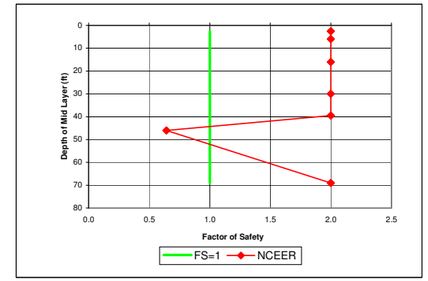
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7

Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$) 1.00

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code
	Donut		0.75	1
	Safety		1	2
	Auto		1.16	3
Borehole Diameter:	(inch)	(mm)	C_B	
	2.5-4.5	65-115	1	1
	6	150	1.05	2
	8	200	1.15	3
Rod Length:	(feet)	(m)	C_R	
	Default			999
Sampling Method:	Type		Cs	
	Stand		1	
	No liners		1.2	

C_E = 3
C_B = 1



Note: F.S. greater than 2 is set to be equal to 2

Layer Number	Soil Type	γ_m	At Bottom of Layer: Depth		At Center of Layer: Depth		σ_o	EQ: u	EQ: σ'_o	r_d	EQ CSR	N raw	Sampler	N SPT	Fines Content	N_{60-cs}	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60-cs}$	$CRR^*_{7.5,1tsf}$	Magnitude Scaling Factor: NCEER K_m: Lower	Upper	Middle	Overburden Correction K_σ	Above GWT?	F.S.	Liquefy ?	F.S=1.0
	(USCS)	pcf	ft	m	ft	m	psf	psf	psf						%	FC< 5%	EQ					during EQ	Critical						NCEER	NCEER	
1	SM	130	5.0	1.52	2.5	0.76	325	0	325	0.996	0.324													1.00	1.00	1.00		Y	2.00	N	1
2	CL	128	7.0	2.13	6.0	1.83	778	187	591	0.988	0.423													1.00	1.00	1.00		N	2.00	N	1
3	SC	144	25.0	7.62	16.0	4.88	2,202	811	1,391	0.966	0.497	51	M	40.8	15	45.3	1.23	1.16	1.00	0.85	1.00	55	0.459	1.00	1.00	1.00	1.000	N	2.00	N	1
4	SC	136	35.0	10.67	30.0	9.14	4,178	1,685	2,493	0.921	0.501	43	S	43	15	47.6	0.92	1.16	1.00	0.95	1.20	58	0.459	1.00	1.00	1.00	0.975	N	2.00	N	1
5	SC	144	44.0	13.41	39.5	12.04	5,506	2,278	3,228	0.855	0.474	78	M	62.4	15	67.9	0.81	1.16	1.00	1.00	1.00	64	0.459	1.00	1.00	1.00	0.933	N	2.00	N	1
6	ML	110	48.0	14.63	46.0	14.02	6,374	2,683	3,691	0.794	0.445	17	S	17	55	25.4	0.76	1.16	1.00	1.00	1.20	27	0.315	1.00	1.00	1.00	0.909	N	0.64	Liquef	1
7	SC	140	90.0	27.43	69.0	21.03	9,534	4,118	5,416	0.597	0.342	59	M	47.2	15	52.0	0.63	1.16	1.00	1.00	1.00	38	0.459	1.00	1.00	1.00	0.829	N	2.00	N	1

Layer Number	Depth to Bot. Layer	Thickness ft	σ_o psf	u psf	σ'_o psf	r_d	$(N_1)_{60-cs}$	Liquefy ? NCEER	τ_{cyc} psf	$CSR_{M=7.5}$ τ_{cyc}/σ'_o	CSR_M τ_{cyc}/σ'_o	Volumetric Strain** %	Settl. in
1	5.0	5.0	325	0	325	0.996		N	105.2	0.324	0.32		0.00
2	7.0	2.0	778	187	591	0.988		N	249.8	0.423	0.42		0.00
3	25.0	18.0	2,202	811	1,391	0.966	55.0	N	691.6	0.497	0.50		0.00
4	35.0	10.0	4,178	1,685	2,493	0.921	58.0	N	1250.0	0.501	0.50		0.00
5	44.0	9.0	5,506	2,278	3,228	0.855	63.8	N	1530.7	0.474	0.47		0.00
6	48.0	4.0	6,374	2,683	3,691	0.794	26.8	Liquef	1643.9	0.445	0.45	1.0	0.48
7	90.0	42.0	9,534	4,118	5,416	0.597	37.7	N	1851.1	0.342	0.34		0.00

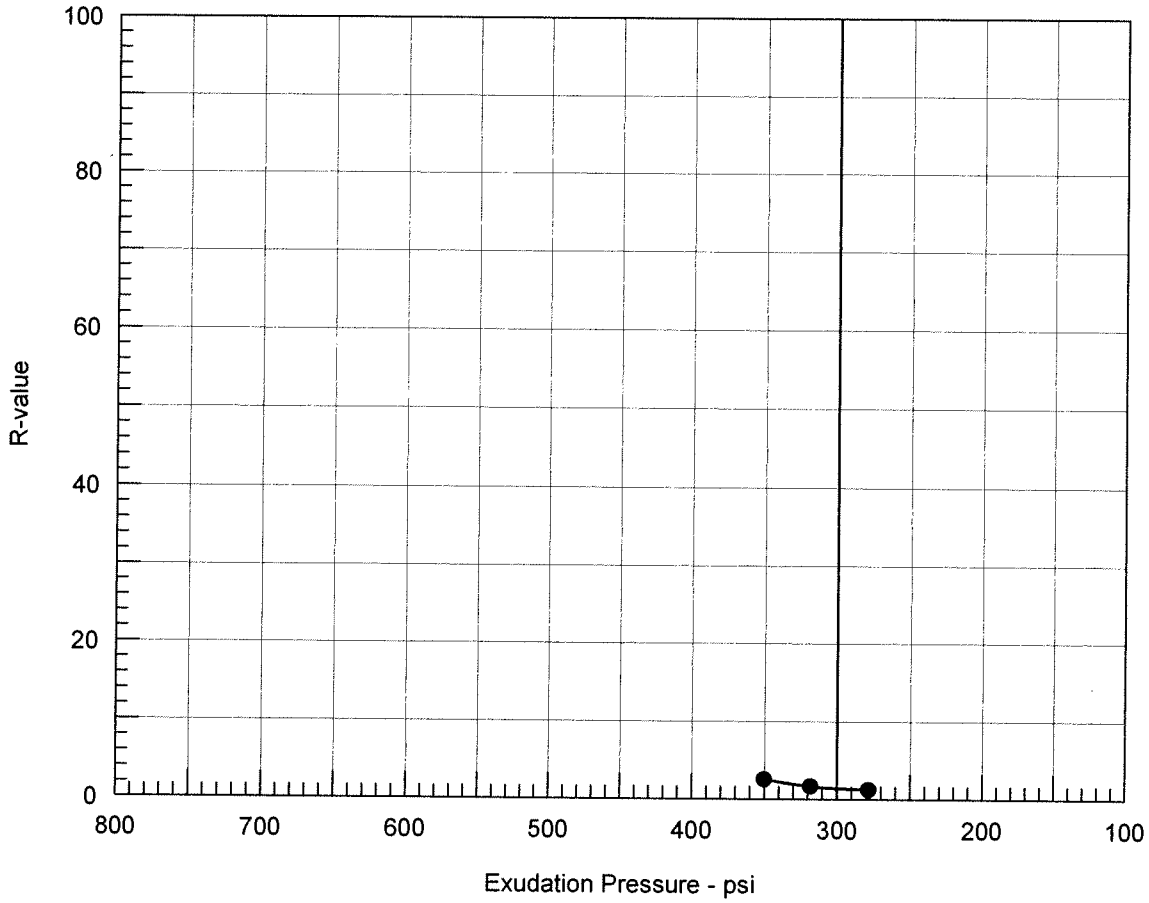
Total Settlement (inch) =	0.48

* Note: The equation used to obtain $CRR_{7.5}$ is not valid for corrected $(N_1)_{60}$ higher than 30. According to NCEER 1997, the soil layer with corrected $(N_1)_{60}$ higher than 30 blows per foot is unlikely to be susceptible to liquefaction.

** Note: These values were obtained from a chart for estimation of volumetric strain in saturated sands based on a cyclic stress ratio and standard penetration resistance (Tokimatsu and Seed, 1987).
See figure 9.53 from "Geotechnical Earthquake Engineering" by S. Kramer.

Resistance value (R-value) tests were performed on twenty five (25) bulk samples of near surface soils at borings. The results of these tests are presented herein.

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	40	109.1	17.5	0.00	152	2.49	350	3	3
2	30	107.8	18.4	0.00	155	2.47	318	2	2
3	20	106.9	19.3	0.00	156	2.30	279	1	1

Test Results	Material Description
R-value at 300 psi exudation pressure = 1	Brown sandy silt with gravel

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB01 **Depth:** 1-5

Date: 1/16/2008

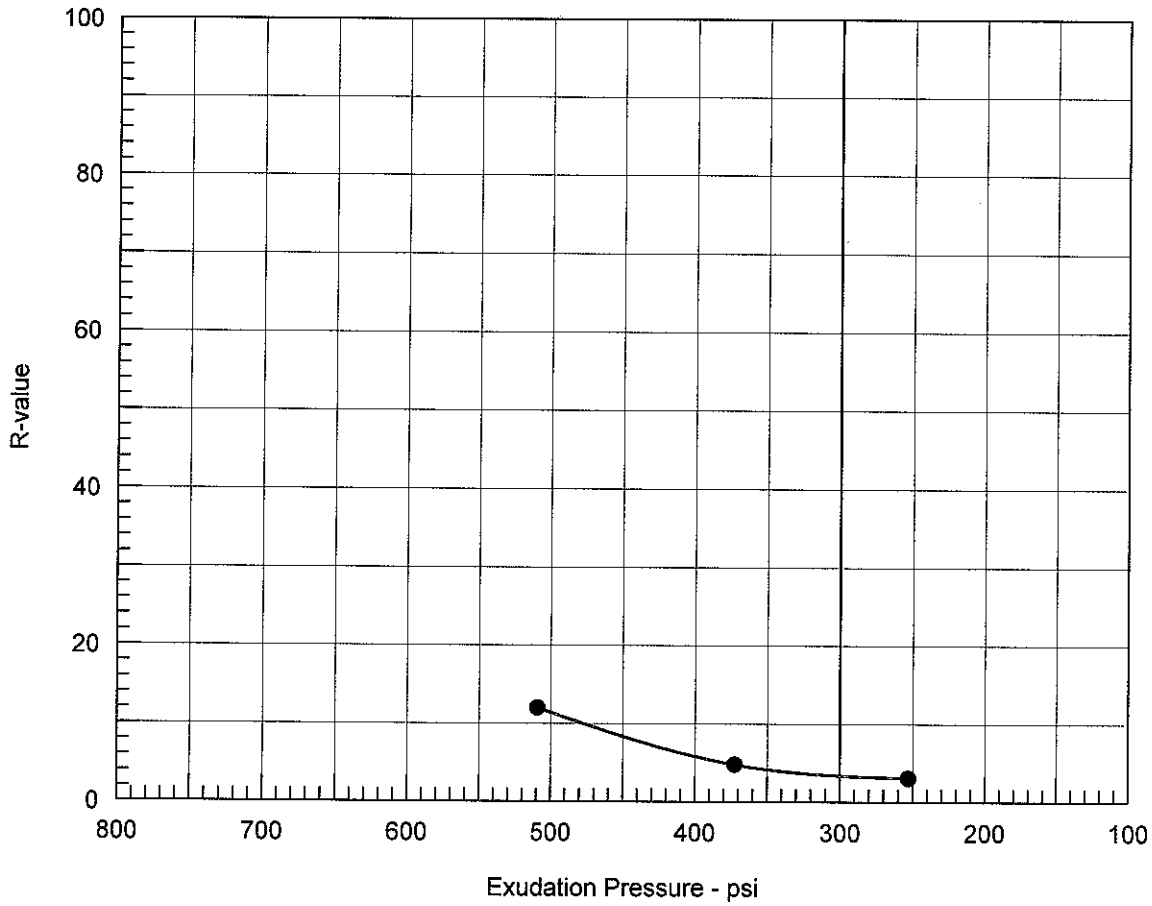
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	50	114.0	15.6	0.00	135	2.56	509	12	12
2	25	108.4	17.8	0.00	147	2.49	372	5	5
3	20	104.1	20.0	0.00	150	2.36	253	3	3

Test Results	Material Description
R-value at 300 psi exudation pressure = 3	Orangish brown Sandy lean clay

Project No.: 26849640
Project: Route 84 Expressway Widening
Source of Sample: RB01 **Depth:** 1-5
Date: 4/4/2008

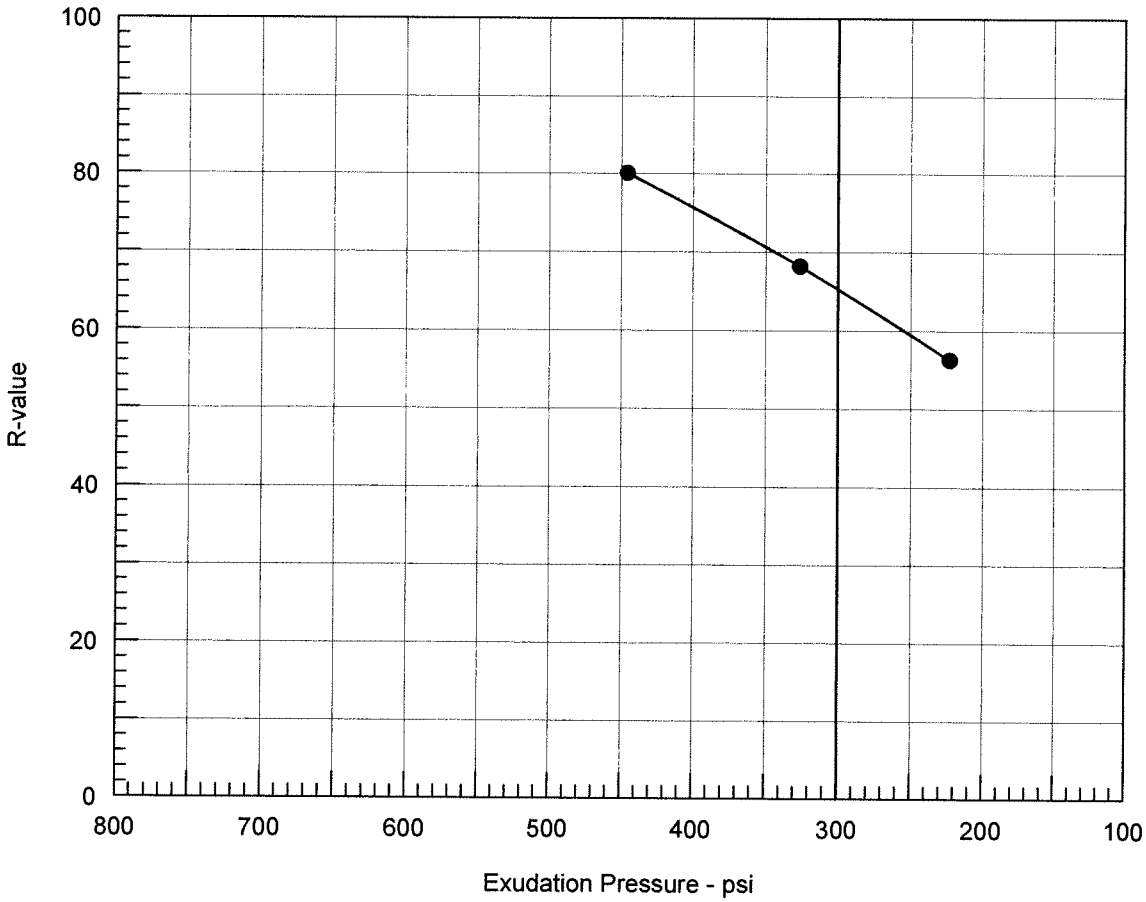
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	132.0	7.6	0.00	26	2.51	446	80	80
2	350	132.8	8.5	0.00	41	2.46	326	68	68
3	350	132.8	9.3	0.00	56	2.46	223	56	56

Test Results	Material Description
R-value at 300 psi exudation pressure = 65	Silty sand with gravel

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB-03 **Depth:** 1-5
Sample Number: L9678
Date: 1/7/2008

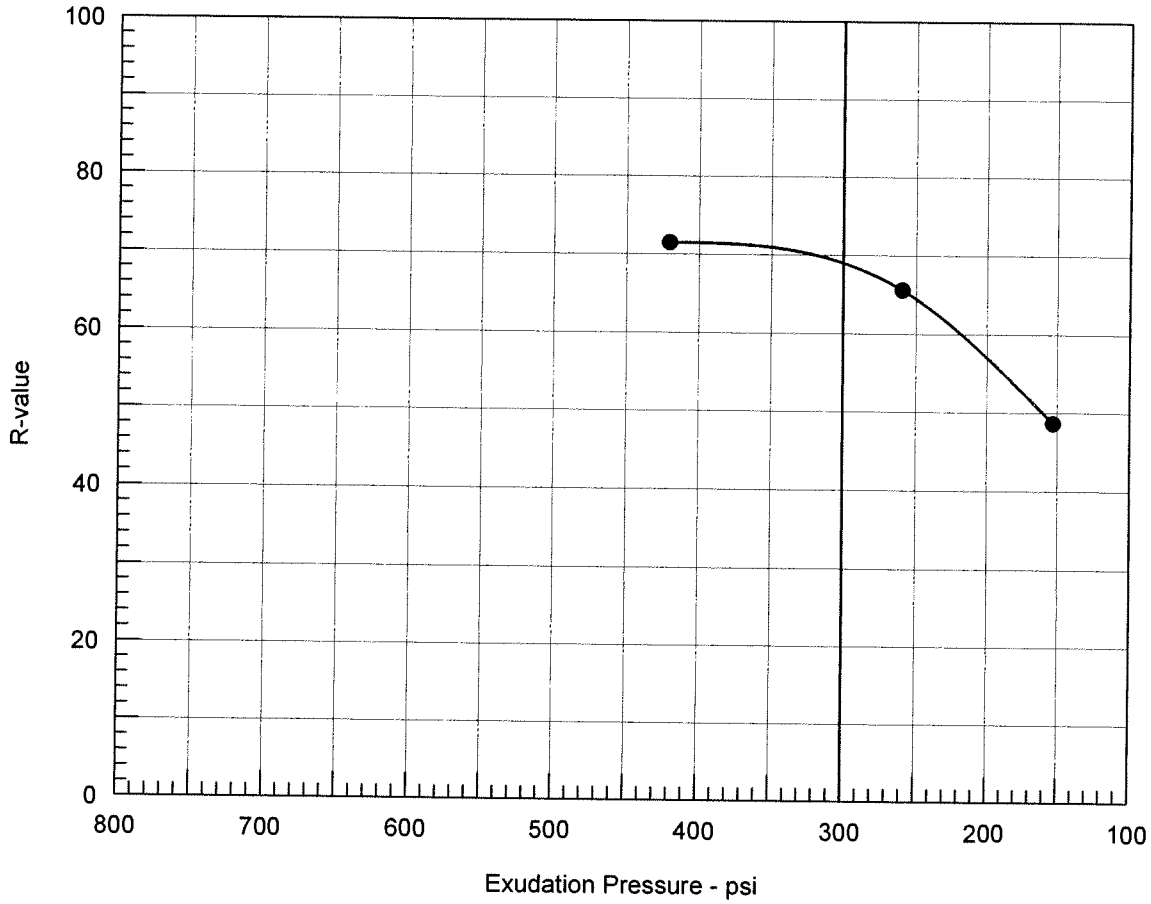
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	250	134.5	7.9	0.00	29	2.49	420	71	71
2	105	131.9	9.2	0.00	65	2.53	153	49	49
3	160	133.0	8.3	0.00	40	2.51	259	66	66

Test Results	Material Description
R-value at 300 psi exudation pressure = 69	Light grayish brown gravelly silt with sand

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB04 **Depth:** 1-5

Date: 1/21/2008

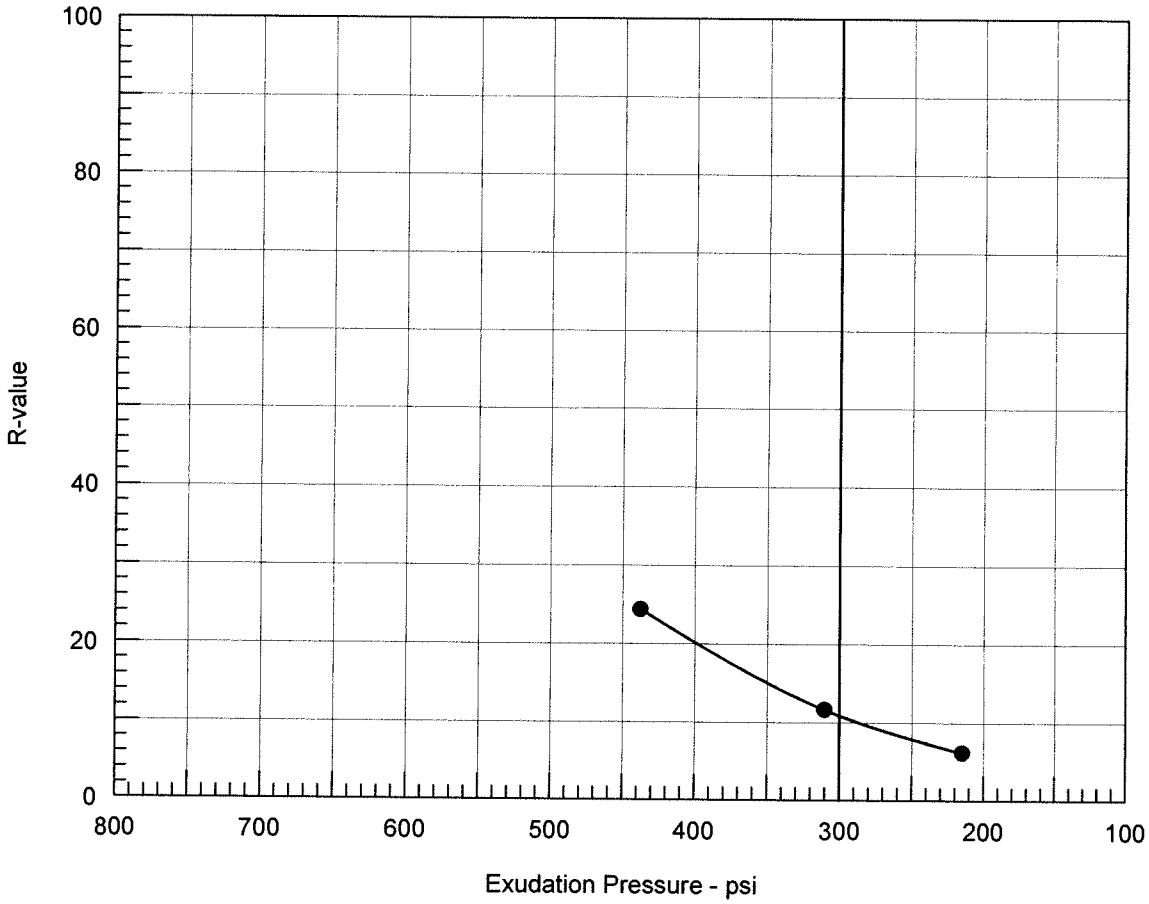
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	150	116.3	16.2	0.39	146	2.52	215	6	6
2	150	117.6	15.3	0.64	135	2.47	310	12	12
3	175	118.6	14.4	1.09	121	2.50	438	24	24

Test Results	Material Description
R-value at 300 psi exudation pressure = 11	Sandy silt with clay

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB-05 **Depth:** 1-5
Sample Number: L9678
Date: 1/7/2008

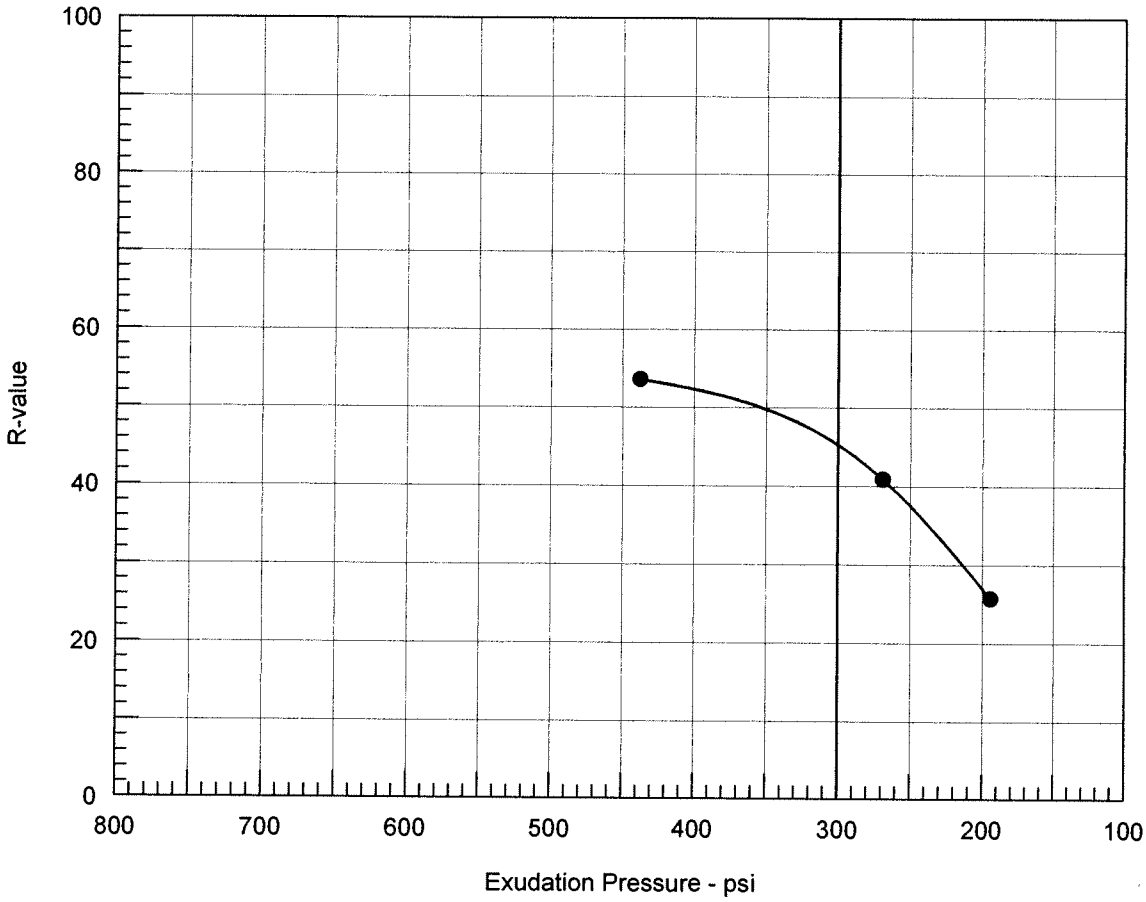
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	200	138.6	7.5	0.00	60	2.50	438	54	54
2	75	136.2	8.4	0.00	107	2.58	194	24	26
3	110	137.7	8.0	0.00	78	2.51	269	41	41

Test Results	Material Description
R-value at 300 psi exudation pressure = 45	Yellowish brown gravelly silt with sand

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB07 **Depth:** 1-5
Date: 1/21/2008

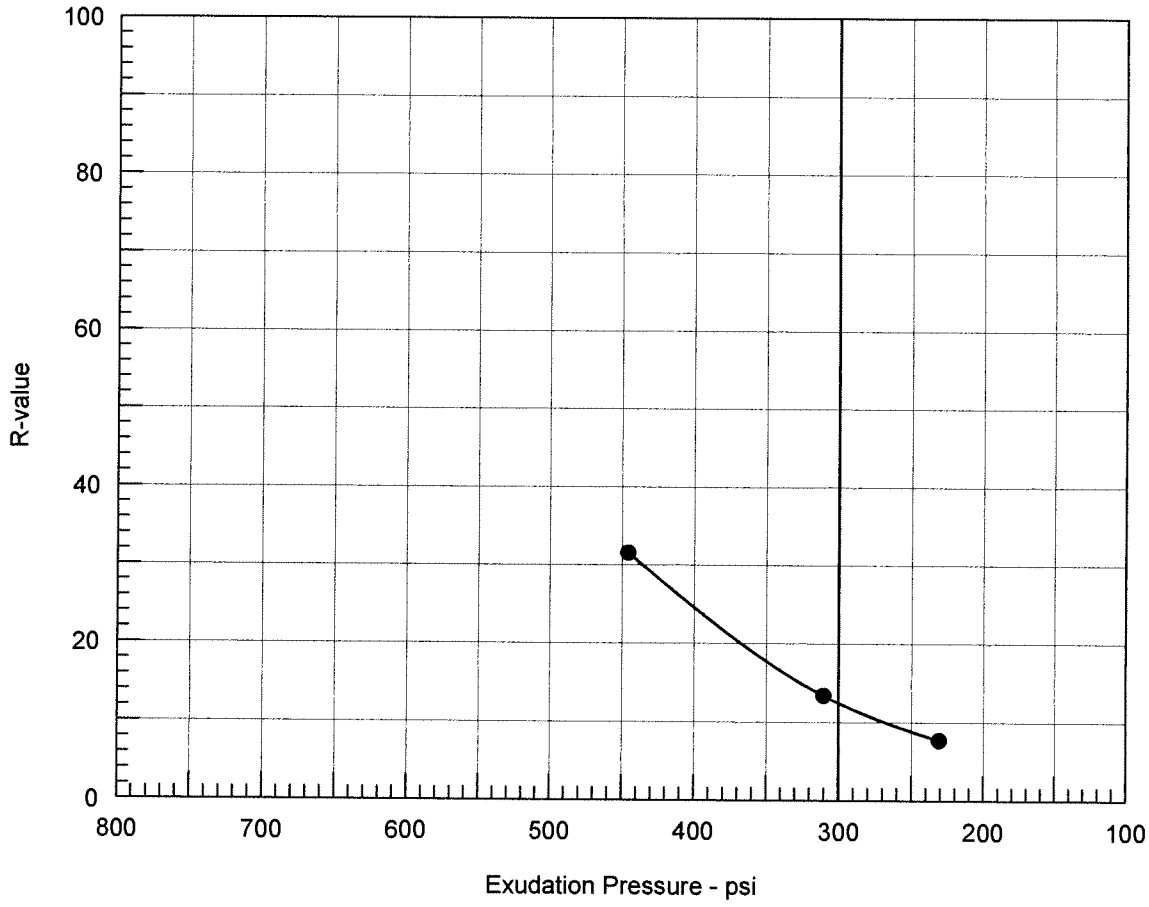
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	225	126.1	12.6	0.15	133	2.46	310	13	13
2	250	127.2	11.7	0.49	100	2.48	446	32	32
3	150	125.8	13.5	0.00	144	2.45	231	8	8

Test Results	Material Description
R-value at 300 psi exudation pressure = 12	Sandy clay

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB-10 **Depth:** 1-5
Sample Number: L9678
Date: 1/7/2008

Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

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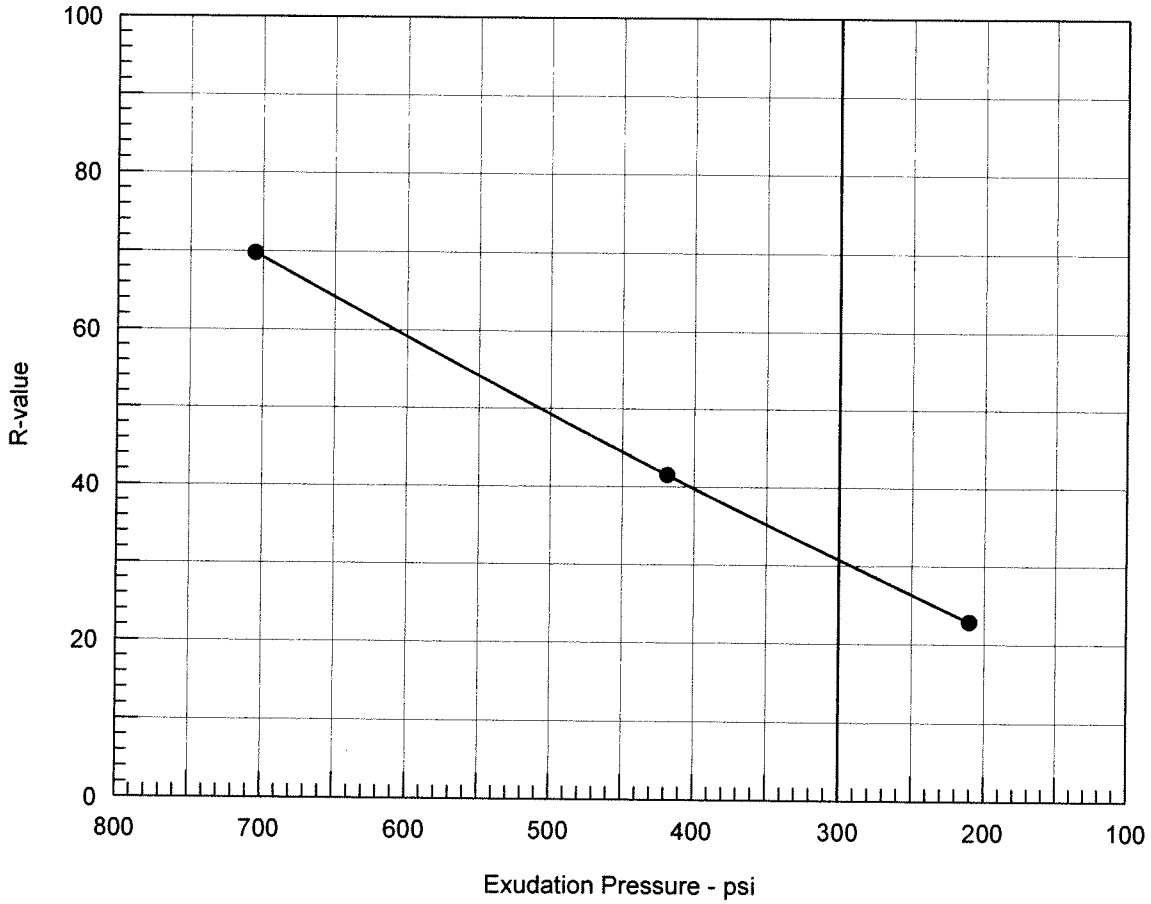
Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	80	128.1	10.5	0.00	114	2.57	210	22	23
2	200	131.0	9.6	0.00	83	2.53	419	41	41
3	350	133.6	8.8	0.27	40	2.49	705	70	70

Test Results	Material Description
R-value at 300 psi exudation pressure = 31	Grayish brown silt with gravel and sand

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB11 **Depth:** 1-5
Date: 1/21/2008

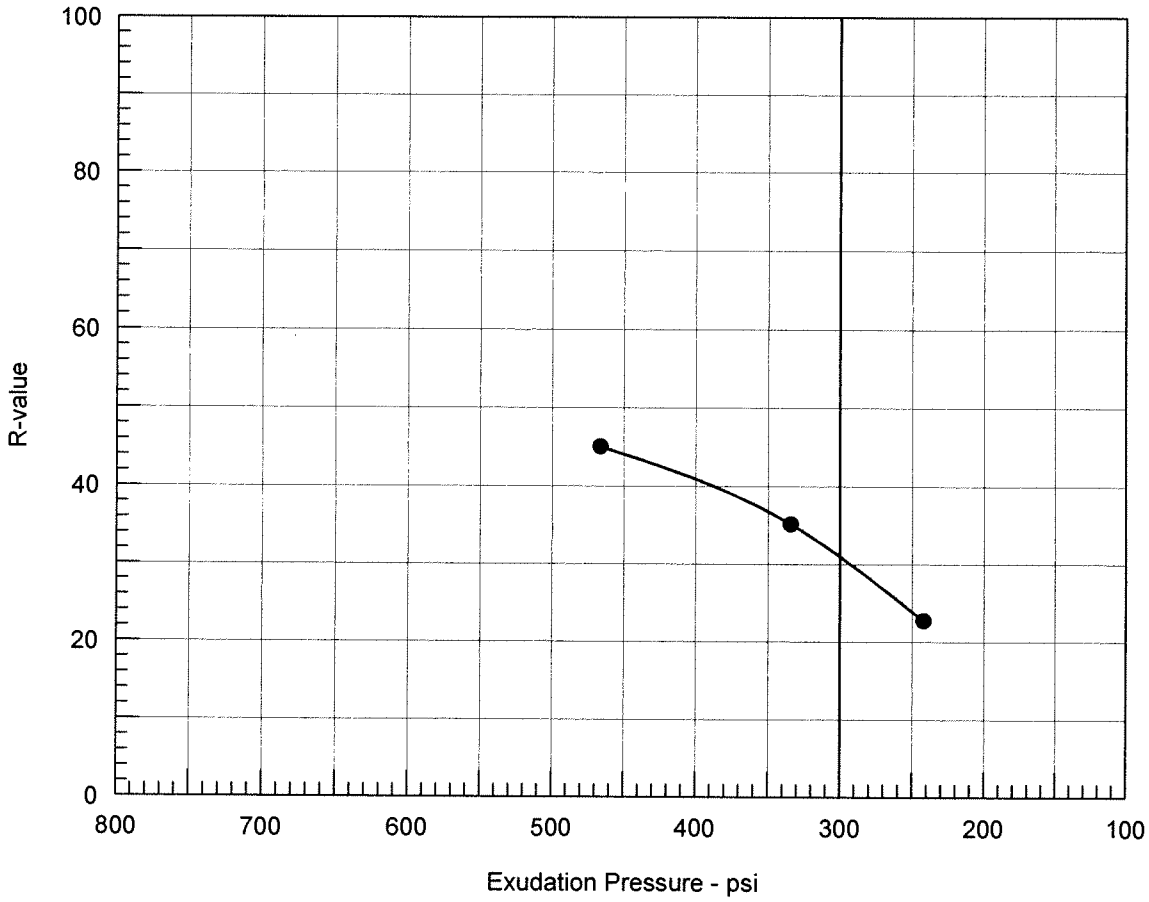
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	50	135.2	8.8	0.00	107	2.43	242	24	23
2	120	137.0	8.0	0.00	72	2.52	466	45	45
3	75	136.4	8.4	0.00	91	2.55	334	35	35

Test Results	Material Description
R-value at 300 psi exudation pressure = 31	Yellowish brown silt with gravel and sand

Project No.: 28649640

Project: Route 84 Expressway Widening

Source of Sample: RB12 **Depth:** 1-5

Date: 1/22/2008

Tested by:

Checked by:

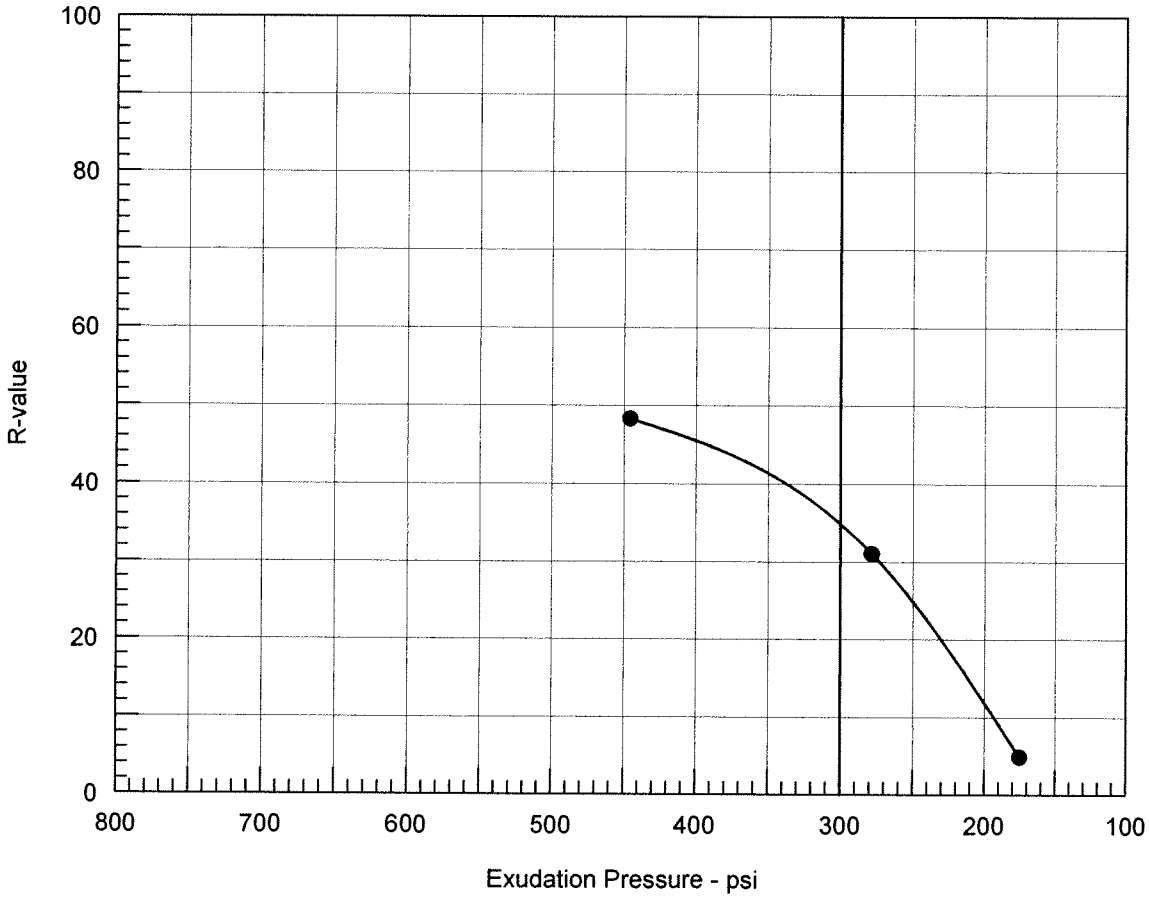
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	275	127.0	11.0	0.30	106	2.51	279	31	31
2	325	128.6	10.1	0.64	74	2.52	446	48	48
3	200	125.7	11.9	0.06	150	2.48	175	5	5

Test Results	Material Description
R-value at 300 psi exudation pressure = 35	Clayey sand

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB-14 **Depth:** 1-5
Sample Number: L9678
Date: 1/7/2008

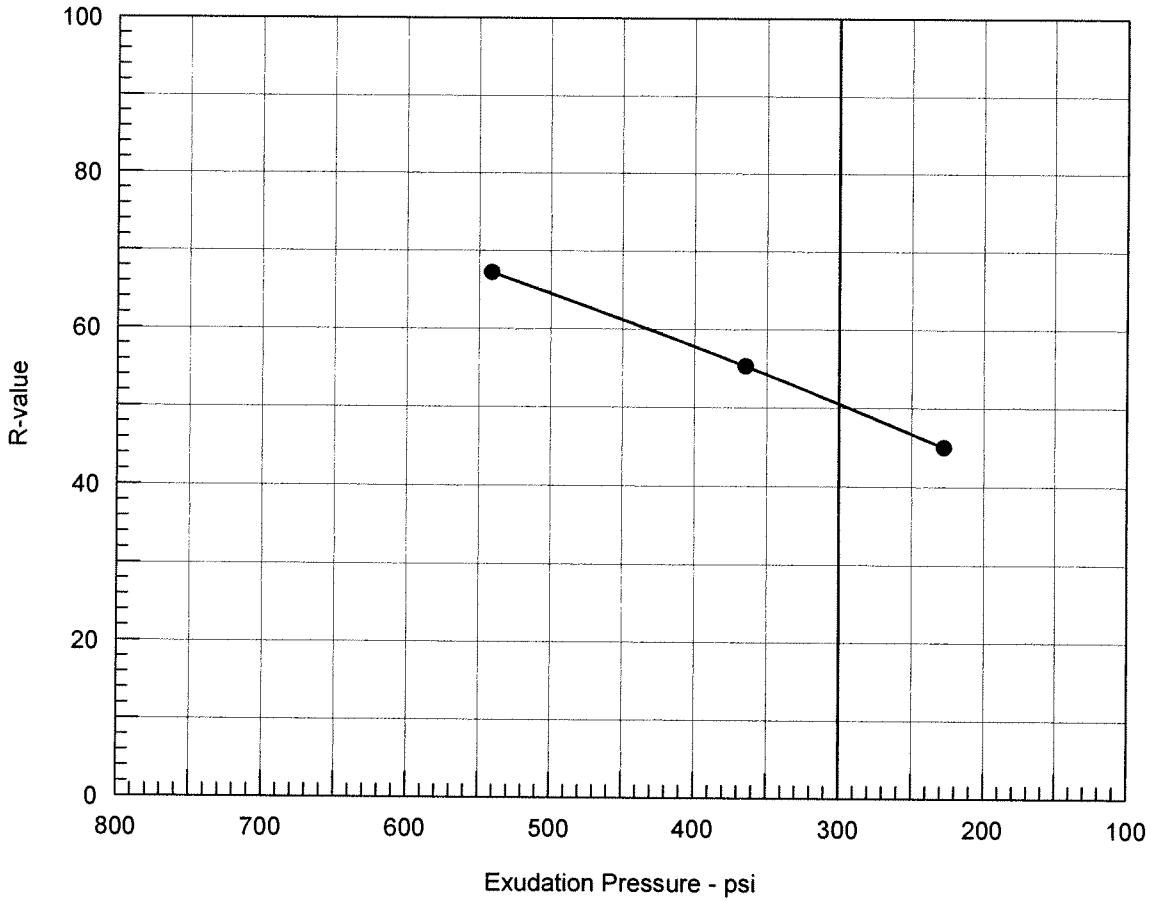
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	275	141.4	6.3	0.00	36	2.41	541	69	67
2	90	139.7	7.2	0.00	74	2.52	228	45	45
3	165	139.4	6.8	0.00	51	2.44	364	57	55

Test Results	Material Description
R-value at 300 psi exudation pressure = 51	Grayish brown gravelly silt with sand

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB16 **Depth:** 1-5

Date: 1/22/2008

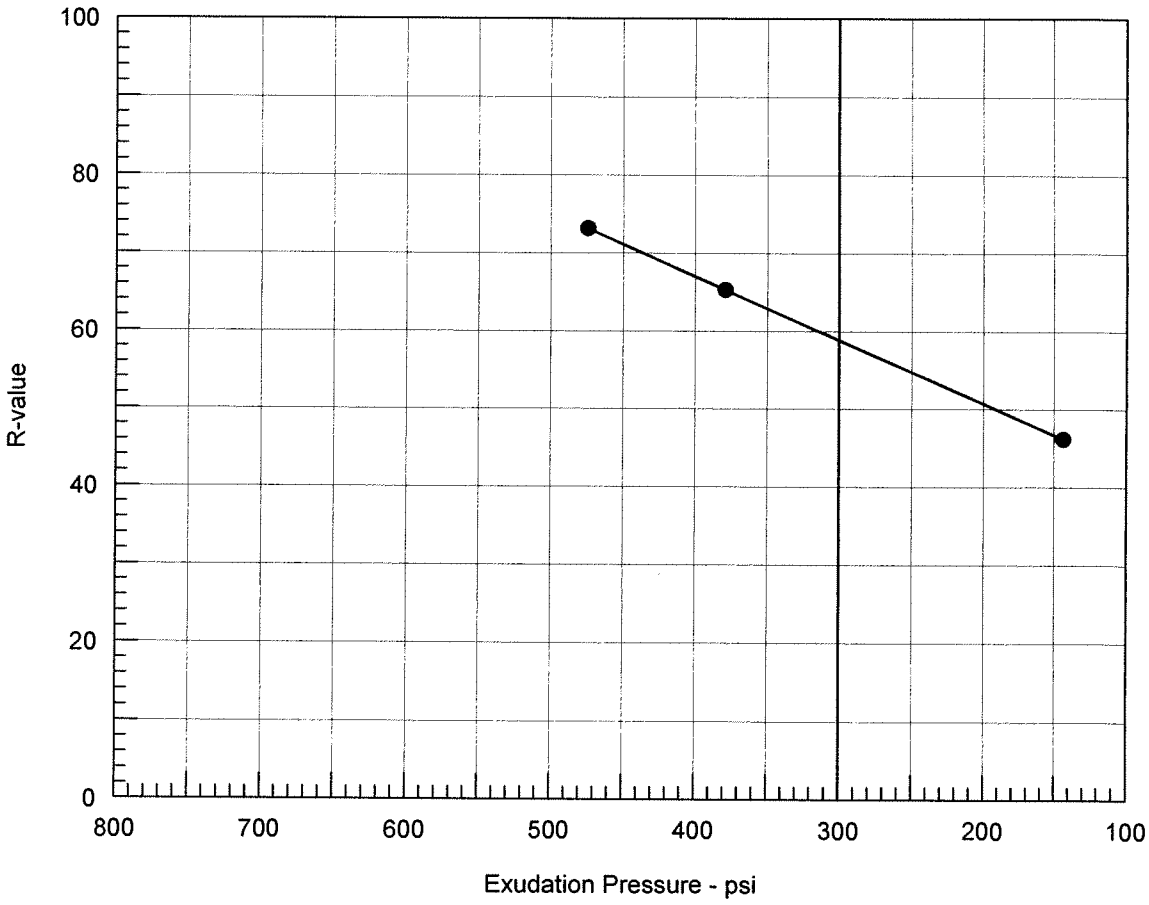
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	125	134.9	8.2	0.00	75	2.56	143	45	46
2	350	135.7	7.4	0.06	33	2.59	474	71	73
3	280	136.0	7.8	0.00	40	2.55	379	65	65

Test Results	Material Description
R-value at 300 psi exudation pressure = 59	Brown silt with gravel and sand

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB18 **Depth:** 1-5

Date: 1/22/2008

Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

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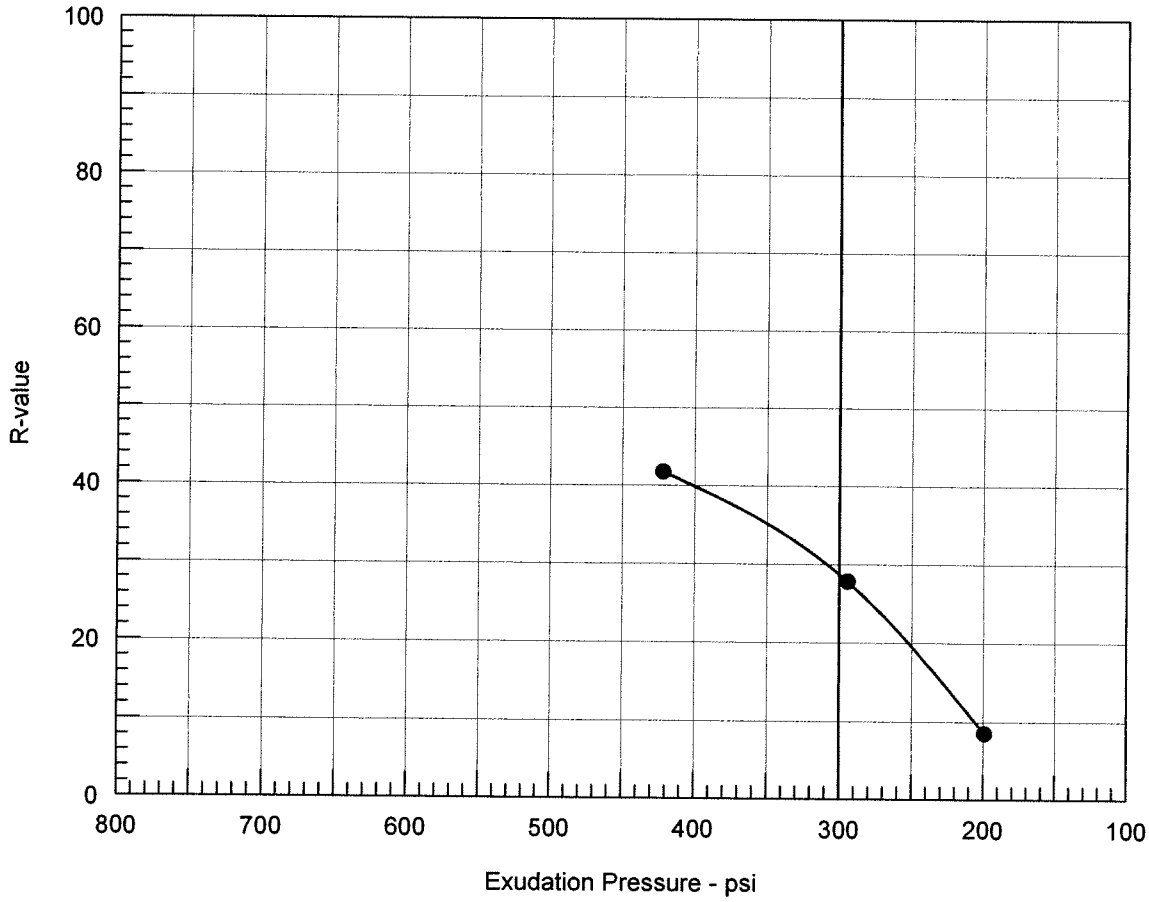
Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	300	132.6	7.7	0.15	110	2.56	294	27	28
2	225	131.5	8.5	0.00	142	2.50	199	9	9
3	325	134.4	6.8	0.42	84	2.51	422	42	42

Test Results	Material Description
R-value at 300 psi exudation pressure = 29	Gravelly silt

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB-21 **Depth:** 1-5
Sample Number: L9678
Date: 1/7/2008

Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

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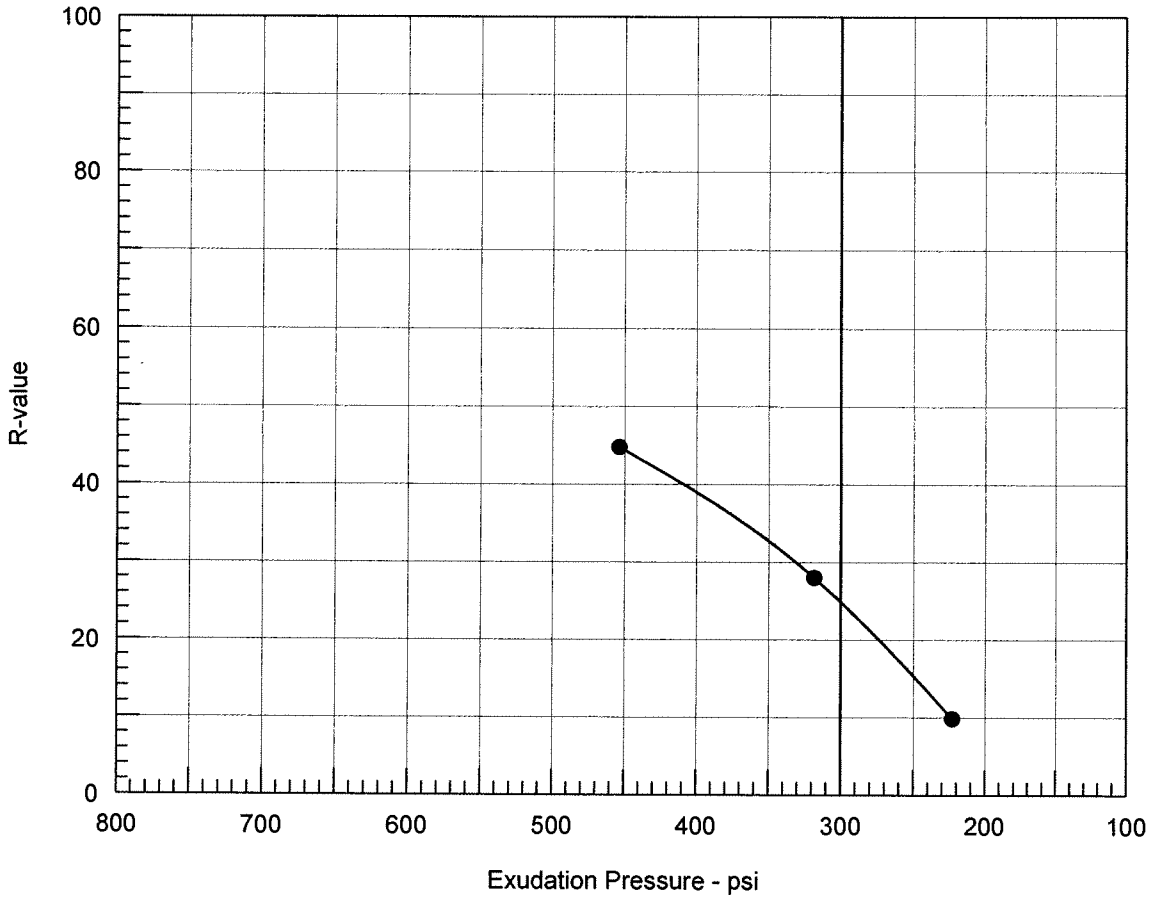
Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	250	125.2	13.4	0.18	102	2.51	318	28	28
2	300	127.3	12.5	0.33	76	2.50	454	45	45
3	200	123.9	14.3	0.00	139	2.48	223	10	10

Test Results	Material Description
R-value at 300 psi exudation pressure = 25	Sandy silt with gravel

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB-24 **Depth:** 1-5
Sample Number: L9678
Date: 1/7/2008

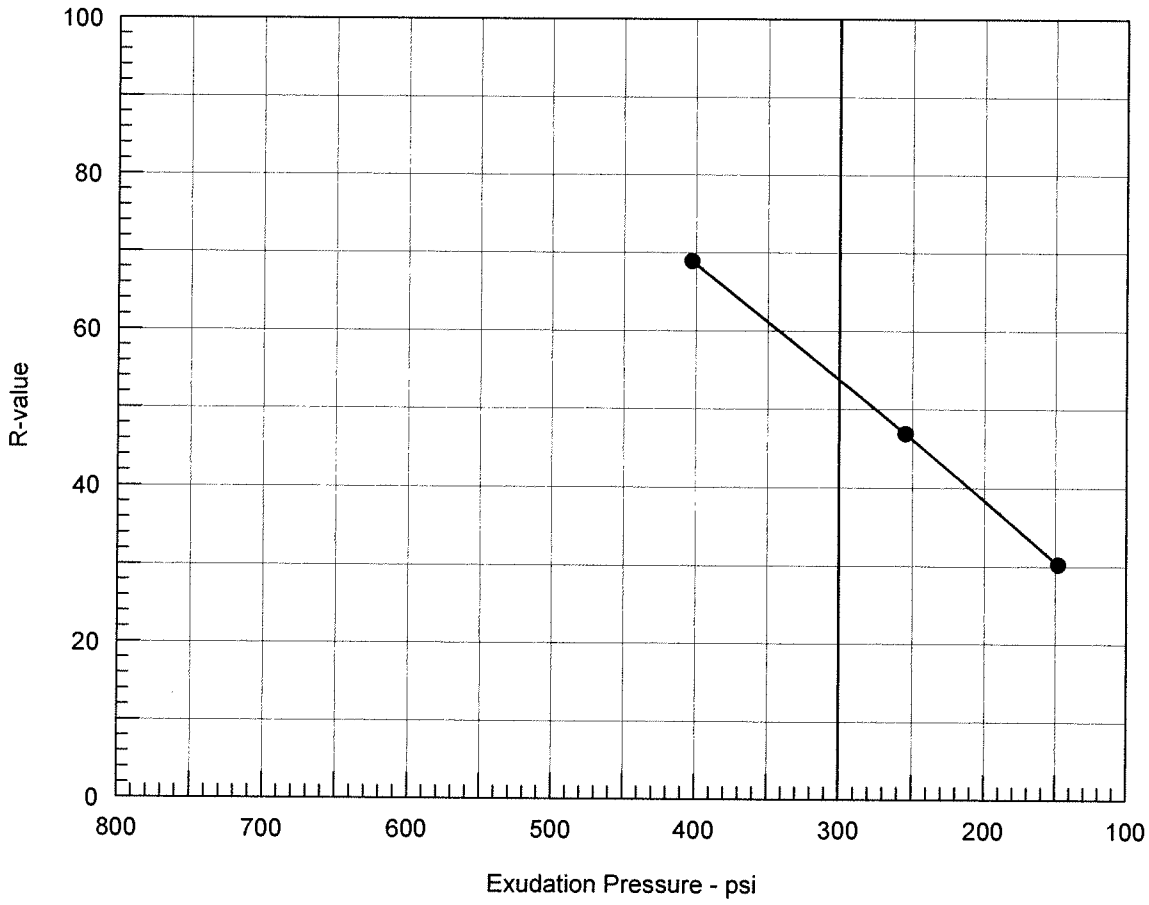
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	230	127.5	11.2	0.00	38	2.56	403	68	69
2	40	126.0	12.0	0.00	94	2.57	148	29	30
3	95	126.6	11.6	0.00	68	2.58	255	45	47

Test Results	Material Description
R-value at 300 psi exudation pressure = 54	Grayish brown sandy silt with gravel

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB25 **Depth:** 1-5

Date: 1/23/2008

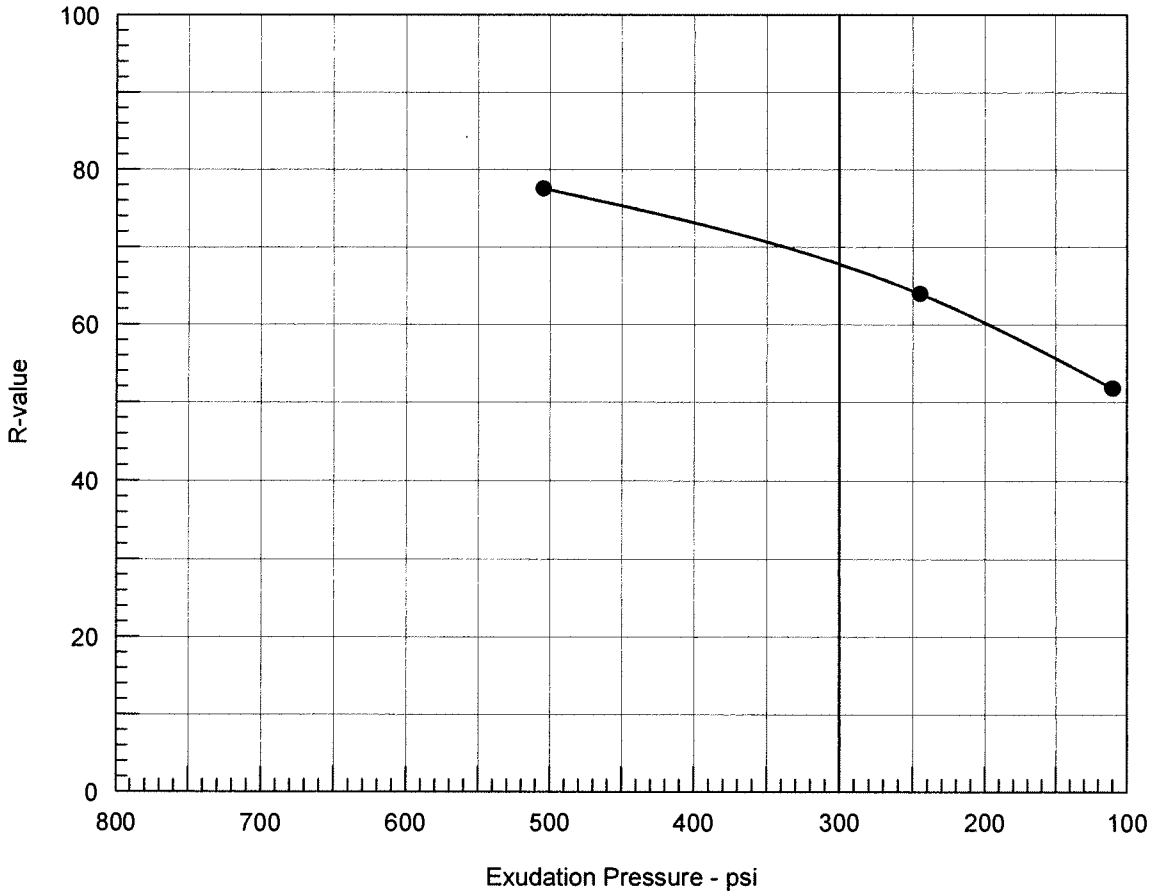
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	135.8	7.7	0.00	23	2.55	505	78	78
2	80	134.0	9.0	0.00	58	2.56	110	50	52
3	185	134.4	8.2	0.00	39	2.59	245	62	64

Test Results	Material Description
R-value at 300 psi exudation pressure = 68	Brown sandy silt with gravel

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB28 **Depth:** 1-5

Date: 1/25/2008

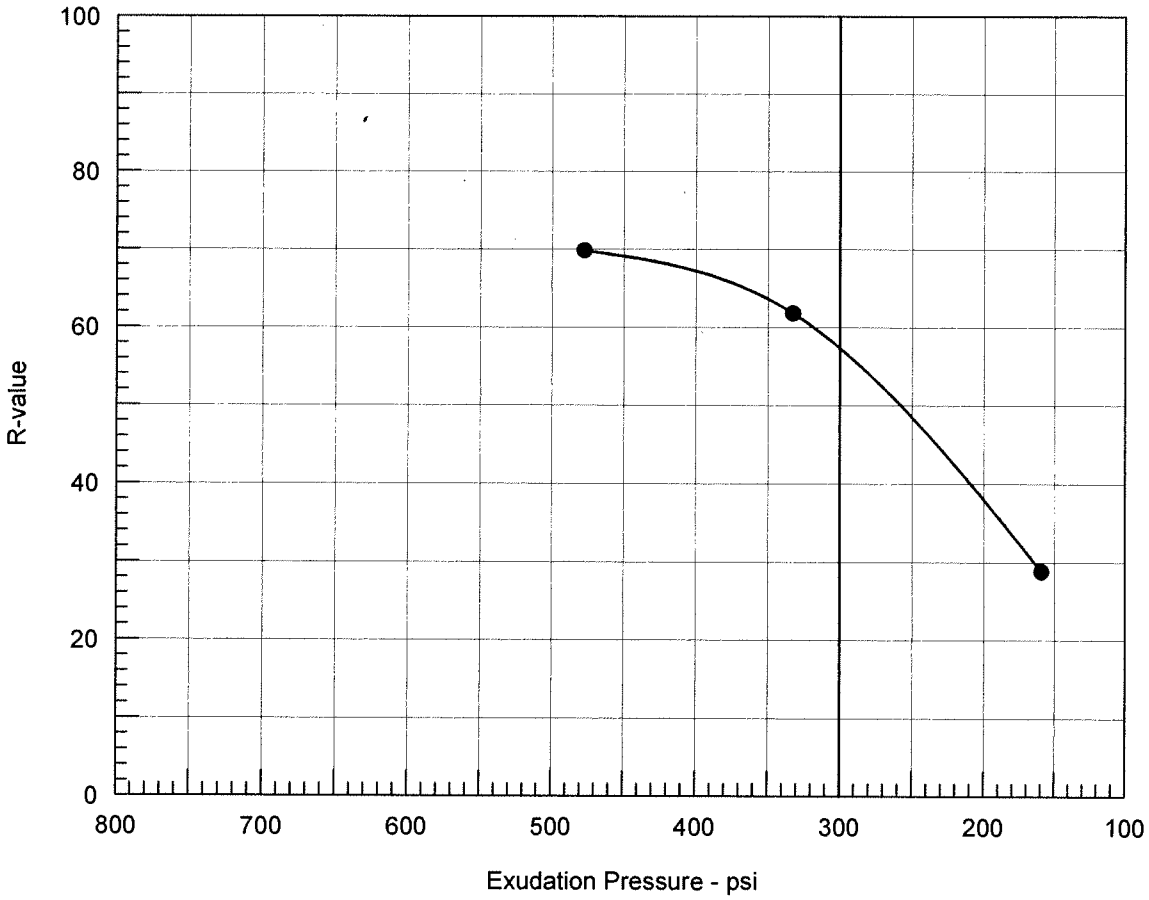
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	30	135.9	8.5	0.00	96	2.45	159	29	29
2	240	140.0	6.8	0.00	35	2.51	477	70	70
3	125	137.3	7.7	0.00	47	2.57	333	60	62

Test Results	Material Description
R-value at 300 psi exudation pressure = 57	Grayish brown gravelly silt with sand

Project No.: 28649640

Project: Route 84 Expressway Widening

Source of Sample: RB31 **Depth:** 1-5

Date: 1/29/2008

Tested by:

Checked by:

Remarks:

R-VALUE TEST REPORT

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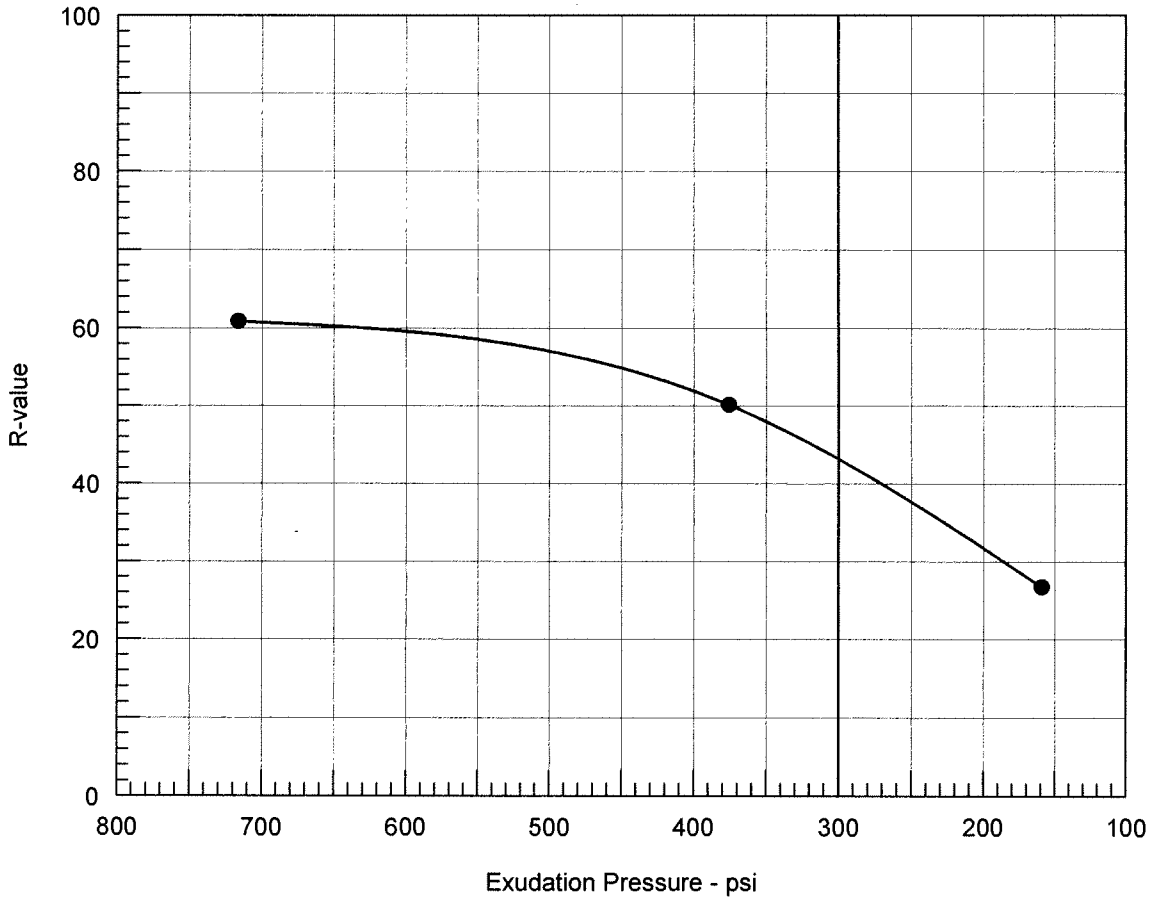
Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	225	140.8	6.9	0.18	45	2.50	716	61	61
2	25	136.7	8.5	0.00	102	2.52	159	27	27
3	85	138.2	7.7	0.00	63	2.54	376	50	50

Test Results	Material Description
R-value at 300 psi exudation pressure = 43	Brown clayey gravel

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB33 **Depth:** 1-5

Date: 1/25/2008

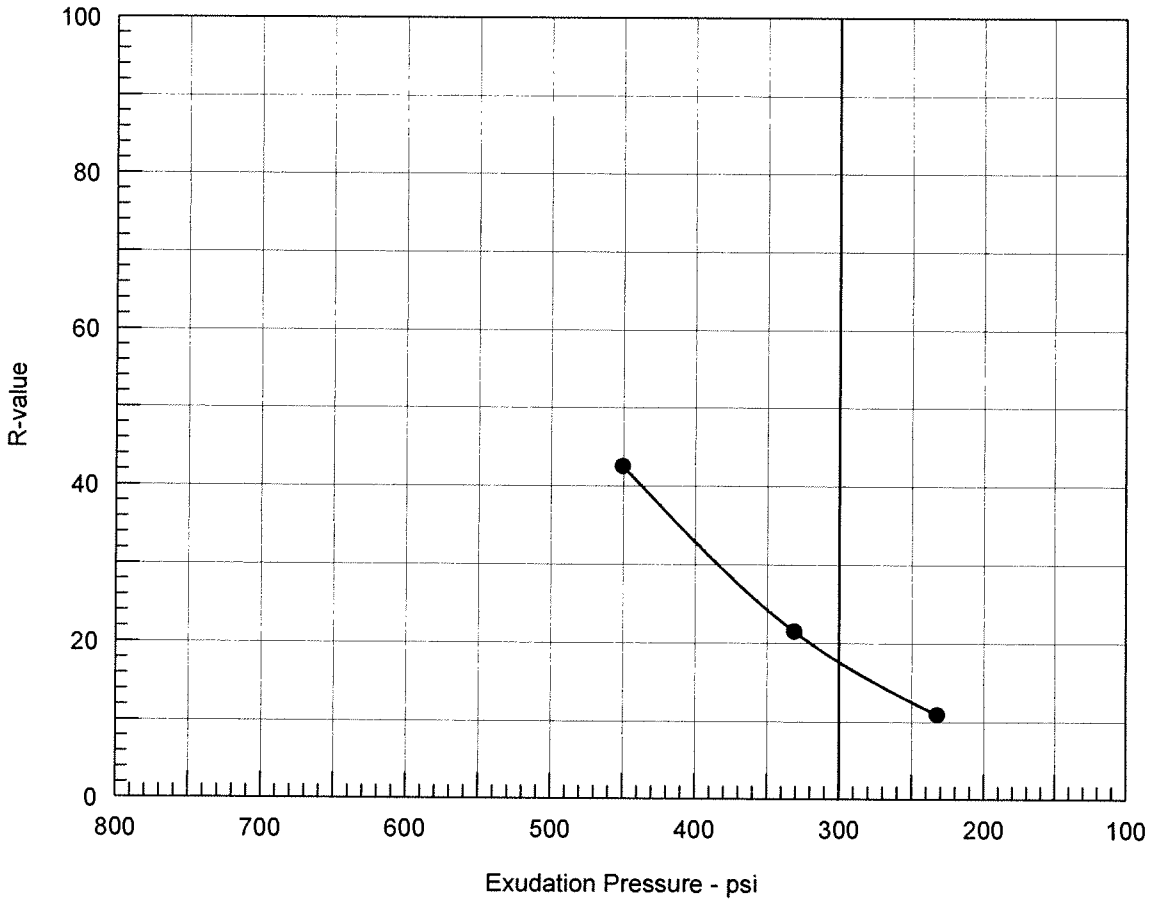
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	100	125.1	11.7	0.00	133	2.60	232	10	11
2	275	130.6	10.0	0.70	74	2.53	450	43	43
3	180	128.6	10.8	0.33	110	2.53	331	21	21

Test Results	Material Description
R-value at 300 psi exudation pressure = 18	Brown silt with clay, gravel and sand

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB35 **Depth:** 1-5
Date: 1/24/2008

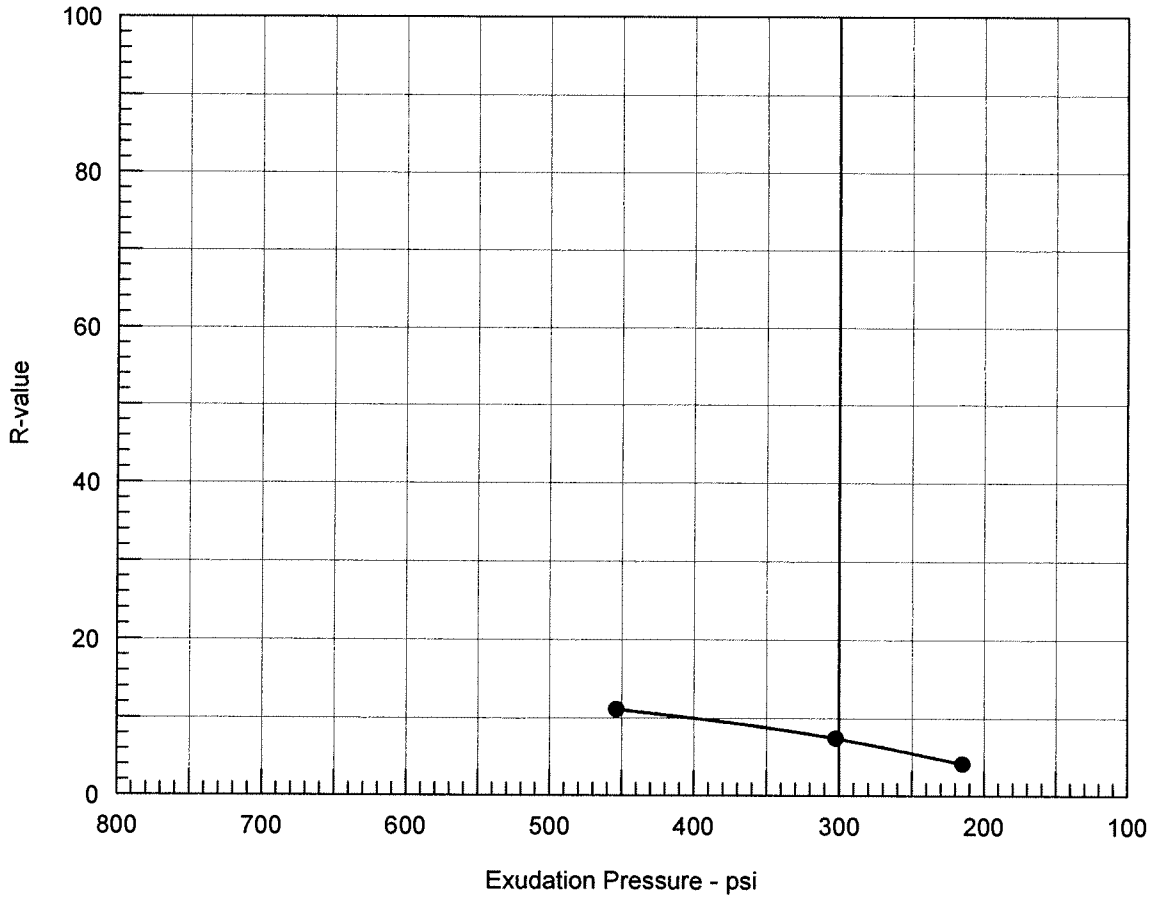
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	175	116.6	15.1	0.76	144	2.57	302	7	7
2	225	117.2	14.2	1.61	134	2.51	454	11	11
3	120	116.3	16.0	0.12	150	2.48	215	4	4

Test Results	Material Description
R-value at 300 psi exudation pressure = 7	Sandy clay

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB-37 **Depth:** 1-5
Sample Number: L9678
Date: 1/7/2008

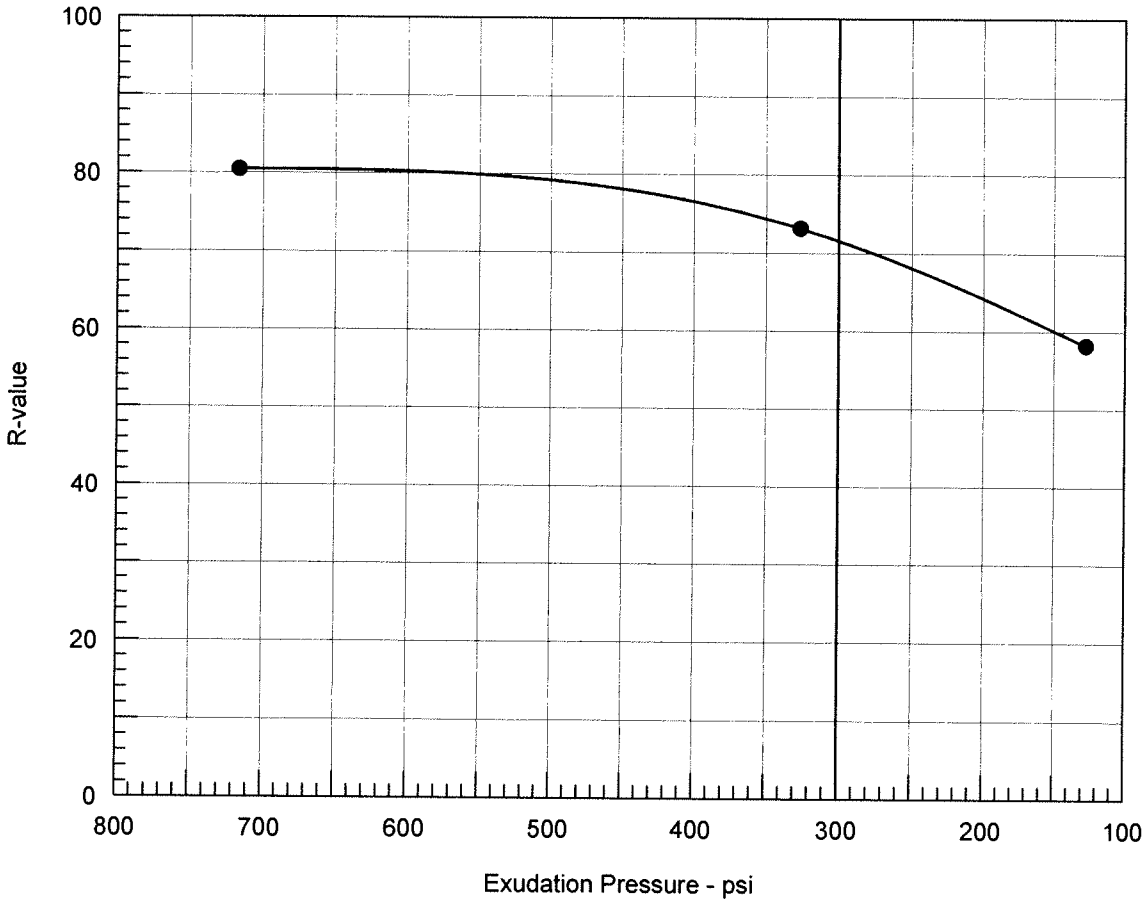
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	150	130.9	9.5	0.00	51	2.62	127	55	58
2	350	131.1	8.2	0.00	20	2.48	716	80	80
3	350	131.0	8.6	0.00	29	2.59	326	71	73

Test Results	Material Description
R-value at 300 psi exudation pressure = 72	Grayish brown gravelly sandy silt

Project No.: 28649640
Project: Route 84 Expressway Widening
Source of Sample: RB40 **Depth:** 1-5

Date: 1/29/2008

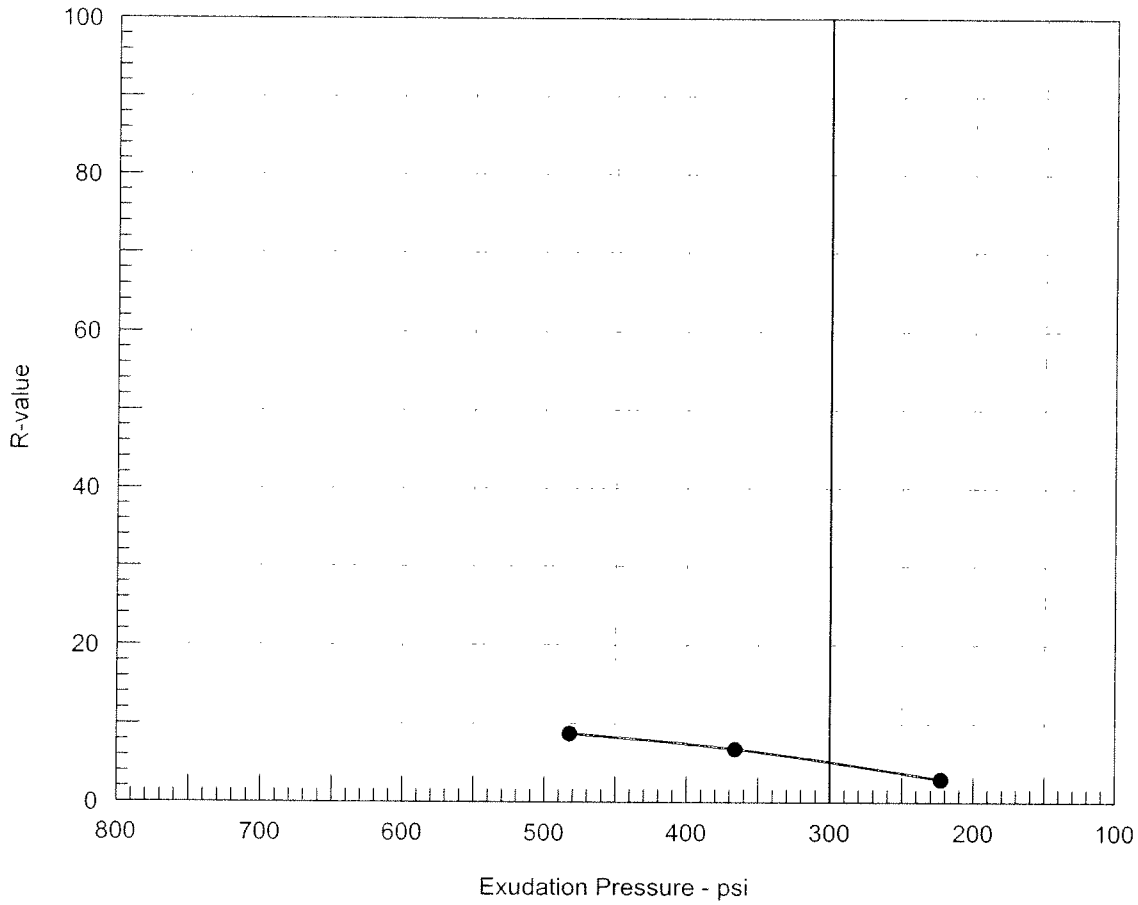
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	25	118.4	13.3	0.00	143	2.58	366	6	7
2	20	114.9	15.0	0.00	151	2.53	223	3	3
3	35	121.2	12.4	0.00	137	2.53	482	9	9

Test Results	Material Description
R-value at 300 psi exudation pressure = 5	Brown silty clay with sand & few gravel, sample received 1/27/2009

Project No.:

Project: Rte 84 Expressway Widening, #28649640

Location: RB-41

Sample Number: L12272-3 **Depth:** 2-5'

Date: 2/4/2009

Tested by: DTN

Checked by: LKL

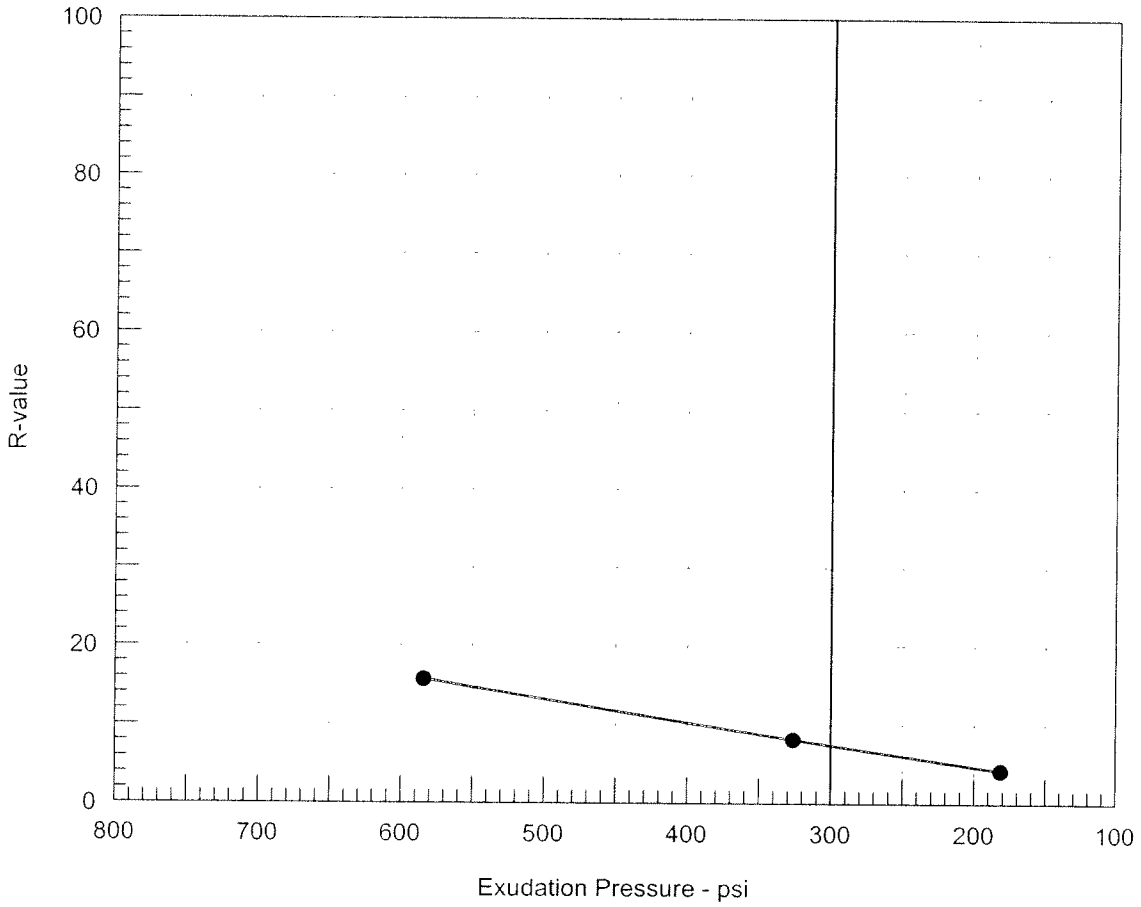
Remarks:
RB-41

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	20	115.9	15.2	0.00	149	2.53	181	4	4
2	35	118.9	13.5	0.00	140	2.51	326	8	8
3	75	123.7	11.8	0.00	128	2.53	584	16	16

Test Results	Material Description
R-value at 300 psi exudation pressure = 7	Olive brown silty clay with sand & few gravel, sample received 1/27/2009

Project No.:

Project: Rte 84 Expressway Widening, #28649640

Location: RB-42

Sample Number: L12272-4 **Depth:** 2-5'

Date: 2/4/2009

Tested by: DTN

Checked by: LKL

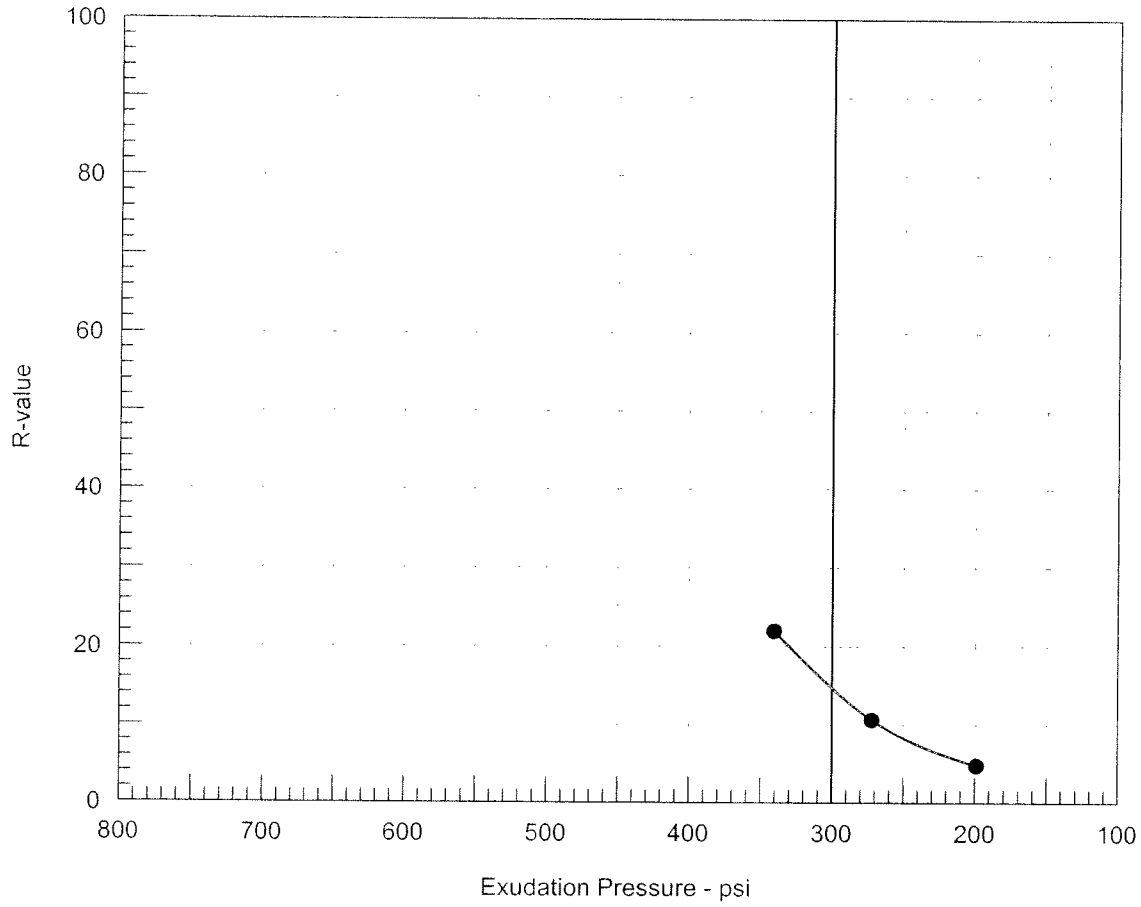
Remarks:
RB-42

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure ____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	25	127.4	11.0	0.00	146	2.59	199	5	5
2	50	130.7	9.3	0.00	112	2.55	341	22	22
3	30	129.8	10.2	0.00	134	2.56	272	10	11

Test Results	Material Description
R-value at 300 psi exudation pressure = 15	Brown gravelly clay with sand, sample received 1/27/2009

Project No.:

Project: Rte 84 Expressway Widening, #28649640

Location: NB-30

Sample Number: L12272-1 **Depth:** 0-5'

Date: 2/4/2009

Tested by: DTN

Checked by: LKL

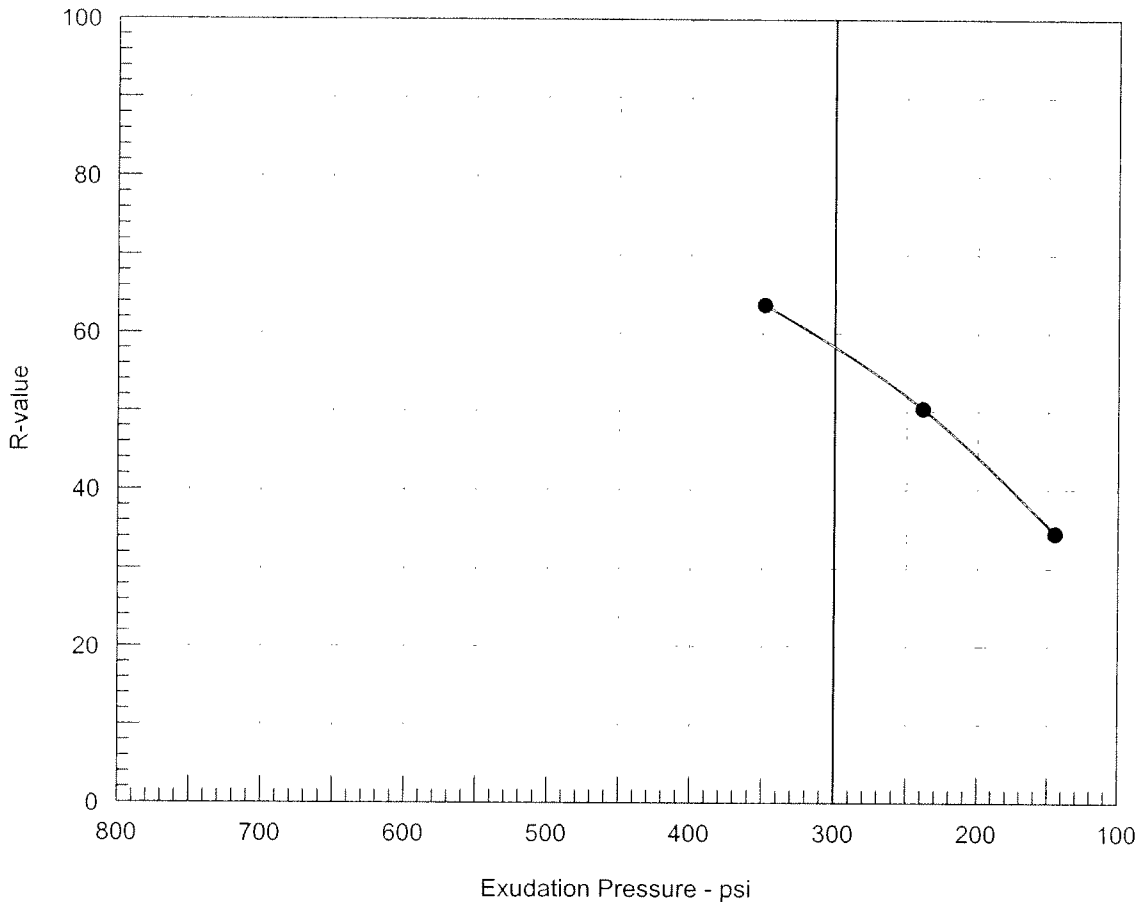
Remarks:
NB-30

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	95	141.7	6.5	0.00	46	2.51	349	64	64
2	30	138.0	7.3	0.00	90	2.56	145	33	34
3	45	138.2	6.9	0.00	60	2.60	239	48	50

Test Results	Material Description
R-value at 300 psi exudation pressure = 58	Brown gravelly sand with clay, sample received 1/27/2009

Project No.:

Project: Rte 84 Expressway Widening, #28649640

Location: NB-36

Sample Number: L12272-2 **Depth:** 0-5'

Date: 2/4/2009

Tested by: DTN

Checked by: LKL

Remarks:
NB-36

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

North Segment Plans

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

NOTES:

1. DIMENSIONS OF THE PAVEMENT STRUCTURE (STRUCTURAL SECTIONS) ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATION ARE SHOWN ON THE SUPERELEVATIONS DIAGRAMS.
3. PLACE 0.15′(Min) HMA UNDER DIKES AND CONCRETE BARRIERS. EXTEND TOP LAYER OF HMA PLACED ON SHOULDER UNDER DIKES AND BARRIER WITH NO JOINT AT THE EDGE OF SHOULDER.
4. FOR LOCATIONS AND LIMITS OF HMA DIKES, CURBS, AND RS SEE LAYOUT AND SUMMARY OF QUANTITY SHEETS.
5. FOR EXACT LOCATIONS AND LIMITS OF EDGE DRAINS AND UNDERDRAINS, SEE SUBSURFACE DRAINS PLANS.
6. FOR EXACT LOCATIONS AND LIMITS OF SAWCUT LOCATIONS, SEE LAYOUT AND CONSTRUCTION DETAILS SHEETS.
7. FOR HMA OVERLAY CONFORM DETAILS, REFER TO CONSTRUCTION DETAILS SHEETS.
8. FOR LOCATIONS, LIMITS AND DETAILS OF RETAINING WALLS, SEE RETAINING WALL OR STRUCTURES PLANS.
9. MATCH EXISTING AND PROPOSED ATPB LAYERS AT SAWCUT LOCATIONS. DEPTH OF HMA MAY VARY FROM THAT POINT TO FG, TO MAKE THIS ADJUSTMENT.
10. FOR LOCATIONS OF DITCH AND GUTTER, SEE DRAINAGE PLANS.
11. PERMEABLE MATERIAL USED IN UNDERDRAIN TRENCH TO BE THE SAME AS SUBBASE LAYER, Cl 3 Perm.

ABBREVIATIONS:

Cl 3 Perm	CLASS 3 PERMEABLE MATERIAL
RHMA-G	RUBBERIZED HMA - GAP GRADED
RS	RUMBLE STRIP
w/	WITH

DESIGN DESIGNATION:

SR 84 NORTH OF STANLEY

ADT (2010)	26,800	D	55%
ADT (2030)	37,500	D	67%
DHV	3,750	T	2.77%
ESAL	3,967,661	V	50 MPH
		TI	11

SR 84 BETWEEN STANLEY AND CONCANNON

ADT (2010)	18,700	D	63%
ADT (2030)	28,400	D	58%
DHV	2,840	T	2.77%
ESAL	3,004,842	V	50 MPH
		TI	11

EXISTING PAVEMENT STRUCTURE SECTIONS:

⑨ TRAVELED WAY AND Shld
0.59′ HMA
0.25′ ATPB
0.69′ AB
1.08′ AS

⑩ TRAVELED WAY AND Shld
0.74′ HMA
0.25′ ATPB
0.69′ AB
1.08′ AS

⑪ TRAVELED WAY AND Shld
0.59′ HMA
0.25′ ATPB
1.08′ AB
0.69′ Cl 3 Perm

⑫ TRAVELED WAY AND Shld
0.46′ HMA
1.54′ AB

PROPOSED PAVEMENT STRUCTURE SECTIONS:

[1] OVERLAY
0.15′ RHMA-G

[2] OVERLAY
0.15′ RHMA-G
0.1′ - 1.0′ HMA (TYPE A)

[3] TRAVELED WAY AND Shld (Typ)
0.15′ RHMA-G
0.60′ HMA (TYPE A)
1.25′ Cl 2 AB
0.75′ Cl 4 AS

[3A] TRAVELED WAY AND Shld (Typ)
0.15′ RHMA-G
0.60′ HMA (TYPE A)
0.35′ Min Cl 2 AB - 1.25′ Cl 2 AB
0.75′ Cl 4 AS

[3B] TRAVELED WAY AND Shld (Typ)
0.15′ RHMA-G
0.60′ HMA (TYPE A)
1.25′ Cl 2 AB
0.75′ Cl 3 Perm

[4] TRAVELED WAY AND Shld (Typ)
0.15′ RHMA-G
0.75′ HMA (TYPE A)
1.10′ Cl 2 AB
0.75′ Cl 4 AS

[5] TRAVELED WAY AND Shld (Typ)
0.15′ RHMA-G
0.60′ - 1.2′ HMA (TYPE A)
0.25′ ATPB
1.0′ Cl 2 AB
0.75′ Cl 4 AS

[6] TRAVELED WAY AND Shld (Typ)
0.15′ RHMA-G
0.75′ - 1.8′ HMA (TYPE A)
0.25′ ATPB
0.85′ Cl 2 AB
0.75′ Cl 4 AS

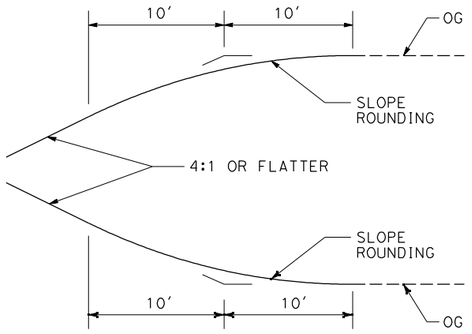
[7] TRAVELED WAY AND Shld (Typ)
0.15′ RHMA-G
0.60′ - 1.6′ HMA (TYPE A)
0.25′ ATPB
1.0′ Cl 2 AB
0.75′ Cl 3 Perm

[8] ACCESS ROAD, TRAIL AND DRIVEWAYS
0.70′ HMA (TYPE A)

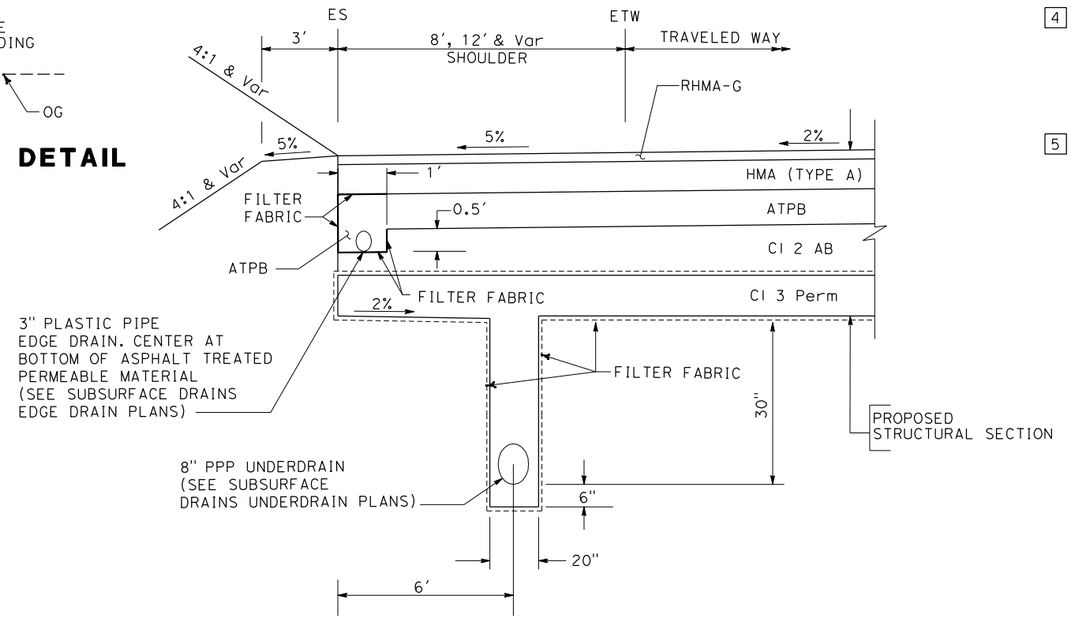
[11] SLIVER WIDENING
0.15′ RHMA-G
1.5′ HMA (TYPE A)

[12] OVERLAY
0.15′ RHMA-G
0.1′ - 1.6′ HMA (TYPE A)

[13] TRAVELED WAY AND Shld (Typ)
0.50′ HMA (TYPE A)
1.55′ Cl 2 AB



TYPICAL SLOPE ROUNDING DETAIL



TYPICAL UNDERDRAIN AND EDGE DRAIN DETAIL

TYPICAL CROSS SECTIONS

NO SCALE

X-1

REVISED BY	DATE REVISED
AB	10/19/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans®

LAST REVISION 10-21-10 — DATE PLOTTED => 1/13/2011 TIME PLOTTED => 11:18:10 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim DGN FILE => ...\CA-TypXsec\0400020580ca001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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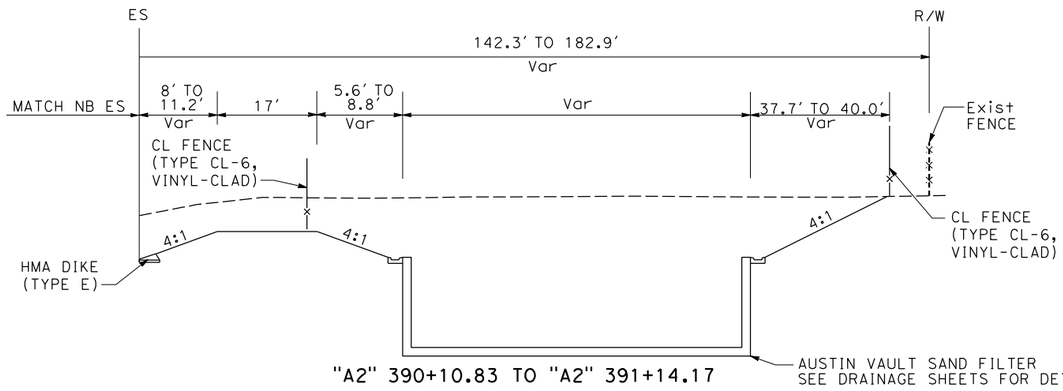
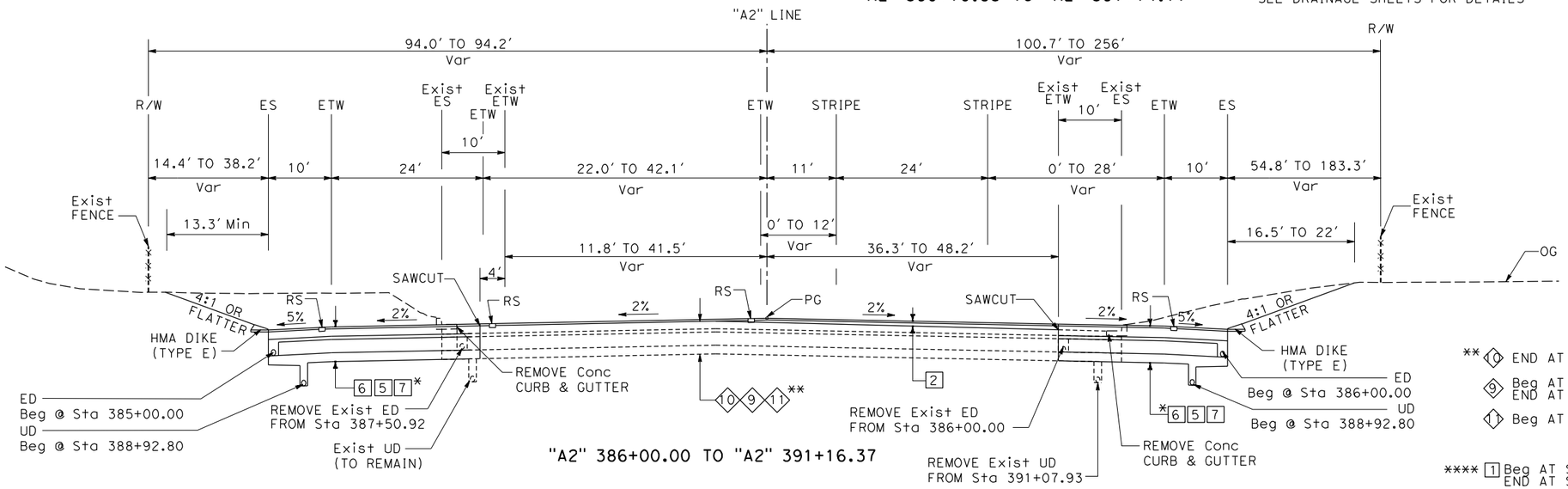


"A2" 390+10.83 TO "A2" 391+14.17



"A2" 386+00.00 TO "A2" 391+16.37

** ◇0 END AT Sta 387+69.00

◇9 Beg AT Sta 387+69.00
END AT Sta 388+90.00

◇1 Beg AT Sta 388+90.00

**** [1] Beg AT Sta 364+00.00
END AT Sta 374+40.00

[2] Beg AT Sta 374+40.00
END AT Sta 408+75.00

SOUTHBOUND

* [6] Beg AT Sta 385+00.00
END AT Sta 387+69.00

[5] Beg AT Sta 387+69.00
END AT Sta 388+92.80

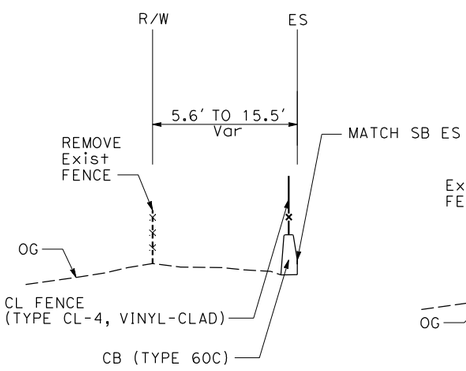
[7] Beg AT Sta 388+92.80
END AT Sta 408+75.00

NORTHBOUND

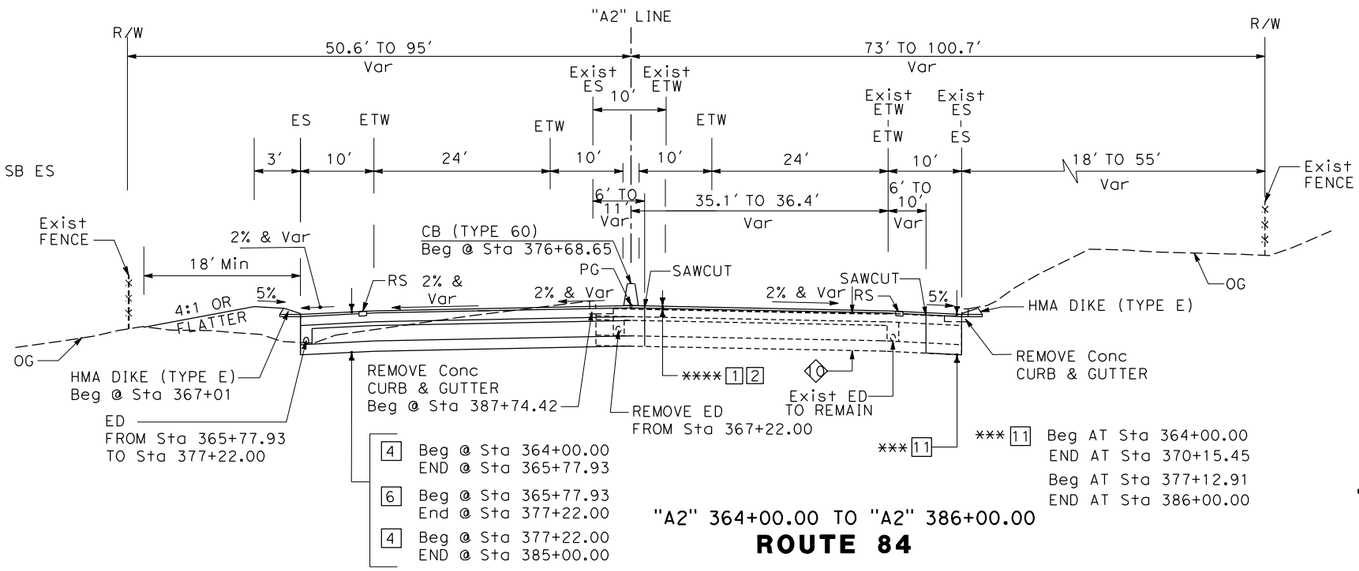
* [6] Beg AT Sta 386+00.00
END AT Sta 387+69.00

[5] Beg AT Sta 387+69.00
END AT Sta 388+90.00

[7] Beg AT Sta 388+90.00
END AT Sta 401+79.62



"A2" 364+00.00 TO "A2" 366+03.98



**** [1] [2]

*** [11]

[4] Beg @ Sta 364+00.00
END @ Sta 365+77.93

[6] Beg @ Sta 365+77.93
End @ Sta 377+22.00

[4] Beg @ Sta 377+22.00
END @ Sta 385+00.00

*** [11] Beg AT Sta 364+00.00
END AT Sta 370+15.45
Beg AT Sta 377+12.91
END AT Sta 386+00.00

"A2" 364+00.00 TO "A2" 386+00.00

ROUTE 84

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-2

REVISED BY	ABHIJEET BHOI	10/19/10
DATE REVISED	ELIE ABI-JAOUDE	
CALCULATED-DESIGNED BY		
CHECKED BY		

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION: DATE PLOTTED => 1/13/2011
10-21-10 TIME PLOTTED => 1:18:17 PM

BORDER LAST REVISED 7/2/2010

USERNAME => minyoung_kim
DGN FILE => ...\ca-typxsec\0400020580ca002.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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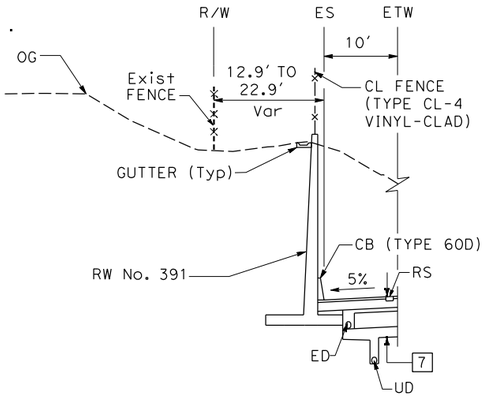
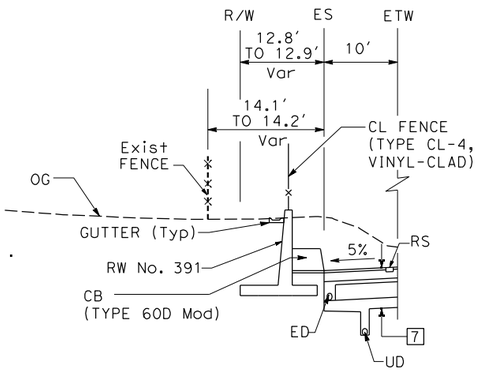
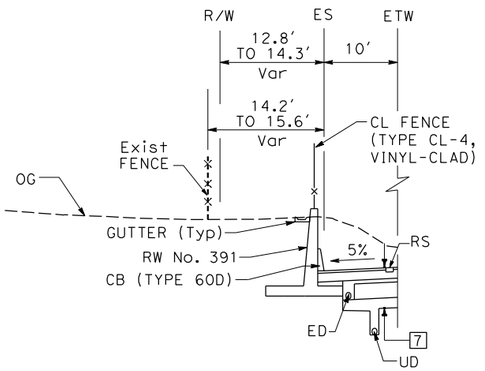
Oakland, CA 94612



"A3" 394+81.43 TO "A3" 399+55.00



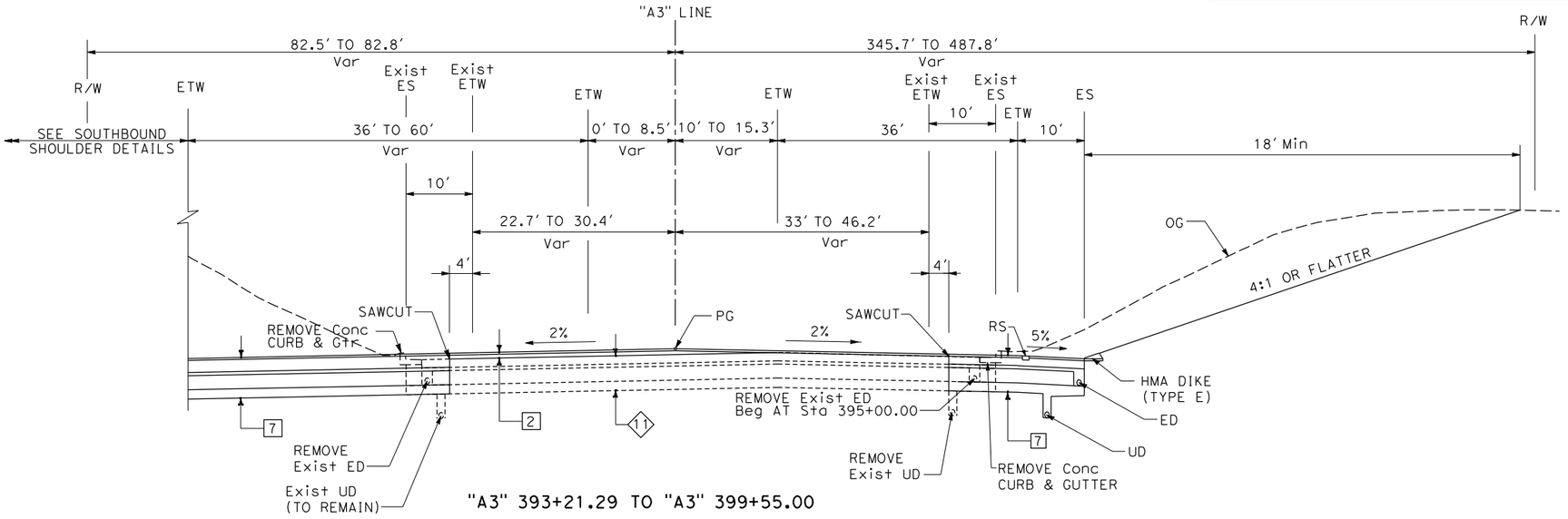
"A2" 392+62.31 TO "A3" 394+81.43



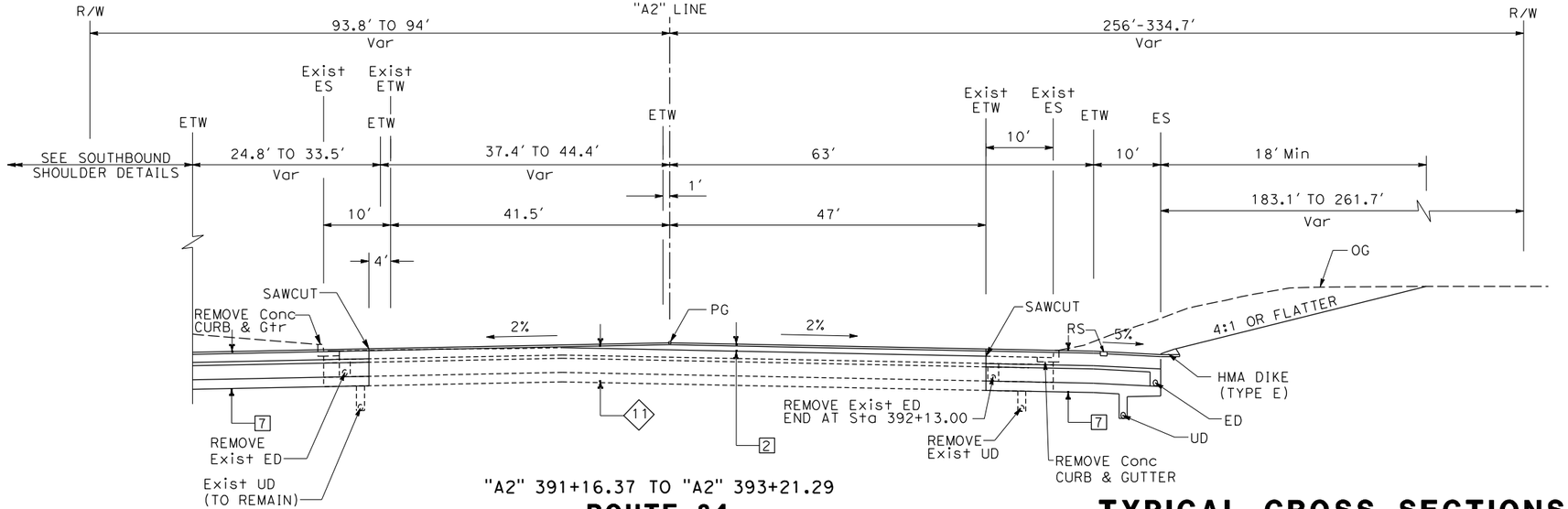
"A2" 391+16.37 TO "A2" 392+62.31

SOUTHBOUND SHOULDER DETAILS

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1



"A3" 393+21.29 TO "A3" 399+55.00



"A2" 391+16.37 TO "A2" 393+21.29

ROUTE 84

TYPICAL CROSS SECTIONS

NO SCALE

X-3

		REVISED BY	AB
		DATE REVISED	10/19/10
		ABHIJEET BHOI	ELIE ABI-JAOUDE
		CALCULATED-DESIGNED BY	CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN		
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans		

LAST REVISION 10-21-10 DATE PLOTTED => 1/13/2011 TIME PLOTTED => 11:18:21 PM

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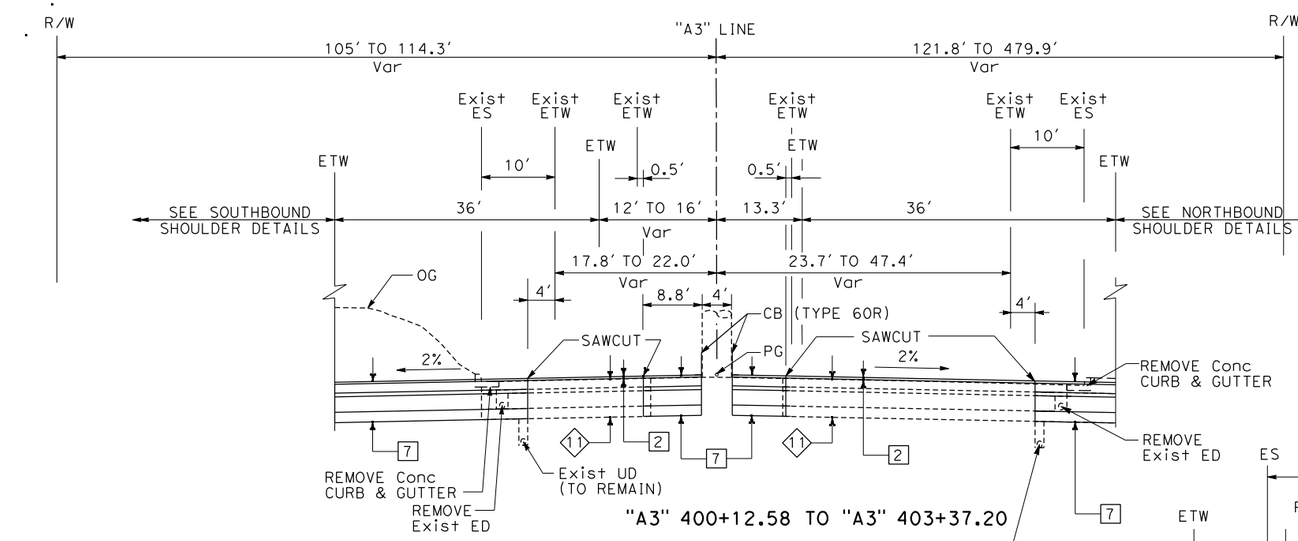
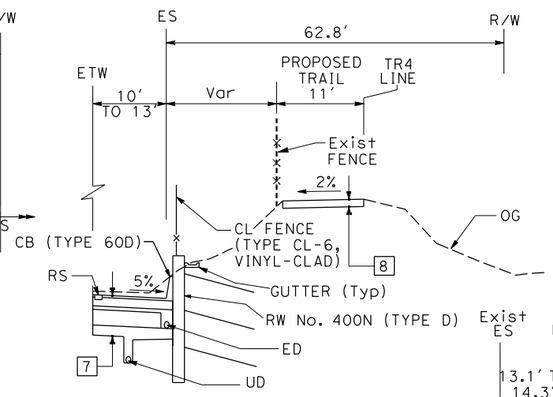
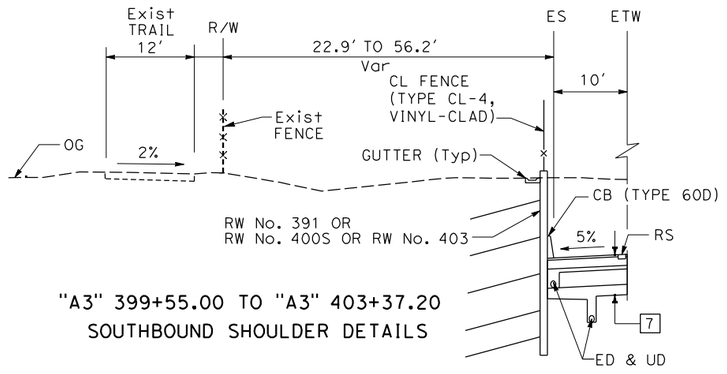


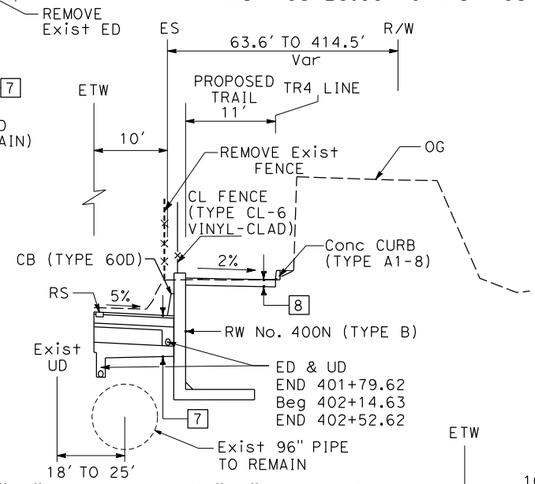
"A3" 400+12.58 TO "A3" 403+37.20



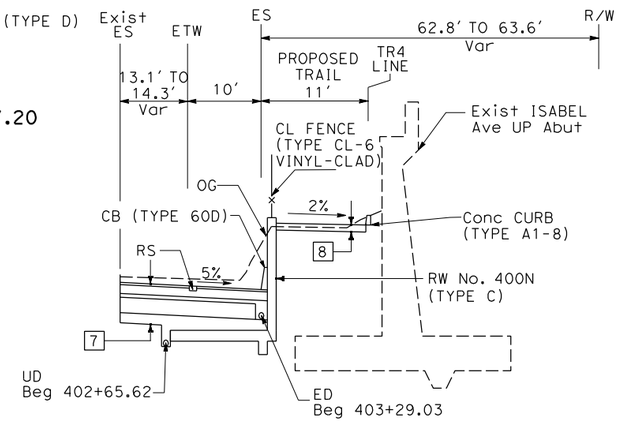
"A3" 403+28.00 TO "A3" 403+37.20



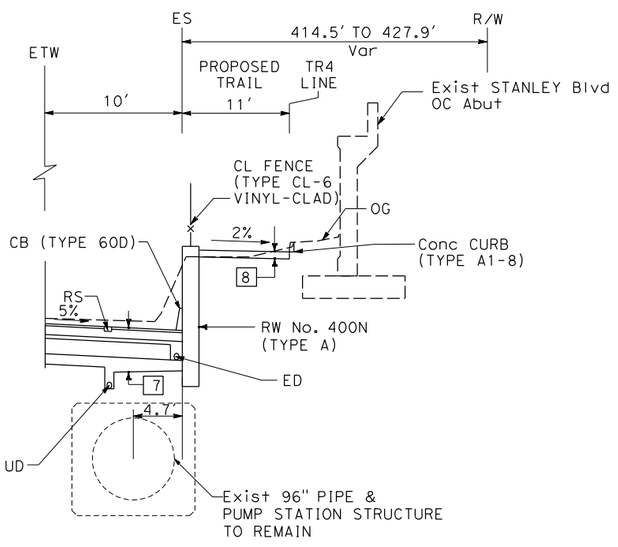
"A3" 399+55.00 TO "A3" 403+37.20
SOUTHBOUND SHOULDER DETAILS



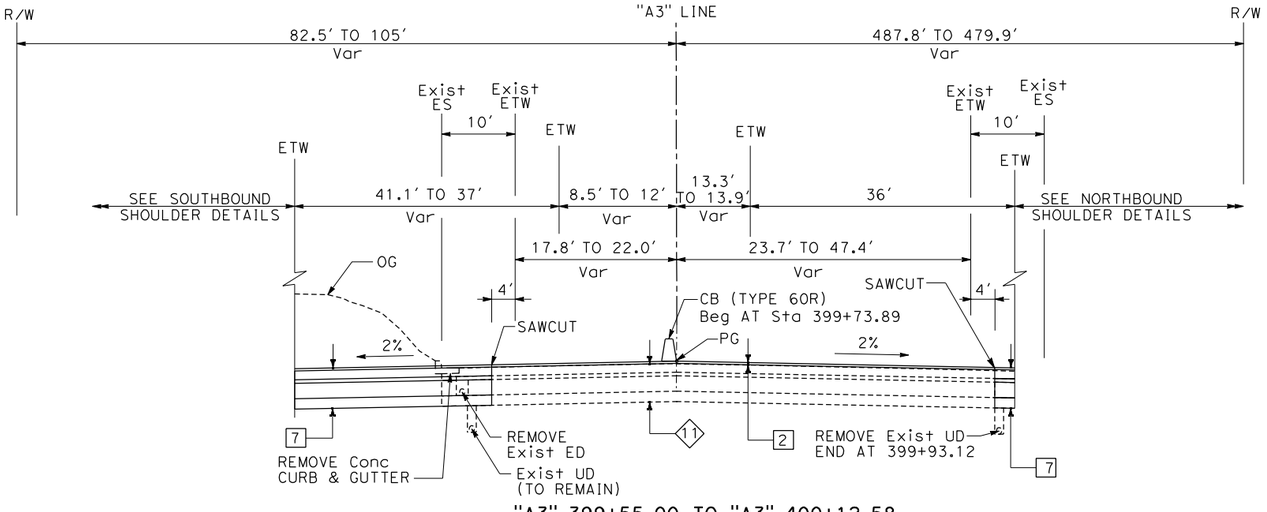
"A3" 401+64.00 TO "A3" 402+73.00



"A3" 402+73.00 TO "A3" 403+28.00



"A3" 399+55.00 TO "A3" 401+64.00
NORTHBOUND SHOULDER DETAILS



"A3" 399+55.00 TO "A3" 400+12.58

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

ROUTE 84

TYPICAL CROSS SECTIONS

NO SCALE

X-4

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

REVISED BY	DATE REVISED
AB	10/19/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION: 10-21-10
DATE PLOTTED => 1/13/2011
TIME PLOTTED => 11:18:25 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\ca-typxsec\0400020580ca004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi — 10/21/10
REGISTERED CIVIL ENGINEER — DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

PLANS APPROVAL DATE

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Suite 800
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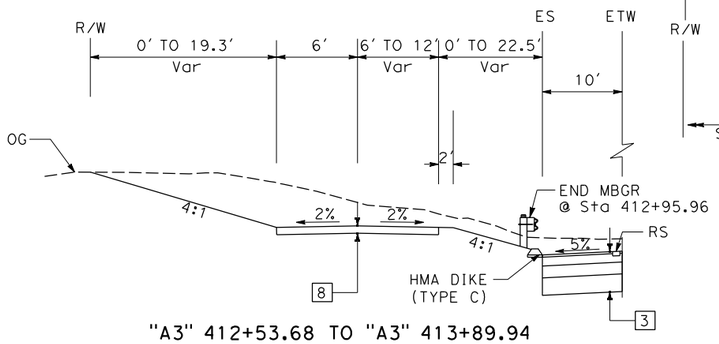
1333 Broadway, Suite 300
Oakland, CA 94612

DATE REVISED	REVISED BY
10/19/10	AB

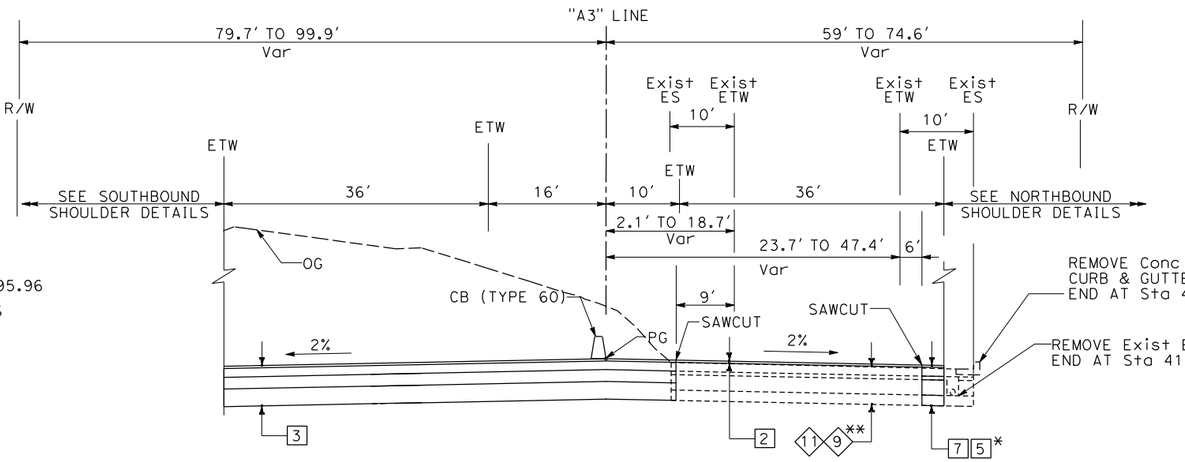
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

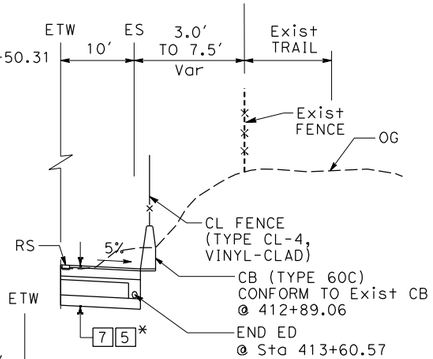
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans



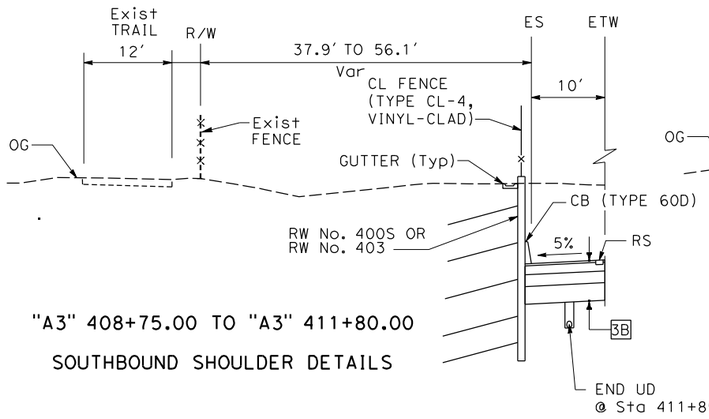
"A3" 412+53.68 TO "A3" 413+89.94



"A3" 408+75.00 TO "A3" 413+89.94

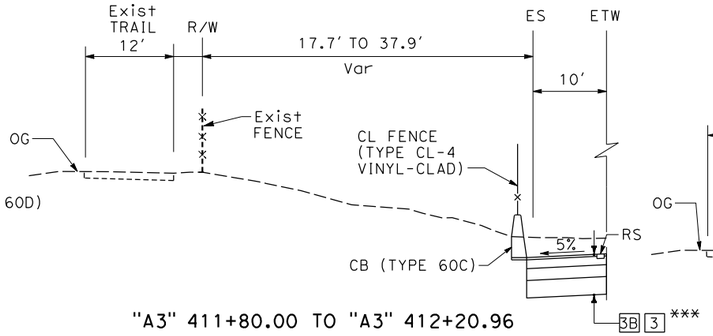


"A3" 411+80.00 TO "A3" 413+89.94



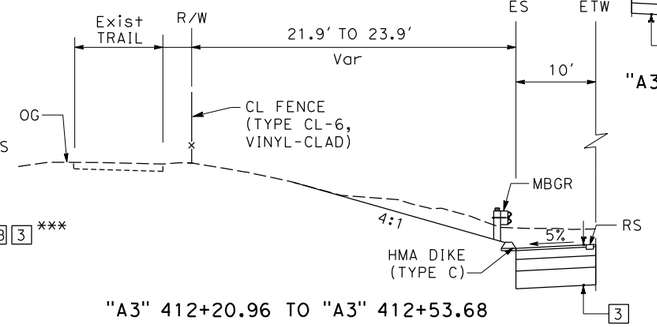
"A3" 408+75.00 TO "A3" 411+80.00

SOUTHBOUND SHOULDER DETAILS



"A3" 411+80.00 TO "A3" 412+20.96

*** 3B END AT Sta 412+06.00
3 Beg AT Sta 412+06.00



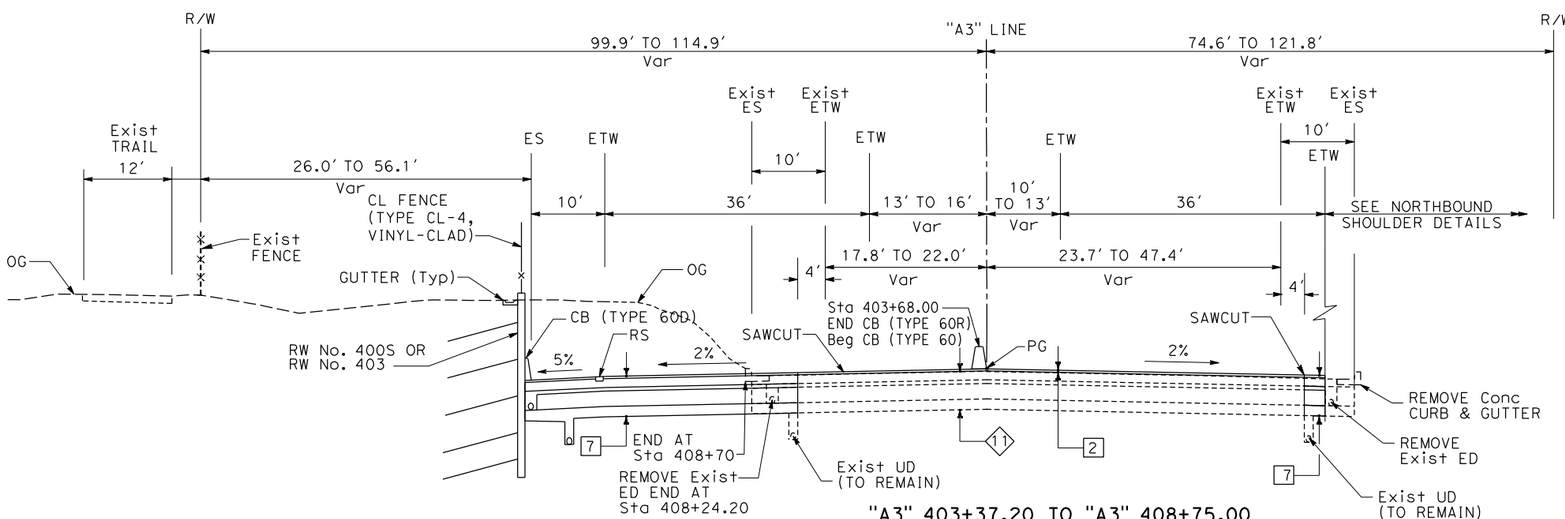
"A3" 412+20.96 TO "A3" 412+53.68

* 7 Beg AT Sta 402+14.63
END AT Sta 412+06.00

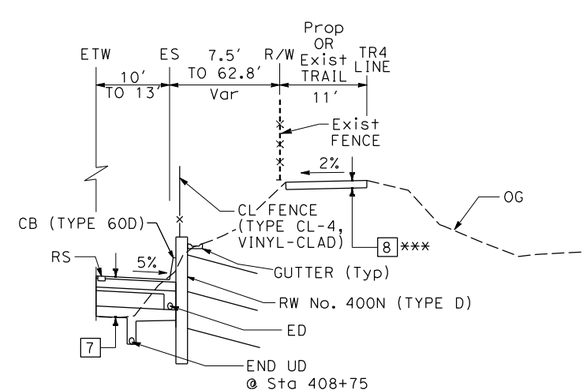
5 Beg AT Sta 412+06.00
END AT Sta 413+61.09

** 11 END AT Sta 412+06.00

9 Beg AT Sta 412+06.00



"A3" 403+37.20 TO "A3" 408+75.00



"A3" 403+37.20 TO "A3" 411+80.00

NORTHBOUND SHOULDER DETAILS

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

ROUTE 84

TYPICAL CROSS SECTIONS

NO SCALE

X-5

LAST REVISION: 10-21-10
DATE PLOTTED => 1/13/2011
TIME PLOTTED => 1:18:29 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\ca-typxsec\0400020580ca005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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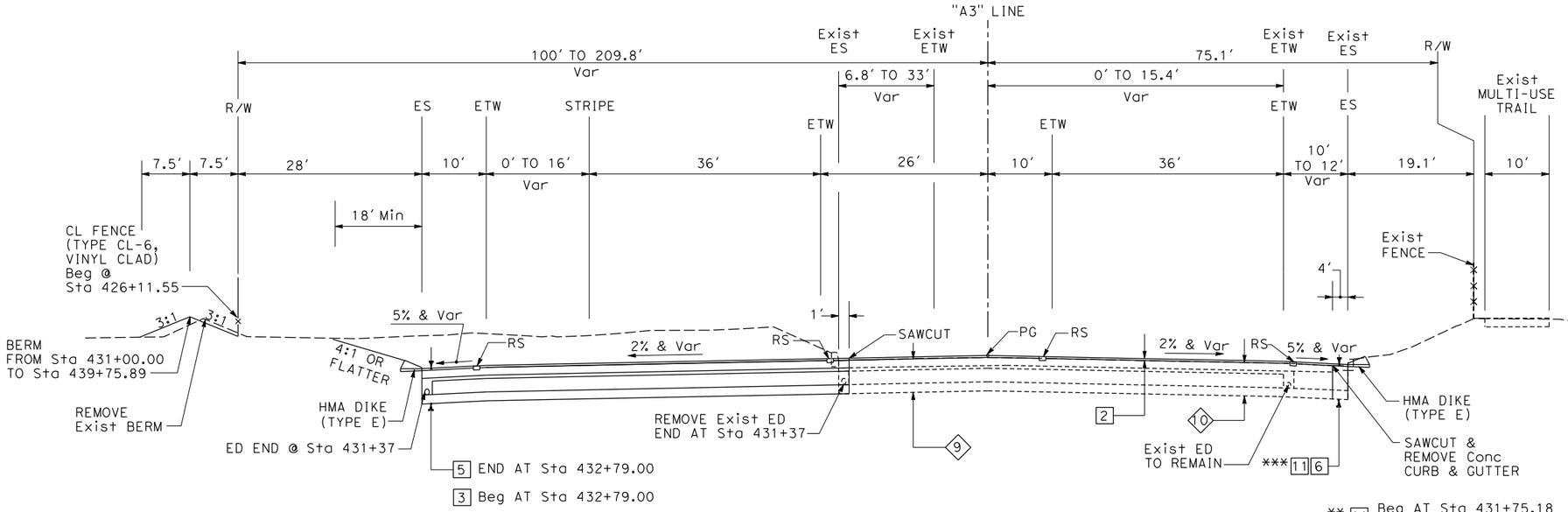
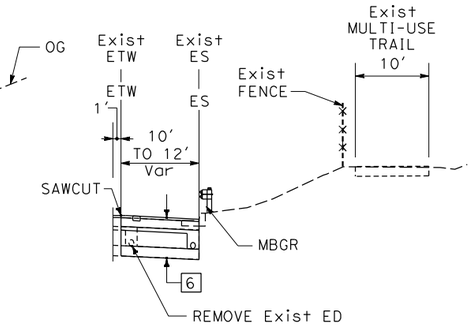
Oakland, CA 94612



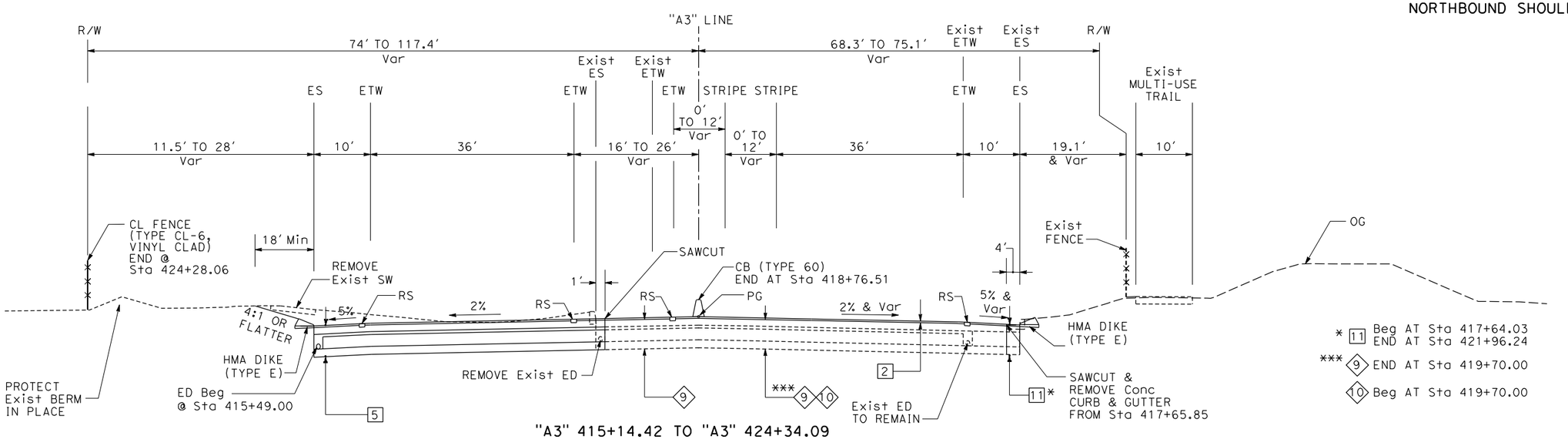
"A3" 424+34.09 TO "A3" 435+85.00

** 11 Beg AT Sta 431+75.18
END AT Sta 435+50.00

6 Beg AT Sta 435+50.00
END AT Sta 447+75.95



"A3" 435+50.00 TO "A3" 435+85.00
NORTHBOUND SHOULDER



"A3" 415+14.42 TO "A3" 424+34.09

* 11 Beg AT Sta 417+64.03
END AT Sta 421+96.24

*** 9 END AT Sta 419+70.00

10 Beg AT Sta 419+70.00

ARROYO MOCHO Cr BRIDGE
Br No. 33-0713
(SEE STRUCTURE PLAN)

"A3" 413+90.57 TO "A3" 415+14.42

ROUTE 84

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-6

	10/19/10	DATE REVISED
	AB	REVISED BY
	ELIE ABI-JAOUDE	CALCULATED-DESIGNED BY
	ABHIJEET BHOI	CHECKED BY
	RAMSEY J. HISSEN	CONSULTANT FUNCTIONAL SUPERVISOR
		DISTRICT DIRECTOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans®

LAST REVISION 10-21-10
DATE PLOTTED => 1/13/2011
TIME PLOTTED => 11:18:33 PM

BORDER LAST REVISED 7/2/2010

USERNAME => minyoung_kim
DGN FILE => ...\ca-typxsec\0400020580ca006.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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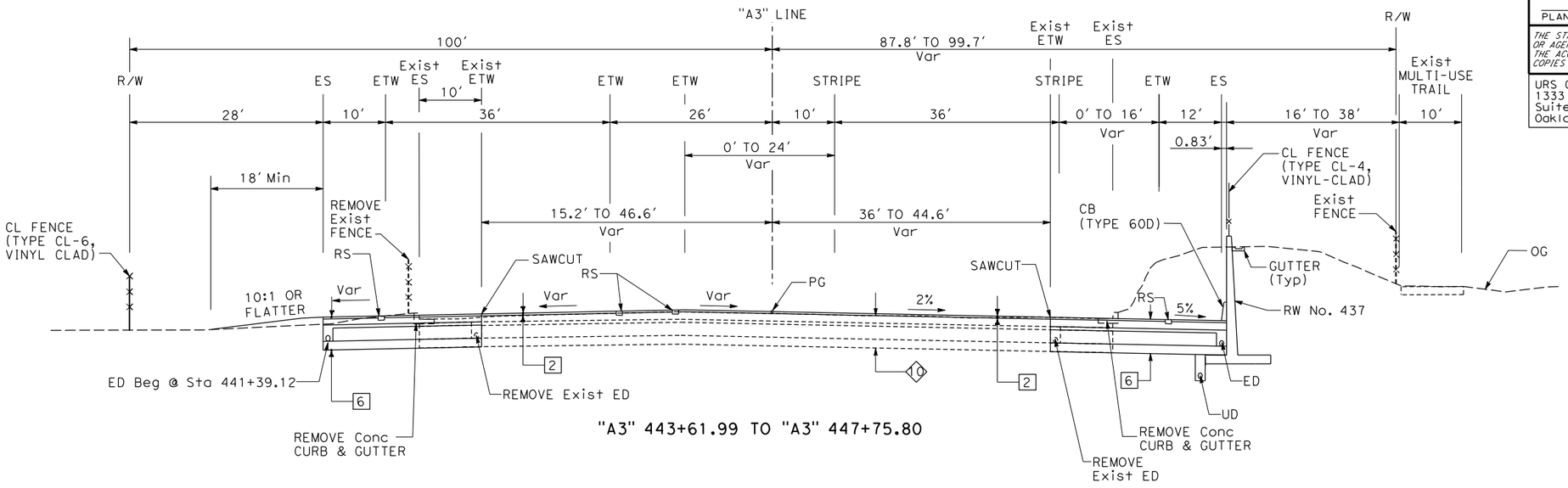
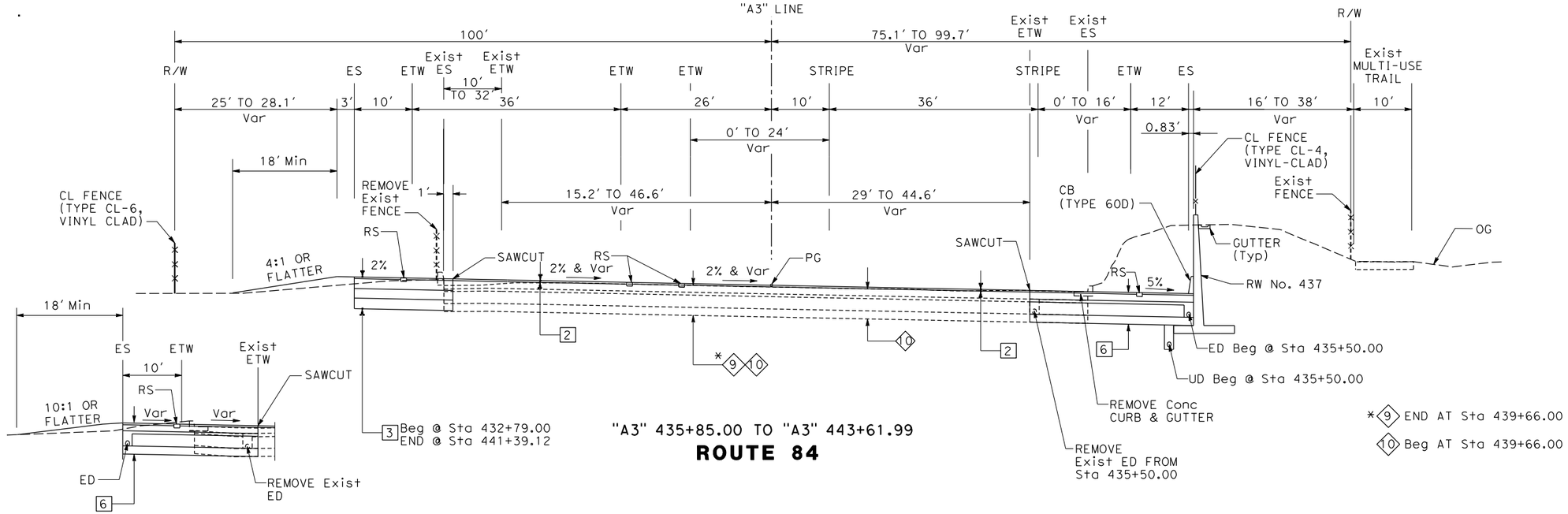


"A3" 443+61.99 TO "A3" 447+75.80



"A3" 435+85.00 TO "A3" 443+61.99

ROUTE 84

"A3" 441+39.12 TO "A3" 443+61.99

SOUTHBOUND SHOULDER

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-7

CALCULATED-DESIGNED BY	CHECKED BY	CONSULTANT FUNCTIONAL SUPERVISOR	REVISED BY	DATE REVISED
ABHIJEET BHOI	ELIE ABI-JAOUDE	RAMSEY J. HISSEN	AB	10/19/10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 10-21-10 | DATE PLOTTED => 1/13/2011 | TIME PLOTTED => 1:18:36 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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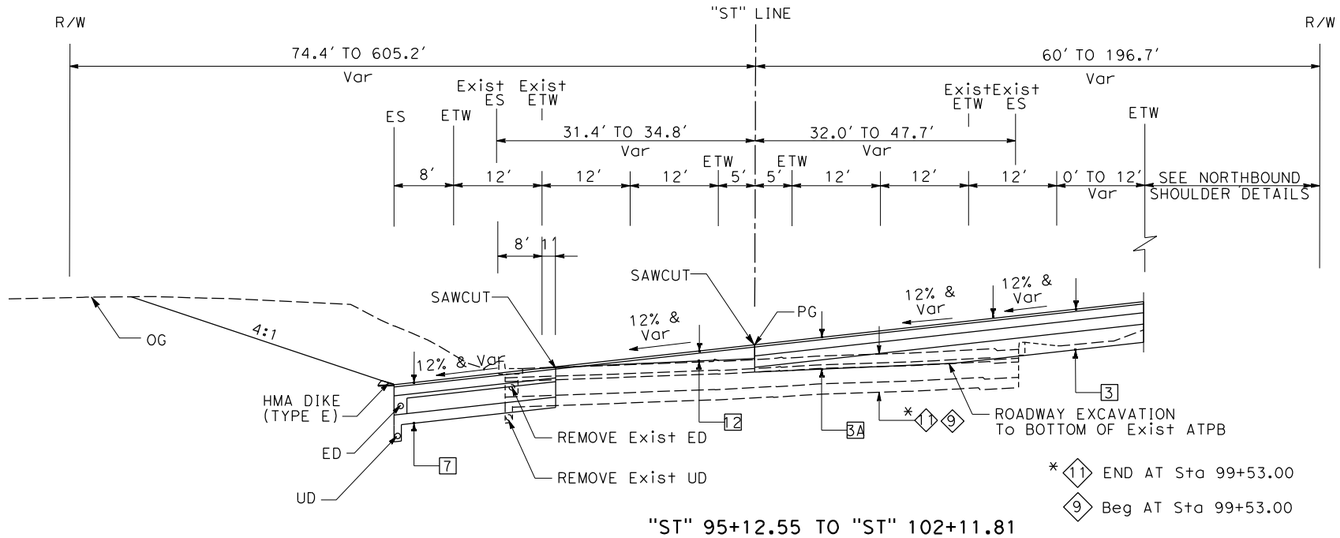
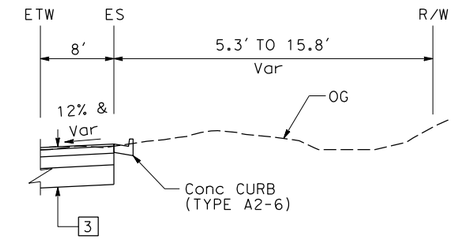
Oakland, CA 94612

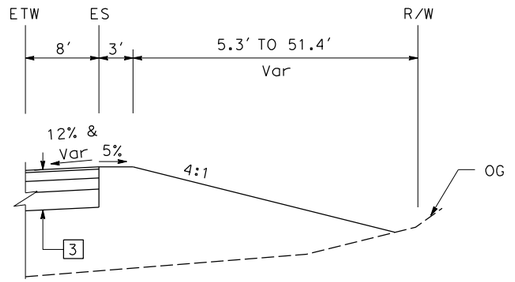


"ST" 95+12.55 TO "ST" 102+11.81

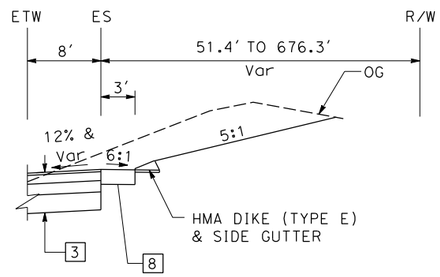
STANLEY CONNECTOR



"ST" 102+88.85 TO "ST" 103+65.00



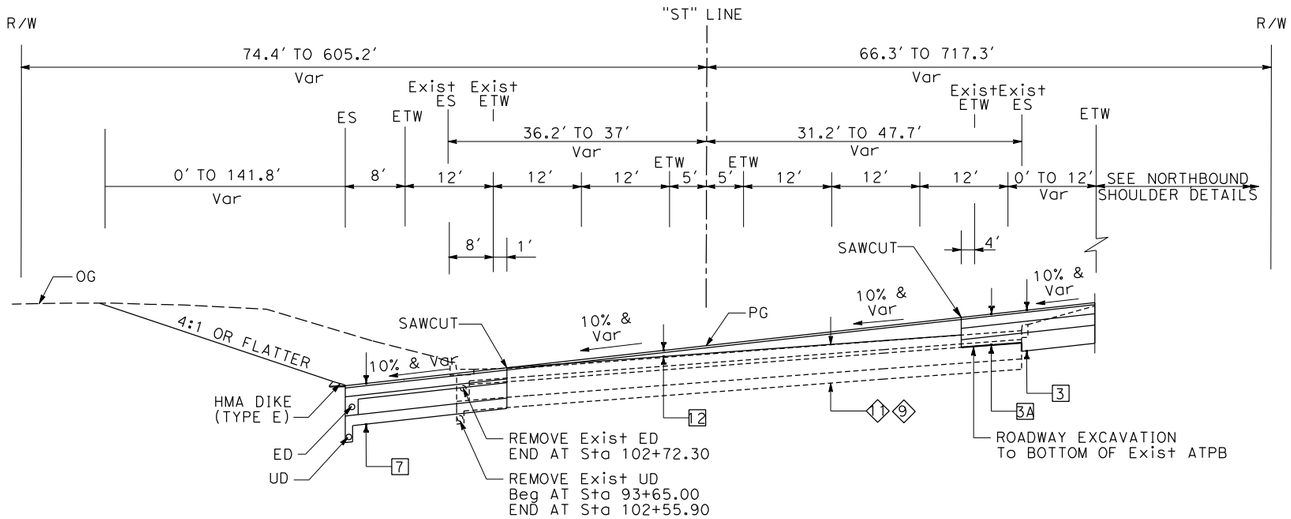
"ST" 96+05.00 TO "ST" 102+88.85



"ST" 93+11.00 TO "ST" 96+05.00

STANLEY CONNECTOR

NORTHBOUND SHOULDER DETAILS



"ST" 93+11.00 TO "ST" 95+12.55
"ST" 102+11.81 TO "ST" 103+65.00

STANLEY CONNECTOR

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-8

LAST REVISION 10-21-10
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TIME PLOTTED => 1:18:39 PM

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: AB
DATE REVISED: 10/19/10

BORDER LAST REVISED 7/2/2010
USERNAME => minyoung_kim
DGN FILE => ...\ca-typxsec\0400020580ca008.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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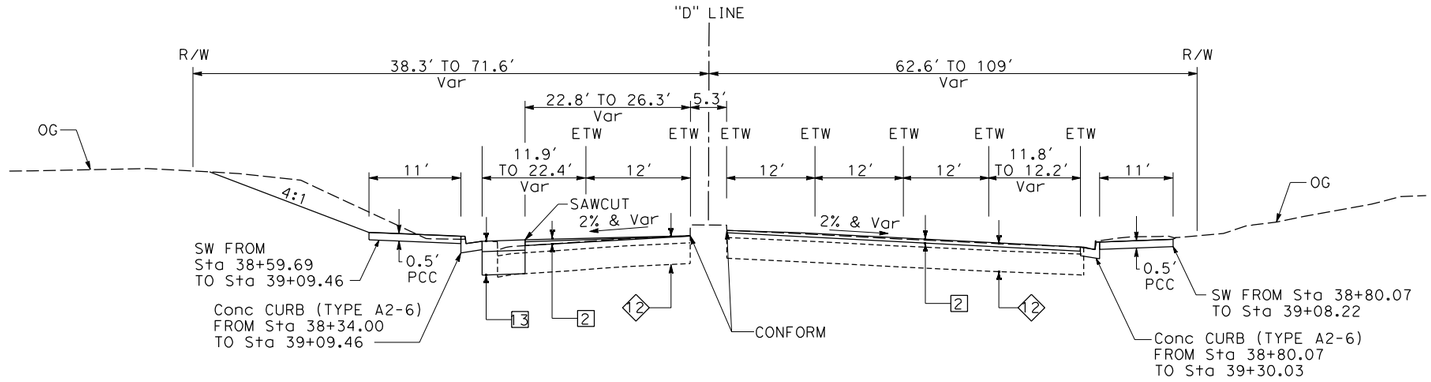
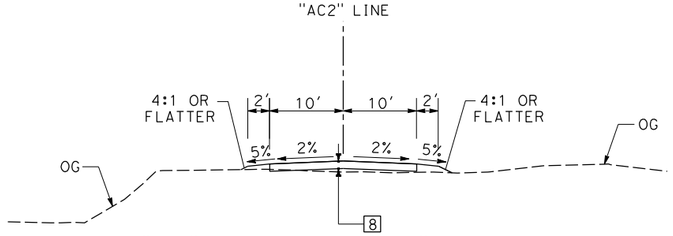
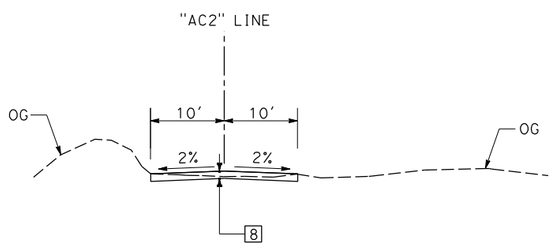
Oakland, CA 94612



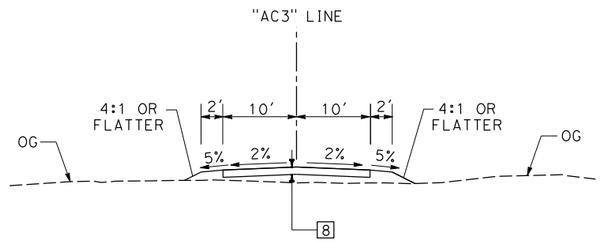
"D" 38+34.00 TO "D" 39+29.40
DISCOVERY DRIVE



"AC2" 212+53.68 TO "AC2" 215+86.00
"AC2" 220+70.00 TO "AC2" 224+37.08
ACCESS ROAD



"AC2" 215+86.00 TO "AC2" 220+70.00
ACCESS ROAD



"AC3" 19+74.43 TO "AC3" 20+47.98
ACCESS ROAD

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

"AC3" 19+74.43 TO "AC3" 20+47.98
ACCESS ROAD

TYPICAL CROSS SECTIONS

NO SCALE

X-9

		REVISED BY	ABHIJEET BHOI
		DATE REVISED	10/19/10
		CALCULATED-DESIGNED BY	ABHIJEET BHOI
		CHECKED BY	ELIE ABI-JAOUDE
		CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN
		STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans

LAST REVISION 10-21-10 | DATE PLOTTED => 1/13/2011 | TIME PLOTTED => 1:18:43 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\ca-typxsec\0400020580ca009.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

April 4, 2008 Job No. 07659

URS
55 South Market Street
Suite 1500
San Jose, CA 95113

Attn: Mr. Stephen Huang
Project Manager

Subject: Rubberized AC Design Modification -Route 84 Expressway Widening Project
Jack London Boulevard to Ruby Hill Road

Gentlemen:

We have completed our report for Route 84 Expressway – Jack London Blvd. to Ruby Hill Road. Per our conversation, Monday March 29th, 2008, we overlooked the CALTRANS design requirement that does not utilize more than 0.20 ft. of RAC as an overlay thickness. We have communicated both with the CALTRANS Lab in Sacramento and our Local Redding office and this report explains the findings and new design recommendations when utilizing RAC.

History and Background

In June of 2001 CALTRANS revised the Flexible Pavement Rehabilitation Design Manual. In this manual CALTRANS states that RAC has a 2:1 trade-off for standard dense grade AC in both structural and reflective cracking requirement. It is also stated that 0.20 ft. of RAC is the maximum layer thickness to be utilized.

A few years later failures started to occur, and CALTRANS took another look at the use of Rubberized AC and then found that the 2:1 trade-off was for reflective cracking only. They determined that there is nothing special in Rubberized AC that gives twice the structural strength.

In Recent discussion with the Redding CALTRANS design group for Rubberized AC designs, they cautioned us on utilizing the 2:1 factor. They told us that CALTRANS, at least up north is utilizing a 1 ½:1 or 1 ¾:1 factor when utilizing RAC. They also confirmed that at this time CALTRANS is still only placing 0.20 ft of rubberized AC as a layer.

So what does this mean for this project? Since there is still nothing in writing Caltrans could give us on the new ratio's the 2:1 reflective cracking trade-off for RAC is still valid. Secondly, this letter, and the re-designed thicknesses utilizing RAC are based on the maximum thickness of RAC being 0.20 ft. placed. So ultimately the new design thicknesses require a layered approach of utilizing a base course of Dense Grade Asphalt Concrete (DGAC) and a surface layer of Rubberized Asphalt Concrete (RAC).

Revised Design Recommendations for RAC Surface

When utilizing DGAC or RAC, there are a few requirements with respect to placement that must be followed.

- Both DGAC and RAC require a minimum thickness of 0.13 ft
- DGAC does not have the same reflective cracking benefit as RAC and therefore may need to be thicker than the RAC Layer placed above

The following table summarizes the new rehabilitation requirement when utilizing RAC as the final surface layer. This is based on the CALTRANS requirements and the deflection testing and sampling completed earlier.

Table 1

Summary of Findings

Road Name	From	To	CTM Structural Requirement	CHEC's Overlay Design Recommendations
SR 84 - Livermore	**Jack London Blvd.**	**Stanley Blvd.**	**0.00 ft. AC Overlay**	**Alternate Design B:** 0.15 ft. DGAC Overlay under 0.15 ft. RAC Overlay (surface layer)

Road Name	From	To	CTM Structural Requirement	CHEC's Overlay Design Recommendations
SR 84 - Livermore	**Stanley Blvd.**	**Concannon Blvd.**	**0.00 ft. AC Overlay**	**Alternate Design B:** 0.13 ft. DGAC Overlay under 0.15 ft. RAC Overlay (surface layer)
SR 84 - Livermore	**Concannon Blvd.**	**Vineyard Ave.**	**0.00 ft. AC Overlay**	**Alternate Design B:** 0.13 ft. DGAC Overlay under 0.15 ft. RAC Overlay (surface layer)
SR 84 - Livermore	**Vineyard Avenue**	**Pavement Change North of Vallecictos Blvd.**	**0.00 ft. AC Overlay**	**Alternate Design B:** 0.13 ft. DGAC Overlay under 0.15 ft. RAC Overlay (surface layer)
SR 84 - Livermore	**Pavement Change North of Vallecictos Blvd.**	**Pavement Change South of Vallecictos Blvd.**	**0.00 ft. AC Overlay**	**Alternate Design B:** 0.13 ft. DGAC Overlay under 0.15 ft. RAC Overlay (surface layer)
SR 84 - Livermore	**Pavement Change South of Vallecictos Blvd.**	**Ruby Hill Road**	**0.25 ft. AC Overlay**	**Alternate Design B:** 0.15 ft. DGAC Overlay under 0.15 ft. RAC Overlay (surface layer)

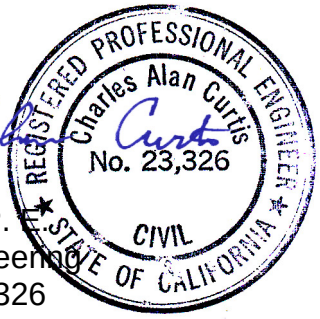
The design recommendations labeled as “Alternate Design B” will replace the RAC Designs found in the report dated March 20th, 2008. As stated in the formal report, reflective cracking is the controlling factor for the designs. These designs meet the requirements for controlling the reflective cracks found on the subject project.

We appreciated the opportunity to work with you on this unique project, and look forward to future opportunities that may arise. If you have any questions regarding this letter report and modifications, please contact CHEC Management Systems at 800-523-2124.

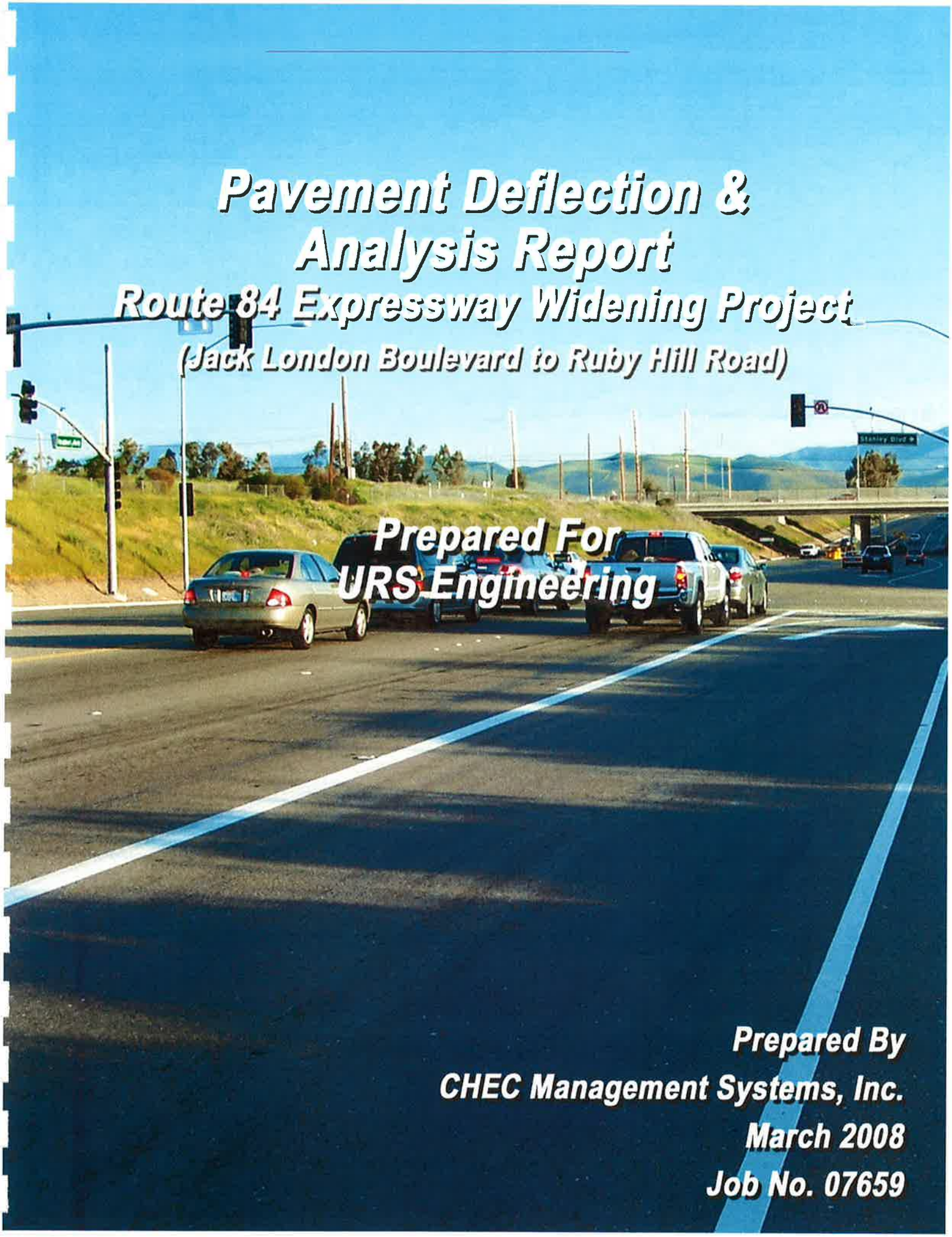
Very truly yours,
CHEC MANAGEMENT SYSTEMS, INC.

James B. Curtis
President

Reviewed by:



Alan Curtis, P.E.
V.P. of Engineering
CA C. E. #23326



Pavement Deflection & Analysis Report

Route 84 Expressway Widening Project

(Jack London Boulevard to Ruby Hill Road)

Prepared For
URS Engineering

Prepared By
CHEC Management Systems, Inc.
March 2008
Job No. 07659

CHEC
MANAGEMENT
SYSTEMS INC.

March 20, 2008 Job No. 07659

URS
55 South Market Street
Suite 1500
San Jose, CA 95113

Attn: Mr. Stephen Huang
Project Manager

Subject: Pavement Deflection Analysis – Route 84 Expressway Widening Project
Jack London Boulevard to Ruby Hill Road

Gentlemen:

We have completed our report for the subject project. In this report, we have included the structural overlay requirements, based on California Test Method 356, our recommendations, graphs, and color photographs for the project.

The Appendix section of this report contains all data to support our findings for this report. If you have any questions regarding this report, please contact CHEC Management Systems at 800-523-2124.

Very truly yours,
CHEC MANAGEMENT SYSTEMS, INC.

James B. Curtis
President

Reviewed by:

REGISTERED PROFESSIONAL ENGINEER
Charles Alan Curtis
No. 23,326
CIVIL
STATE OF CALIFORNIA

Alan Curtis, P. E.
V.P. of Engineering
CA C. E. #23326

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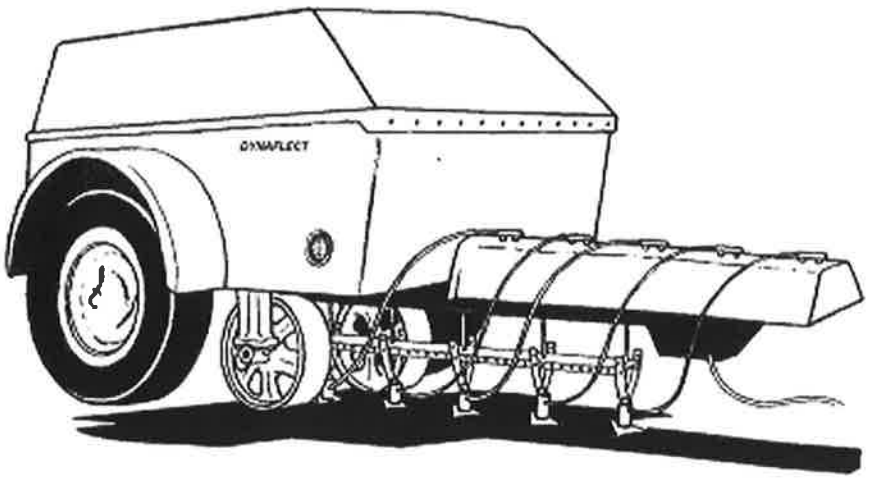
DEFLECTION TESTING AND ANALYSIS

TESTING AND ANALYSIS PROCEDURE

California Test Method 356

Testing was performed using the DYNAFLECT nondestructive pavement testing device. The device places a 1000-lb. oscillatory load on the pavement surface. Motion sensing geophones (sensors) placed on the pavement surface "read" the pavement deflection resulting from the load. A strong pavement will deflect less than a weak pavement under the same loading. The image on this page provides a schematic of this device. A single sensor was used for this analysis. The testing equipment and analysis procedure are based on California Test Method (CTM) 356 (using a DYNAFLECT and the Caltrans Flexible Pavement Rehabilitation Design Manual dated 2001).



1. The procedure is basically a fatigue analysis. The measured maximum deflection is the amplitude of pavement bending for each repetition of a load. (The design number of load repetitions is indicated by the Traffic Index - T.I.) If the existing pavement is fairly thick, the tolerable deflection to prevent fatigue failure is lower than for a comparable thinner pavement. Thus, a thicker pavement requires a thicker overlay to reduce the deflection. In the State of California all rehabilitation designs are given a 10-year life. This is mainly because of the reflective crack control issues.

2. The second half of the analysis is based on the need to retard reflective cracking, or the propagation of old cracks in the underlying pavement through the new overlay. The overlay should be at least half the thickness of the existing pavement to retard reflective cracking. A fabric innerlayer may be substituted for 0.10 ft. of AC for crack control purposes only. The structural needs of the pavement must first be satisfied before reflective crack retardation is considered.

NOTE:

The CALTRANS Flexible Pavement Rehabilitation Design Manual has the following statement:

"A Thickness Equivalency of no more than 1:2 is given to the RAC Type G when compared to the dense graded asphalt concrete (DGAC) for structural adequacy or reflective crack retardation." (Second Paragraph of Section 4-20)

This is only a half true statement. CALTRANS has since found that RAC Type G does not have a twice the structural strength as dense grade asphalt concrete. Therefore the statement with respect to structural adequacy requirement is not true in the published manual, and is not considered in this report. If the structural need is 0.40 ft overlay then the material being dense grade asphalt concrete or RAC will not matter, the requirement is still 0.40 ft. of either material.

The other half of the statement still holds true, and a credit to control reflective cracking will be given.

DESIGNER'S GENERAL NOTES

The following notes are provided to assist the design engineer in developing the plans and specifications for this project. Some of these guidelines are reflected in the recommendations found within this report.

1. All specified thicknesses in this report are design minimums and do not include construction tolerances.

2. With asphalt overlays, wedge cutting is recommended at all conforms to provide a smooth taper and transition.

3. Prior to an overlay, an adequate application of a tack coat is required for a proper bond. The type and application rates are to be determined by the design engineer.

4. All areas of moderate to severe alligator cracking and/or bleeding should be removed and replaced with full-depth AC repairs. The thickness of the repairs may vary but should never be less than the thickness of the existing AC section, and preferably one to two inches below the existing AC surface layer.

5. All transverse and longitudinal cracks wider than 1/4 of an inch should be sealed with an emulsified crack seal.

BACKGROUND

CHEC Management Systems, Inc. was hired to collect data and perform the necessary analysis to provide URS with the required pavement rehabilitation overlay design thickness. For this project there were five distinct sections that we tested. The five sections are listed in Table 1 of this report, along with a summary of the finding and our recommendation.

On March 11, 2008, Mr. Robert Freeman and crew started the deflection testing of State Route 84 in Livermore. Traffic control started setting up at 8:00 am, and the Testing started at 9:00 a.m. and continued until approximately 3:30 p.m. This schedule continued the following day as well. At the end of the second day all 19 section had been tested, and all cores had been taken in the travel lanes tested. At that time the crew headed back to the office to enter the data and start the analysis portion of the project. There were no traffic incidences during the field work.

The design Traffic Index for each section was provided by URS to CHEC Management Systems, Inc. For this project, the 10-year Design Traffic Index is an 11.0. We have prepared this report which provides a measure of the structural adequacy of each road section, and our recommendation of current repair technique.

Using our analysis, this report provides overlay requirements, to protect the existing street investment for a 10-year service life minimum, and alternative design methods were utilized as needed to look at the most cost effective approach while still receiving a 10-year design life. Other methods of analysis that looks at mill and inlay designs were not utilized, but can be completed in the future if an overlay is not deemed feasible due to geometric constraints, and the adjacent new construction designs.

The designs provided are for the entire width of the road including shoulder sections. CHEC performed analysis on each of the 19 sections tested, and utilized the controlling test section to determine the overall design for the segment of road. Because these roads are being widened and realigned the design must work for the entire section, not just a direction of travel. The following table provides our design recommendations for each of the five pavement segments.

Table 1

Summary of Findings

Road Name	From	To	CTM Structural Requirement	CHEC's Overlay Design Recommendations
SR 84 - Livermore	**Jack London Blvd.**	**Stanley Blvd.**	**0.00 ft. AC Overlay**	0.46 ft. AC Overlay **Alternate Design A:** 0.36 ft. AC Overlay with Paving Mat (TruPave) **Alternate Design B:** 0.30 ft. RAC Overlay
SR 84 - Livermore	**Stanley Blvd.**	**Concannon Blvd.**	**0.00 ft. AC Overlay**	0.45 ft. AC Overlay **Alternate Design A:** 0.35 ft. AC Overlay with Paving Mat (TruPave) **Alternate Design B:** 0.25 ft. RAC Overlay

Road Name	From	To	CTM Structural Requirement	CHEC's Overlay Design Recommendations
SR 84 - Livermore	**Concannon Blvd.**	**Vineyard Ave.**	**0.00 ft. AC Overlay**	0.45 ft. AC Overlay **Alternate Design A:** 0.35 ft. AC Overlay with Paving Mat (TruPave) **Alternate Design B:** 0.25 ft. RAC Overlay
SR 84 - Livermore	**Vineyard Avenue**	**Pavement Change North of Vallecictos Blvd.**	**0.00 ft. AC Overlay**	0.375 ft. AC Overlay **Alternate Design A:** 0.30 ft. AC Overlay with Paving Mat (TruPave) **Alternate Design B:** 0.25 ft. RAC Overlay
SR 84 - Livermore	**Pavement Change North of Vallecictos Blvd.**	**Pavement Change South of Vallecictos Blvd.**	**0.00 ft. AC Overlay**	0.375 ft. AC Overlay **Alternate Design A:** 0.30 ft. AC Overlay with Paving Mat (TruPave) **Alternate Design B:** 0.25 ft. RAC Overlay
SR 84 - Livermore	**Pavement Change South of Vallecictos Blvd.**	**Ruby Hill Road**	**0.25 ft. AC Overlay**	0.375 ft. AC Overlay **Alternate Design A:** 0.30 ft. AC Overlay with Paving Mat (TruPave) **Alternate Design B:** 0.30 ft. RAC Overlay

PROCEDURE

The structural overlay requirement was determined using California Test Method 356 and the Caltrans Rehabilitation Manual (2001), which is based on a 10-year design. CHEC's design recommendations are for a 10-year service life. CHEC Management Systems, Inc. was asked to evaluate State Route Highway 84 in Livermore from Jack London Blvd. in the north to Ruby Hill Road in the south. The Design T.I. is 11.0 for the project.

Deflection testing was performed in both the travel lanes and shoulders that will become travel lanes in the future as the road is widened and realigned. Pavement sections were selected based on pavement type, visual defects present in the road and geometric changes. The testing occurred in both directions, and in each block section of the roadway. Tests were taken at an interval that provided at least 20 points per segment and followed the CTM 356. The actual interval used is stated on the deflection graphs located in the Appendix.

The next step in our field work was to note the existing visible defects, take color photographs, and obtain coring data. Core samples were taken by CHEC Management Systems, Inc. in the travel lanes, and URS provided the shoulder thicknesses that were taken prior to testing to determine the existing thickness of asphalt concrete (AC) which aided in segmentation of the roadway.

CHEC'S FINDINGS AND RECOMMENDATIONS

SR 84 - Livermore

Jack London Blvd. to Stanley Blvd.

Area Description	Limits	Traffic Index	Existing AC Thickness	CTM OL Requirement
NB Lane 1	0 ft. – 1320 ft.	11.0	9.5 inches	0.00 ft AC Overlay
NB Shoulder	2640 ft. – 3960 ft.	11.0	9.0 inches	0.00 ft AC Overlay
SB Lane 1	0 ft. – 1320 ft.	11.0	10.0 inches	0.00 ft AC Overlay
****SB Shoulder**	**2640 ft. – 3960 ft.**	**11.0**	**11.0 inches**	**0.00 ft AC Overlay**

Note:

**The bold item above represents the controlling design section for this segment of roadway.

This section of road starts at Jack London Blvd. and continues South to Stanley Blvd. and consists of different structural section for each lane of travel as outlined

in the table above. The photo above shows the condition of the road on the day of testing.

Testing was completed in both directions of travel, in both the travel lanes and on the shoulders (future travel lanes).

CHEC's Design Recommendation

For this section of road to satisfy both the structural and reflective cracking requirements of the design procedure we recommend:

Because the structural overlay requirement for this section of highway is 0.00 ft. in all lanes tested, the reflective cracking control becomes the controlling factor of this design. Because the specific alignment is unknown to CHEC, the design that will satisfy all lanes reflective crack control requirements is to overlay this section of highway with 5.5 inches of standard asphalt concrete (AC) or 0.46 ft. of AC. The southbound shoulder is the controlling design lane for this section of highway.

CHEC's Alternate Design A

Because reflective cracking is the controlling factor for this section design, the use of pavement reinforcing fabric/mat can be highly beneficial. The CALTRANS Flexible Pavement Rehabilitation Design Manual allows a reduction of 0.10ft of dense grade asphalt thickness when fabric is utilized to control reflective cracking.

For this design we highly recommend utilizing a paving fabric, such as TruPave, to help retard reflective cracking and allow the pavement section to be decreased by 0.10 ft. of AC. This would be more cost effective than the design that does not utilize a pavement reinforcing fabric. So the "Alternate Design A" for this

section of highway is to place a 0.36 ft of AC over a Paving Mat (TruPave). (4 3/8 inches of AC)

The TruPave fabric is recommended because of the recycling capabilities, and the fact that disposal of the asphalt with TruPave fabric does not have an increase in cost over asphalt alone, saving future rehabilitation dollars.

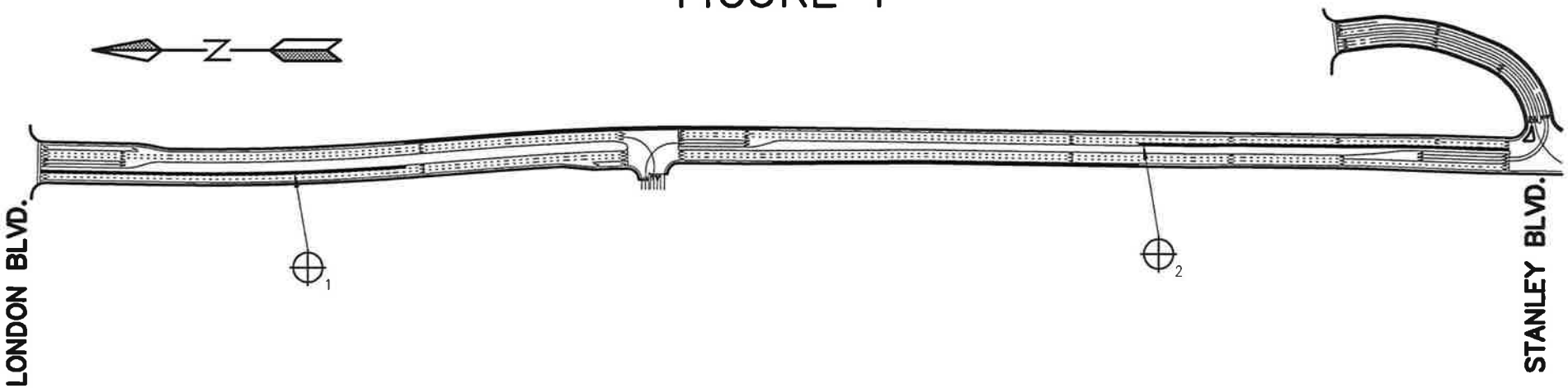
CHEC's Alternate Design B

Another option when dealing with reflective cracking control would be to utilize Rubberized Asphalt Concrete. So the "Alternate Design B" for this section of highway is to place a 0.30 ft of RAC over the existing surface. (3.6 inches of RAC)

HIGHWAY 84

PAVEMENT TESTING (Jack London to Stanley)

FIGURE 1



STRUCTURAL DESIGN REQUIREMENTS				
LANE	LIMITS	AC THICKNESS	OL REQ	T.I.
NORTH BOUND 1	0–1320	9.5"	0.00 FT.	11.0
NORTH BOUND SHOULDER	2640–3960	9.0"	0.00 FT.	11.0
SOUTH BOUND 1	0–1320	10.0"	0.00 FT.	11.0
SOUTH BOUND SHOULDER	2640–3960	11.0"	0.00 FT.	11.0

Ⓐ = ALTERNATE DESIGN "A"

Ⓑ = ALTERNATE DESIGN "B"

OVERALL SECTION DESIGN				
LANE	BASIS	EXISTING AC	OL MATERIAL	OL THICKNESS
NORTH BOUND	REFLECTIVE CRACKING	9.5"	STD AC	4.75" or .40'
Ⓐ NORTH BOUND	REFLECTIVE CRACKING	9.5"	AC W/ FABRIC	4.4" or .36'
Ⓑ NORTH BOUND	REFLECTIVE CRACKING	9.5"	RAC	3.0" or .25'
SOUTH BOUND	REFLECTIVE CRACKING	11.0"	STD AC	5.5" or .46'
Ⓐ SOUTH BOUND	REFLECTIVE CRACKING	11.0"	AC W/ FABRIC	4.4" or .36'
Ⓑ SOUTH BOUND	REFLECTIVE CRACKING	11.0"	RAC	3.5" or .29'

#	THICKNESS	BASE
1	9 1/2"	3/4"
2	10"	3/4"

NOT TO SCALE

LEGEND

⊕# = CORE TEST

▬ = PAVEMENT TESTING

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

JACK LONDON - STANLY ...x|....

SB1: 0 - 1320	Reading	Plot	Comment
Interval 0	26.00	6	
Interval 52	28.00	6	
Interval 104	23.00	5	
Interval 156	23.00	5	
Interval 208	17.00	4	
Interval 260	19.00	4	
Interval 312	18.00	4	
Interval 364	20.00	4	
Interval 416	18.00	4	
Interval 468	19.00	4	
Interval 520	19.00	4	
Interval 572	15.00	3	
Interval 624	20.00	4	
Interval 676	15.00	3	
Interval 728	17.00	4	
Interval 780	15.00	3	
Interval 832	16.00	3	
Interval 884	18.00	4	
Interval 936	17.00	4	
Interval 988	16.00	3	
Interval 1040	15.00	3	
Interval 1092	18.00	4	
Interval 1144	16.00	3	
Interval 1196	14.00	3	
Interval 1248	15.00	3	
Interval 1300	14.00	3	

STATISTICAL ANALYSIS

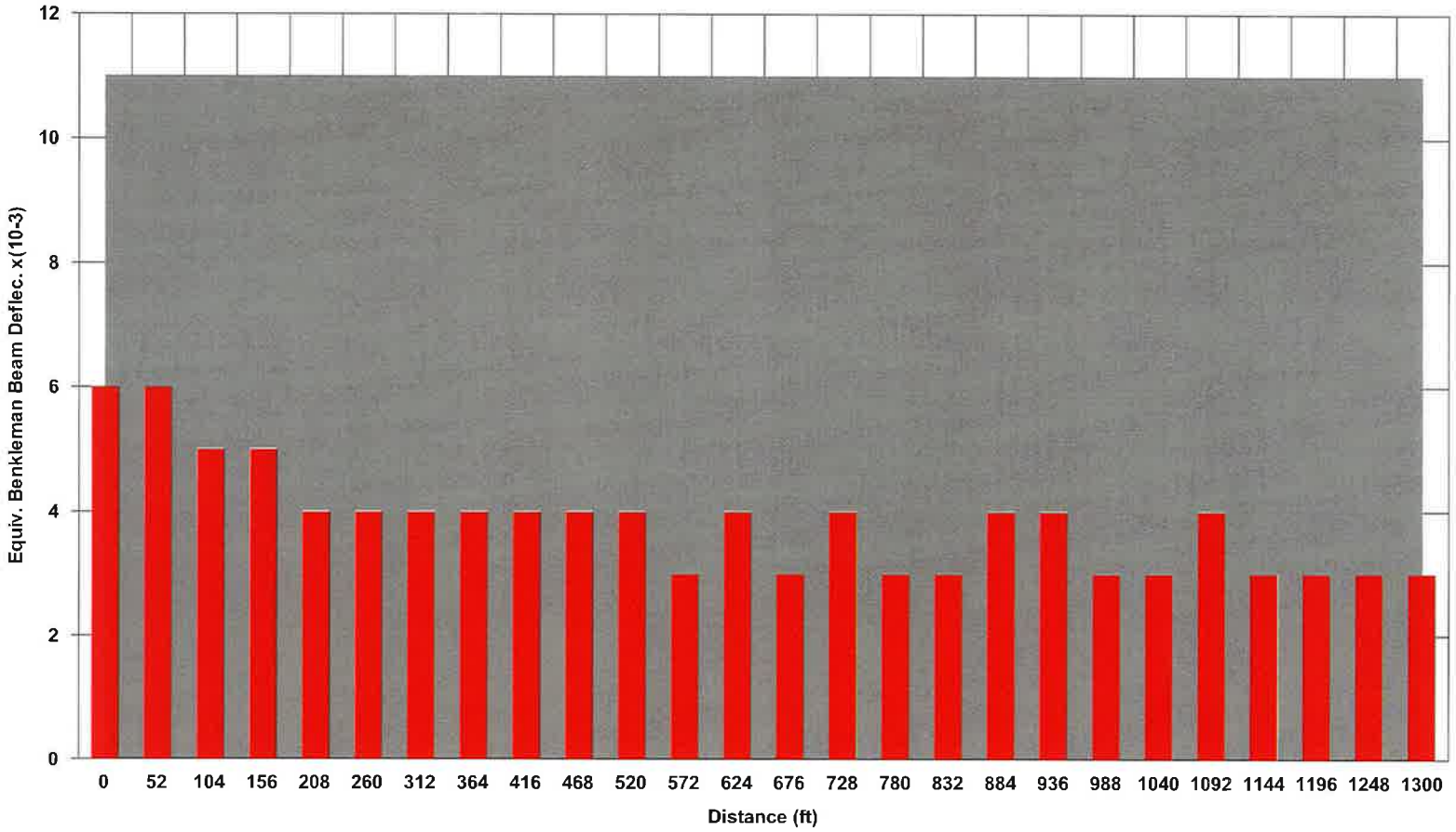
80th %	90th %	Mean	Min	Max
5	5	4	3	6

STRUCTURAL DATA **Thickness:** 10.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
5	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR 84 S HW Direction: S(...x|....) Start: 0 Interval: 52 ft
Road Number: SB1: 0 - 1320 From: JACK LONDON BL To: STANLY BL

STATISTICAL ANALYSIS AS TESTED 80th %: 5 90th %: 5 Mean: 4 Min: 3 Max: 6

STRUCTURAL DATA Thickness: 10.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 5 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

JACK LONDON - STANLY ...x|....

SB,SH 2640 - 3960	Reading	Plot	Comment
Interval 2640	45.00	10	
Interval 2692	40.00	9	
Interval 2744	43.00	9	
Interval 2796	41.00	9	
Interval 2848	44.00	10	
Interval 2900	50.00	11	
Interval 2952	46.00	10	
Interval 3004	50.00	11	
Interval 3056	40.00	9	
Interval 3108	36.00	8	
Interval 3160	28.00	6	
Interval 3212	43.00	9	
Interval 3264	40.00	9	
Interval 3316	43.00	9	
Interval 3368	34.00	7	
Interval 3420	25.00	5	
Interval 3472	22.00	5	
Interval 3524	27.00	6	
Interval 3576	42.00	9	
Interval 3628	27.00	6	
Interval 3680	21.00	5	
Interval 3732	22.00	5	
Interval 3784	21.00	5	
Interval 3836	15.00	3	
Interval 3888	17.00	4	
Interval 3940	21.00	5	
Interval 3992	20.00	4	
Interval 4044	24.00	5	
Interval 4096	21.00	5	
Interval 4148	22.00	5	

STATISTICAL ANALYSIS

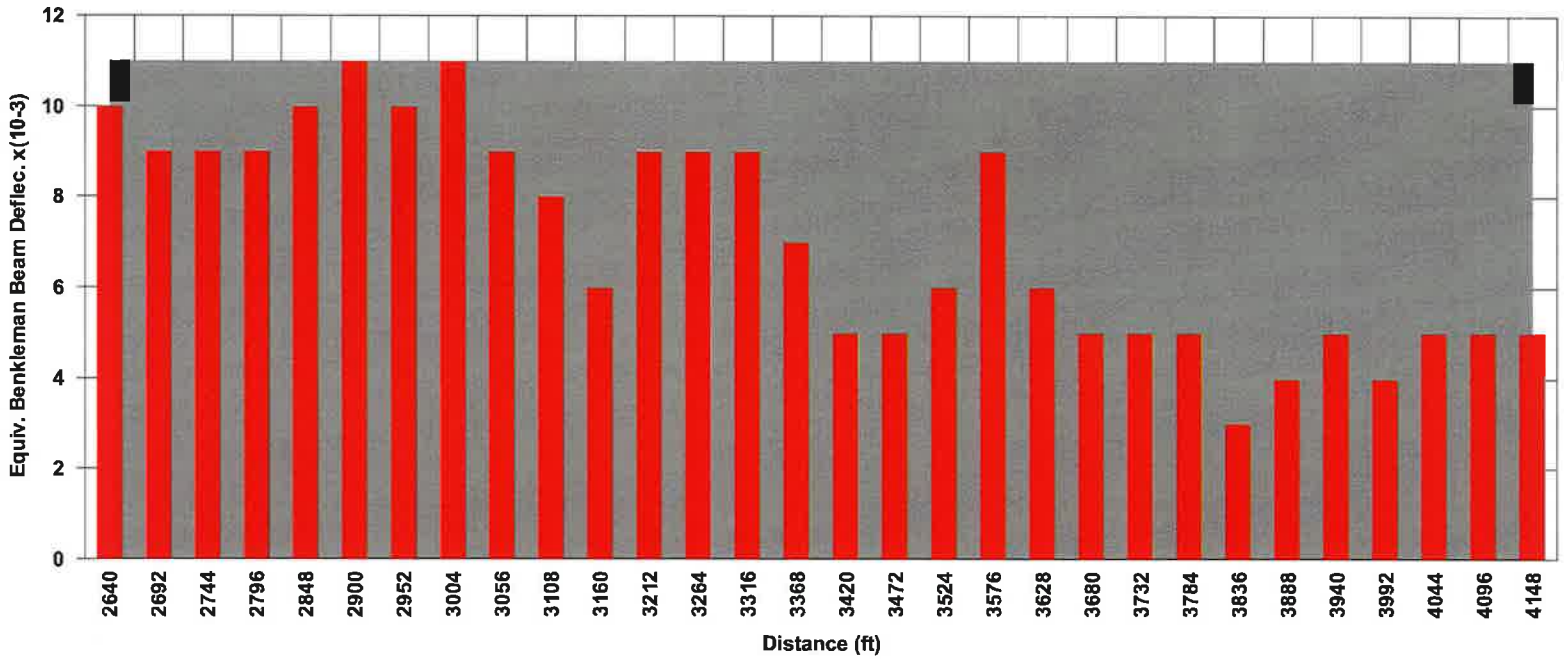
80th %	90th %	Mean	Min	Max
9	10	7	3	11

STRUCTURAL DATA **Thickness:** 11.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
9	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Deflection Data Tolerable Limit

Road Name: SR 84 S HW Direction: S(...x|....) Start: 2640 Interval: 52 ft
Road Number: SB,SH 2640 - 3960 From: JACK LONDON BL To: STANLY BL

STATISTICAL ANALYSIS AS TESTED 80th %: 9 90th %: 10 Mean: 7 Min: 3 Max: 11

STRUCTURAL DATA Thickness: 11.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 9 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

STANLY - JACK LONDON ....|x...

NB1: 0 - 1320	Reading	Plot	Comment
Interval 0	14.00	3	
Interval 52	12.00	3	
Interval 104	14.00	3	
Interval 156	14.00	3	
Interval 208	13.00	3	
Interval 260	14.00	3	
Interval 312	15.00	3	
Interval 364	17.00	4	
Interval 416	20.00	4	
Interval 468	19.00	4	
Interval 520	19.00	4	
Interval 572	22.00	5	
Interval 624	22.00	5	
Interval 676	21.00	5	
Interval 728	23.00	5	
Interval 780	18.00	4	
Interval 832	28.00	6	
Interval 884	25.00	5	
Interval 936	25.00	5	
Interval 988	27.00	6	
Interval 1040	28.00	6	
Interval 1092	24.00	5	
Interval 1144	23.00	5	
Interval 1196	25.00	5	
Interval 1248	17.00	4	
Interval 1300	16.00	3	

STATISTICAL ANALYSIS

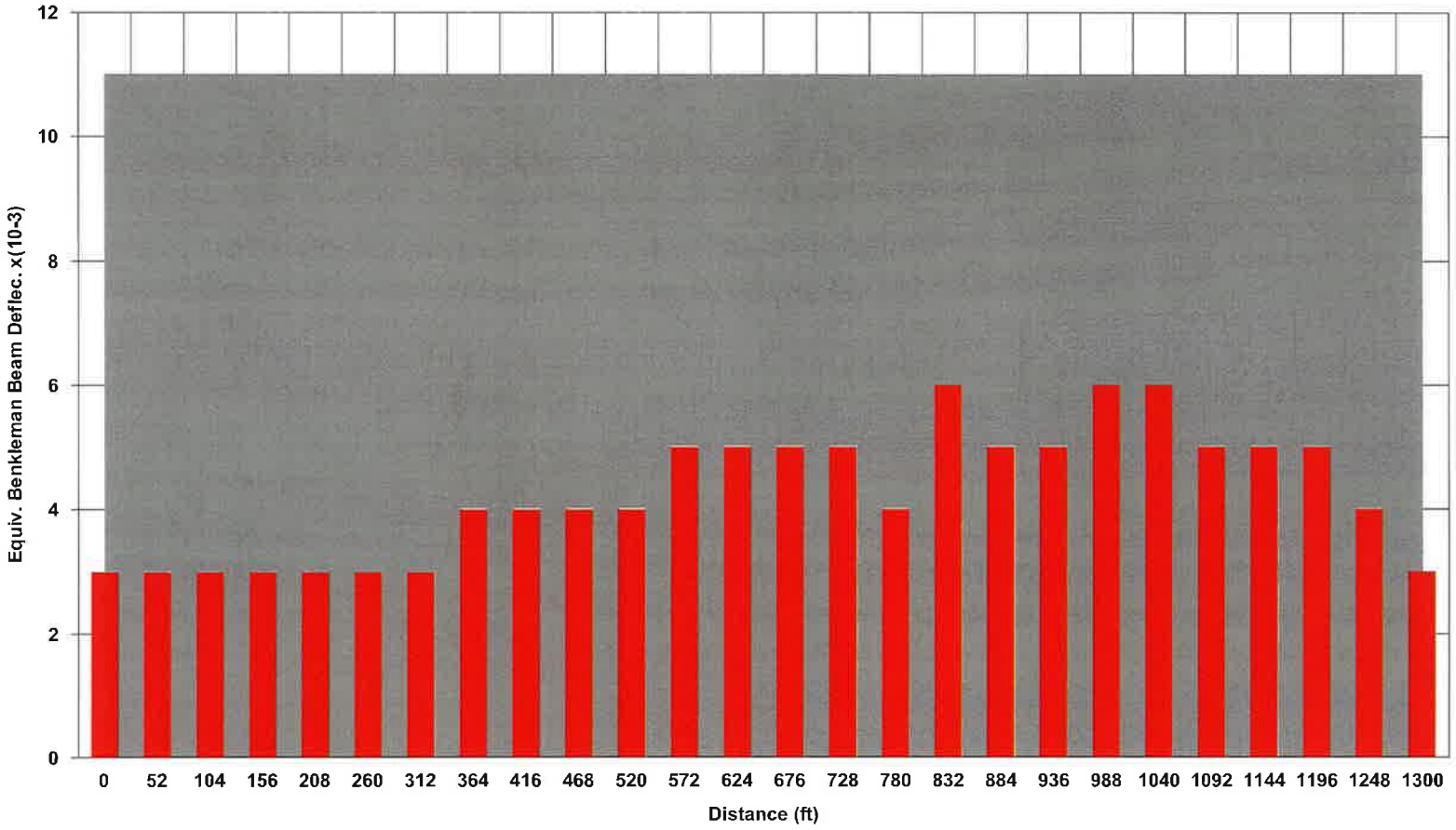
80th %	90th %	Mean	Min	Max
5	6	4	3	6

STRUCTURAL DATA **Thickness:** 9.50 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
5	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR N 84 HW Direction: N(....|x...) Start: 0 Interval: 52 ft
Road Number: NB1: 0 - 1320 From: STANLY BL To: JACK LONDON BL

STATISTICAL ANALYSIS AS TESTED 80th %: 5 90th %: 6 Mean: 4 Min: 3 Max: 6

STRUCTURAL DATA Thickness: 9.50 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 5 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

STANLY - JACK LONDON ....|x...

NB,SH: 2640 - 3960	Reading	Plot	Comment
Interval 2640	26.00	6	
Interval 2692	33.00	7	
Interval 2744	26.00	6	
Interval 2796	25.00	5	
Interval 2848	38.00	8	
Interval 2900	27.00	6	
Interval 2952	27.00	6	
Interval 3004	25.00	5	
Interval 3056	25.00	5	
Interval 3108	23.00	5	
Interval 3160	17.00	4	
Interval 3212	23.00	5	
Interval 3264	27.00	6	
Interval 3316	20.00	4	
Interval 3368	23.00	5	
Interval 3420	18.00	4	
Interval 3472	16.00	3	
Interval 3524	16.00	3	
Interval 3576	16.00	3	
Interval 3628	19.00	4	
Interval 3680	20.00	4	
Interval 3732	24.00	5	
Interval 3784	22.00	5	
Interval 3836	21.00	5	
Interval 3888	20.00	4	

STATISTICAL ANALYSIS

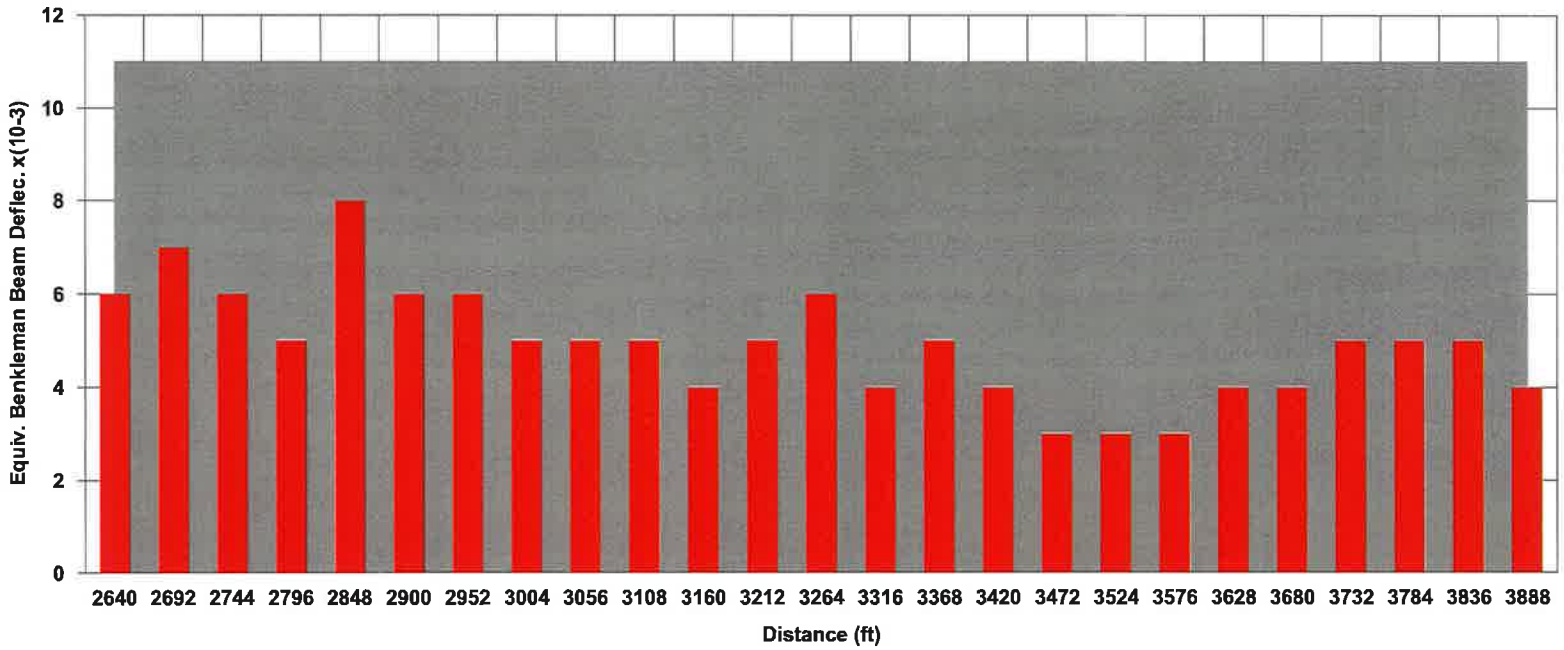
80th %	90th %	Mean	Min	Max
6	6	5	3	8

STRUCTURAL DATA **Thickness:** 9.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
6	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Deflection Data Tolerable Limit

Road Name: SR N 84 HW Direction: N(....|x...) Start: 2640 Interval: 52 ft
Road Number: NB,SH: 2640 - 3960 From: STANLY BL To: JACK LONDON BL

STATISTICAL ANALYSIS AS TESTED 80th %: 6 90th %: 6 Mean: 5 Min: 3 Max: 8

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 6 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

SR 84 - Livermore

Stanley Blvd. to Concannon Blvd.

Area Description	Limits	Traffic Index	Existing AC Thickness	CTM OL Requirement
**** NB Lane 1**	**1,188 ft. – 2,376 ft.**	**11.0**	**10.75 inches**	**0.00 ft AC Overlay**
NB Shoulder	2,376 ft. – 3,564 ft.	11.0	7.0 inches	0.00 ft AC Overlay
SB Lane 1	0 ft. – 1,188 ft.	11.0	10.5 inches	0.00 ft AC Overlay
SB Shoulder	3,564 ft. – 4,752 ft.	11.0	7.0 inches	0.00 ft AC Overlay

Note:

**The bold item above represents the controlling design section for this segment of roadway.

This section of road starts at Stanley Blvd. and continues South to Concannon Blvd. and consists of different structural section for each lane of travel as outlined

in the table above. The photo above shows the condition of the road on the day of testing.

Testing was completed in both directions of travel, in both the travel lanes and on the shoulders (future travel lanes).

CHEC's Design Recommendation

For this section of road to satisfy both the structural and reflective cracking requirements of the design procedure we recommend:

Because the structural overlay requirement for this section of highway is 0.00 ft. in all lanes tested, the reflective cracking control becomes the controlling factor of this design. Because the specific alignment is unknown by CHEC the design that will satisfy all lanes reflective crack control requirements is to overlay this section of highway with 5.4 inches of standard asphalt concrete (AC) or 0.45 ft. of AC. The Northbound travel lane is the controlling design lane for this section of highway.

CHEC's Alternate Design A

Because reflective cracking is the controlling factor for this section design, the use of pavement reinforcing fabric/mat can be highly beneficial. The CALTRANS Flexible Pavement Rehabilitation Design Manual allows a reduction of 0.10ft of dense grade asphalt thickness when fabric is utilized to control reflective cracking.

For this design we highly recommend utilizing a paving fabric, such as TruPave, to help retard reflective cracking and allow the pavement section to be decreased by 0.10 ft. of AC. This would be more cost effective than the design that does not utilize a pavement reinforcing fabric. So the "Alternate Design A" for this

section of highway is to place a 0.35 ft of AC over a Paving Mat (TruPave). (4.2 inches of AC)

The TruPave fabric is recommended because of the recycling capabilities, and the fact that disposal of the asphalt with TruPave fabric does not have an increase in cost over asphalt alone, saving future rehabilitation dollars.

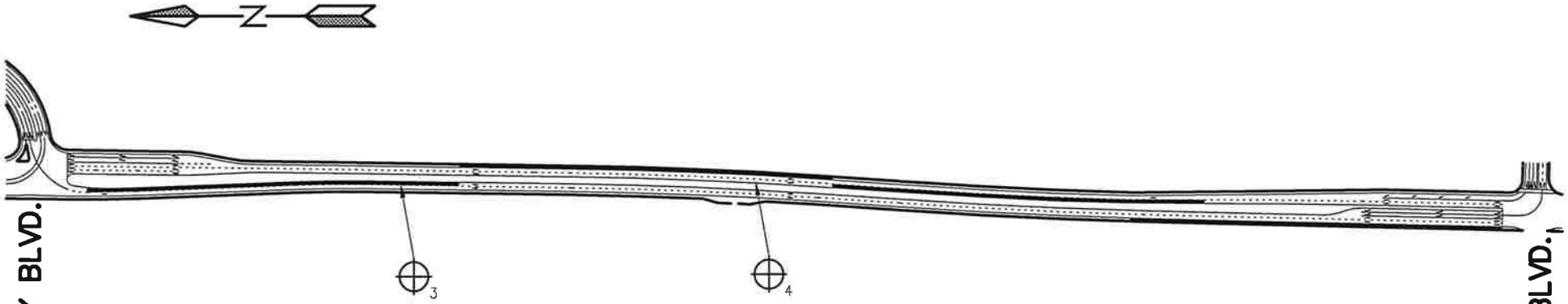
CHEC's Alternate Design B

Another option when dealing with reflective cracking control would be to utilize Rubberized Asphalt Concrete. So the "Alternate Design B" for this section of highway is to place a 0.25 ft of RAC over the existing surface. (3.0 inches of RAC)

HIGHWAY 84

PAVEMENT TESTING (Stanley to Concannon)

FIGURE 2



STRUCTURAL DESIGN REQUIREMENTS				
LANE	LIMITS	AC THICKNESS	OL REQ	T.I.
NORTH BOUND 1	1188–2376	10.75"	0.00 FT.	11.0
NORTH BOUND SHOULDER	2376–3564	7.0"	0.05 FT.	11.0
SOUTH BOUND 1	0–1188	10.5"	0.00 FT.	11.0
SOUTH BOUND SHOULDER	3564–4752	7.0"	0.00 FT.	11.0

OVERALL SECTION DESIGN				
LANE	BASIS	EXISTING AC	OL MATERIAL	OL THICKNESS
NORTH BOUND	REFLECTIVE CRACKING	10.75"	STD AC	5.4" or .45'
Ⓐ NORTH BOUND	REFLECTIVE CRACKING	10.75"	AC W/ FABRIC	4.2" or .35'
Ⓑ NORTH BOUND	REFLECTIVE CRACKING	10.75"	RAC	3.0" or .25'
SOUTH BOUND	REFLECTIVE CRACKING	10.5"	STD AC	5.25" or .44'
Ⓐ SOUTH BOUND	REFLECTIVE CRACKING	10.5"	AC W/ FABRIC	4.2" or .35'
Ⓑ SOUTH BOUND	REFLECTIVE CRACKING	10.5"	RAC	2.75" or .23'

Ⓐ = ALTERNATE DESIGN "A"

Ⓑ = ALTERNATE DESIGN "B"

#	THICKNESS	BASE
3	10 1/2"	3/4"
4	10 3/4"	3/4"

LEGEND

⊕# = CORE TEST

▬ = PAVEMENT TESTING

NOT TO SCALE

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

STANLY - CONNANNON ...x|....

SB1: 0 - 1188	Reading	Plot	Comment
Interval 0	13.00	3	
Interval 47	13.00	3	
Interval 94	14.00	3	
Interval 141	15.00	3	
Interval 188	15.00	3	
Interval 235	14.00	3	
Interval 282	14.00	3	
Interval 329	13.00	3	
Interval 376	15.00	3	
Interval 423	12.00	3	
Interval 470	12.00	3	
Interval 517	20.00	4	
Interval 564	26.00	6	
Interval 611	26.00	6	
Interval 658	22.00	5	
Interval 705	23.00	5	
Interval 752	18.00	4	
Interval 799	17.00	4	
Interval 846	21.00	5	
Interval 893	22.00	5	
Interval 940	19.00	4	
Interval 987	15.00	3	
Interval 1034	13.00	3	
Interval 1081	14.00	3	
Interval 1128	13.00	3	
Interval 1175	18.00	4	

STATISTICAL ANALYSIS

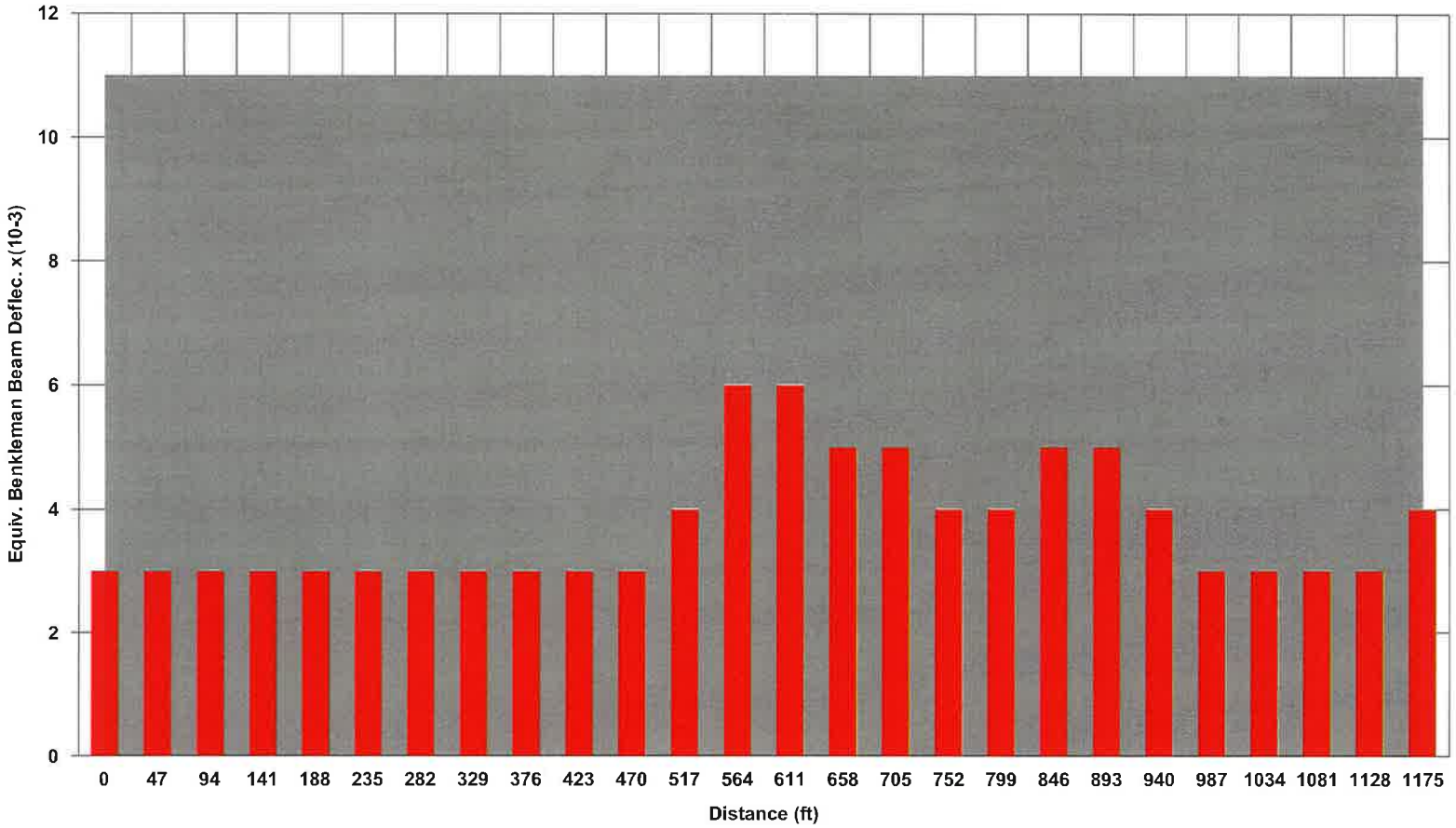
80th %	90th %	Mean	Min	Max
4	5	4	3	6

STRUCTURAL DATA **Thickness:** 10.50 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
4	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR 84 S HW Direction: N(...x|....) Start: 0 Interval: 47 ft
Road Number: SB1: 0 - 1188 From: STANLY BL To: CONNANNON AV

STATISTICAL ANALYSIS AS TESTED 80th %: 4 90th %: 5 Mean: 4 Min: 3 Max: 6

STRUCTURAL DATA Thickness: 10.50 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 4 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

STANLY - CONNANNON ...x|....

SB,SH 3564 - 4752	Reading	Plot	Comment
Interval 3564	17.00	4	
Interval 3611	16.00	3	
Interval 3658	17.00	4	
Interval 3705	17.00	4	
Interval 3752	19.00	4	
Interval 3799	30.00	6	
Interval 3846	31.00	7	
Interval 3893	28.00	6	
Interval 3940	29.00	6	
Interval 3987	32.00	7	
Interval 4034	23.00	5	
Interval 4081	28.00	6	
Interval 4128	25.00	5	
Interval 4175	25.00	5	
Interval 4222	23.00	5	
Interval 4269	21.00	5	
Interval 4316	20.00	4	
Interval 4363	20.00	4	
Interval 4410	16.00	3	
Interval 4457	15.00	3	
Interval 4504	17.00	4	
Interval 4551	23.00	5	
Interval 4598	22.00	5	
Interval 4645	21.00	5	
Interval 4692	21.00	5	
Interval 4739	23.00	5	

STATISTICAL ANALYSIS

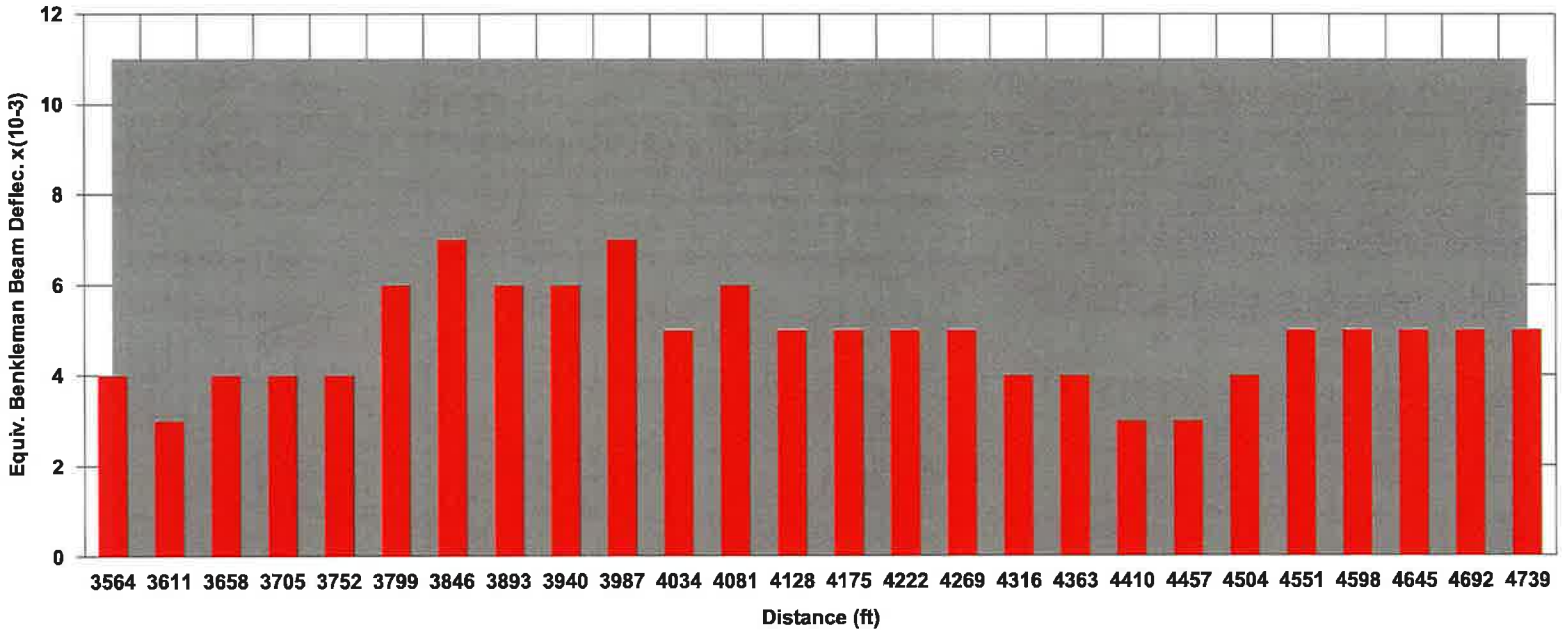
80th %	90th %	Mean	Min	Max
6	6	5	3	7

STRUCTURAL DATA **Thickness:** 7.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
6	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Deflection Data Tolerable Limit

Road Name: SR 84 S HW Direction: N(...x|....) Start: 3564 Interval: 47 ft
Road Number: SB,SH 3564 - 4752 From: STANLY BL To: CONNANNON AV

STATISTICAL ANALYSIS AS TESTED 80th %: 6 90th %: 6 Mean: 5 Min: 3 Max: 7

STRUCTURAL DATA Thickness: 7.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 6 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

CONNANNON - STANLY ....|x...

NB1: 1188 - 2376	Reading	Plot	Comment
Interval 1188	11.00	2	
Interval 1235	11.00	2	
Interval 1282	15.00	3	
Interval 1329	14.00	3	
Interval 1376	12.00	3	
Interval 1423	11.00	2	
Interval 1470	13.00	3	
Interval 1517	15.00	3	
Interval 1564	15.00	3	
Interval 1611	14.00	3	
Interval 1658	12.00	3	
Interval 1705	15.00	3	
Interval 1752	13.00	3	
Interval 1799	11.00	2	
Interval 1846	11.00	2	
Interval 1893	12.00	3	
Interval 1940	15.00	3	
Interval 1987	18.00	4	
Interval 2034	15.00	3	
Interval 2081	18.00	4	
Interval 2128	15.00	3	
Interval 2175	12.00	3	
Interval 2222	13.00	3	
Interval 2269	13.00	3	
Interval 2316	22.00	5	
Interval 2363	17.00	4	

STATISTICAL ANALYSIS

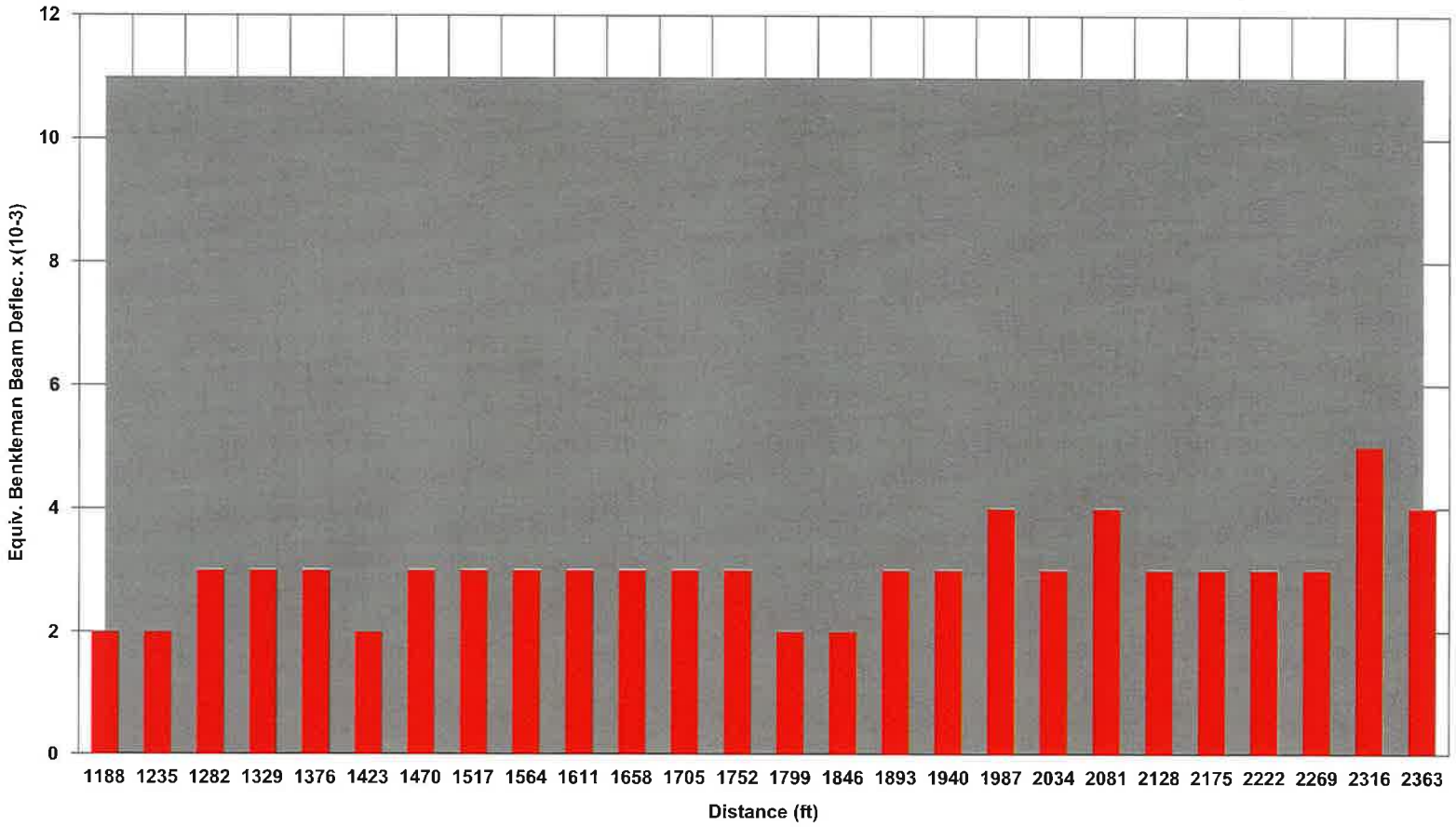
80th %	90th %	Mean	Min	Max
4	4	3	2	5

STRUCTURAL DATA **Thickness:** 10.75 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
4	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR N 84 HW Direction: N(....|x...) Start: 1188 Interval: 47 ft
Road Number: NB1: 1188 - 2376 From: CONNANNON AV To: STANLY BL

STATISTICAL ANALYSIS AS TESTED 80th %: 4 90th %: 4 Mean: 3 Min: 2 Max: 5

STRUCTURAL DATA Thickness: 10.75 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 4 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

CONNANNON - STANLY ....|x...

NB,SH: 2376 - 3564	Reading	Plot	Comment
Interval 2376	190.00	41	
Interval 2423	20.00	4	
Interval 2470	18.00	4	
Interval 2517	16.00	3	
Interval 2564	20.00	4	
Interval 2611	15.00	3	
Interval 2658	20.00	4	
Interval 2705	17.00	4	
Interval 2752	18.00	4	
Interval 2799	17.00	4	
Interval 2846	17.00	4	
Interval 2893	17.00	4	
Interval 2940	18.00	4	
Interval 2987	18.00	4	
Interval 3034	22.00	5	L
Interval 3081	20.00	4	L
Interval 3128	18.00	4	L
Interval 3175	26.00	6	L
Interval 3222	30.00	6	L
Interval 3269	23.00	5	
Interval 3316	20.00	4	L
Interval 3363	24.00	5	
Interval 3410	23.00	5	L
Interval 3457	18.00	4	L
Interval 3504	20.00	4	L

STATISTICAL ANALYSIS

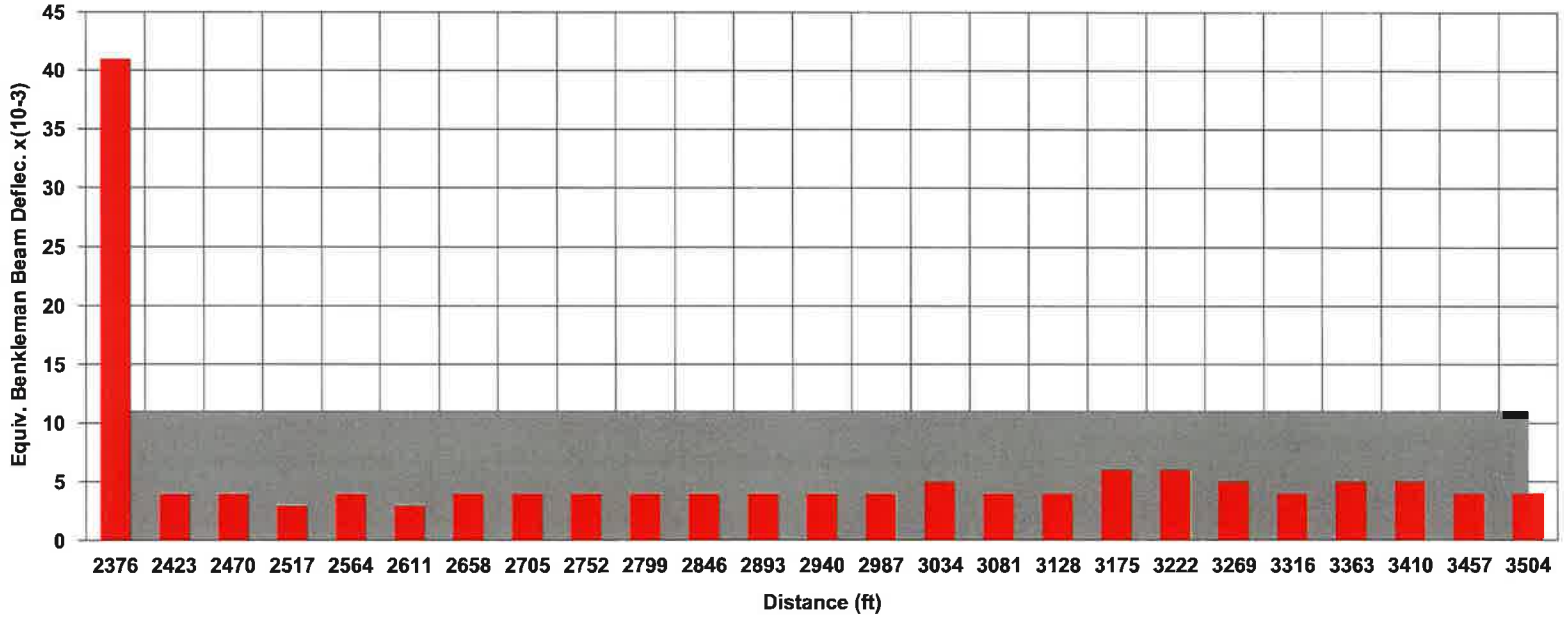
80th %	90th %	Mean	Min	Max
12	15	6	3	41

STRUCTURAL DATA **Thickness:** 7.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
12	11	8	0.05

Dynaflect Analysis
URS
Hwy. 84 Livermore



Deflection Data Tolerable Limit

Road Name: SR N 84 HW Direction: N(....|x...) Start: 2376 Interval: 47 ft
Road Number: NB,SH: 2376 - 3564 From: CONNANNON AV To: STANLY BL

STATISTICAL ANALYSIS AS TESTED 80th %: 12 90th %: 15 Mean: 6 Min: 3 Max: 41

STRUCTURAL DATA Thickness: 7.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 12 Tolerable: 11 % Reduction: 8 Overlay: 0.05 ft

SR 84 - Livermore

Concannon Blvd. to Vineyard Avenue

Area Description	Limits	Traffic Index	Existing AC Thickness	CTM OL Requirement
**** NB Lane 1**	**0 ft. – 1,056 ft.**	**11.0**	**11.0 inches**	**0.00 ft AC Overlay**
SB Lane 1	0 ft. – 1,056 ft.	11.0	10.5 inches	0.00 ft AC Overlay
SB Shoulder	1,056 ft. – 2,112 ft.	11.0	6.0 inches	0.00 ft AC Overlay

Note:

**The bold item above represents the controlling design section for this segment of roadway.

This section of road starts at Concannon Blvd. and continues South to Vineyard Avenue and consists of different structural section for each lane of travel as

outlined in the table above. The photo above shows the condition of the road on the day of testing.

Testing was completed in both directions of travel, in both the travel lanes and on the southbound shoulder.

CHEC's Design Recommendation

For this section of road to satisfy both the structural and reflective cracking requirements of the design procedure we recommend:

Because the structural overlay requirement for this section of highway is 0.00 ft. in all lanes tested, the reflective cracking control becomes the controlling factor of this design. Because the specific alignment is unknown to CHEC, the design that will satisfy all lanes reflective crack control requirements is to overlay this section of highway with 5.4 inches of standard asphalt concrete (AC) or 0.45 ft. of AC.

CHEC's Alternate Design A

Because reflective cracking is the controlling factor for this section design, the use of pavement reinforcing fabric/mat can be highly beneficial. The CALTRANS Flexible Pavement Rehabilitation Design Manual allows a reduction of 0.10ft of dense grade asphalt thickness when fabric is utilized to control reflective cracking.

For this design we highly recommend utilizing a paving fabric, such as TruPave, to help retard reflective cracking and allow the pavement section to be decreased by 0.10 ft. of AC. This would be more cost effective than the design that does not utilize a pavement reinforcing fabric. So the "Alternate Design A" for this

section of highway is to place a 0.35 ft of AC over a Paving Mat (TruPave). (4.2 inches of AC)

The TruPave fabric is recommended because of the recycling capabilities, and the fact that disposal of the asphalt with TruPave fabric does not have an increase in cost over asphalt alone, saving future rehabilitation dollars.

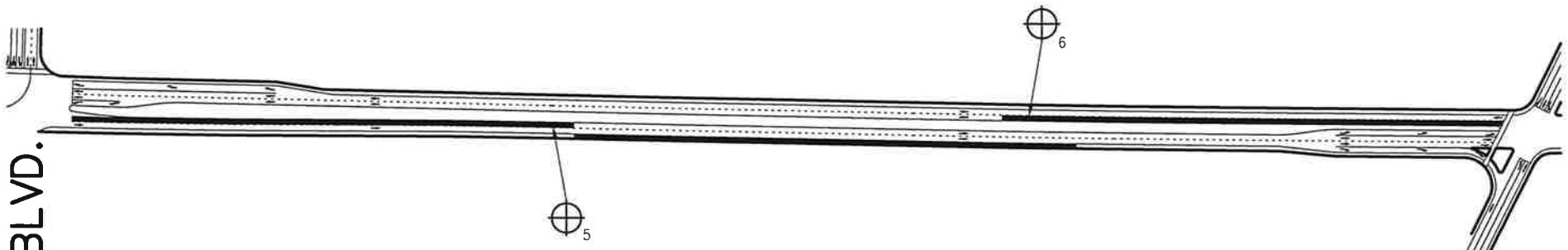
CHEC's Alternate Design B

Another option when dealing with reflective cracking control would be to utilize Rubberized Asphalt Concrete. So the "Alternate Design B" for this section of highway is to place a 0.25 ft of RAC over the existing surface. (3.0 inches of RAC)

HIGHWAY 84

PAVEMENT TESTING (Concannon to Vineyard)

FIGURE 3



CONCANNON BLVD.

VINEYARD AVE.

STRUCTURAL DESIGN REQUIREMENTS				
LANE	LIMITS	AC THICKNESS	OL REQ	T.I.
NORTH BOUND 1	0–1056	11.0"	0.00 FT.	11.0
SOUTH BOUND 1	0–1056	10.5"	0.00 FT.	11.0
SOUTH BOUND SHOULDER	1056–2112	6.0"	0.00 FT.	11.0

OVERALL SECTION DESIGN				
LANE	BASIS	EXISTING AC	OL MATERIAL	OL THICKNESS
NORTH BOUND	REFLECTIVE CRACKING	11.0"	STD AC	5.5" or .45'
Ⓐ NORTH BOUND	REFLECTIVE CRACKING	11.0"	AC W/ FABRIC	4.2" or .35'
Ⓑ NORTH BOUND	REFLECTIVE CRACKING	11.0"	RAC	3.0" or .25'
SOUTH BOUND	REFLECTIVE CRACKING	10.5"	STD AC	5.5" or .45'
Ⓐ SOUTH BOUND	REFLECTIVE CRACKING	10.5"	AC W/ FABRIC	4.2" or .35'
Ⓑ SOUTH BOUND	REFLECTIVE CRACKING	10.5"	RAC	3.0" or .25'

NOT TO SCALE

Ⓐ = ALTERNATE DESIGN "A"

Ⓑ = ALTERNATE DESIGN "B"

#	THICKNESS	BASE
5	10 1/2"	3/4"
6	11"	3/4"

LEGEND

⊕# = CORE TEST

▬ = PAVEMENT TESTING

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

CONNANNON - VINYARD ...x|....

SB1: 0 - 1056	Reading	Plot	Comment
Interval 0	20.00	4	
Interval 42	23.00	5	
Interval 84	18.00	4	
Interval 126	25.00	5	
Interval 168	22.00	5	
Interval 210	23.00	5	
Interval 252	23.00	5	
Interval 294	23.00	5	
Interval 336	23.00	5	
Interval 378	24.00	5	
Interval 420	24.00	5	
Interval 462	23.00	5	
Interval 504	25.00	5	
Interval 546	20.00	4	
Interval 588	23.00	5	
Interval 630	21.00	5	
Interval 672	26.00	6	
Interval 714	23.00	5	
Interval 756	24.00	5	
Interval 798	23.00	5	
Interval 840	31.00	7	
Interval 882	23.00	5	
Interval 924	21.00	5	
Interval 966	21.00	5	
Interval 1008	22.00	5	
Interval 1050	23.00	5	

STATISTICAL ANALYSIS

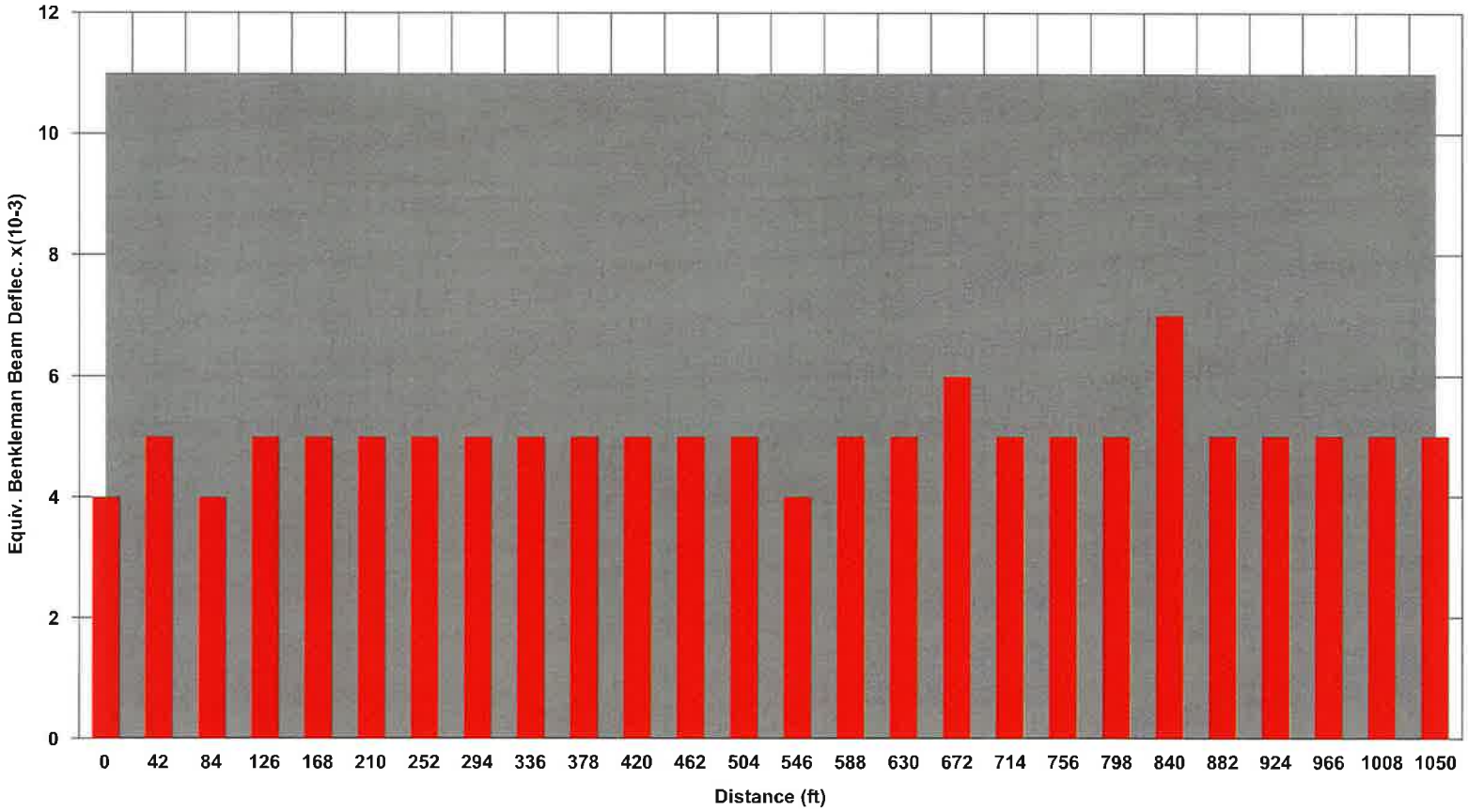
80th %	90th %	Mean	Min	Max
5	6	5	4	7

STRUCTURAL DATA **Thickness:** 10.50 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
5	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR 84 S HW Direction: S(...x|....) Start: 0 Interval: 42 ft
Road Number: SB1: 0 - 1056 From: CONNANNON AV To: VINYARD AV

STATISTICAL ANALYSIS AS TESTED 80th %: 5 90th %: 6 Mean: 5 Min: 4 Max: 7

STRUCTURAL DATA Thickness: 10.50 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 5 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

CONNANNON - VINYARD ...x|....

SB,SH 1056 - 2112	Reading	Plot	Comment
Interval 1056	25.00	5	
Interval 1098	23.00	5	
Interval 1140	30.00	6	
Interval 1182	32.00	7	
Interval 1224	25.00	5	
Interval 1266	22.00	5	
Interval 1308	22.00	5	
Interval 1350	14.00	3	
Interval 1392	18.00	4	
Interval 1434	18.00	4	
Interval 1476	18.00	4	
Interval 1518	12.00	3	
Interval 1560	10.00	2	
Interval 1602	21.00	5	
Interval 1644	23.00	5	
Interval 1686	23.00	5	
Interval 1728	20.00	4	
Interval 1770	24.00	5	
Interval 1812	22.00	5	
Interval 1854	21.00	5	
Interval 1896	23.00	5	
Interval 1938	25.00	5	
Interval 1980	26.00	6	
Interval 2022	21.00	5	
Interval 2064	19.00	4	
Interval 2106	21.00	5	
Interval 2148	23.00	5	

STATISTICAL ANALYSIS

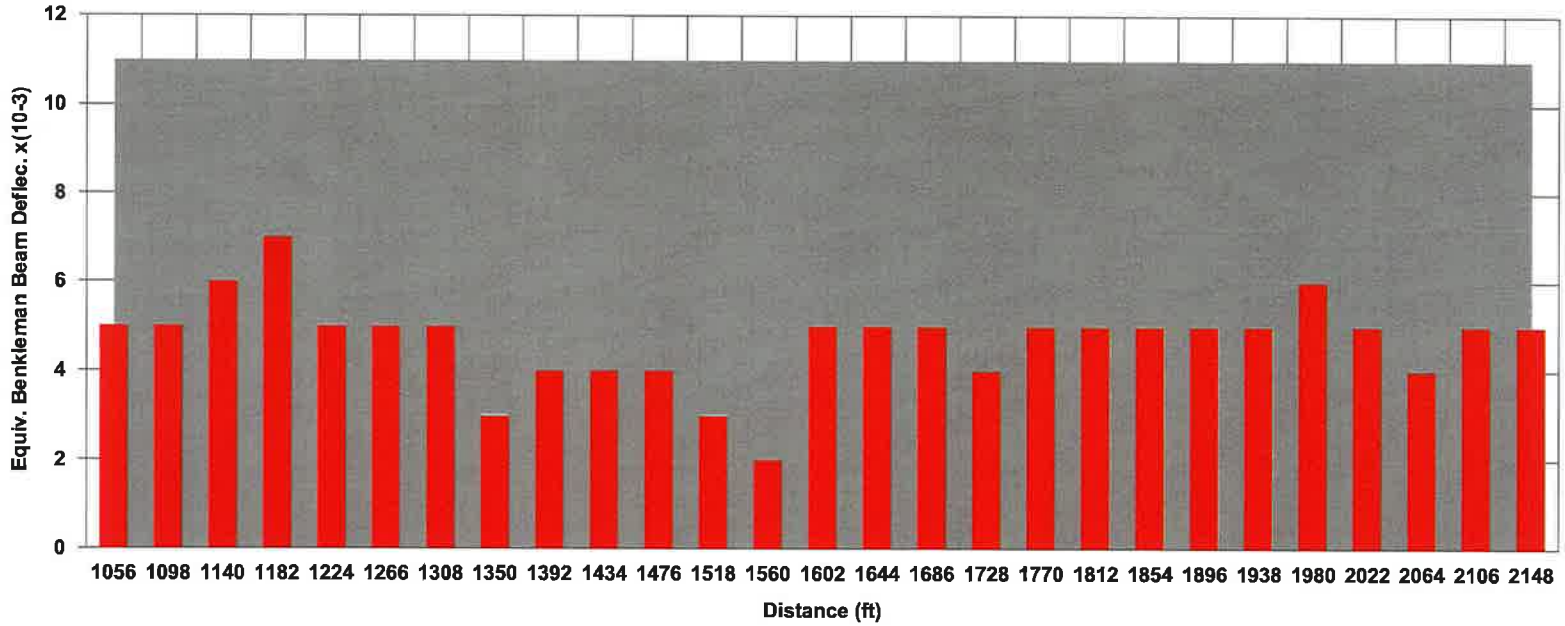
80th %	90th %	Mean	Min	Max
6	6	5	2	7

STRUCTURAL DATA **Thickness:** 6.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
6	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Deflection Data Tolerable Limit

Road Name: SR 84 S HW Direction: S(...x|....) Start: 1056 Interval: 42 ft
Road Number: SB,SH 1056 - 2112 From: CONNANNON AV To: VINYARD AV

STATISTICAL ANALYSIS AS TESTED 80th %: 6 90th %: 6 Mean: 5 Min: 2 Max: 7

STRUCTURAL DATA Thickness: 6.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 6 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

VINYARD - CONNANNON ....|x...

NB1: 0 - 1056	Reading	Plot	Comment
Interval 0	18.00	4	
Interval 42	24.00	5	
Interval 84	32.00	7	
Interval 126	31.00	7	
Interval 168	29.00	6	
Interval 210	38.00	8	
Interval 252	35.00	8	
Interval 294	38.00	8	
Interval 336	26.00	6	
Interval 378	23.00	5	
Interval 420	26.00	6	
Interval 462	28.00	6	
Interval 504	46.00	10	
Interval 546	0.00	0	
Interval 588	0.00	0	
Interval 630	0.00	0	
Interval 672	25.00	5	
Interval 714	23.00	5	
Interval 756	21.00	5	
Interval 798	16.00	3	
Interval 840	17.00	4	
Interval 882	20.00	4	
Interval 924	21.00	5	
Interval 966	17.00	4	
Interval 1008	21.00	5	
Interval 1050	18.00	4	

STATISTICAL ANALYSIS

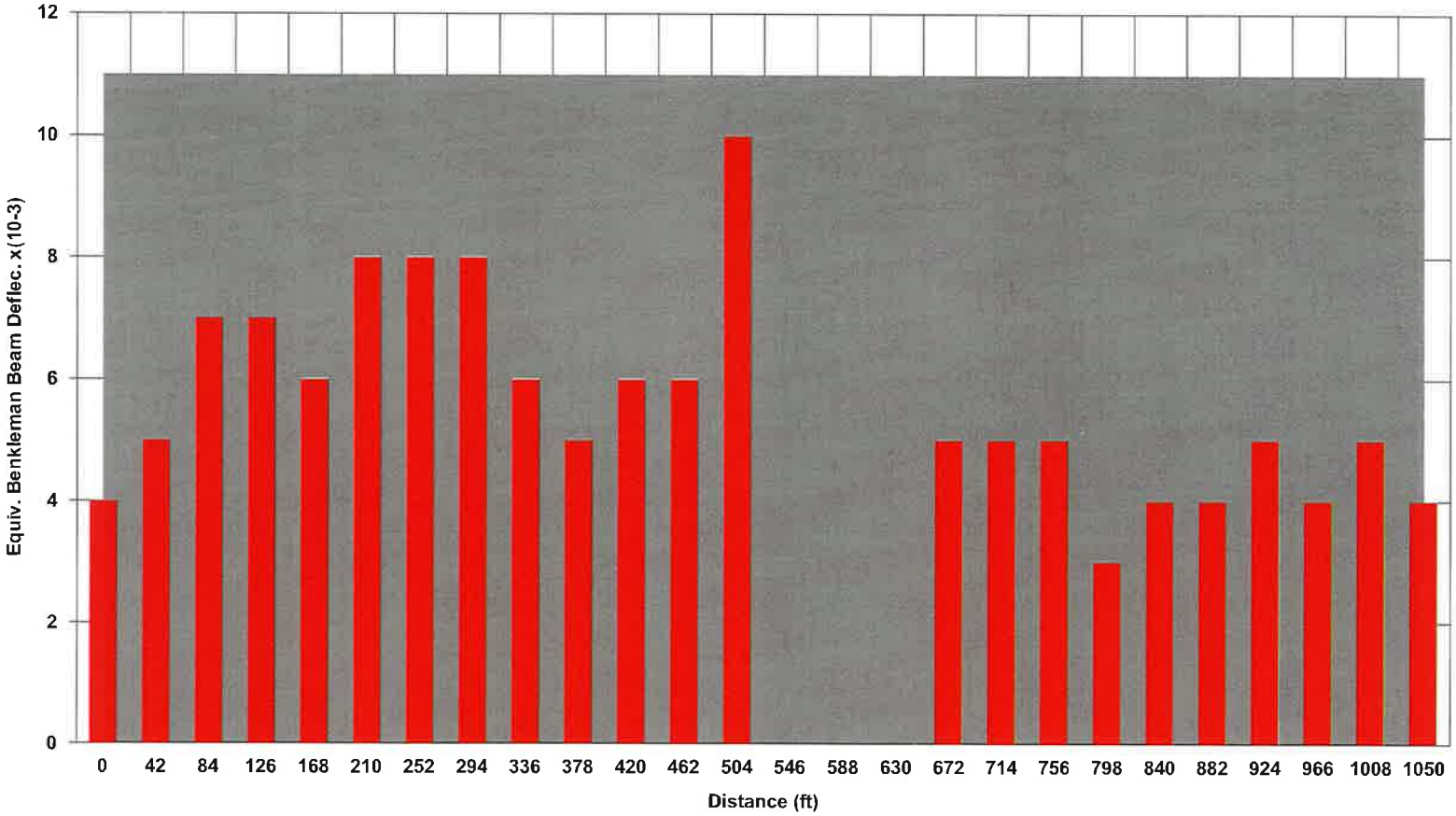
80th %	90th %	Mean	Min	Max
7	8	6	3	10

STRUCTURAL DATA **Thickness:** 11.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
7	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR N 84 HW Direction: N(....|x...) Start: 0 Interval: 42 ft
Road Number: NB1: 0 - 1056 From: VINYARD AV To: CONNANNON AV

STATISTICAL ANALYSIS AS TESTED 80th %: 7 90th %: 8 Mean: 6 Min: 3 Max: 10

STRUCTURAL DATA Thickness: 11.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 7 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

SR 84 - Livermore

Vineyard Avenue to Pavement Change North of Vallecictos Blvd.

Area Description	Limits	Traffic Index	Existing AC Thickness	CTM OL Requirement
**** NB Lane 1**	**0 ft. – 1,250 ft.**	**11.0**	**9.0 inches**	**0.00 ft AC Overlay**
NB Shoulder	1,250 ft. – 3,649 ft.	11.0	7.0 inches	0.00 ft AC Overlay
**** SB Lane 1**	**0 ft. – 1,250 ft.**	**11.0**	**9.0 inches**	**0.00 ft AC Overlay**
SB Shoulder	3,560 ft. – 4,900 ft.	11.0	6.0 inches	0.00 ft AC Overlay

Note:

**The bold item above represents the controlling design section for this segment of roadway. In this case the travel lanes are the controlling lanes for the design.

This section of road starts at Vineyard Avenue and continues South to the pavement change just north of Vallecictos Blvd. and consists of two different structural section as outlined in the table above. The photo above shows the condition of the road on the day of testing.

Testing was completed in both directions of travel, in both the travel lanes and on the shoulders (future travel lanes).

CHEC's Design Recommendation

For this section of road to satisfy both the structural and reflective cracking requirements of the design procedure we recommend:

Because the structural overlay requirement for this section of highway is 0.00 ft. in all lanes tested, the reflective cracking control becomes the controlling factor of this design. Because the specific alignment is unknown the design that will satisfy all lanes reflective crack control requirements is to overlay this section of highway with 4.5 inches of standard asphalt concrete (AC) or 0.375 ft. of AC.

CHEC's Alternate Design A

Because reflective cracking is the controlling factor for this section design, the use of pavement reinforcing fabric/mat can be highly beneficial. The CALTRANS Flexible Pavement Rehabilitation Design Manual allows a reduction of 0.10ft of dense grade asphalt thickness when fabric is utilized to control reflective cracking.

For this design we highly recommend utilizing a paving fabric, such as TruPave, to help retard reflective cracking and allow the pavement section to be decreased by 0.10 ft. of AC. This would be more cost effective than the design that does not utilize a pavement reinforcing fabric. So the "Alternate Design A" for this section of highway is to place a 0.30 ft of AC over a Paving Mat (TruPave). (3.6 inches of AC)

The TruPave fabric is recommended because of the recycling capabilities, and the fact that disposal of the asphalt with TruPave fabric does not have an increase in cost over asphalt alone, saving future rehabilitation dollars.

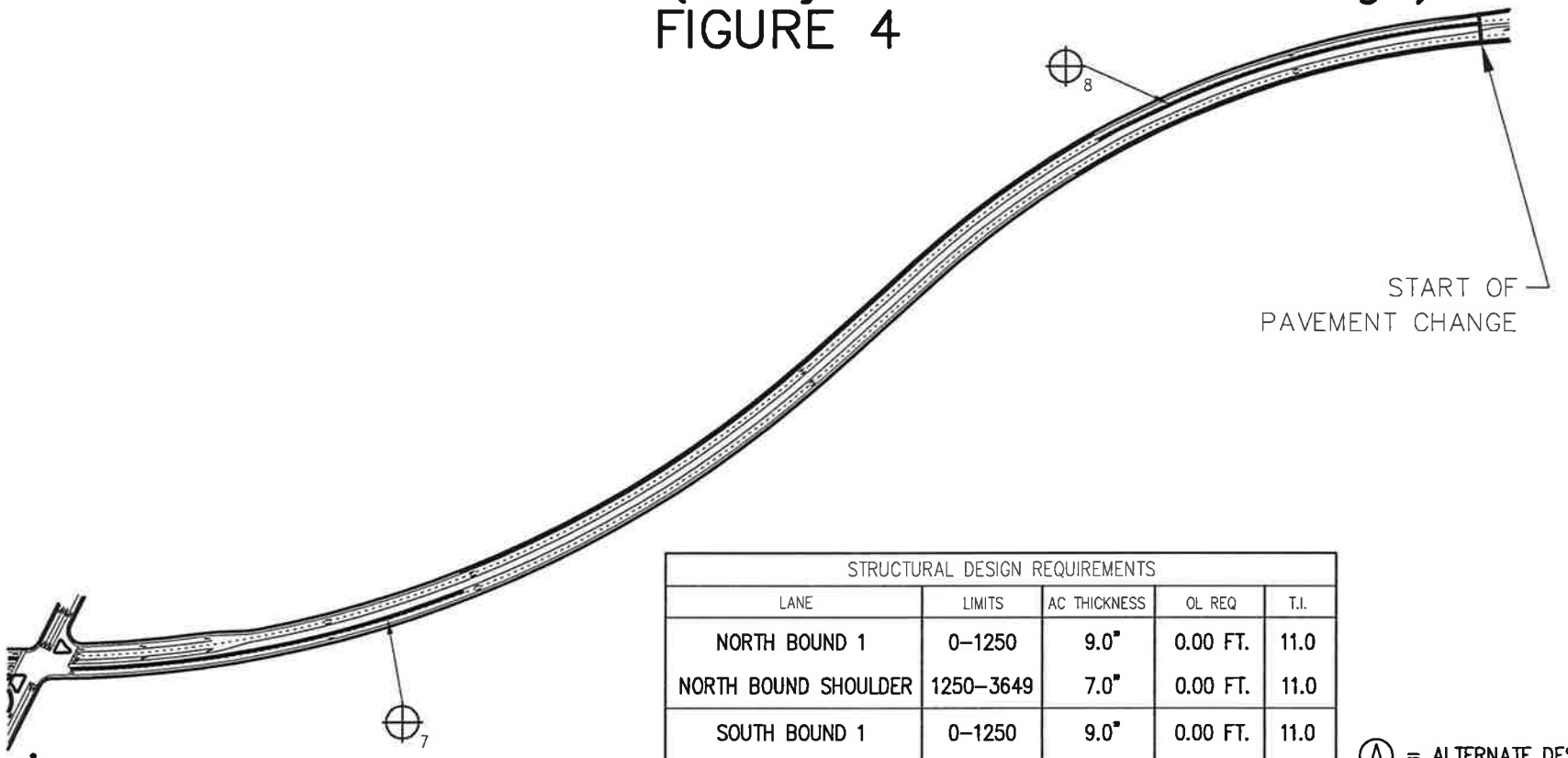
CHEC's Alternate Design B

Another option when dealing with reflective cracking control would be to utilize Rubberized Asphalt Concrete. So the "Alternate Design B" for this section of highway is to place a 0.25 ft of RAC over the existing surface. (3.0 inches of RAC)

HIGHWAY 84

PAVEMENT TESTING (Vineyard to Pvmnt Change)

FIGURE 4



STRUCTURAL DESIGN REQUIREMENTS				
LANE	LIMITS	AC THICKNESS	OL REQ	T.I.
NORTH BOUND 1	0–1250	9.0"	0.00 FT.	11.0
NORTH BOUND SHOULDER	1250–3649	7.0"	0.00 FT.	11.0
SOUTH BOUND 1	0–1250	9.0"	0.00 FT.	11.0
SOUTH BOUND SHOULDER	3560–4900	6.0"	0.00 FT.	11.0

Ⓐ = ALTERNATE DESIGN "A"

Ⓑ = ALTERNATE DESIGN "B"

OVERALL SECTION DESIGN				
LANE	BASIS	EXISTING AC	OL MATERIAL	OL THICKNESS
NORTH BOUND	REFLECTIVE CRACKING	9.0"	STD AC	4.5" or .375'
Ⓐ NORTH BOUND	REFLECTIVE CRACKING	9.0"	AC W/ FABRIC	3.6" or .30'
Ⓑ NORTH BOUND	REFLECTIVE CRACKING	9.0"	RAC	3.0" or .25'
SOUTH BOUND	REFLECTIVE CRACKING	9.0"	STD AC	4.5" or .375'
Ⓐ SOUTH BOUND	REFLECTIVE CRACKING	9.0"	AC W/ FABRIC	3.6" or .30'
Ⓑ SOUTH BOUND	REFLECTIVE CRACKING	9.0"	RAC	3.0" or .25'

#	THICKNESS	BASE
7	9"	3/4"
8	9"	3/4"

NOT TO SCALE

LEGEND

⊕# = CORE TEST

▬ = PAVEMENT TESTING

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

VINYARD - PVMT CHNG ...x|....

SB: 0 - 1250	Reading	Plot	Comment
Interval 0	25.00	5	
Interval 50	33.00	7	
Interval 100	56.00	12	
Interval 150	38.00	8	
Interval 200	29.00	6	
Interval 250	32.00	7	
Interval 300	27.00	6	
Interval 350	27.00	6	
Interval 400	24.00	5	
Interval 450	26.00	6	
Interval 500	28.00	6	
Interval 550	27.00	6	
Interval 600	25.00	5	
Interval 650	28.00	6	
Interval 700	25.00	5	
Interval 750	24.00	5	
Interval 800	22.00	5	
Interval 850	25.00	5	
Interval 900	22.00	5	
Interval 950	28.00	6	
Interval 1000	32.00	7	
Interval 1050	26.00	6	
Interval 1100	29.00	6	
Interval 1150	19.00	4	
Interval 1200	28.00	6	
Interval 1250	29.00	6	

STATISTICAL ANALYSIS

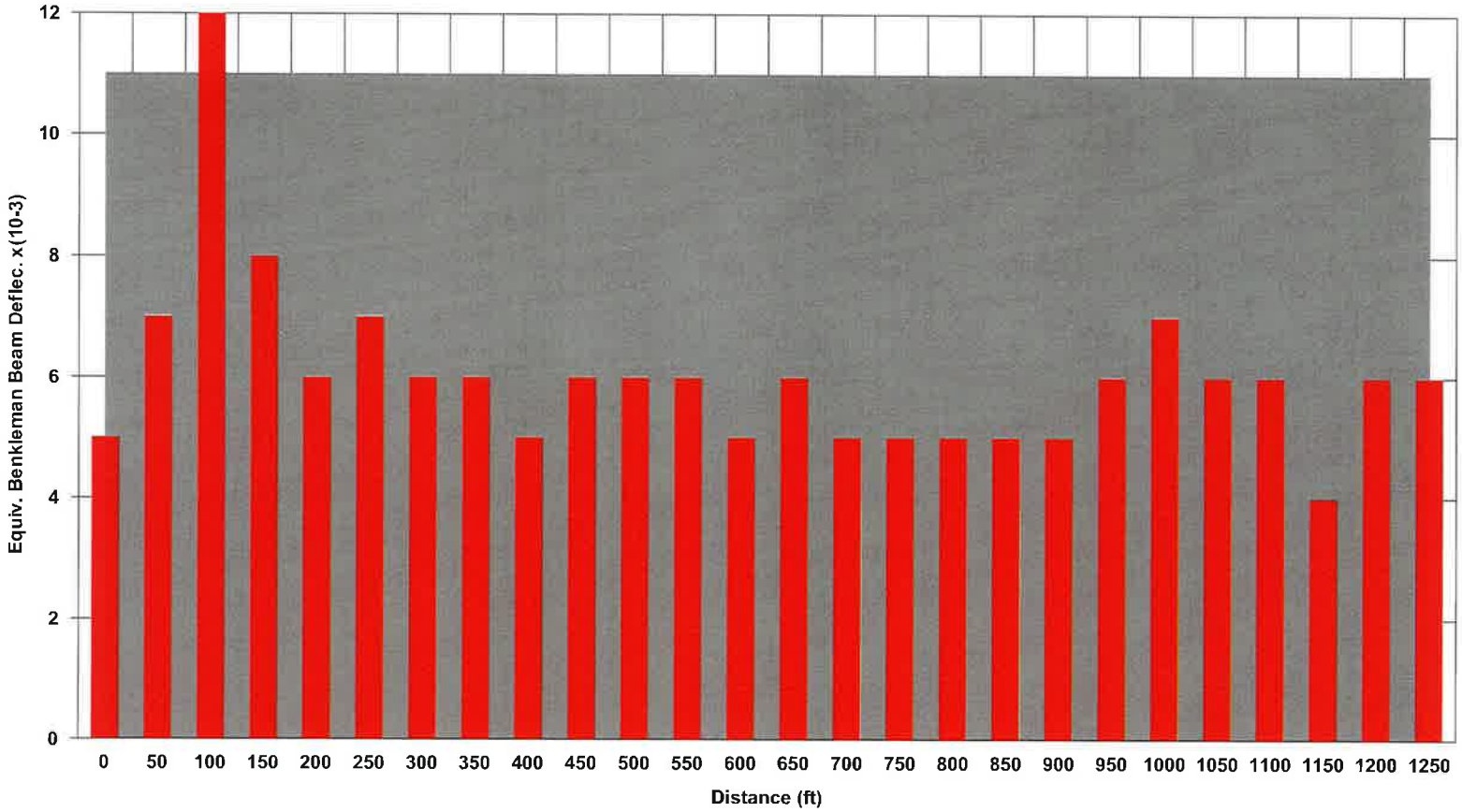
80th %	90th %	Mean	Min	Max
7	8	6	4	12

STRUCTURAL DATA **Thickness:** 9.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
7	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR 84 S HW Direction: S(...x|....) Start: 0 Interval: 50 ft
Road Number: SB: 0 - 1250 From: VINYARD AV To: PVMT CHNG

STATISTICAL ANALYSIS AS TESTED 80th %: 7 90th %: 8 Mean: 6 Min: 4 Max: 12

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 7 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

VINYARD - PVMT CHNG ...x|....

SBSH: 3560 - 4900	Reading	Plot	Comment
Interval 3650	36.00	8	
Interval 3700	39.00	8	
Interval 3750	42.00	9	
Interval 3800	43.00	9	
Interval 3850	43.00	9	
Interval 3900	46.00	10	
Interval 3950	45.00	10	
Interval 4000	46.00	10	
Interval 4050	40.00	9	
Interval 4100	45.00	10	
Interval 4150	53.00	11	
Interval 4200	47.00	10	
Interval 4250	44.00	10	
Interval 4300	45.00	10	
Interval 4350	43.00	9	
Interval 4400	41.00	9	
Interval 4450	39.00	8	
Interval 4500	44.00	10	
Interval 4550	41.00	9	
Interval 4600	43.00	9	
Interval 4650	33.00	7	
Interval 4700	36.00	8	
Interval 4750	42.00	9	
Interval 4800	37.00	8	
Interval 4850	37.00	8	

STATISTICAL ANALYSIS

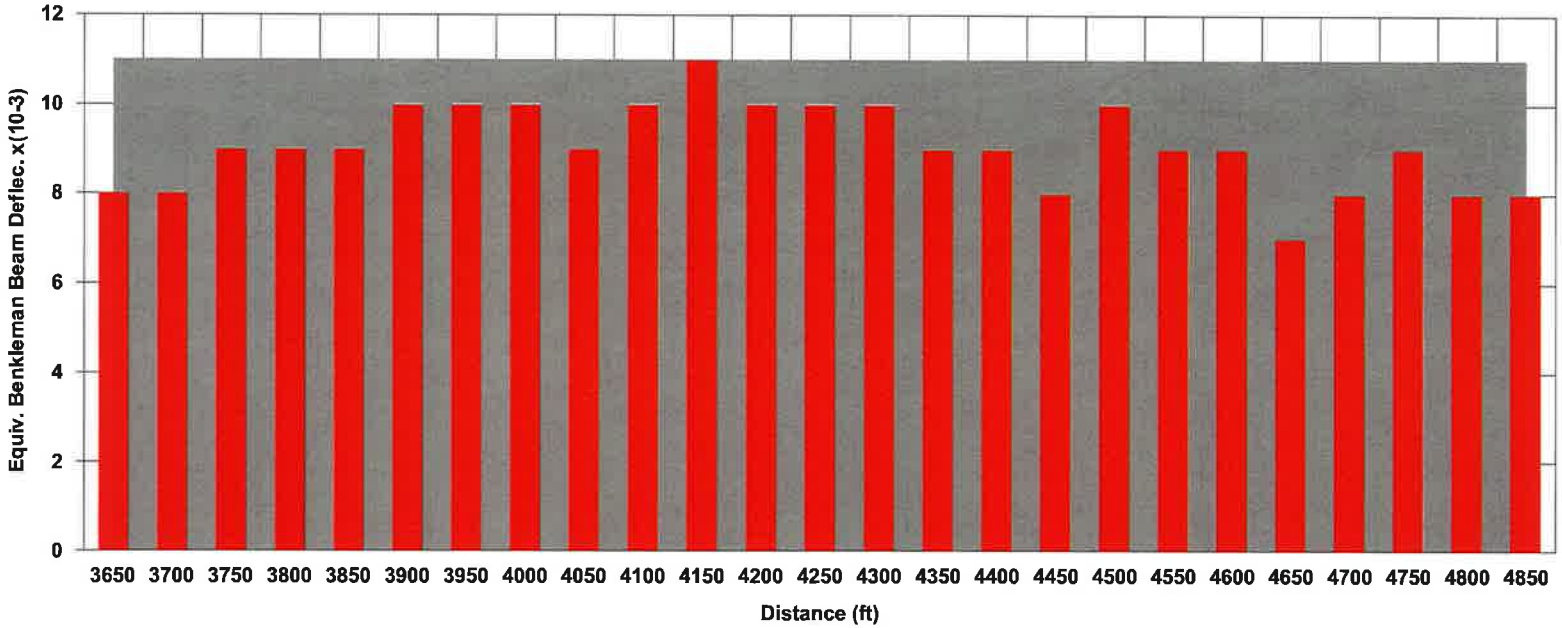
80th %	90th %	Mean	Min	Max
10	10	9	7	11

STRUCTURAL DATA **Thickness:** 6.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
10	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Deflection Data Tolerable Limit

Road Name: SR 84 S HW Direction: S(...x|....) Start: 3650 Interval: 50 ft
Road Number: SBSH: 3560 - 4900 From: VINYARD AV To: PVMT CHNG

STATISTICAL ANALYSIS AS TESTED 80th %: 10 90th %: 10 Mean: 9 Min: 7 Max: 11

STRUCTURAL DATA Thickness: 6.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 10 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

PVMT CHNG - VINYARD ....|x...

NB: 0 - 1250	Reading	Plot	Comment
Interval 0	26.00	6	
Interval 50	23.00	5	
Interval 100	20.00	4	
Interval 150	19.00	4	
Interval 200	24.00	5	
Interval 250	23.00	5	
Interval 300	23.00	5	
Interval 350	21.00	5	
Interval 400	26.00	6	
Interval 450	27.00	6	
Interval 500	32.00	7	
Interval 550	31.00	7	
Interval 600	33.00	7	
Interval 650	32.00	7	
Interval 700	31.00	7	
Interval 750	31.00	7	
Interval 800	37.00	8	
Interval 850	40.00	9	
Interval 900	48.00	10	
Interval 950	37.00	8	
Interval 1000	38.00	8	
Interval 1050	33.00	7	
Interval 1100	36.00	8	
Interval 1150	36.00	8	
Interval 1200	36.00	8	
Interval 1250	35.00	8	

STATISTICAL ANALYSIS

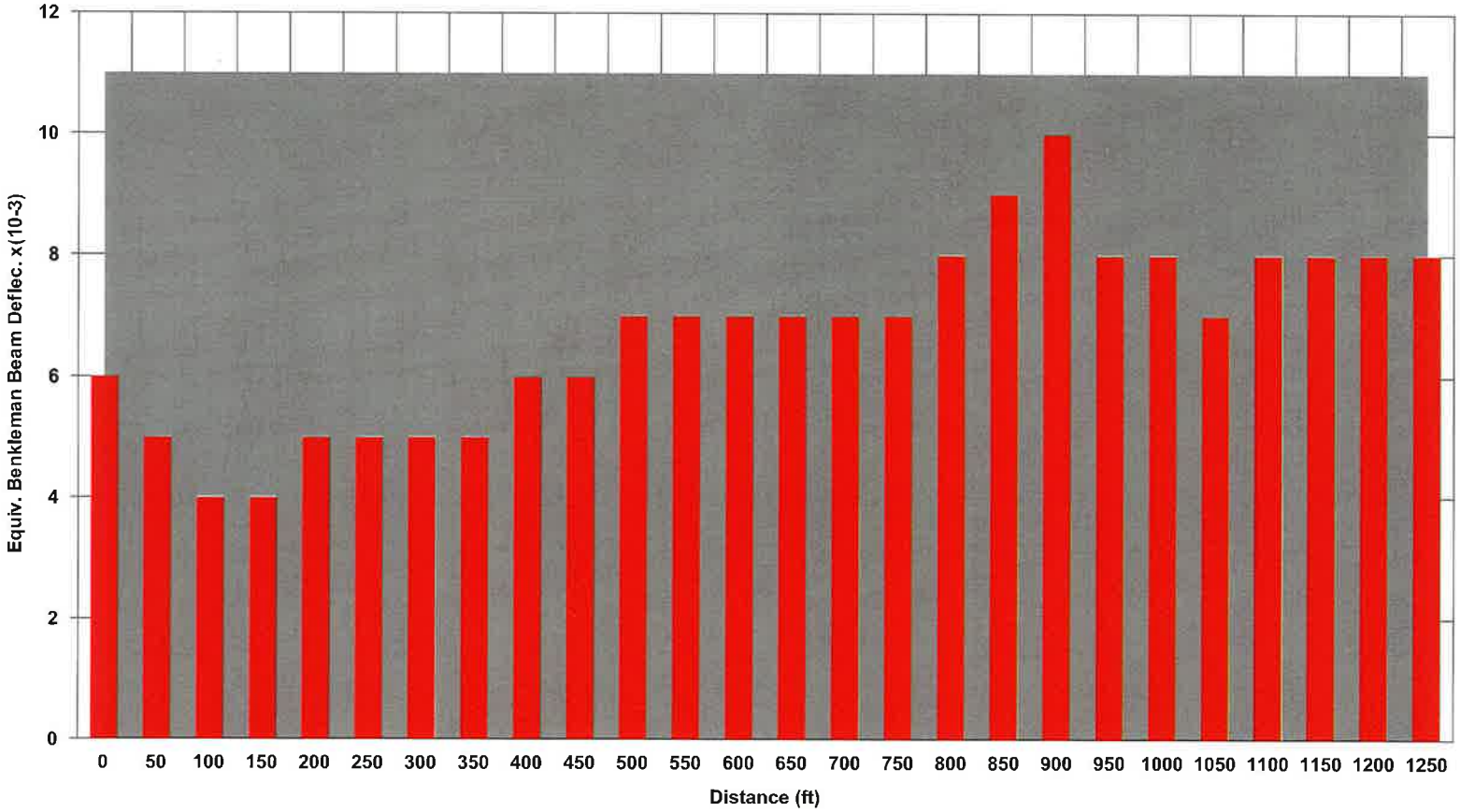
80th %	90th %	Mean	Min	Max
8	9	7	4	10

STRUCTURAL DATA **Thickness:** 9.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
8	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR N 84 HW Direction: N(....|x...) Start: 0 Interval: 50 ft
Road Number: NB: 0 - 1250 From: PVMT CHNG To: VINYARD AV

STATISTICAL ANALYSIS AS TESTED 80th %: 8 90th %: 9 Mean: 7 Min: 4 Max: 10

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 8 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

PVMT CHNG - VINYARD ....|x...

NBSH: 1250 - 3649	Reading	Plot	Comment
Interval 0	37.00	8	
Interval 1300	38.00	8	
Interval 1350	39.00	8	
Interval 1400	45.00	10	
Interval 1450	43.00	9	
Interval 1500	40.00	9	
Interval 1550	41.00	9	
Interval 1600	45.00	10	
Interval 1650	46.00	10	
Interval 1700	52.00	11	
Interval 1750	43.00	9	
Interval 1800	50.00	11	
Interval 1850	44.00	10	
Interval 1900	48.00	10	
Interval 1950	41.00	9	
Interval 2000	44.00	10	
Interval 2050	43.00	9	
Interval 2100	47.00	10	
Interval 2150	43.00	9	
Interval 2200	43.00	9	
Interval 2250	53.00	11	
Interval 2300	53.00	11	
Interval 2350	51.00	11	
Interval 2400	47.00	10	
Interval 2450	45.00	10	
Interval 2500	42.00	9	
Interval 2550	37.00	8	
Interval 2600	39.00	8	
Interval 2650	46.00	10	
Interval 2700	45.00	10	
Interval 2750	54.00	12	
Interval 2800	43.00	9	
Interval 2850	48.00	10	

STATISTICAL ANALYSIS

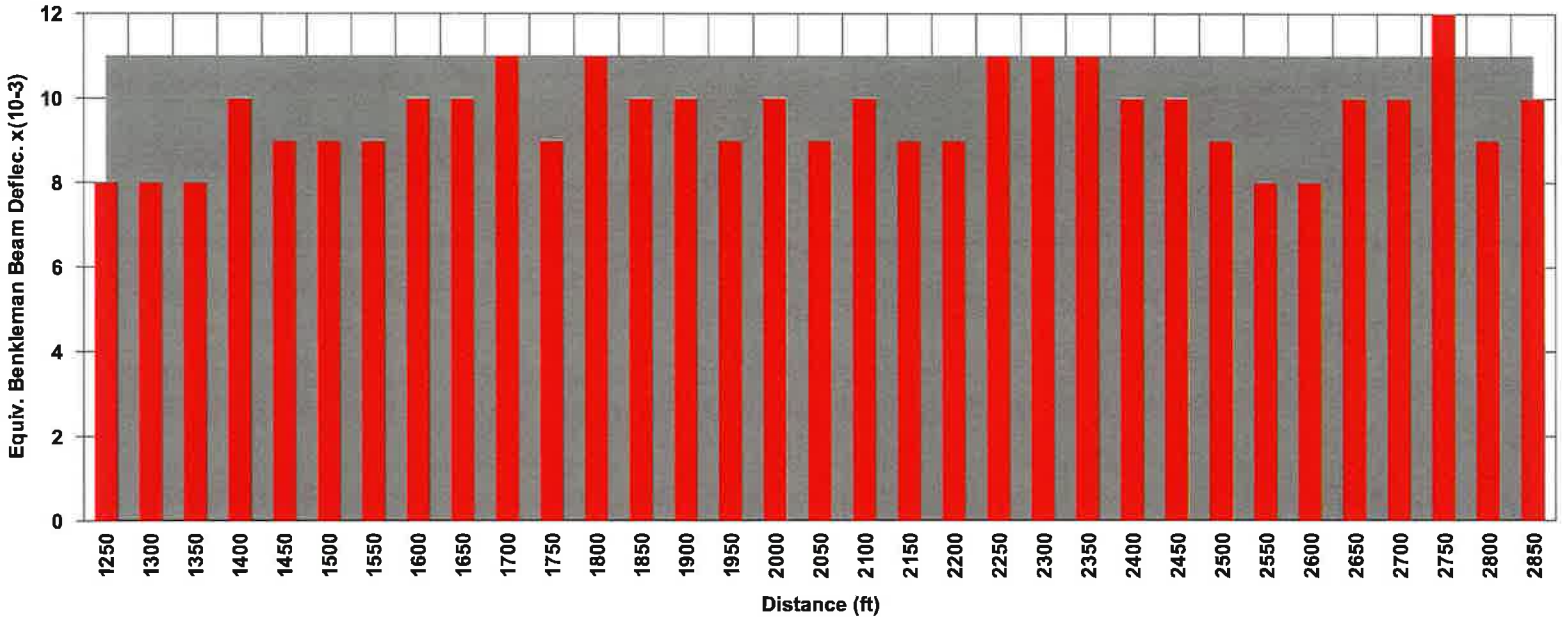
80th %	90th %	Mean	Min	Max
10	11	10	8	12

STRUCTURAL DATA Thickness: 7.00 TI: 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
10	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Deflection Data Tolerable Limit

Road Name: SR N 84 HW Direction: N(....|x...) Start: 1250 Interval: 50 ft
Road Number: NBSH: 1250 - 3649 From: PVMT CHNG To: VINYARD AV

STATISTICAL ANALYSIS AS TESTED 80th %: 10 90th %: 11 Mean: 10 Min: 8 Max: 12

STRUCTURAL DATA Thickness: 7.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 10 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

SR 84 - Livermore

Pavement Change North of Vallecictos Blvd.

to

Pavement Change South of Vallecictos Blvd.

Area Description	Limits	Traffic Index	Existing AC Thickness	CTM OL Requirement
****NB Shoulder**	**0 ft. – 1,255 ft.**	**11.0**	**9.0 inches**	**0.00 ft AC Overlay**
SB Shoulder	5,560 ft. – 6,640 ft.	11.0	6.0 inches	0.00 ft AC Overlay

Note:

**The bold item above represents the controlling design section for this segment of roadway.

This section of road starts at the pavement change, just north of Vallecictos Boulevard, and continues south past Vallecictos Boulevard to the other pavement change limit. This highway section consists of different structural

section for each shoulder as outlined in the table above. The photo above shows the condition of the road on the day of testing.

Testing was completed on both shoulders.

CHEC's Design Recommendation

For this section of highway, to satisfy both the structural and reflective cracking requirements of the design procedure we recommend the following rehabilitation action.

Because the structural overlay requirement for this section of highway is 0.00 ft. in all lanes tested, the reflective cracking control becomes the controlling factor of this design. Because the specific alignment is unknown the design that will satisfy all lanes reflective crack control requirements is to overlay this section of highway with 4.5 inches of standard asphalt concrete (AC) or 0.375 ft. of AC. The northbound shoulder is the controlling lane for this section of highway.

CHEC's Alternate Design A

Because reflective cracking is the controlling factor for this section design, the use of pavement reinforcing fabric/mat can be highly beneficial. The CALTRANS Flexible Pavement Rehabilitation Design Manual allows a reduction of 0.10ft of dense grade asphalt thickness when fabric is utilized to control reflective cracking.

For this design we highly recommend utilizing a paving fabric, such as TruPave, to help retard reflective cracking and allow the pavement section to be decreased by 0.10 ft. of AC. This would be more cost effective than the design that does not utilize a pavement reinforcing fabric. So the "Alternate Design A" for this section of highway is to place a 0.30 ft of AC over a Paving Mat (TruPave). (3.6 inches of AC)

The TruPave fabric is recommended because of the recycling capabilities, and the fact that disposal of the asphalt with TruPave fabric does not have an increase in cost over asphalt alone, saving future rehabilitation dollars.

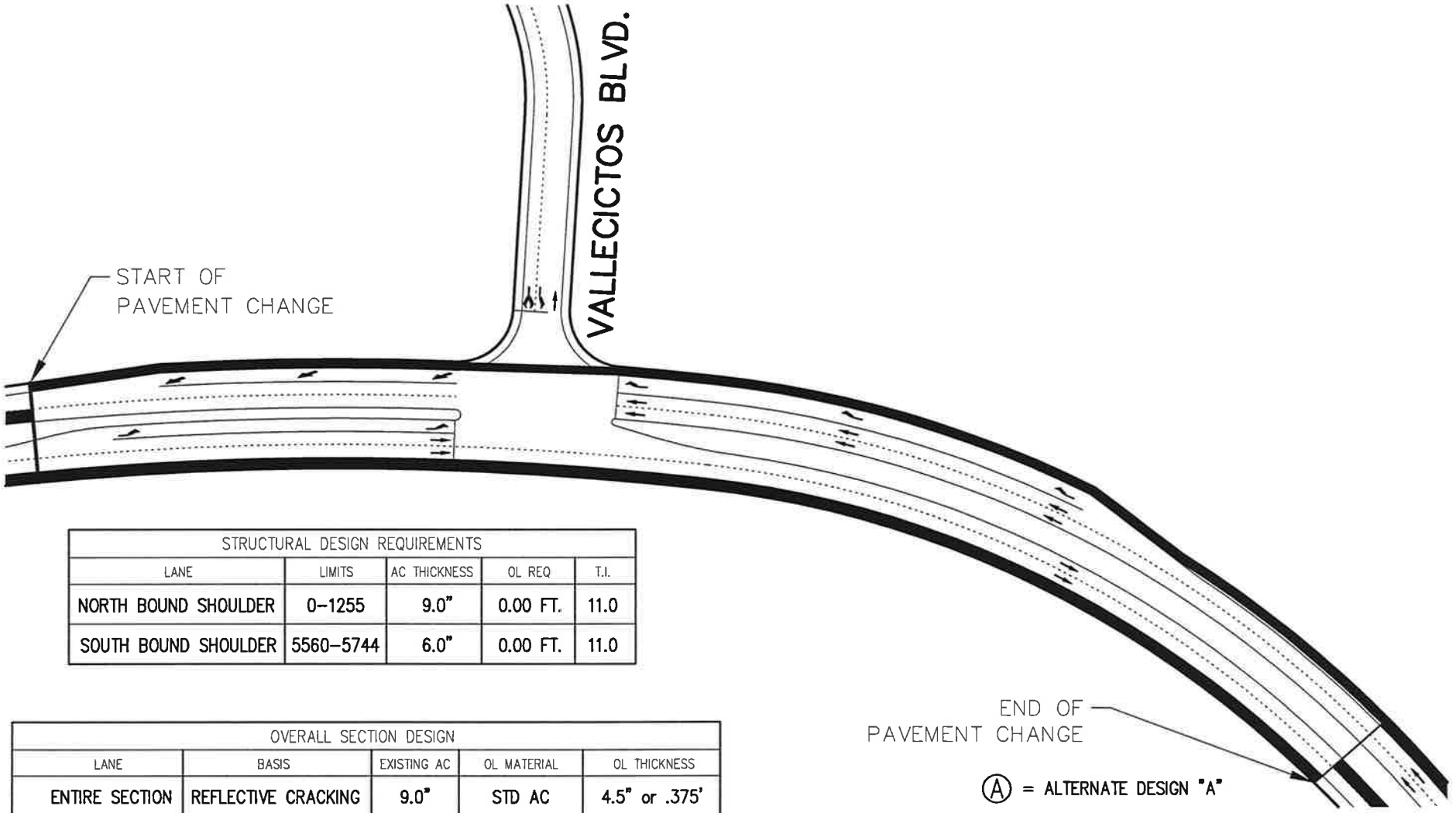
CHEC's Alternate Design B

Another option when dealing with reflective cracking control would be to utilize Rubberized Asphalt Concrete. So the "Alternate Design B" for this section of highway is to place a 0.25 ft of RAC over the existing surface. (3.0 inches of RAC)

HIGHWAY 84

PAVEMENT TESTING (Pvmnt Change to Pvmnt Change)

FIGURE 5



STRUCTURAL DESIGN REQUIREMENTS				
LANE	LIMITS	AC THICKNESS	OL REQ	T.I.
NORTH BOUND SHOULDER	0–1255	9.0"	0.00 FT.	11.0
SOUTH BOUND SHOULDER	5560–5744	6.0"	0.00 FT.	11.0

OVERALL SECTION DESIGN				
LANE	BASIS	EXISTING AC	OL MATERIAL	OL THICKNESS
ENTIRE SECTION	REFLECTIVE CRACKING	9.0"	STD AC	4.5" or .375'
Ⓐ ENTIRE SECTION	REFLECTIVE CRACKING	9.0"	AC W/ FABRIC	3.6" or .30'
Ⓑ ENTIRE SECTION	REFLECTIVE CRACKING	9.0"	RAC	3.0" or .25'

Ⓐ = ALTERNATE DESIGN "A"

Ⓑ = ALTERNATE DESIGN "B"

LEGEND

= PAVEMENT TESTING

NOT TO SCALE

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

PVMT CHNG - END PVMT CHNG ...x|....

SBSH: 5560 - 5744	Reading	Plot	Comment
Interval 5560	34.00	7	
Interval 5600	34.00	7	
Interval 5640	16.00	3	
Interval 5680	15.00	3	
Interval 5720	15.00	3	
Interval 5760	17.00	4	
Interval 5800	17.00	4	
Interval 5840	19.00	4	
Interval 5880	19.00	4	
Interval 5920	19.00	4	
Interval 5960	17.00	4	
Interval 6000	20.00	4	
Interval 6040	15.00	3	
Interval 6080	16.00	3	
Interval 6120	17.00	4	
Interval 6160	19.00	4	
Interval 6200	40.00	9	
Interval 6240	22.00	5	
Interval 6280	18.00	4	
Interval 6320	16.00	3	
Interval 6360	14.00	3	
Interval 6400	15.00	3	
Interval 6440	14.00	3	
Interval 6480	14.00	3	
Interval 6520	13.00	3	
Interval 6560	15.00	3	
Interval 6600	17.00	4	
Interval 6640	14.00	3	

STATISTICAL ANALYSIS

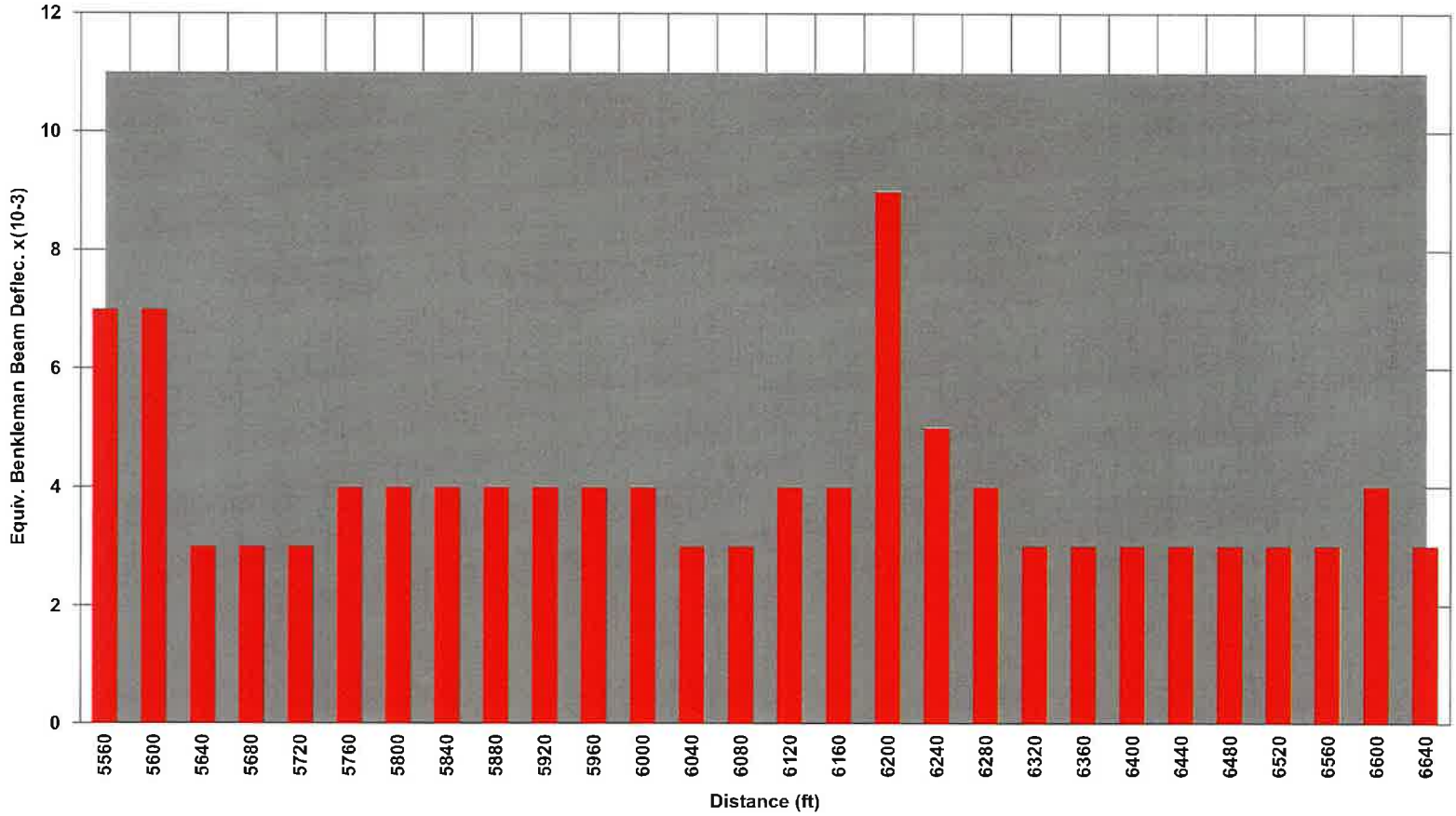
80th %	90th %	Mean	Min	Max
5	6	4	3	9

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
5	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR 84 S HW Direction: S(...x|....) Start: 5560 Interval: 40 ft
Road Number: SBSH: 5560 - 5744 From: PVMT CHNG To: END PVMT CHNG

STATISTICAL ANALYSIS AS TESTED 80th %: 5 90th %: 6 Mean: 4 Min: 3 Max: 9

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 5 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

END PVMT CHNG - PVMT CHNG ....|x...

NBSH: 0 - 1255	Reading	Plot	Comment
Interval 0	18.00	4	
Interval 50	20.00	4	
Interval 100	23.00	5	
Interval 150	23.00	5	
Interval 200	20.00	4	
Interval 250	24.00	5	
Interval 300	23.00	5	
Interval 350	26.00	6	
Interval 400	25.00	5	
Interval 450	25.00	5	
Interval 500	27.00	6	
Interval 550	32.00	7	
Interval 600	21.00	5	
Interval 650	20.00	4	
Interval 700	18.00	4	
Interval 750	21.00	5	
Interval 800	20.00	4	
Interval 850	18.00	4	
Interval 900	20.00	4	
Interval 950	20.00	4	
Interval 1000	18.00	4	
Interval 1050	18.00	4	
Interval 1100	20.00	4	
Interval 1150	29.00	6	
Interval 1200	39.00	8	
Interval 1250	43.00	9	

STATISTICAL ANALYSIS

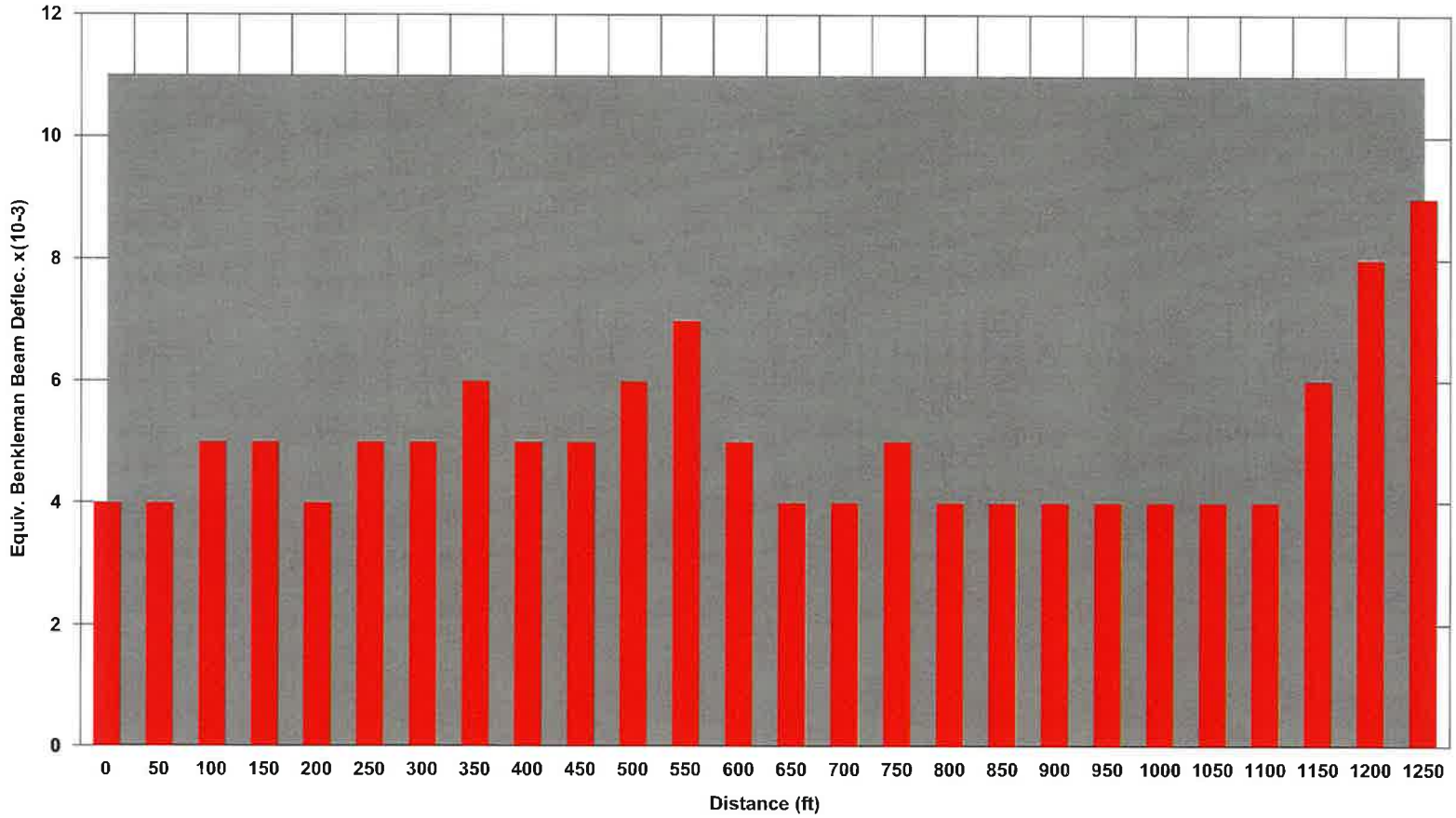
80th %	90th %	Mean	Min	Max
6	7	5	4	9

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
6	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR N 84 HW Direction: N(....|x...) Start: 0 Interval: 50 ft
Road Number: NBSH: 0 - 1255 From: END PVMT CHNG To: PVMT CHNG

STATISTICAL ANALYSIS AS TESTED 80th %: 6 90th %: 7 Mean: 5 Min: 4 Max: 9

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 6 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

SR 84 - Livermore

Pavement Change South of Vallecictos Blvd. to Ruby Hill Road

Area Description	Limits	Traffic Index	Existing AC Thickness	CTM OL Requirement
****NB Shoulder**	**2640 ft. – 3960 ft.**	**11.0**	**9.0 inches**	**0.25 ft AC Overlay**
SB Shoulder	2640 ft. – 3960 ft.	11.0	7.5 inches	0.00 ft AC Overlay

Note:

**The bold item above represents the controlling design section for this segment of roadway.

This section of road starts at the Pavement Change south of Vallecictos Blvd. and continues south to Ruby Hill Road. This highway sections consists of different structural section for each lane of travel as outlined in the table above. We also found that the North Bound Shoulder was not structurally adequate for the design traffic index value of 11.0. The photo above shows the condition of the road on the day of testing.

When comparing the structural overlay design requirement to the overlay requirement to control the reflective, the reflective cracking requirement is thicker and therefore is the controlling factor of this sections design.

Testing was completed in both directions of travel on the shoulders. This was defined in the proposal as potential future lanes of travel, and has the highest probability that the shoulders are not originally designed to withstand the traffic loadings of a traffic index value of 11.0.

CHEC's Design Recommendation

For this section of road to satisfy both the structural and reflective cracking requirements of the design procedure we recommend:

Because the structural overlay requirement for this section of highway is 0.25 ft. on the northbound shoulder and the reflective cracking control overlay requirement is a thickness of .375 ft. of dense grade asphalt , the reflective cracking control becomes the controlling factor of this design. Because the specific alignment is unknown the design that will satisfy all lanes reflective crack control requirements is to overlay this section of highway with 4.5 inches of standard asphalt concrete (AC) or 0.375 ft. of AC.

CHEC's Alternate Design A

Because reflective cracking is the controlling factor for this section design, the use of pavement reinforcing fabric/mat can be highly beneficial. The CALTRANS Flexible Pavement Rehabilitation Design Manual allows a reduction of 0.10ft of dense grade asphalt thickness when fabric is utilized to control reflective cracking.

For this design we highly recommend utilizing a paving fabric, such as TruPave, to help retard reflective cracking and allow the pavement section to be decreased by 0.10 ft. of AC. This would be more cost effective than the design that does not utilize a pavement reinforcing fabric. So the "Alternate Design A" for this section of highway is to place a 0.30 ft of AC over a Paving Mat (TruPave). (3.6 inches of AC) This design still satisfies both the structural and reflective cracking requirements.

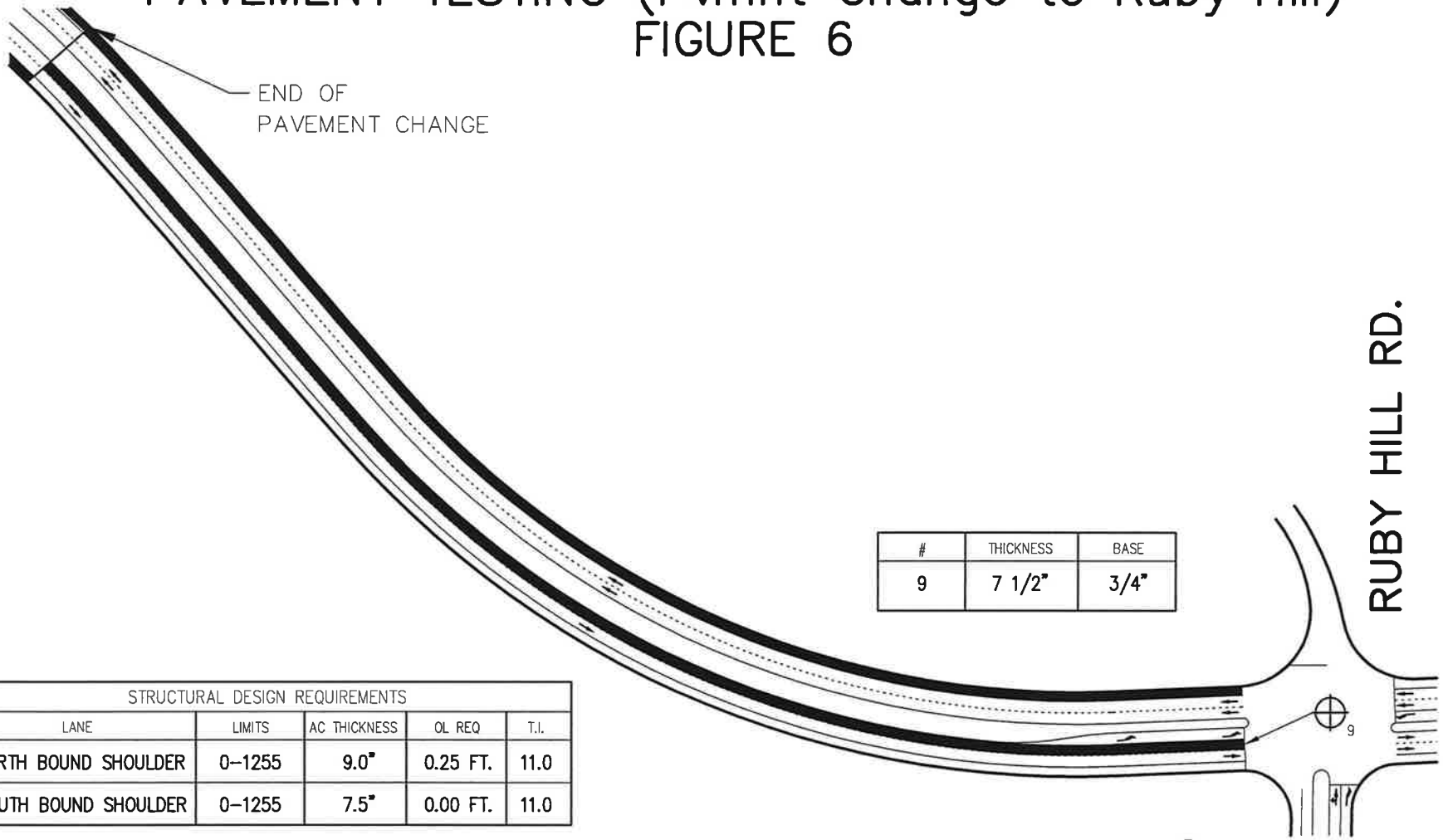
The TruPave fabric is recommended because of the recycling capabilities, and the fact that disposal of the asphalt with TruPave fabric does not have an increase in cost over asphalt alone, saving future rehabilitation dollars.

CHEC's Alternate Design B

Another option when dealing with reflective cracking control would be to utilize Rubberized Asphalt Concrete. So the "Alternate Design B" for this section of highway is to place a 0.30 ft of RAC over the existing surface. (3.6 inches of RAC) A paving fabric is not required and the structural requirement of a minimum of 0.25 ft. of AC or RAC is still met.

HIGHWAY 84

PAVEMENT TESTING (Pvmnt Change to Ruby Hill)
FIGURE 6



#	THICKNESS	BASE
9	7 1/2"	3/4"

STRUCTURAL DESIGN REQUIREMENTS				
LANE	LIMITS	AC THICKNESS	OL REQ	T.I.
NORTH BOUND SHOULDER	0–1255	9.0"	0.25 FT.	11.0
SOUTH BOUND SHOULDER	0–1255	7.5"	0.00 FT.	11.0

OVERALL SECTION DESIGN				
LANE	BASIS	EXISTING AC	OL MATERIAL	OL THICKNESS
ENTIRE SECTION	REFLECTIVE CRACKING	9.0"	STD AC	4.5" or .375'
Ⓐ ENTIRE SECTION	REFLECTIVE CRACKING	9.0"	AC W/ FABRIC	3.6" or .30'
Ⓑ ENTIRE SECTION	REFLECTIVE CRACKING	9.0"	RAC	3.6" or .30'

Ⓐ = ALTERNATE DESIGN "A"

Ⓑ = ALTERNATE DESIGN "B"

LEGEND

⊕# = CORE TEST

▬ = PAVEMENT TESTING

NOT TO SCALE

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW

END PVMT CHNG - RUBY HILL ...x|....

SB1: 0 - 1255	Reading	Plot	Comment
Interval 0	41.00	9	
Interval 50	37.00	8	
Interval 100	48.00	10	
Interval 150	45.00	10	
Interval 200	46.00	10	
Interval 250	39.00	8	
Interval 300	28.00	6	
Interval 350	33.00	7	
Interval 400	40.00	9	
Interval 450	39.00	8	
Interval 500	45.00	10	
Interval 550	39.00	8	
Interval 600	30.00	6	
Interval 650	56.00	12	
Interval 700	41.00	9	
Interval 750	43.00	9	
Interval 800	54.00	12	
Interval 850	42.00	9	
Interval 900	36.00	8	
Interval 950	37.00	8	
Interval 1000	43.00	9	
Interval 1050	54.00	12	
Interval 1100	51.00	11	
Interval 1150	52.00	11	
Interval 1200	48.00	10	
Interval 1250	41.00	9	

STATISTICAL ANALYSIS

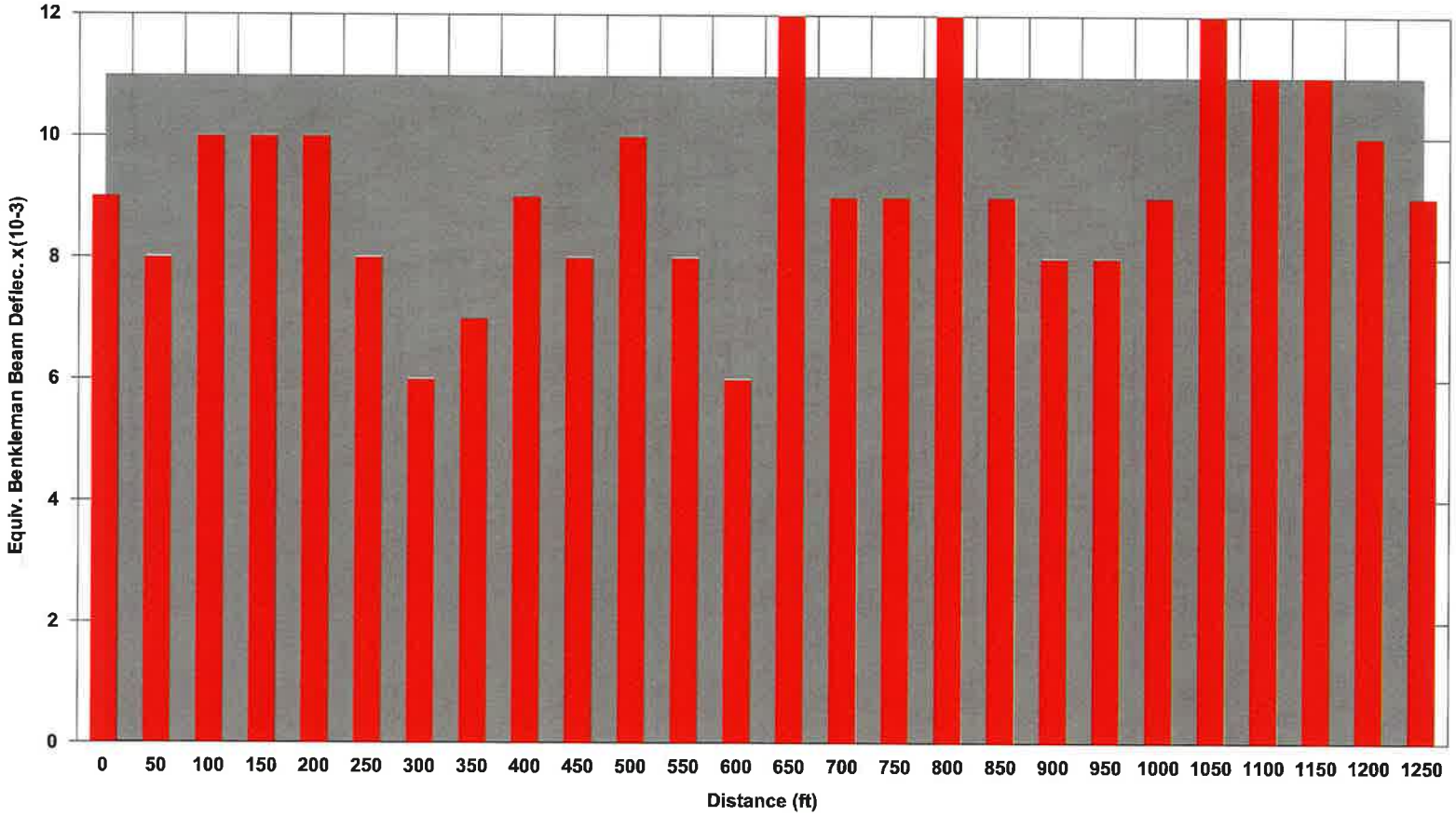
80th %	90th %	Mean	Min	Max
11	11	9	6	12

STRUCTURAL DATA Thickness: 7.50 TI: 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
11	11	0	0.00

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR 84 S HW Direction: S(...x|....) Start: 0 Interval: 50 ft
Road Number: SB1: 0 - 1255 From: END PVMT CHNG To: RUBY HILL DR

STATISTICAL ANALYSIS AS TESTED 80th %: 11 90th %: 11 Mean: 9 Min: 6 Max: 12

STRUCTURAL DATA Thickness: 7.50 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 11 Tolerable: 11 % Reduction: 0 Overlay: 0.00 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW

RUBY HILL - END PVMT CHNG ....|x...

NB,SH 0 - 1255	Reading	Plot	Comment
Interval 0	53.00	11	
Interval 50	56.00	12	
Interval 100	57.00	12	
Interval 150	55.00	12	
Interval 200	53.00	11	
Interval 250	51.00	11	
Interval 300	51.00	11	
Interval 350	53.00	11	
Interval 400	62.00	13	
Interval 450	57.00	12	
Interval 500	61.00	13	
Interval 550	56.00	12	
Interval 600	52.00	11	
Interval 650	75.00	16	
Interval 700	68.00	15	
Interval 750	67.00	14	
Interval 800	75.00	16	
Interval 850	98.00	21	
Interval 900	86.00	19	
Interval 950	116.00	25	
Interval 1000	99.00	21	
Interval 1050	107.00	23	
Interval 1100	87.00	19	
Interval 1150	32.00	7	
Interval 1200	31.00	7	
Interval 1250	25.00	5	

STATISTICAL ANALYSIS

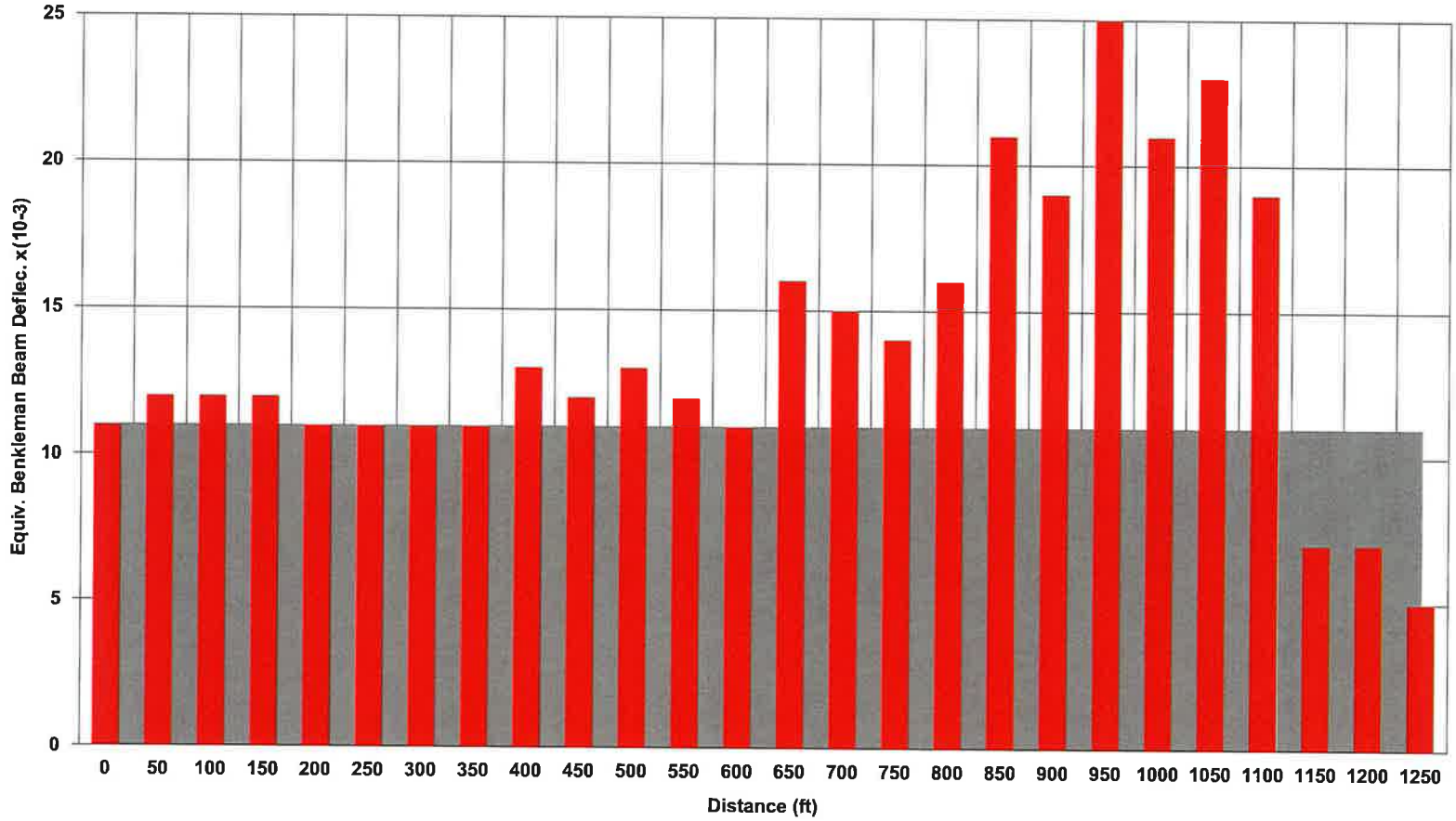
80th %	90th %	Mean	Min	Max
18	20	14	5	25

STRUCTURAL DATA **Thickness:** 9.00 **TI:** 11.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
18	11	39	0.25

Dynaflect Analysis
URS
Hwy. 84 Livermore



Road Name: SR N 84 HW Direction: N(....|x...) Start: 0 Interval: 50 ft
Road Number: NB,SH 0 - 1255 From: RUBY HILL DR To: END PVMT CHNG

STATISTICAL ANALYSIS AS TESTED 80th %: 18 90th %: 20 Mean: 14 Min: 5 Max: 25

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN AS TESTED Deflection: 18 Tolerable: 11 % Reduction: 39 Overlay: 0.25 ft

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR 84 S HW
CONNANNON - VINYARD
SB,SH 1056 - 2112

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	6	6	5	2	7

STRUCTURAL DATA Thickness: 6.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	6	11	0	0.00

ROAD: SR 84 S HW
VINYARD - PVMT CHNG
SB: 0 - 1250

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	7	8	6	4	12

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	7	11	0	0.00

ROAD: SR 84 S HW
VINYARD - PVMT CHNG
SBSH: 3560 - 4900

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	10	10	9	7	11

STRUCTURAL DATA Thickness: 6.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	10	11	0	0.00

ROAD: SR 84 S HW
PVMT CHNG - END PVMT CHNG
SBSH: 5560 - 5744

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	5	6	4	3	9

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	5	11	0	0.00

ROAD: SR 84 S HW
END PVMT CHNG - RUBY HILL
SB1: 0 - 1255

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	11	11	9	6	12

STRUCTURAL DATA Thickness: 7.50 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	11	11	0	0.00

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW
RUBY HILL - END PVMT CHNG
NB,SH 0 - 1255

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	18	20	14	5	25

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	18	11	39	0.25

ROAD: SR N 84 HW
END PVMT CHNG - PVMT CHNG
NBSH: 0 - 1255

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	6	7	5	4	9

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	6	11	0	0.00

ROAD: SR N 84 HW
PVMT CHNG - VINYARD
NB: 0 - 1250

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	8	9	7	4	10

STRUCTURAL DATA Thickness: 9.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	8	11	0	0.00

ROAD: SR N 84 HW
PVMT CHNG - VINYARD
NBSH: 1250 - 3649

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	10	11	10	8	12

STRUCTURAL DATA Thickness: 7.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	10	11	0	0.00

ROAD: SR N 84 HW
VINYARD - CONNANNON
NB1: 0 - 1056

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	7	8	6	3	10

STRUCTURAL DATA Thickness: 11.00 TI: 11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	7	11	0	0.00

Dynaflect Analysis

Hwy. 84 Livermore

URS

ROAD: SR N 84 HW
CONNANNON - STANLY
NB1: 1188 - 2376

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	4	4	3	2	5

STRUCTURAL DATA	Thickness:	10.75	TI:	11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	4	11	0	0.00

ROAD: SR N 84 HW
CONNANNON - STANLY
NB,SH: 2376 - 3564

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	12	15	6	3	41

STRUCTURAL DATA	Thickness:	7.00	TI:	11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	12	11	8	0.05

ROAD: SR N 84 HW
STANLY - JACK LONDON
NB1: 0 - 1320

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	5	6	4	3	6

STRUCTURAL DATA	Thickness:	9.50	TI:	11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	5	11	0	0.00

ROAD: SR N 84 HW
STANLY - JACK LONDON
NB,SH: 2640 - 3960

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	6	6	5	3	8

STRUCTURAL DATA	Thickness:	9.00	TI:	11.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	6	11	0	0.00

CHEC
MANAGEMENT
SYSTEMS INC
(800) 523-2124

North Segment A2 and A3 Lines

September 2010 South Segment A1 and A2 Lines

NOTE:

THE VERTICAL DATUM IS NAVD 1988.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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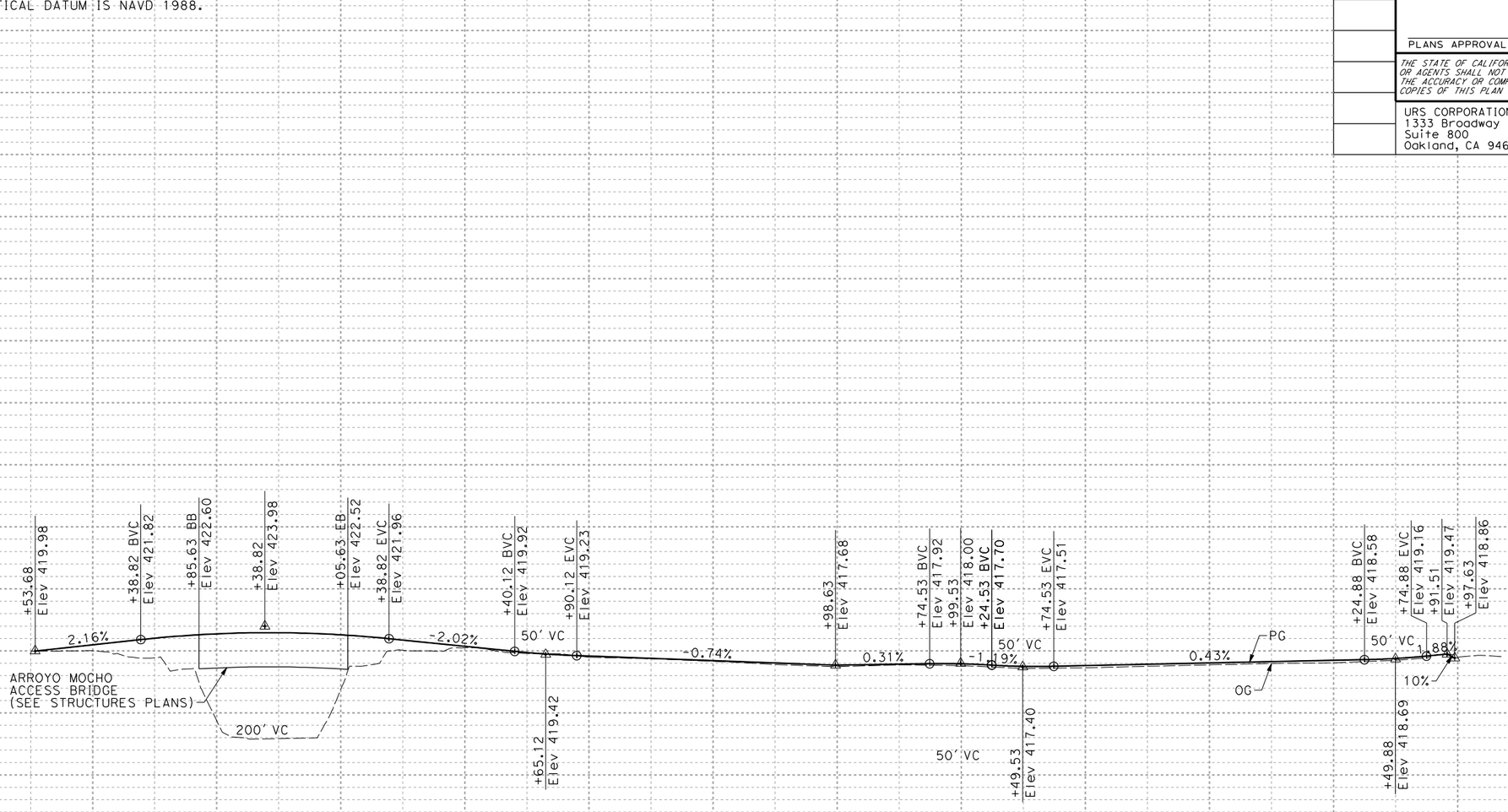

WEST ACCESS RD No. 2
"AC2" LINE

PROFILE
SCALE: Horiz 1" = 50'
Vert 1" = 10'

P-1

STATION	2	3	4	215	6	7	8	9	220	1	2	3	4	TOTAL
CY Exc	←					1,926							→	1,926
CY Emb	←					32							→	32

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans®

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

REVISED BY	DATE REVISED
AB	12/15/10

LAST REVISION — DATE PLOTTED => 1/13/2011
10-21-10 — TIME PLOTTED => 11:24:42 PM

BORDER LAST REVISED 7/2/2010

USERNAME => minyoung_kim
DGN FILE => ...\0400020580fa001.dgn

RELATIVE BORDER SCALE IS IN INCHES: 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
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PLANS APPROVAL DATE

Abhijeet R. Bhoi
No. 68606
Exp. 09-30-11
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REGISTERED PROFESSIONAL ENGINEER
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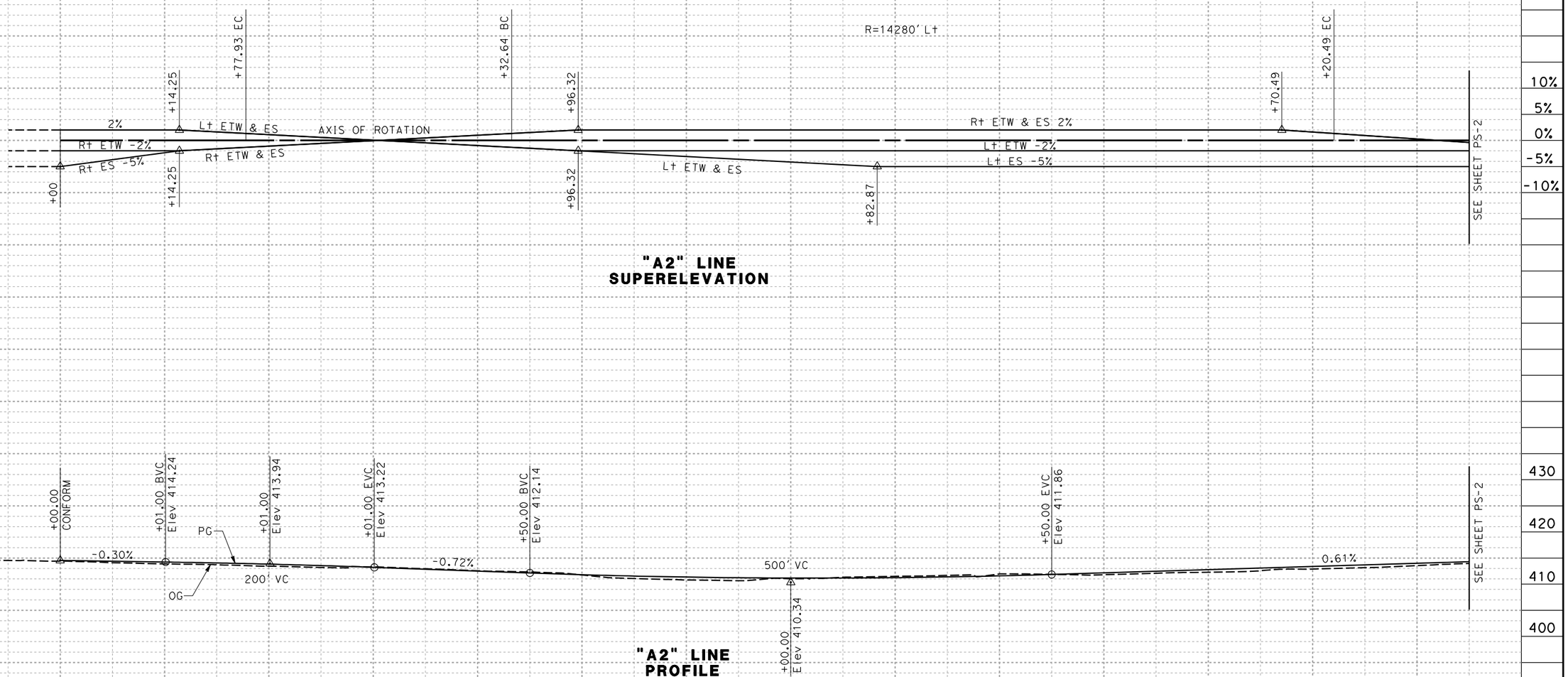
NOTES:

1. THE VERTICAL DATUM IS NAVD 1988.
2. AXIS OF ROTATION IS AT PROFILE GRADE POINT, SEE TYPICAL SECTIONS FOR LOCATION OF PROFILE GRADE POINT.



"A2" LINE SUPERELEVATION

"A2" LINE PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-1

STATION	3	4	365	6	7	8	9	370	1	2	3	4	375	6	7	TOTAL
CY Exc		←							11,142						→	11,142
CY Emb		←							85						→	85

REVISED BY	AB		
DATE REVISED	12/15/10		
CALCULATED-DESIGNED BY	ABHIJEET BHOI		
CHECKED BY	ELIE ABI-JAOUDE		
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN		
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans		

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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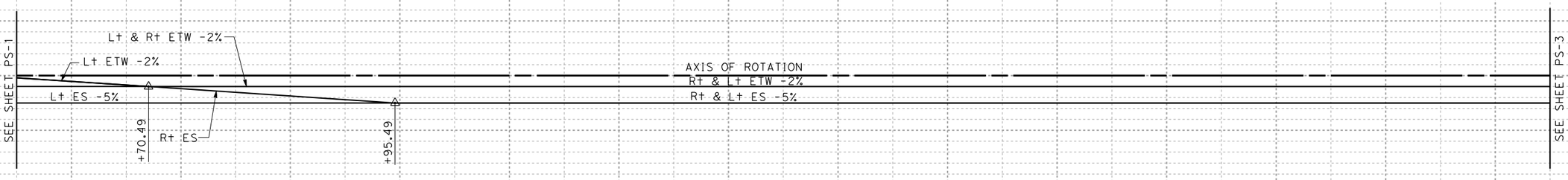
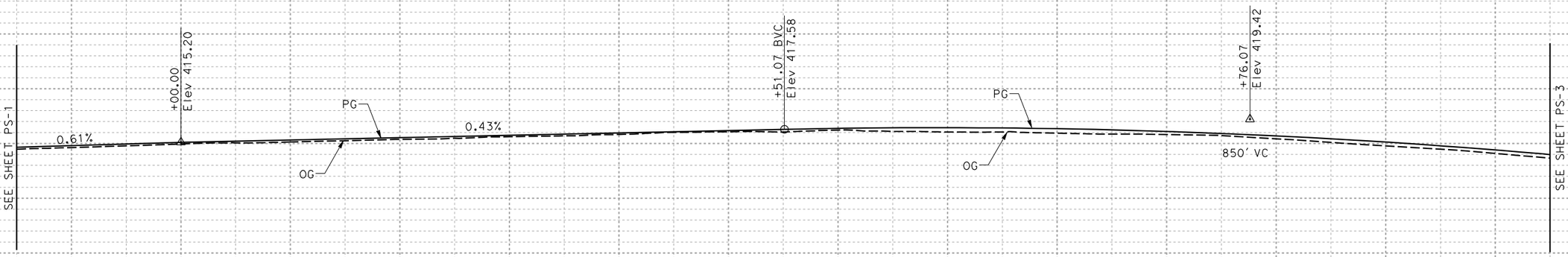


"A2" LINE
SUPERELEVATION



"A2" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-2

STATION	7	8	9	380	1	2	3	4	385	6	7	8	9	390	1	TOTAL
CY Exc						12,814										12,814
CY Emb						72										72

CALCULATED-DESIGNED BY	
CHECKED BY	ELIE ABI-JAOUDE
REVISED BY	ABHIJEET BHOI
DATE REVISED	AB
	12/15/10
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN

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LAST REVISION 10-21-10
DATE PLOTTED => 1/13/2011
TIME PLOTTED => 1:24:48 PM

BORDER LAST REVISED 7/2/2010

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DGN FILE => ...\0400020580fb002.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi
No. 68606
Exp. 09-30-11
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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AB	12/15/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

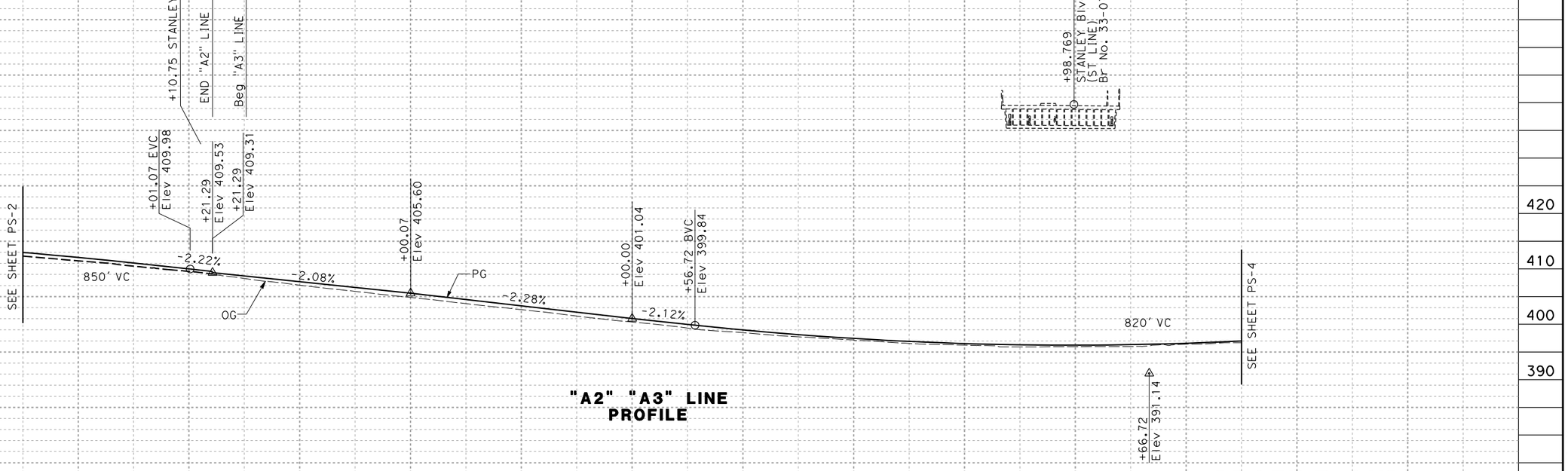
SEE SHEET PS-2

AXIS OF ROTATION
Rt & Lt ETW -2%
Rt & Lt ES -5%

SEE SHEET PS-4

10%
5%
0%
-5%
-10%

"A2" "A3"LINE SUPERELEVATION



"A2" "A3" LINE PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-3

STATION	390	1	2	3	4	395	6	7	8	9	400	1	2	TOTAL
CY Exc		3,163				25,156								28,319
CY Emb		8				124								132

LAST REVISION: 10-21-10
DATE PLOTTED => 1/13/2011
TIME PLOTTED => 11:24:50 PM

BORDER LAST REVISED 7/2/2010

USERNAME => minyoung_kim
DGN FILE => ...\0400020580fb003.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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REVISED BY: AB — DATE REVISED: 12/15/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

"A3" LINE SUPERELEVATION

10% 5% 0% -5% -10%

SEE SHEET PS-3

AXIS OF ROTATION
Rt & Lt ETW -2%
Rt & Lt ES -5%

+35.00

SEE SHEET PS-5

"A3" LINE PROFILE

420 410 400 390

SEE SHEET PS-3

+96.23
℄ Rail
℄ Road
TSABEL Ave UP ℄
Br No. 33-0712
TOP OF RAIL Elev 422.57

+76.72 EVC
Elev 403.44

+77.21 BVC
Elev 403.45

820' VC

3.00%

PG

OG

1495' VC

SEE SHEET PS-5

STATION	2	3	4	405	6	7	8	9	410	1	2	TOTAL
CY Exc		←				23,359					→	23,359
CY Emb		←				22					→	22

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-4

LAST REVISION: DATE PLOTTED => 1/13/2011
10-21-10 TIME PLOTTED => 1:24:53 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — State of California

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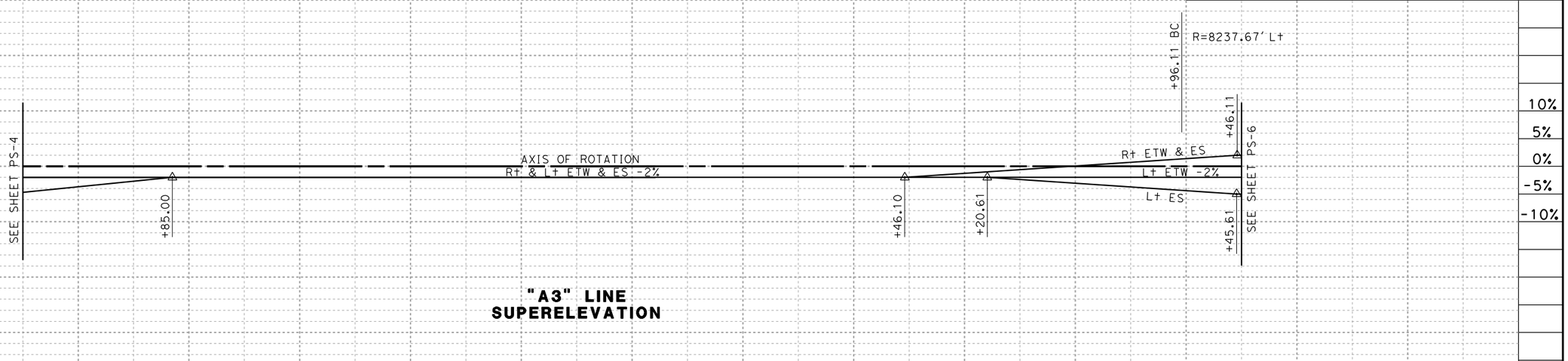
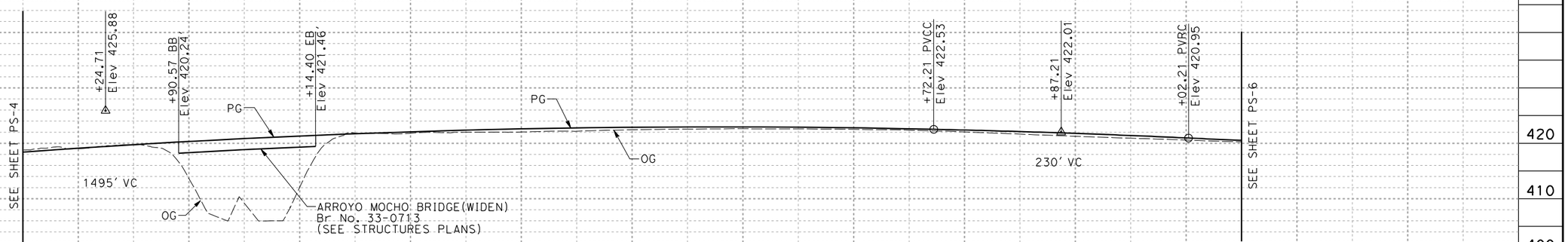


"A3" LINE SUPERELEVATION



"A3" LINE PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-5

STATION	3	4	415	6	7	8	9	420	1	2	3	TOTAL
CY Exc		1,351		5,110								6,461
CY Emb		13		62								75

10%	5%	0%	-5%	-10%
420	410	400	390

	AB	12/15/10
	ABHIJEET BHOI	ELIE ABI-JAOUDE
	CALCULATED-DESIGNED BY	CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN	
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans	

REVISED BY / DATE REVISED

LAST REVISION 10-21-10 — DATE PLOTTED => 1/13/2011 — TIME PLOTTED => 1:24:55 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\0400020580fb005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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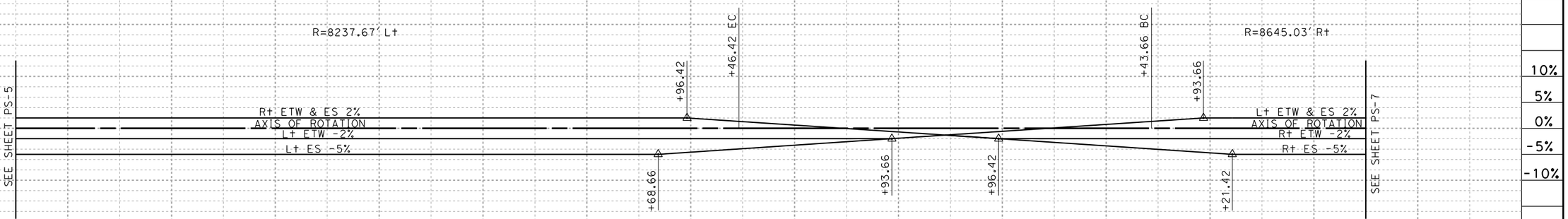
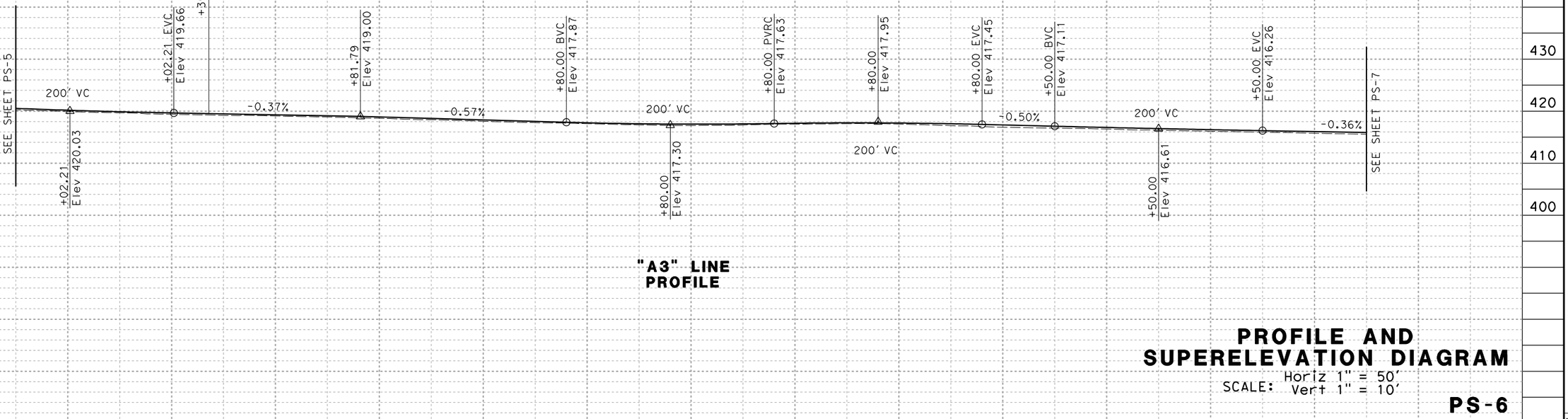


"A3" LINE
SUPERELEVATION



"A3" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-6

STATION	4	425	6	7	8	9	430	1	2	3	4	435	6	TOTAL
CY Exc	← 13,687 →													13,687
CY Emb	← 61 →													61

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: AB
DATE REVISED: 12/15/10

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DATE PLOTTED => 1/13/2011
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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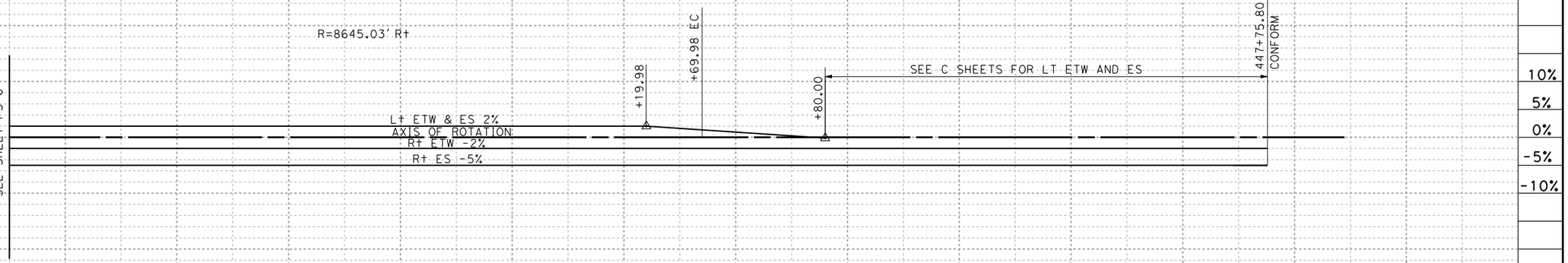
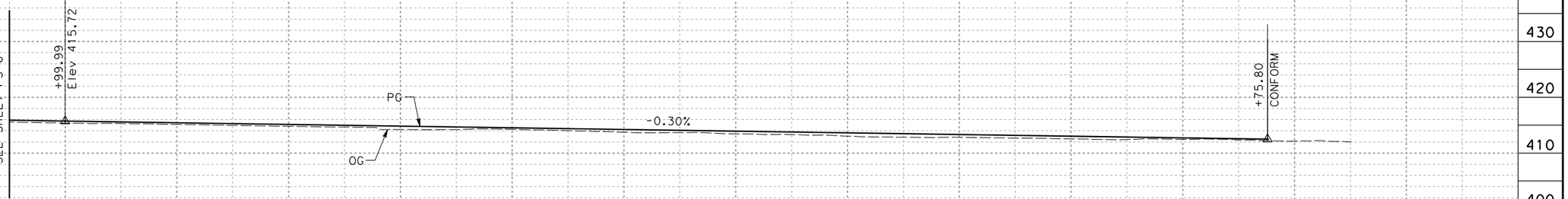


"A3" LINE SUPERELEVATION



"A3" LINE PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-7

STATION	435	6	7	8	9	440	1	2	3	4	445	6	7	8	TOTAL
CY Exc			10,596												10,596
CY Emb			606												606

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CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

REVISED BY	DATE REVISED
AB	12/15/10

LAST REVISION 10-21-10
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — State of California

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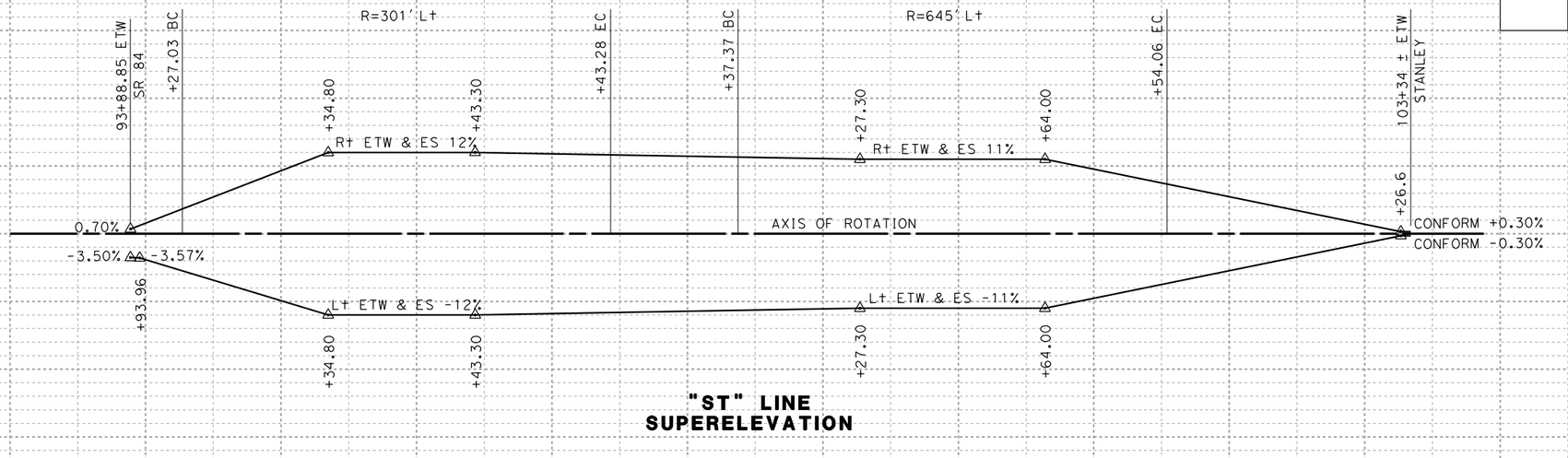
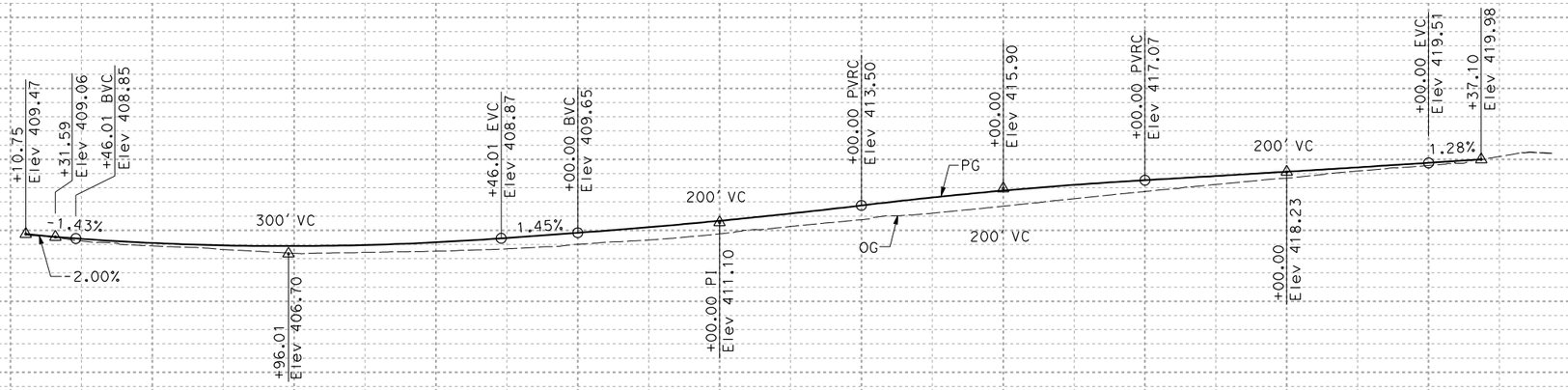


"ST" LINE SUPERELEVATION



"ST" LINE PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-8

STATION	3	4	95	6	7	8	9	100	1	2	3	4	105	TOTAL
CY Exc						16,037								16,037
CY Emb						922								922

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CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

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10-21-10

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UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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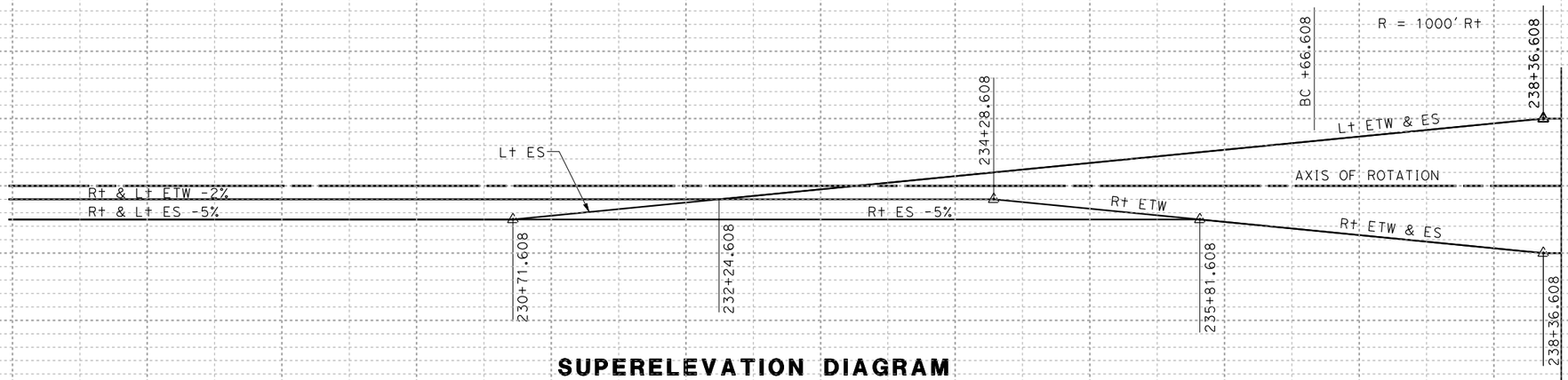
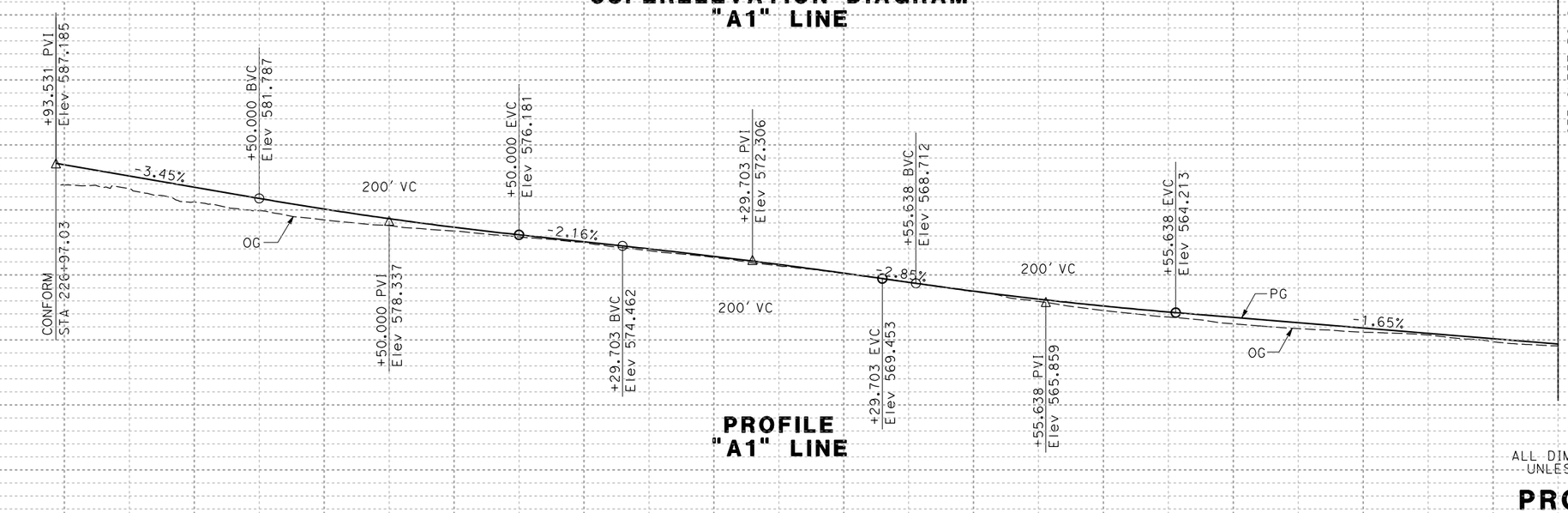
NOTES:

THE HORIZONTAL DATUM IS NAD 83 (1991.35).
THE VERTICAL DATUM IS NAVD 1988.



SUPERELEVATION DIAGRAM "A1" LINE

SEE SHEET PS-2



PROFILE "A1" LINE

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-1

STATION	227	228	229	230	231	232	233	234	235	236	237	238	TOTAL
CY Exc													
CY Emb													

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CU 04257

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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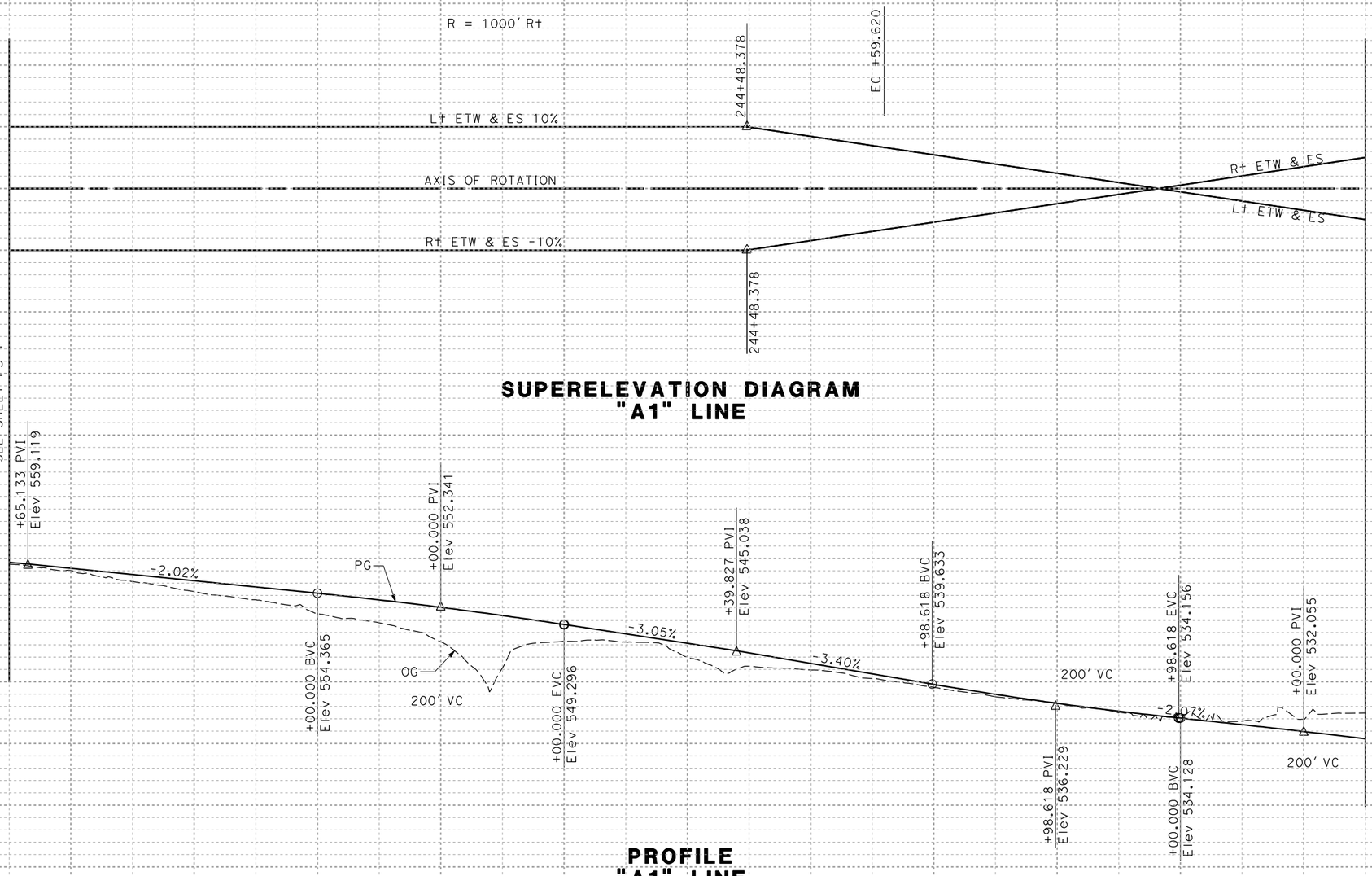

SUPERELEVATION DIAGRAM
"A1" LINE

PROFILE
"A1" LINE

STATION	239	240	241	242	243	244	245	246	247	248	249	TOTAL
CY Exc												
CY Emb												

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-2

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CU 04257

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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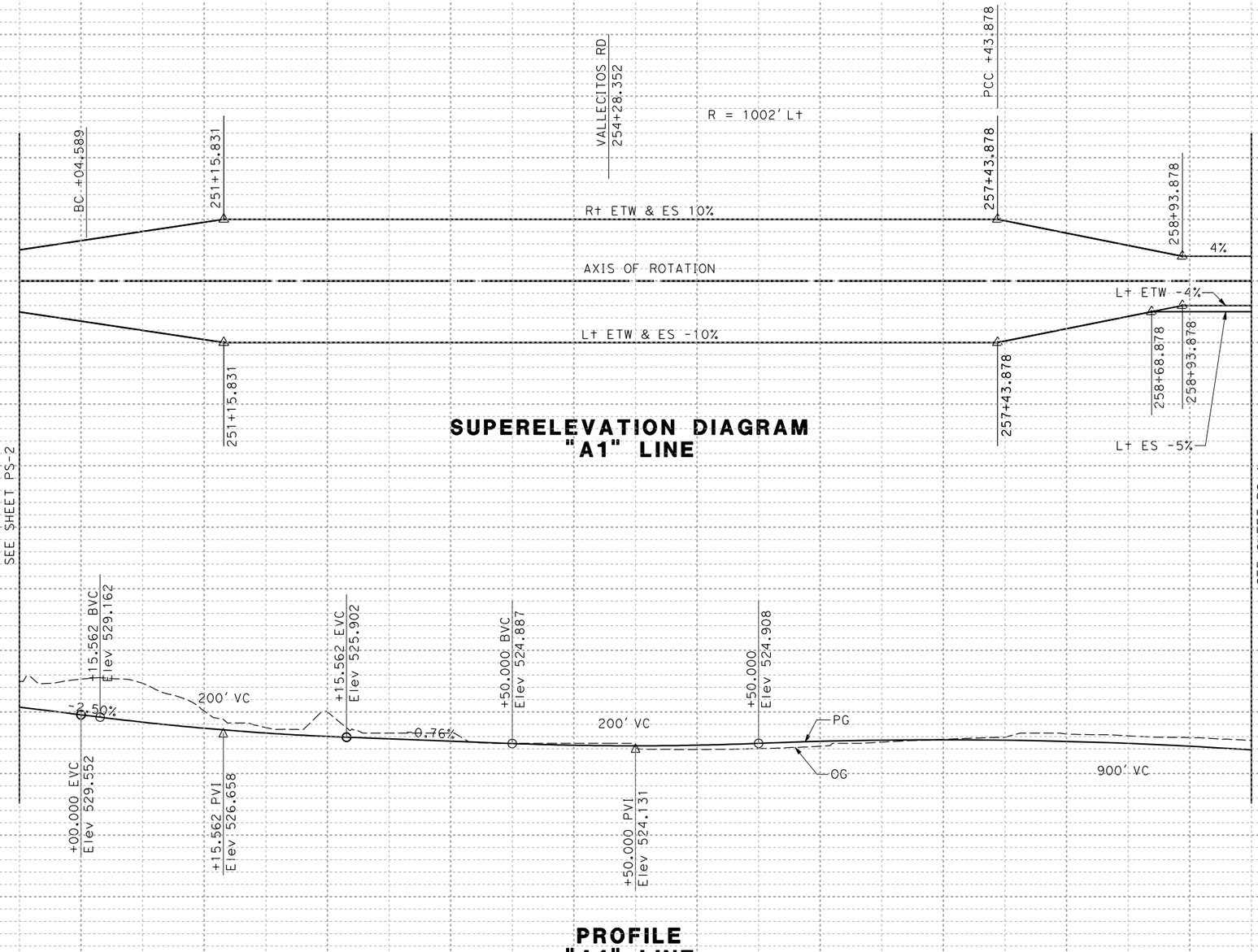

SUPERELEVATION DIAGRAM "A1" LINE

PROFILE "A1" LINE

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-3

STATION	250	251	252	253	254	255	256	257	258	259	TOTAL
CY Exc											
CY Emb											

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EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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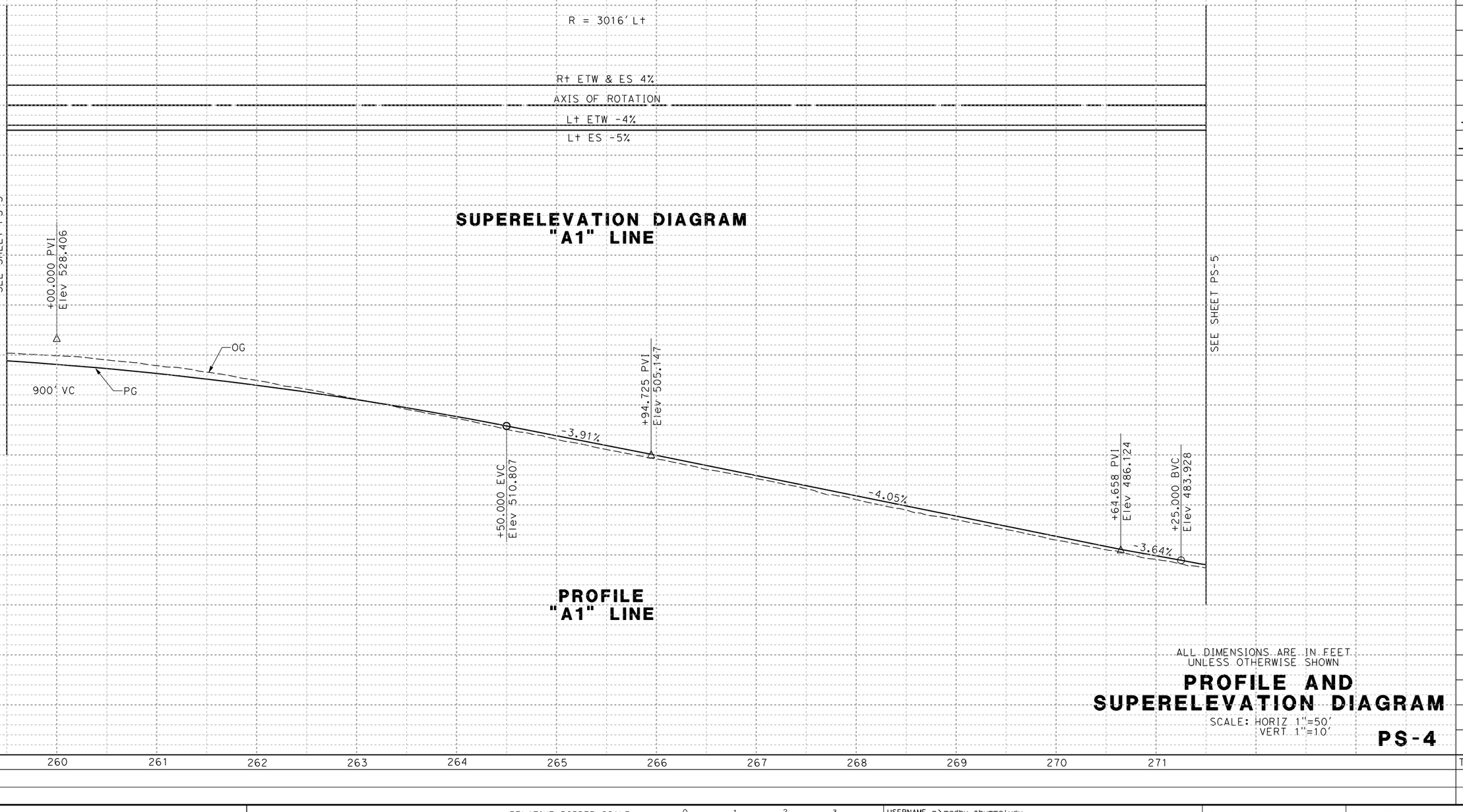

SUPERELEVATION DIAGRAM
"A1" LINE

PROFILE
"A1" LINE

STATION	260	261	262	263	264	265	266	267	268	269	270	271	TOTAL
CY Exc													
CY Emb													

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-4

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CU 04257

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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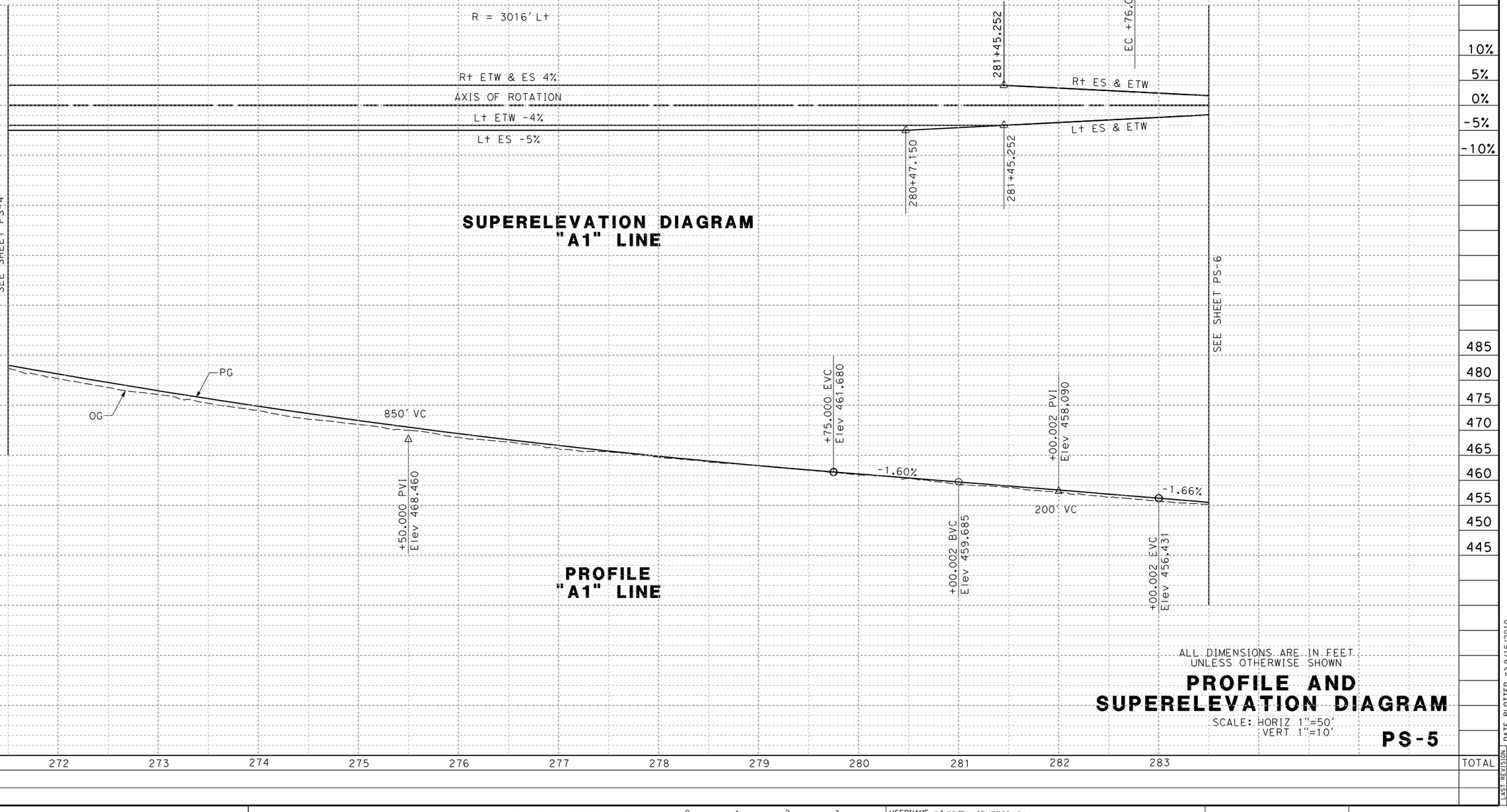

SUPERELEVATION DIAGRAM "A1" LINE

PROFILE "A1" LINE

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-5

STATION	272	273	274	275	276	277	278	279	280	281	282	283	TOTAL
CY Exc													
CY Emb													

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EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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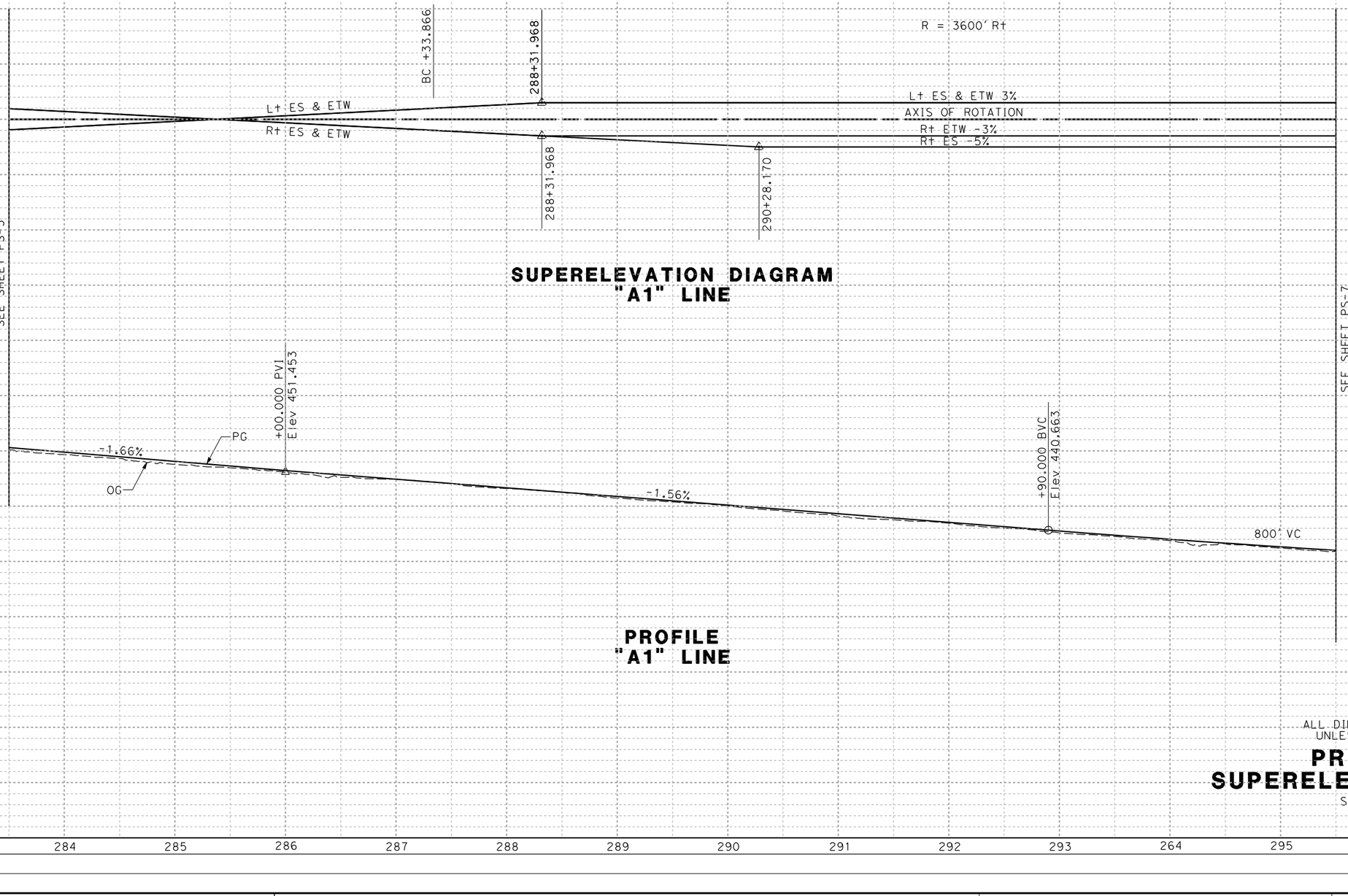

SUPERELEVATION DIAGRAM "A1" LINE

PROFILE "A1" LINE

STATION	284	285	286	287	288	289	290	291	292	293	264	295	TOTAL
CY Exc													
CY Emb													

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-6

LAST REVISION | DATE PLOTTED => 9/16/2010
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CU 04257

EA 297601

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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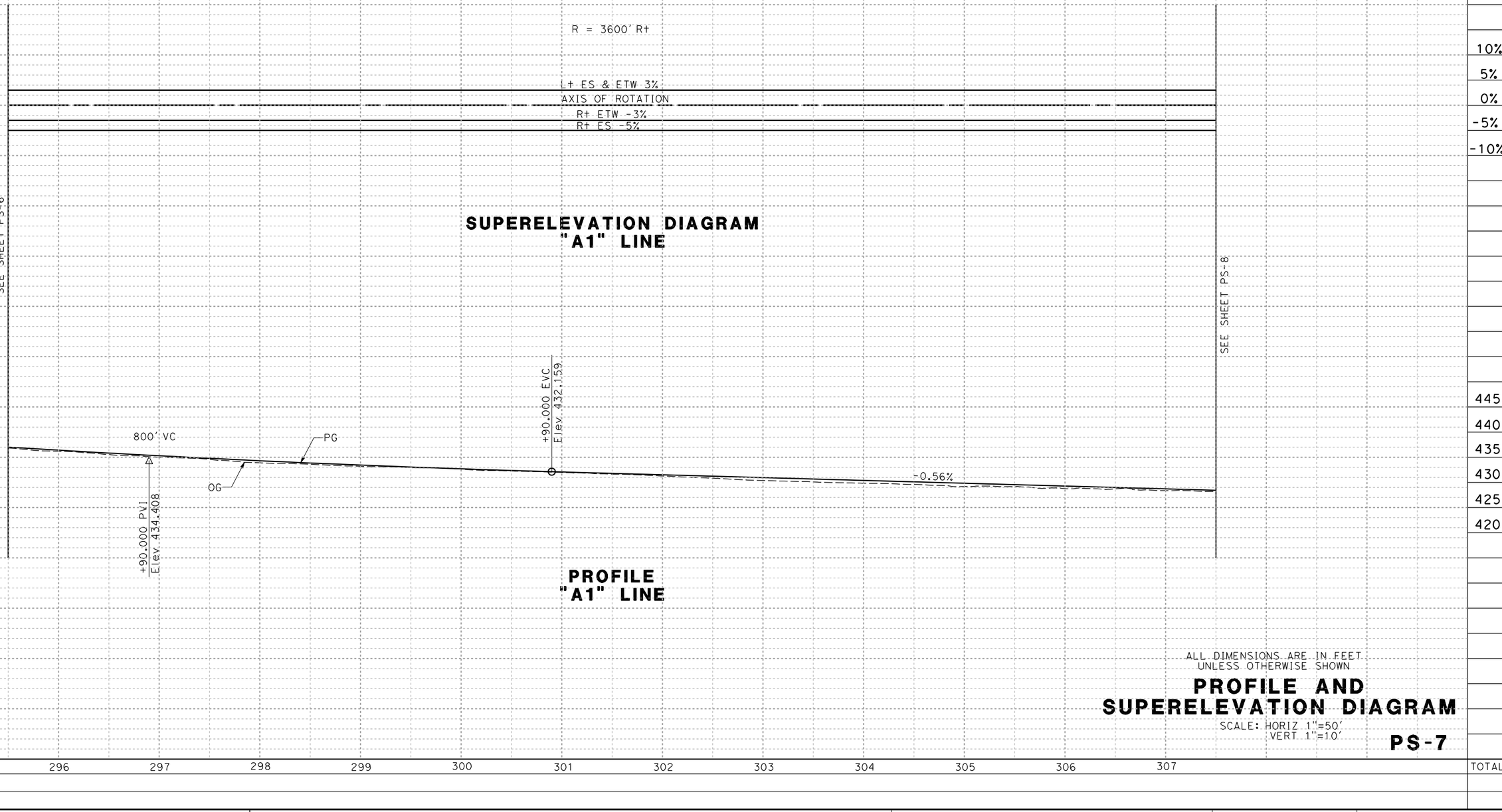

SUPERELEVATION DIAGRAM
"A1" LINE

PROFILE
"A1" LINE

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-7

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CU 04257

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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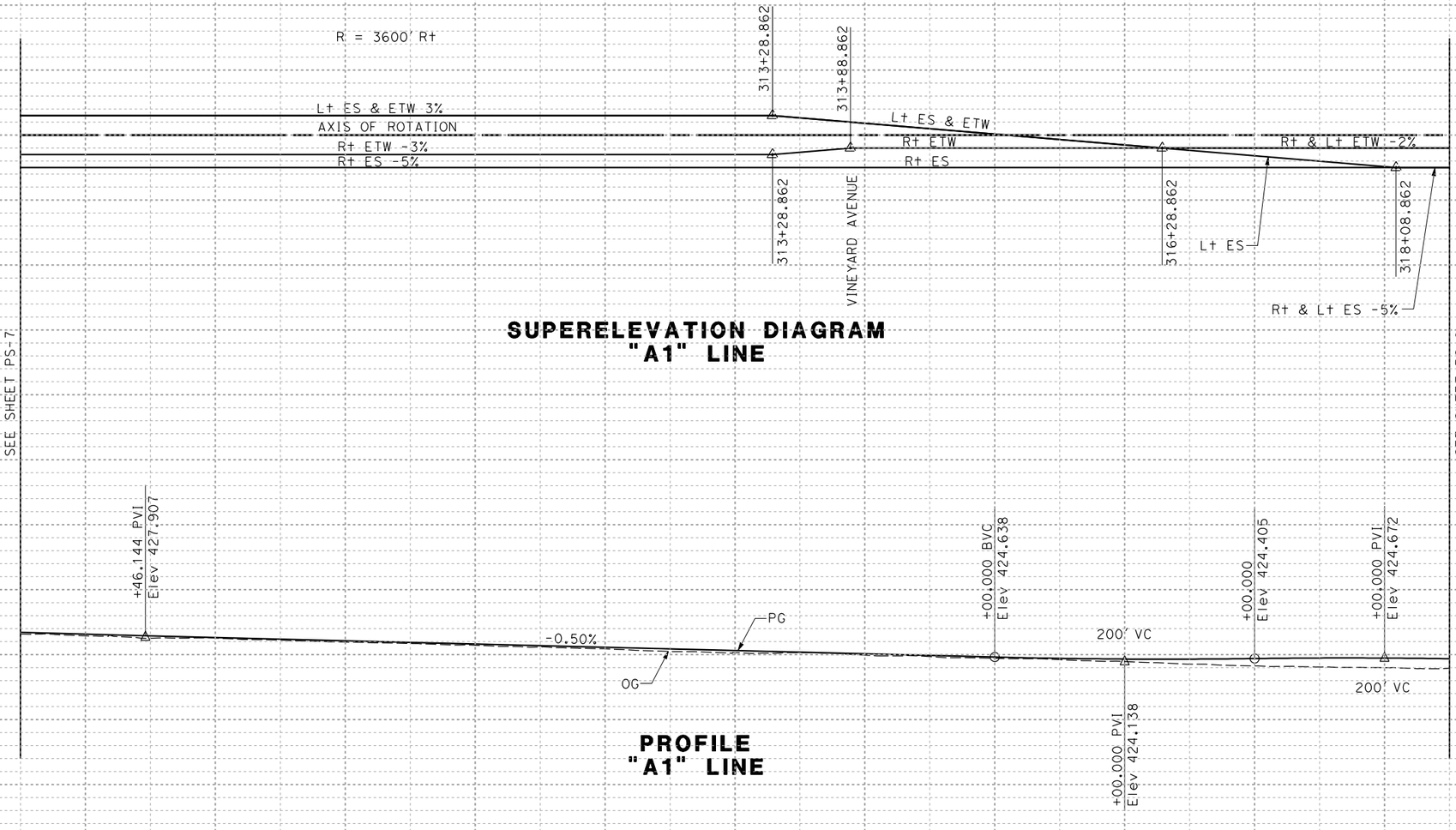

SUPERELEVATION DIAGRAM "A1" LINE

PROFILE "A1" LINE

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-8

STATION	308	309	310	311	312	313	314	315	316	317	318	TOTAL
CY Exc												
CY Emb												

REVISED BY | DATE REVISED

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

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CU 04257

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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R=35000' Rt

BC +48.208

EC +67.073

AXIS OF ROTATION
Rt & Lt ETW -2%
Rt & Lt ES -5%

SEE SHEET PS-8

SEE SHEET PS-10

SUPERELEVATION DIAGRAM "A1" LINE

10%
5%
0%
-5%
-10%

PROFILE "A1" LINE

435
430
425
420
415
410
405

PG
-0.50%
+99.848 BVC
Elev 423.177
200' VC
-0.30%
+99.848 EVC
Elev 422.377
+100.000 BVC
Elev 422.075
200' VC
+100.000 EVC
Elev 422.073
0.30%
+77.632 PVI
Elev 422.605
0.37%

OG
+00.000 EVC
Elev 424.173
+99.848 PVI
Elev 422.678
+100.000 PVI
Elev 421.773
+00.000 BVC
Elev 423.053

STATION	319	320	321	322	323	324	325	326	327	328	329	TOTAL
CY Exc												
CY Emb												

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-9

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EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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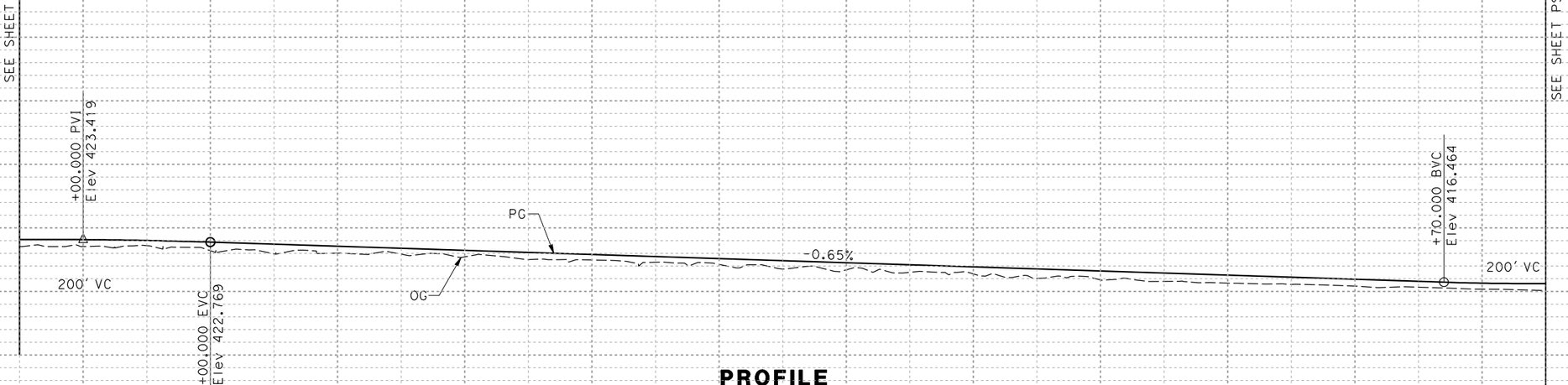
SUPERELEVATION DIAGRAM "A1" LINE

AXIS OF ROTATION
Rt & Lt ETW -2%
Rt & Lt ES -5%

SEE SHEET PS-9

SEE SHEET PS-11



PROFILE "A1" LINE

STATION	330	331	332	333	334	335	336	337	338	339	340	341	TOTAL
CY Exc													
CY Emb													

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-10

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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SUPERELEVATION DIAGRAM "A1", "A2" LINE

AXIS OF ROTATION
Rt & Lt ETW -2%
Rt & Lt ES -5%

SEE SHEET PS-10

SEE SHEET PS-12

10% 5% 0% -5% -10%

+70.000 PVI Elev 415.814

+70.000 EVC Elev 417.124

+70.220 BVC Elev 418.437

+70.220 PVI Elev 419.746

+70.220 EVC Elev 420.632

+72.330 PVI Elev 419.772

+72.356 PVI Elev 420.8603

+00.000 BVC Elev 420.032

+00.000 EVC Elev 420.794

+50.000 PVI Elev 421.444

353+16.149

200' VC | 1.31% | PC | 200' VC | 0.80% | 0.941% | 300' VC | -0.434%

OG

END "A1" LINE
Beg "A2" LINE

430 425 420 415 410 405 400

PROFILE "A1", "A2" LINE

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-11

STATION	342	343	344	345	346	347	348	349	350	351	352	353	TOTAL
CY Exc													
CY Emb													

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EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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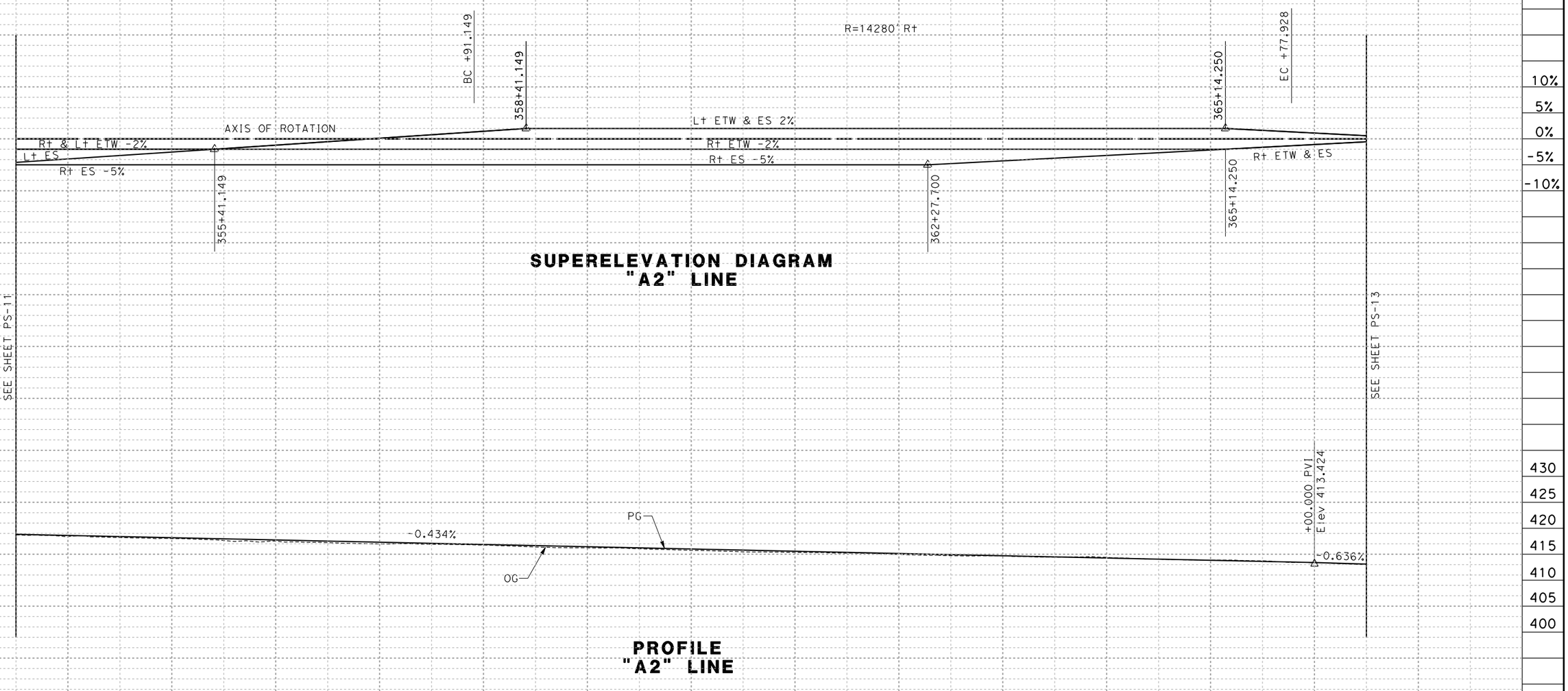

SUPERELEVATION DIAGRAM "A2" LINE

PROFILE "A2" LINE

STATION	354	355	356	357	358	359	360	361	362	363	364	365	366	TOTAL
CY Exc														
CY Emb														

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UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-12

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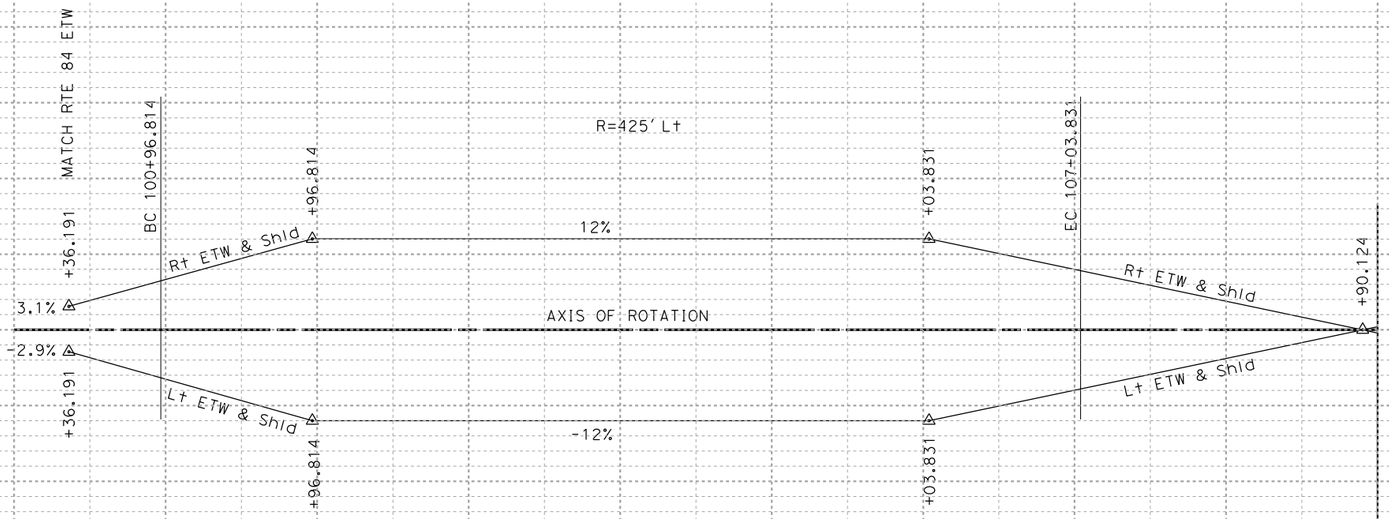
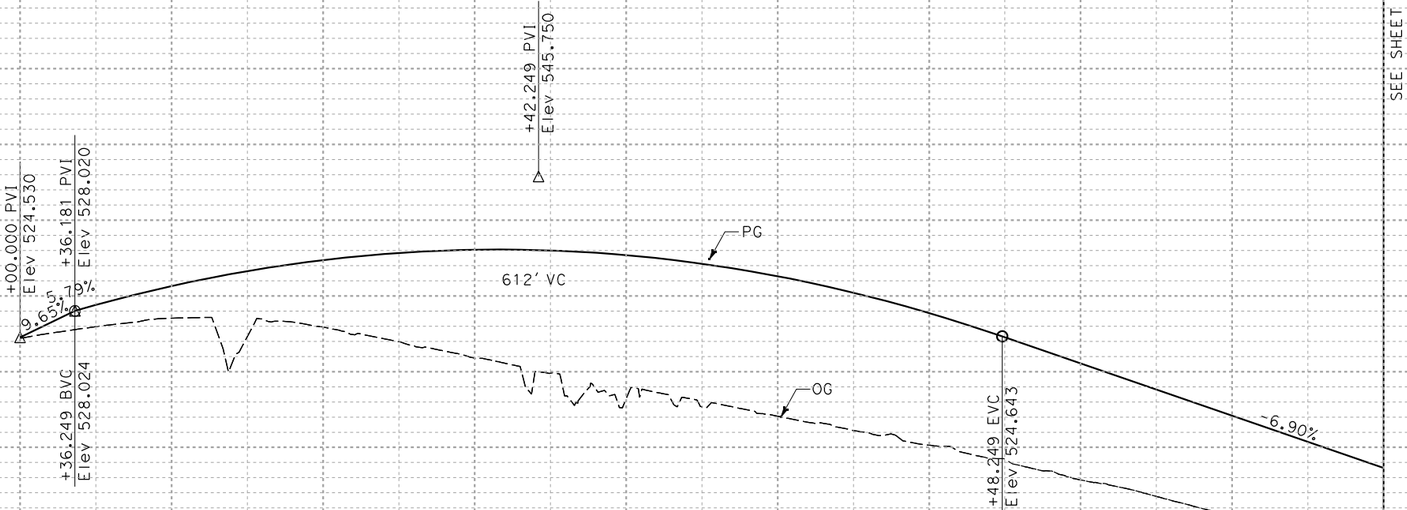


SUPERELEVATION DIAGRAM
VALLECITOS Rd



PROFILE
VALLECITOS Rd

STATION	100	101	102	103	104	105	106	107	108	109	TOTAL
CY Exc											
CY Emb											

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-20

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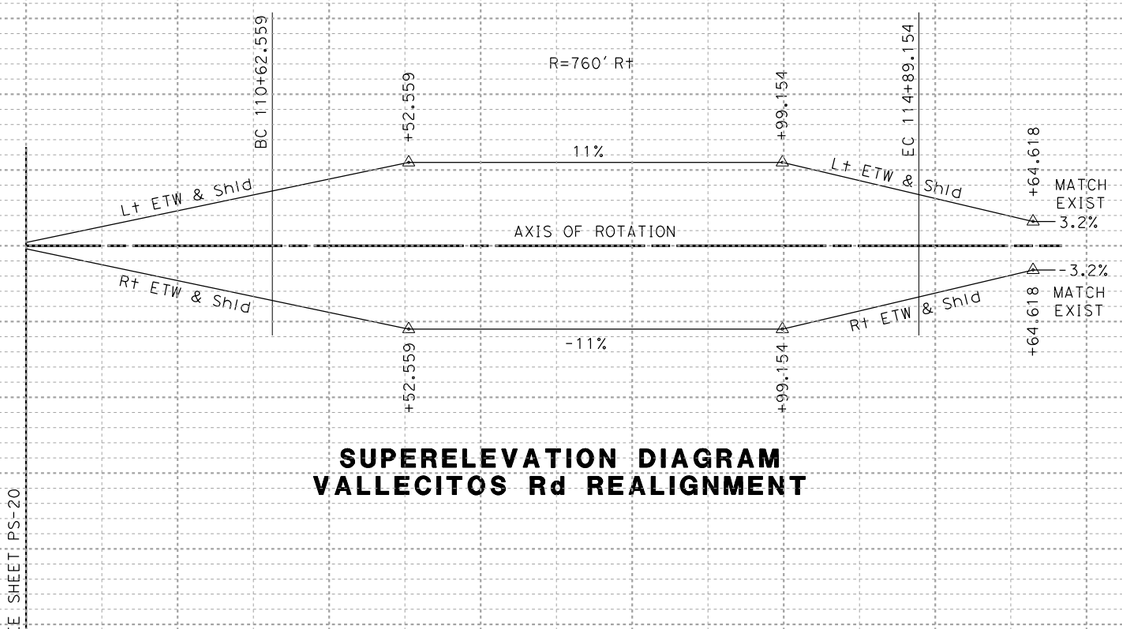
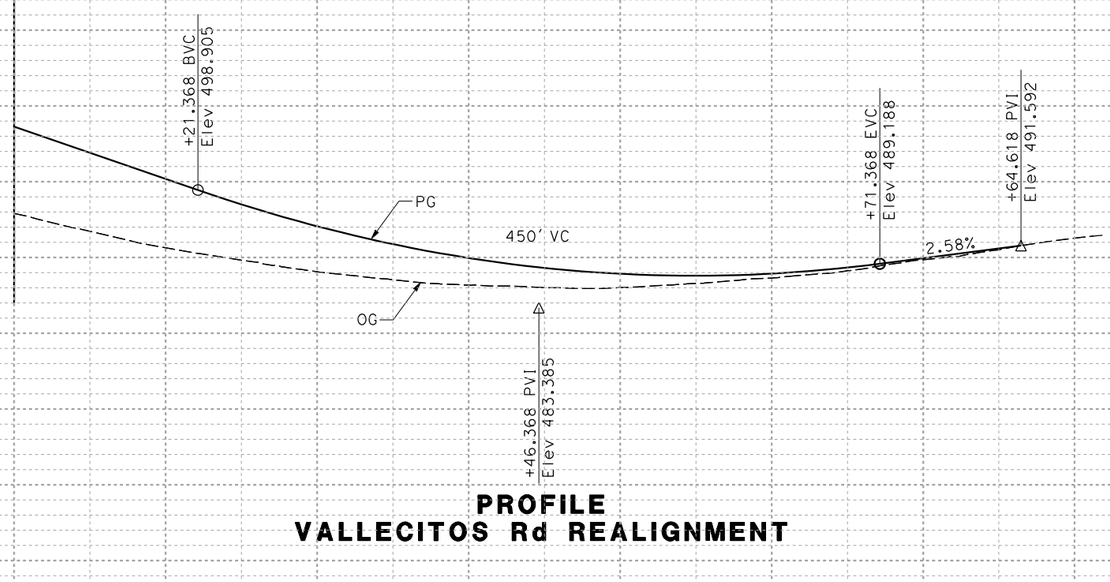


SUPERELEVATION DIAGRAM
VALLECITOS Rd REALIGNMENT



PROFILE
VALLECITOS Rd REALIGNMENT

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-21

STATION	109	110	111	112	113	114	115	116	TOTAL
CY Exc									
CY Emb									

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04	Ala	84	22.9/27.1		

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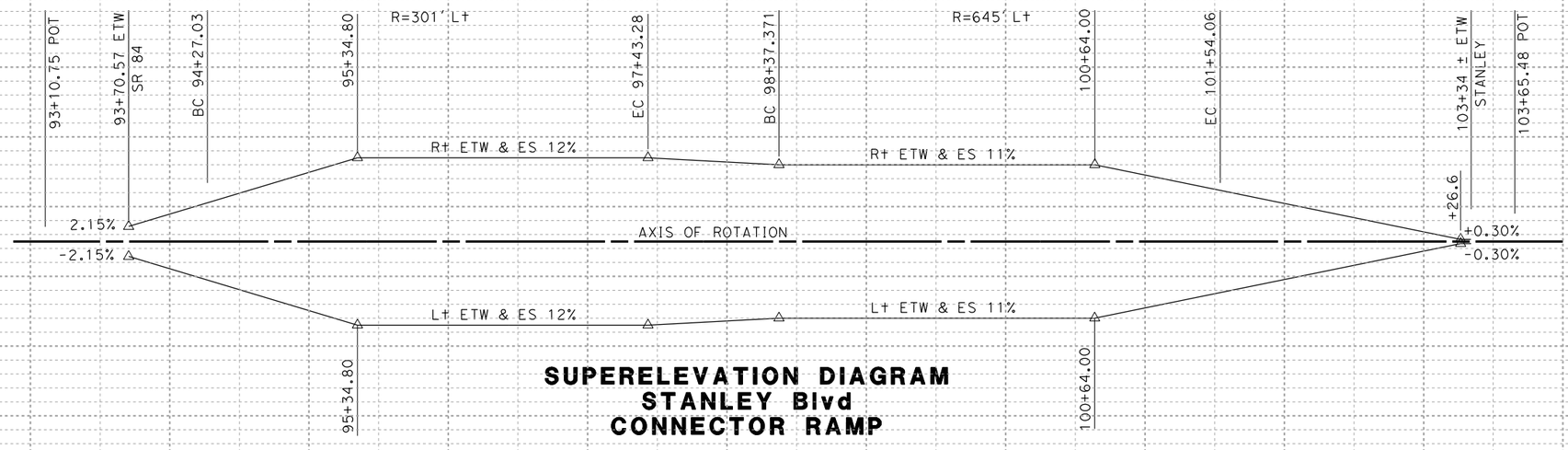
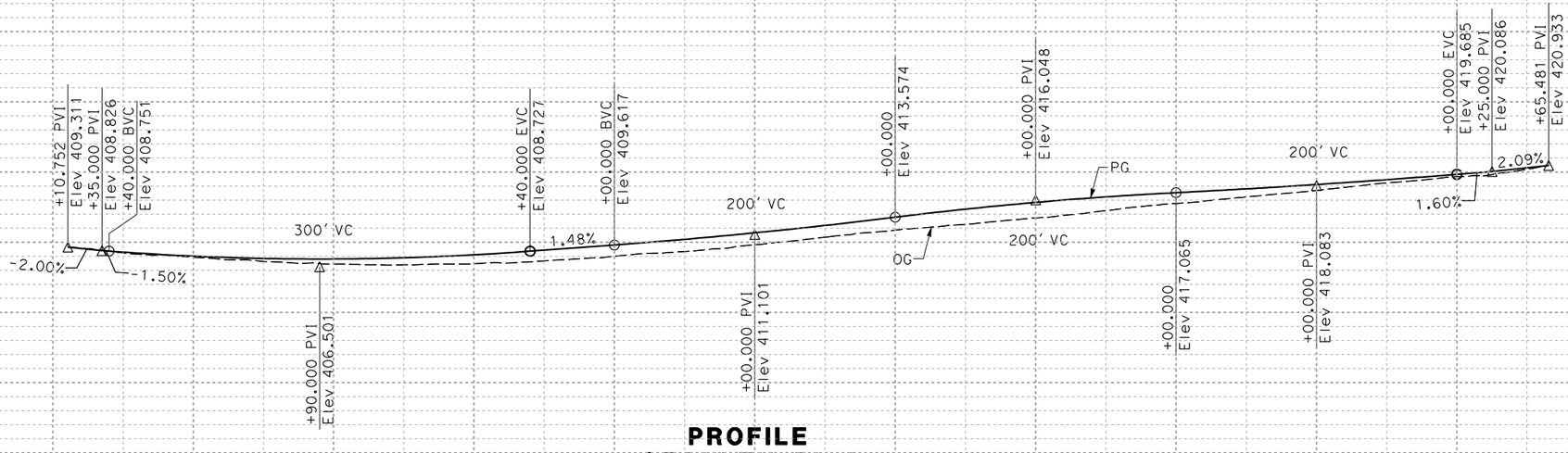


SUPERELEVATION DIAGRAM
STANLEY Blvd
CONNECTOR RAMP



PROFILE
STANLEY Blvd
CONNECTOR RAMP

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-22

STATION	93	94	95	96	97	98	99	100	101	102	103	104	105	TOTAL
CY Exc														
CY Emb														

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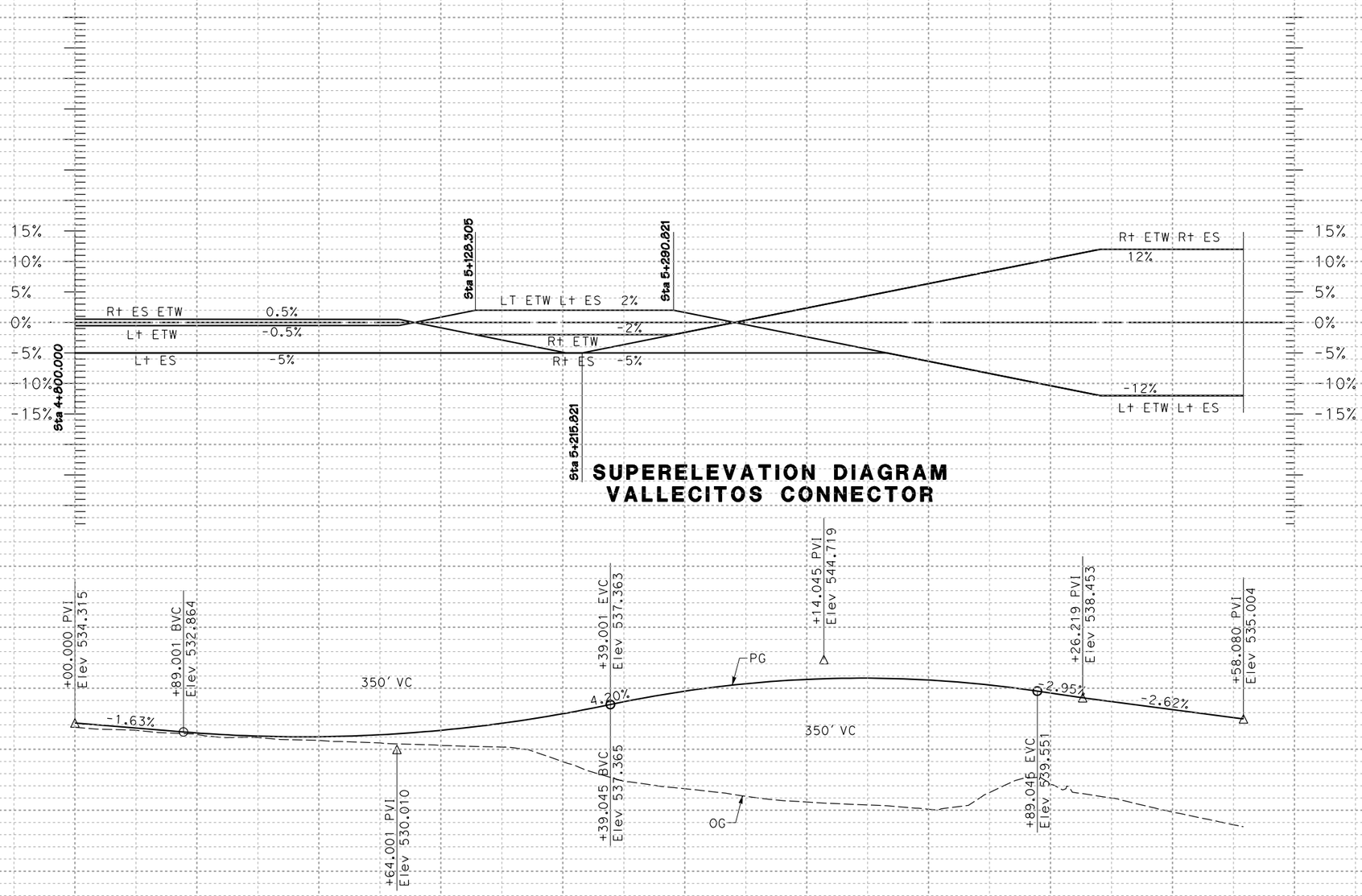

SUPERELEVATION DIAGRAM
VALLECITOS CONNECTOR

PROFILE
VALLECITOS CONNECTOR

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: HORIZ 1"=50'
VERT 1"=10'

PS-23

STATION	48+00	49+00	50+00	51+00	52+00	53+00	54+00	55+00	56+00	57+00	58+00	TOTAL
CY Exc												
CY Emb												

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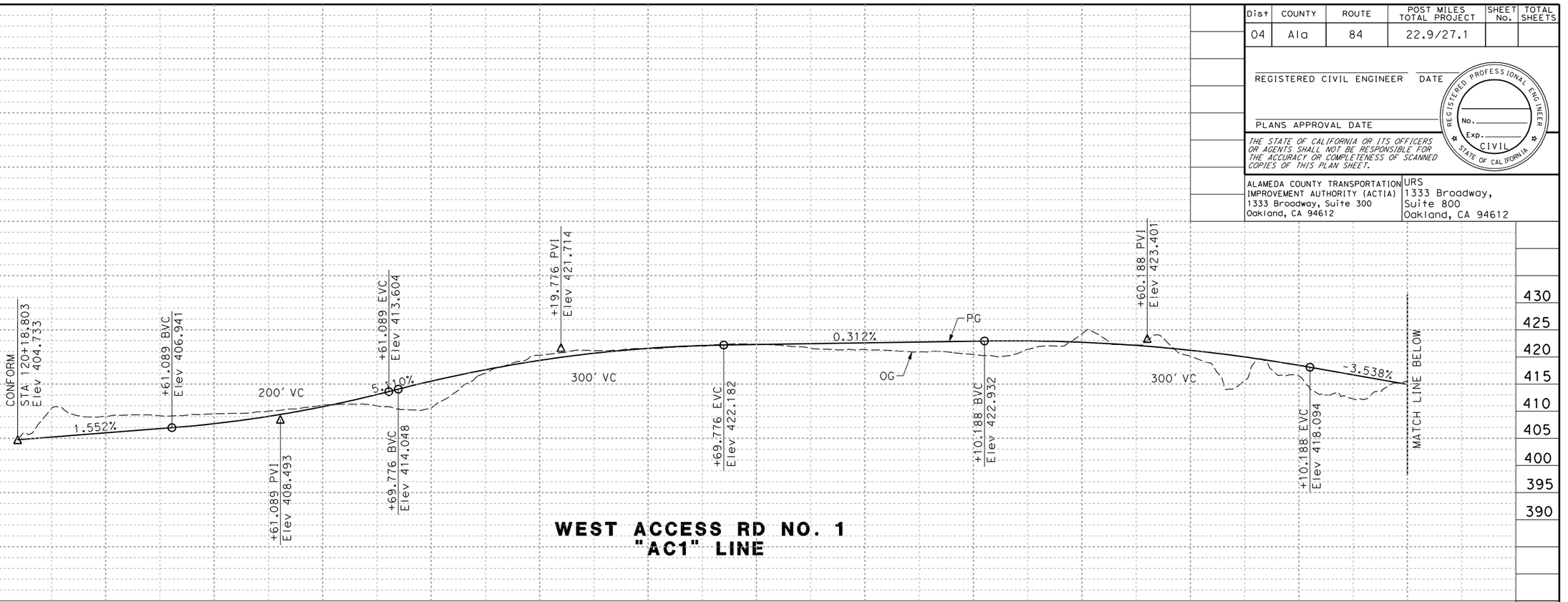
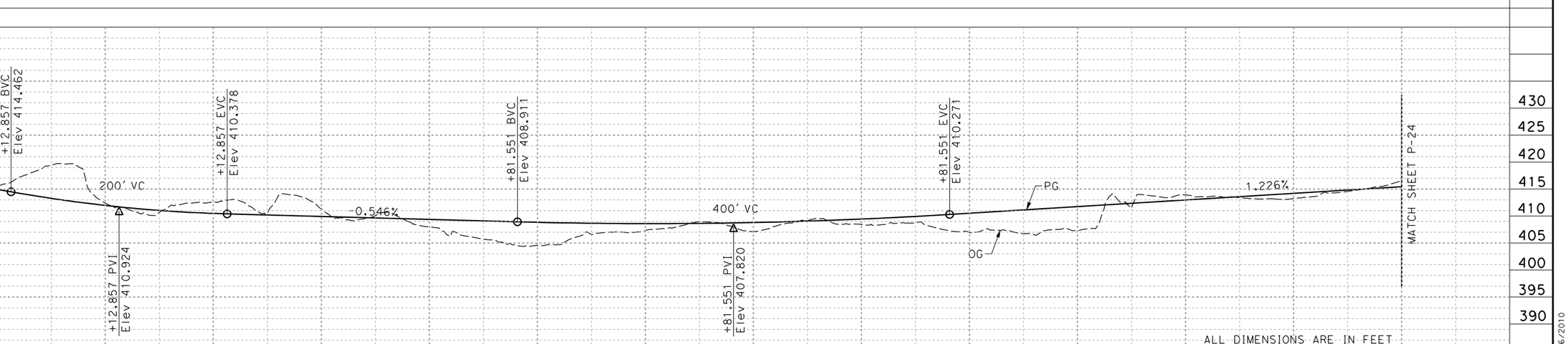


WEST ACCESS RD NO. 1
"AC1" LINE

STATION	120+00	121+00	122+00	123+00	124+00	125+00	126+00	127+00	128+00	129+00	130+00	131+00	132+00	133+00	TOTAL
CY Exc															
CY Emb															



ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

WEST ACCESS RD NO. 1
"AC1" LINE

PROFILE

SCALE: HORIZ 1"=50'
VERT 1"=10'

P-1

STATION	133	134	135	136	137	138	139	140	141	142	143	144	145	146	TOTAL
CY Exc															
CY Emb															

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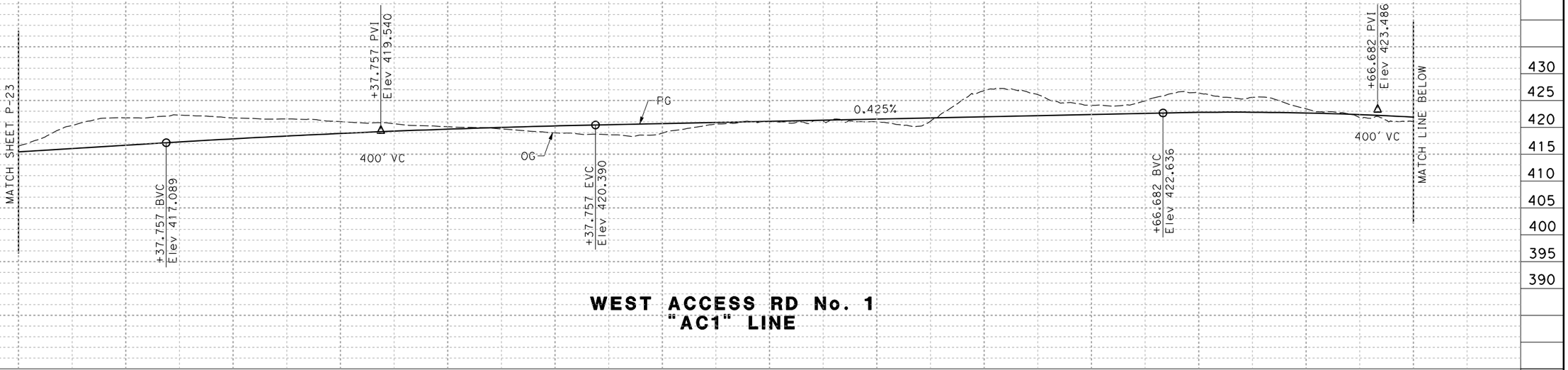
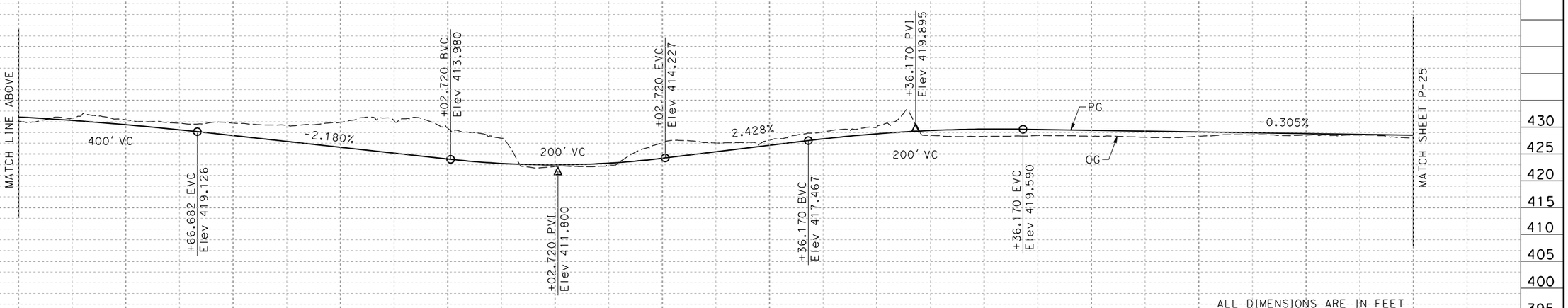


STATION 146 147 148 149 150 151 152 153 154 155 156 157 158 159 TOTAL

CY Exc

CY Emb

WEST ACCESS RD No. 1
"AC1" LINE



STATION 159 160 161 162 163 164 165 166 167 168 169 170 171 172 TOTAL

CY Exc

CY Emb

WEST ACCESS RD No. 1
"AC1" LINE

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE

SCALE: HORIZ 1"=50'
VERT 1"=10'

P-2

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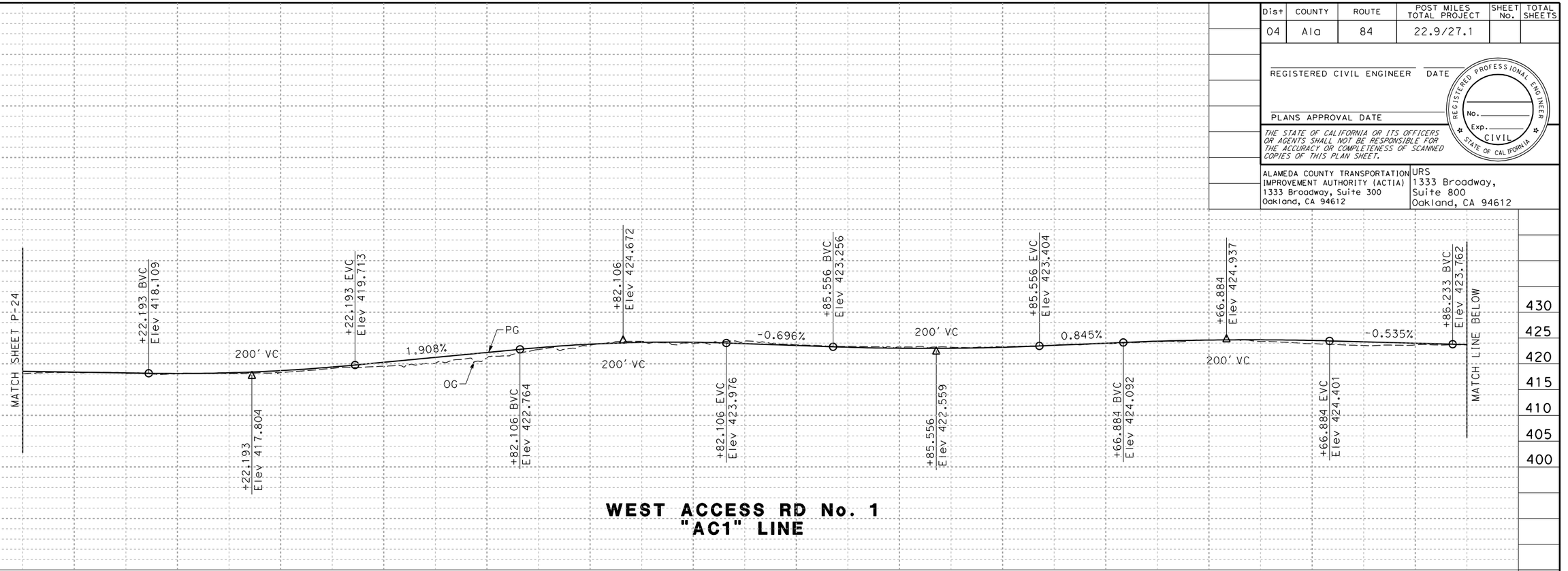
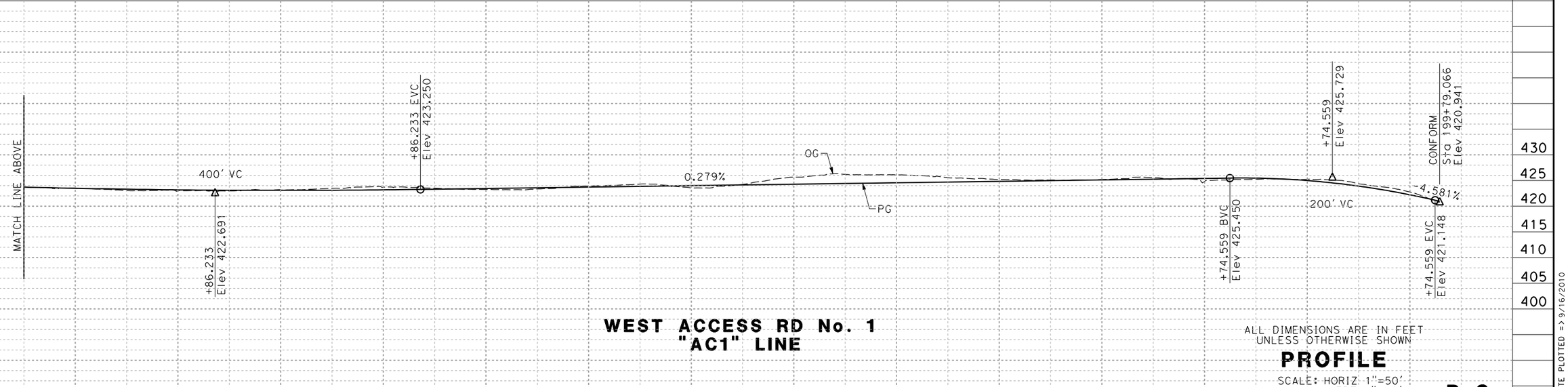


WEST ACCESS RD No. 1
"AC1" LINE

STATION	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	TOTAL
CY Exc																
CY Emb																



WEST ACCESS RD No. 1
"AC1" LINE

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE

SCALE: HORIZ 1"=50'
VERT 1"=10'

P-3

STATION	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	TOTAL
CY Exc																
CY Emb																

LAST REVISION | DATE PLOTTED => 9/16/2010
00-00-00 | TIME PLOTTED => 21:46:08 PM

BORDER LAST REVISED 2/1/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

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DGN FILE => ...\to Wreco\429760fb_P3.dgn

CU 04257

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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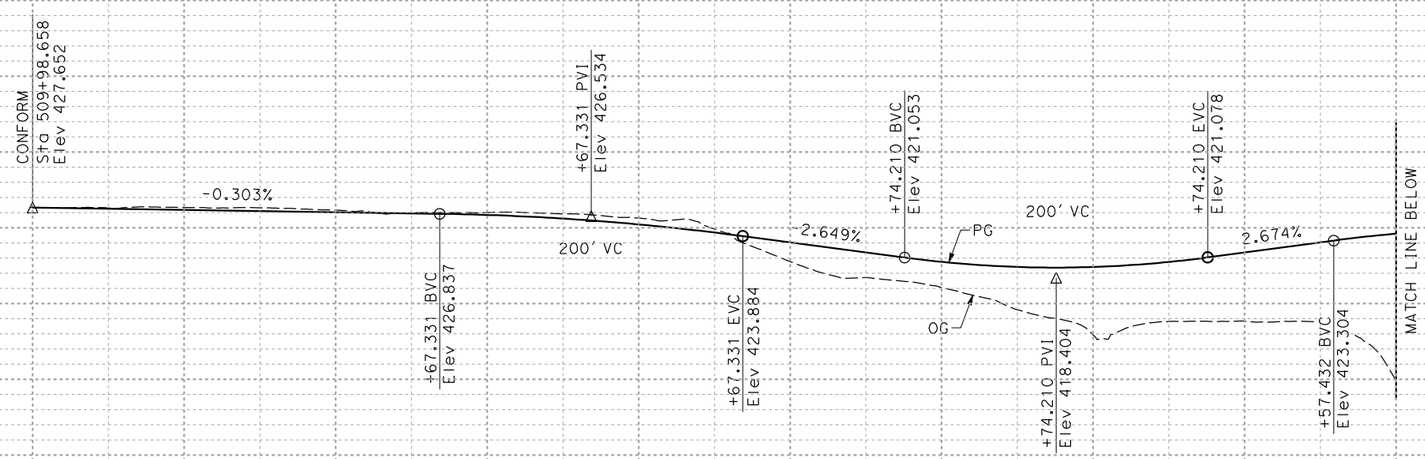
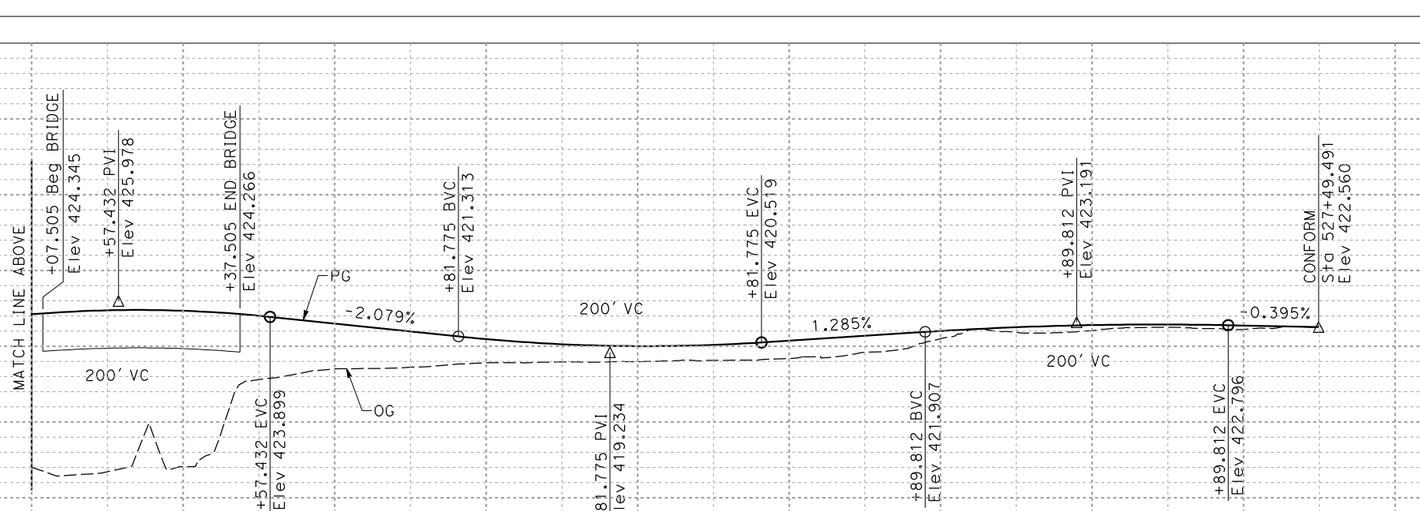


STATION 510 511 512 513 514 515 516 517 518 519 TOTAL

CY Exc

CY Emb

EAST MULTI USE TRAIL
"TR1" LINE



STATION 519 520 521 522 523 524 525 526 527 528 TOTAL

CY Exc

CY Emb

EAST MULTI USE TRAIL
"TR1" LINE

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

PROFILE

SCALE: HORIZ 1"=50'
VERT 1"=10'

P-4

LAST REVISION 00-00-00 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 2:45:01 PM

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DGN FILE => ...\to Wreco\429760fb_P4.dgn

CU 04257

EA 297601

September 2010 South Segment Plans and Profile Sheets

North Segment Plans and Profile Sheets

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

LEGEND:

- Exist STORM DRAIN
- GUTTER/DITCH FLOW LINE
- Exist DITCH FLOW LINE
- No. — DRAINAGE SYSTEM No.
- h — DRAINAGE UNIT
- GRADE TO DRAIN
- INLET
- GCP INLET
- Exist INLET
- RSP
- Cap DI
- INFILTRATION OR DETENTION BASIN
- BIOFILTRATION STRIP
- BIOFILTRATION SWALE
- MEDIA FILTER

ABBREVIATIONS:

GCP	CONCRETE PIPE INLET
SGD	STANDARD GUTTER DEPRESSION
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA

NOTES:

1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAIL ON SHEET DD-1.
3. TOP OF GRATE ELEVATION INCLUDES Std GUTTER DEPRESSION.
4. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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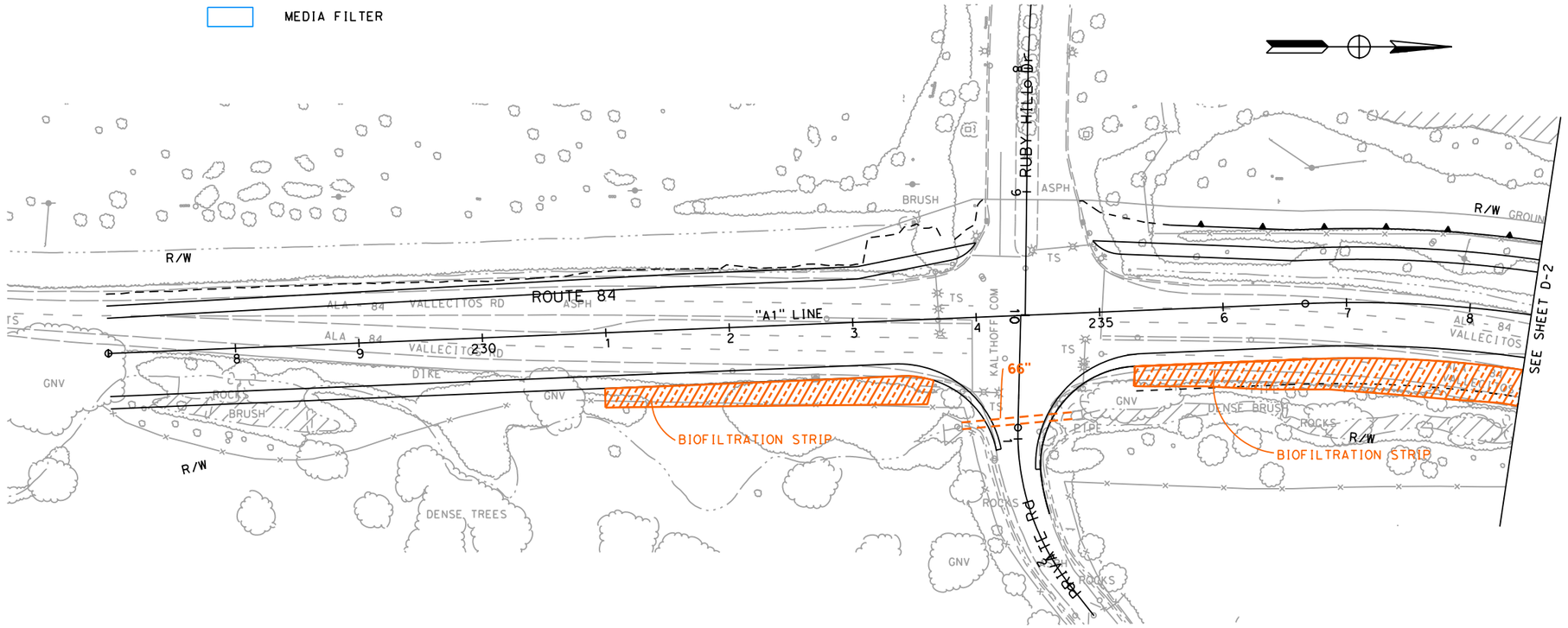

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE 1"=50'

D-1

BORDER LAST REVISED 3/1/2007	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	USERNAME => $USER DGN FILE => $FILE$	CU 00000	EA 297601

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TIME PLOTTED => $TIME

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NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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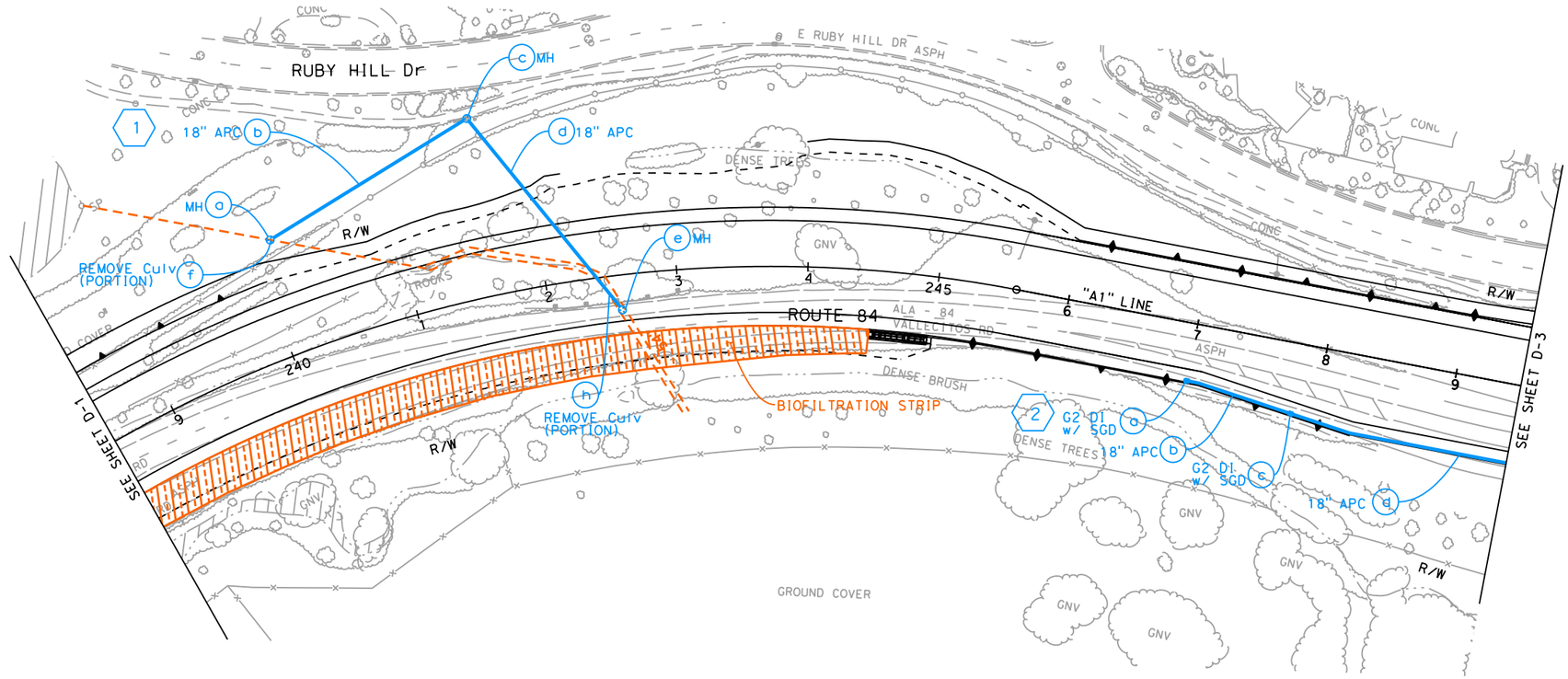

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1"=50'

D-2

REVISED BY	DATE REVISED
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CU 00000

EA 297601

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NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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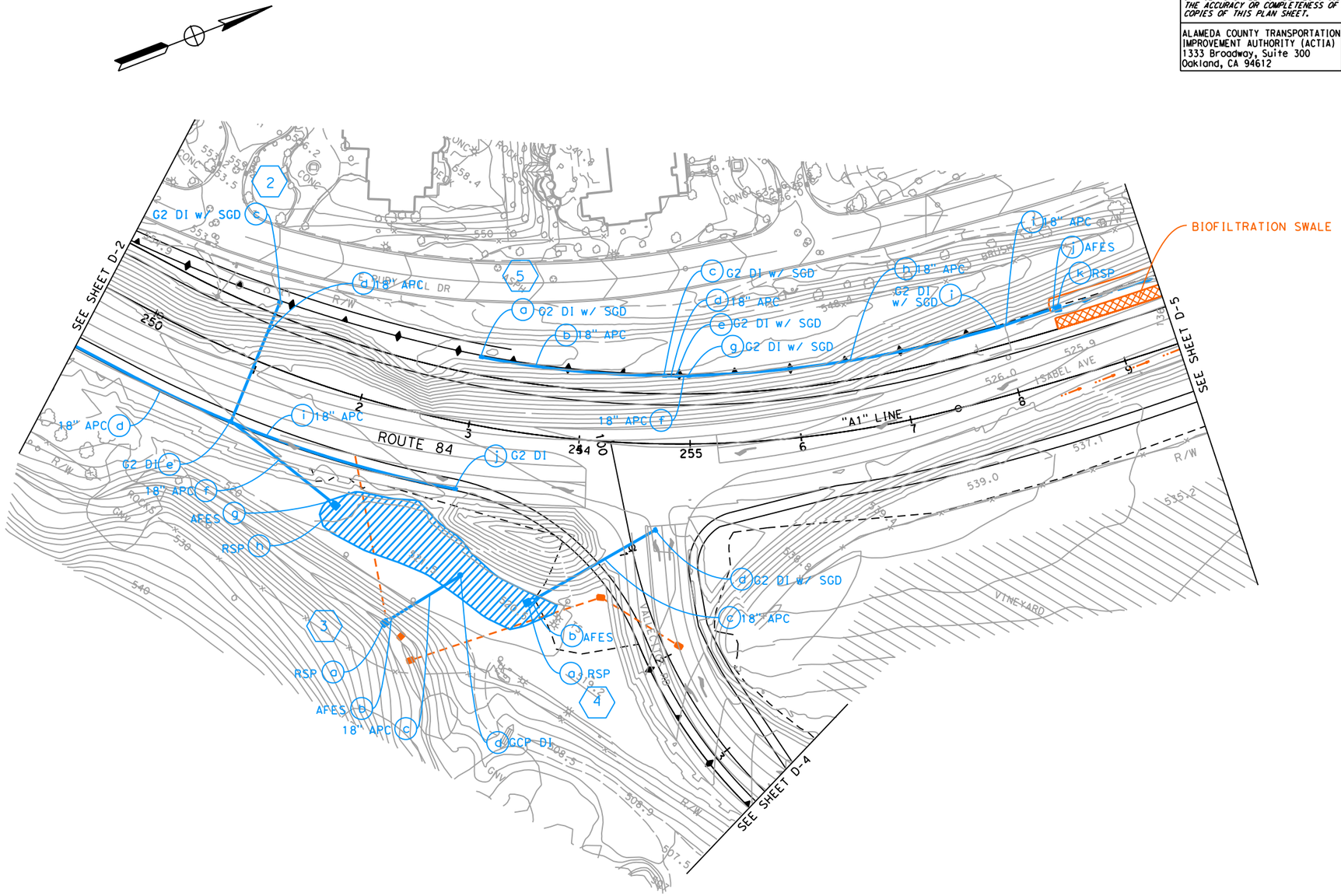

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1"=50'

D-3

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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NOTE:
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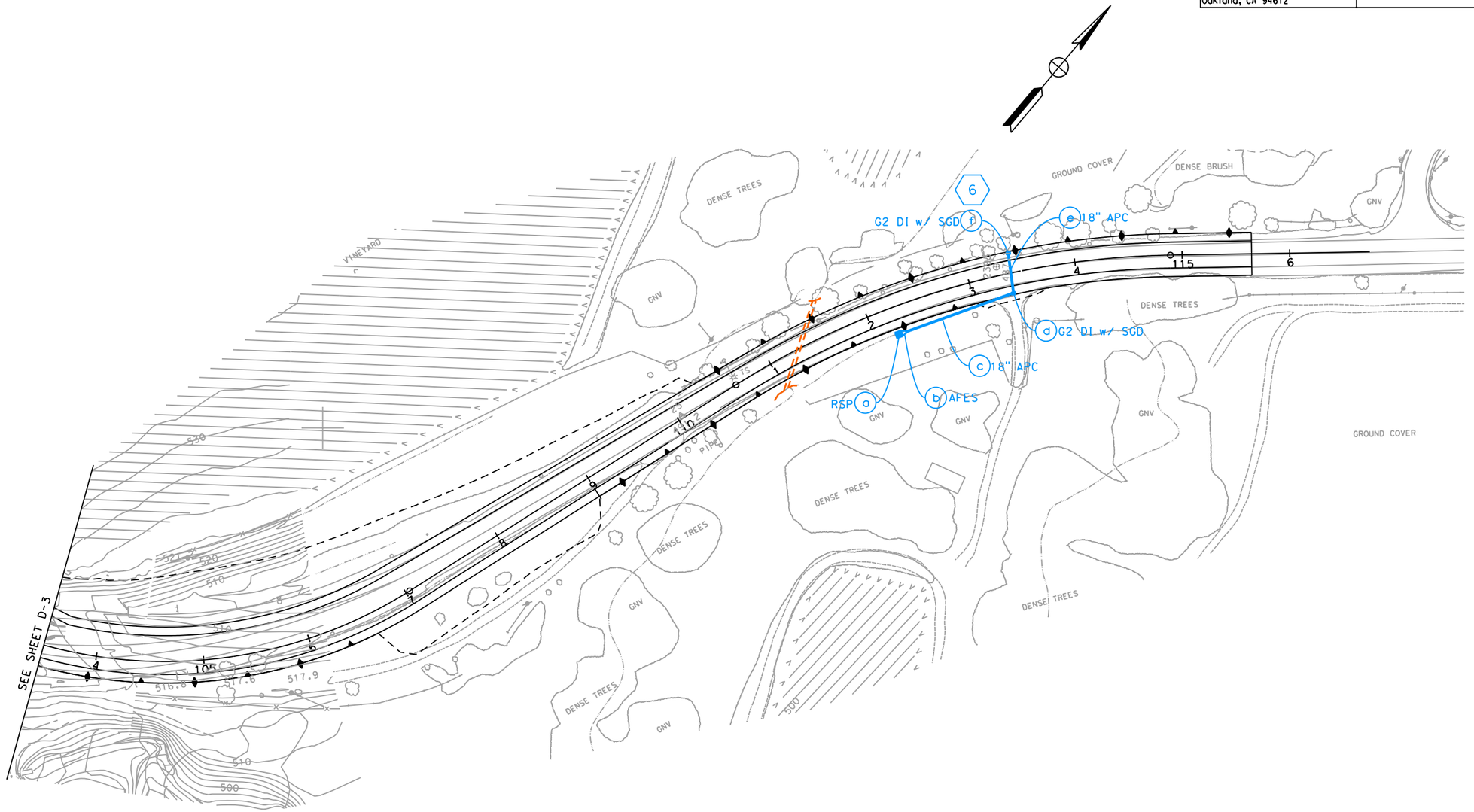

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1"=50'

D-4

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CU 00000

EA 297601

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NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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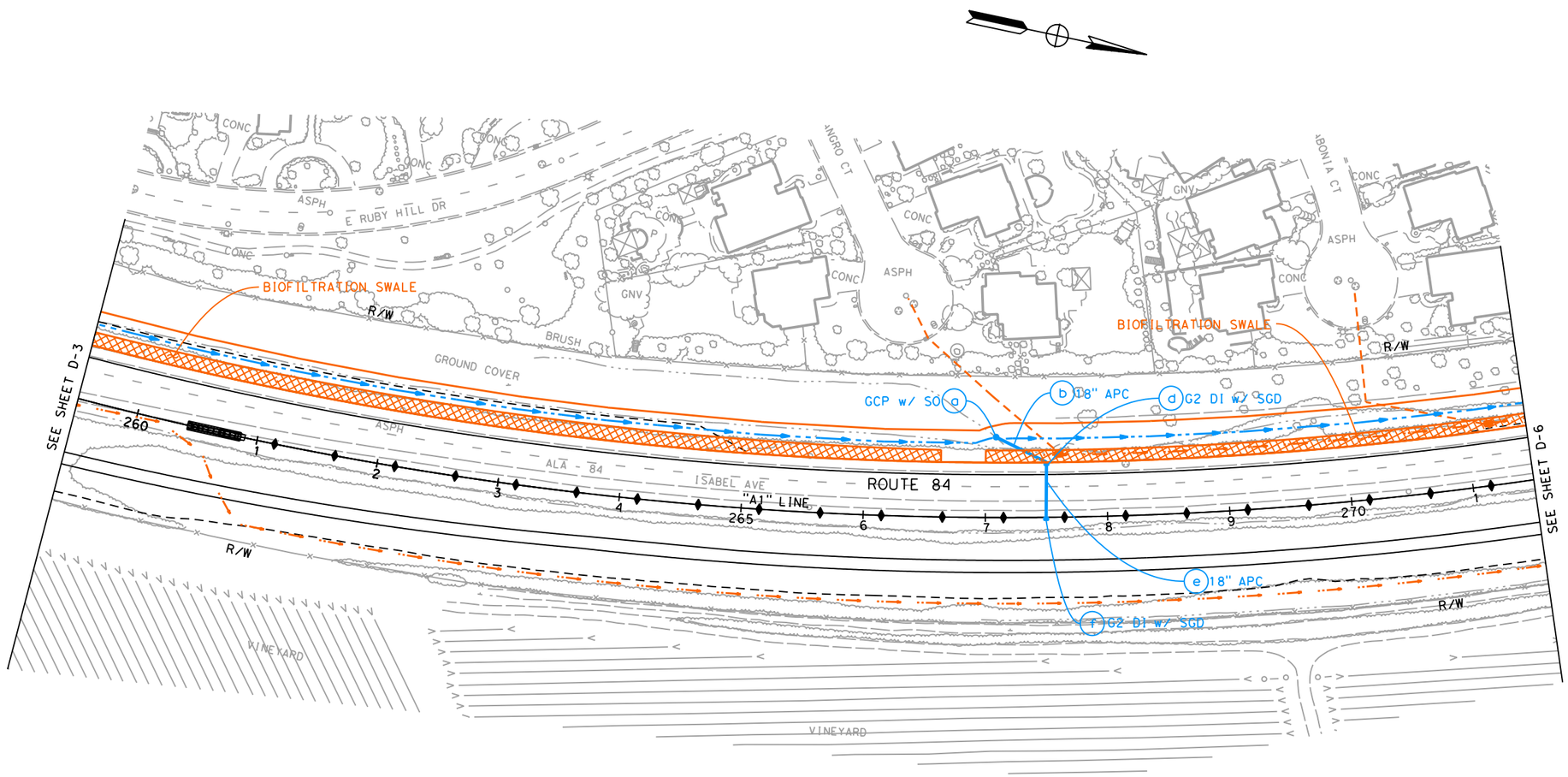

DRAINAGE PLAN

SCALE 1"=50'

D-5

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

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EA 297601

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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NOTE:
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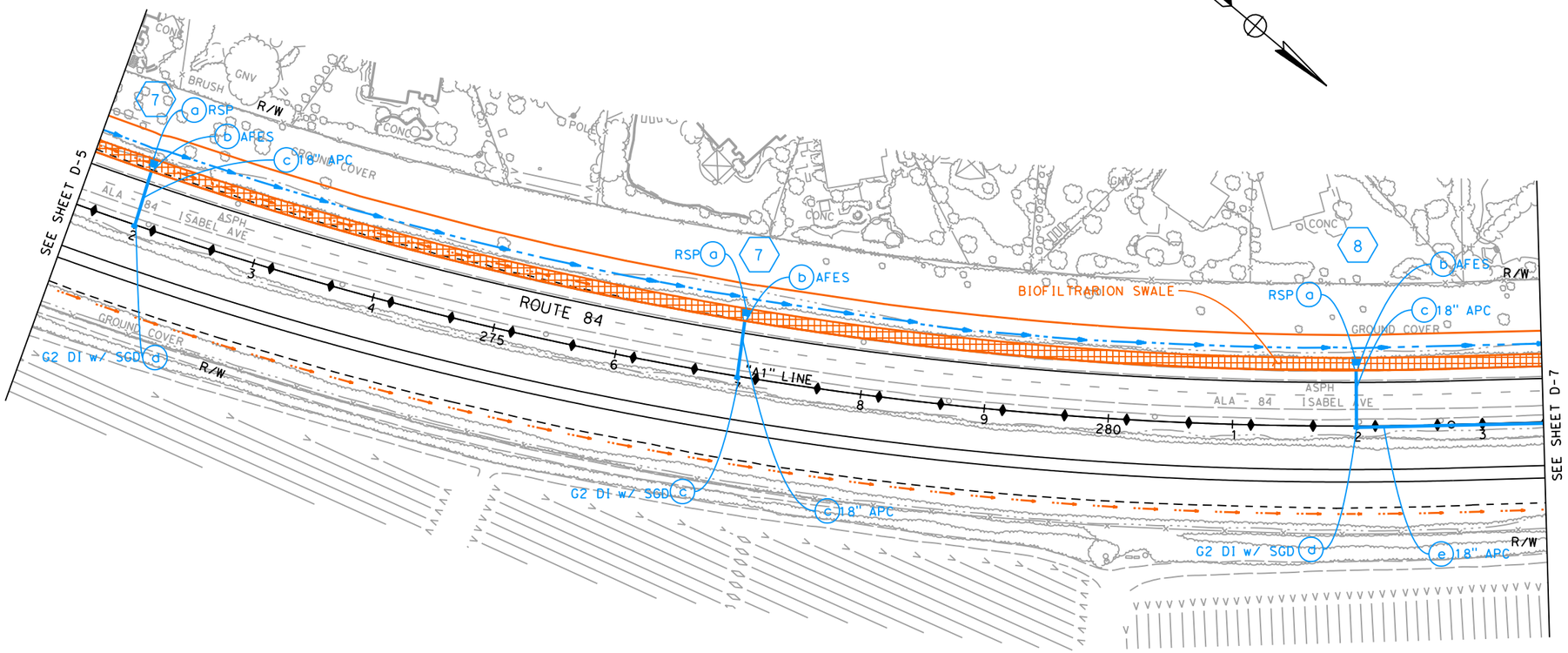

DRAINAGE PLAN

SCALE 1"=50'

D-6

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

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NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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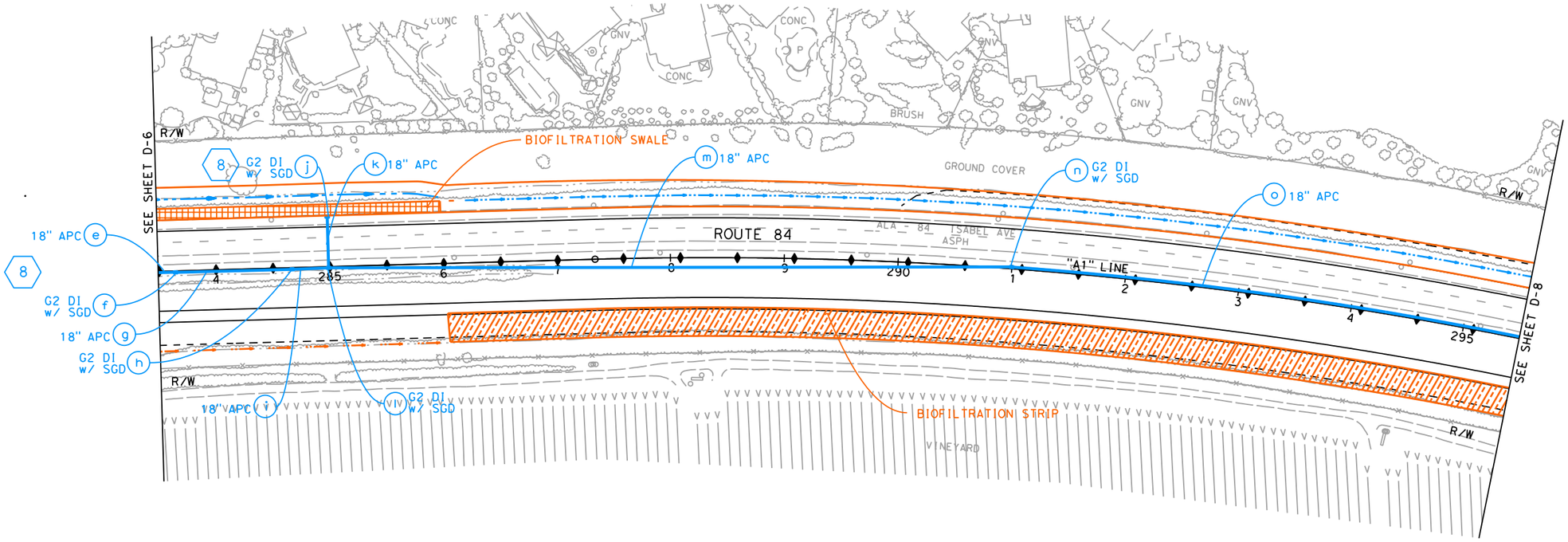

DRAINAGE PLAN

SCALE 1"=50'

D-7

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NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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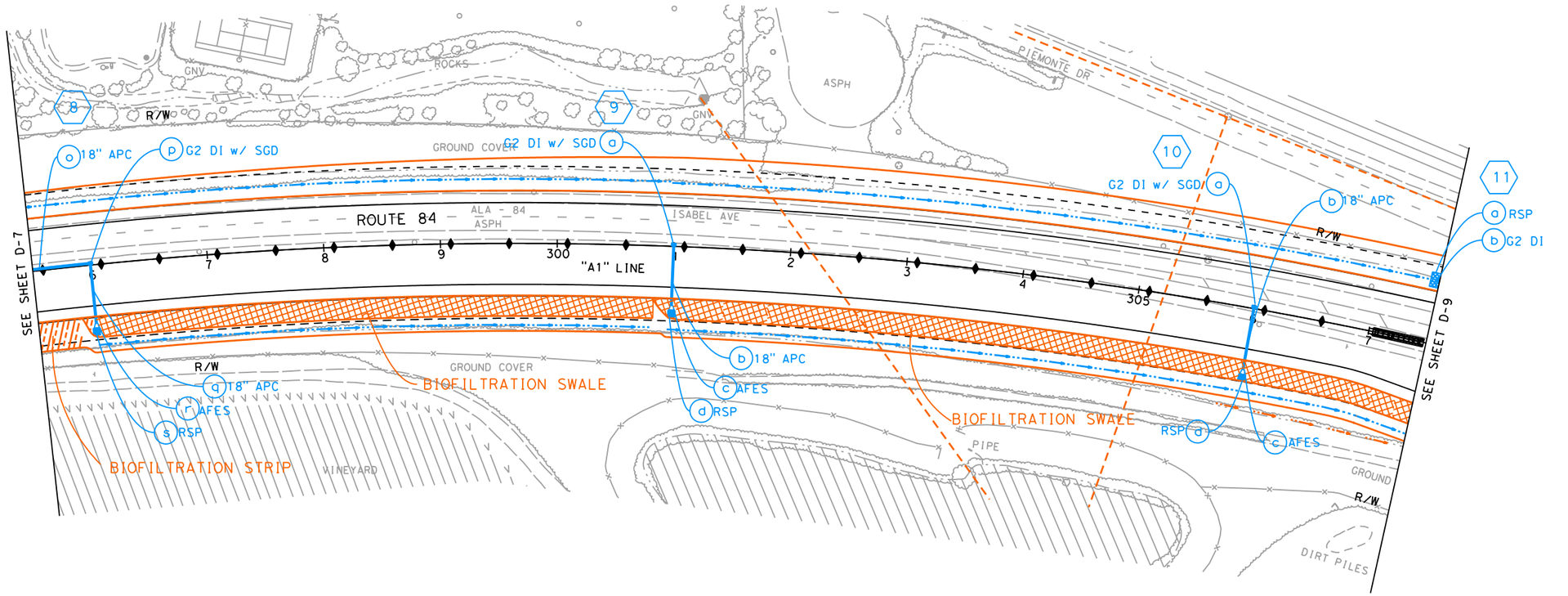

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1"=50'

D-8

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NOTE:
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SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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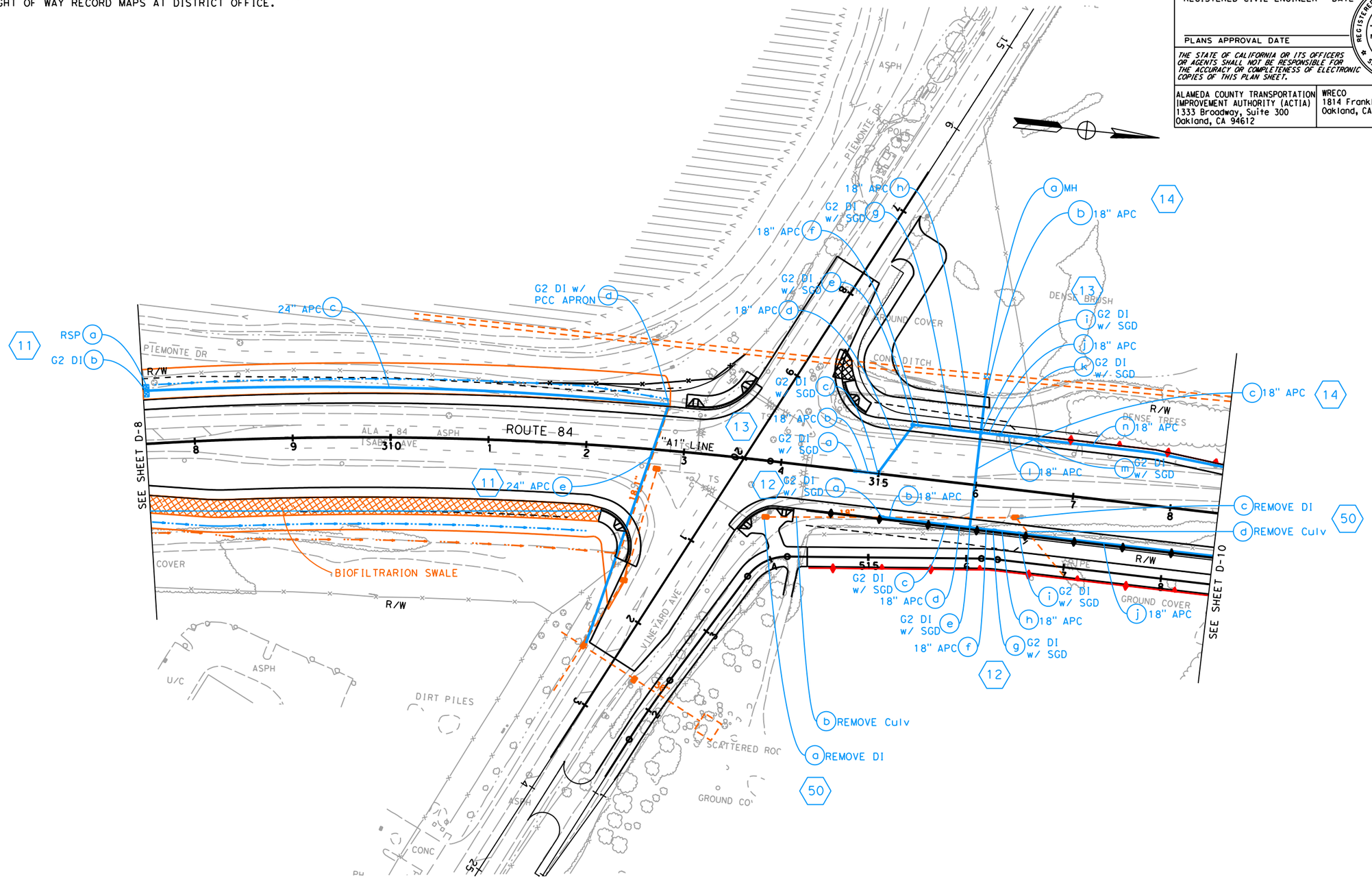

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1"=50'

D-9

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CU 00000

EA 297601

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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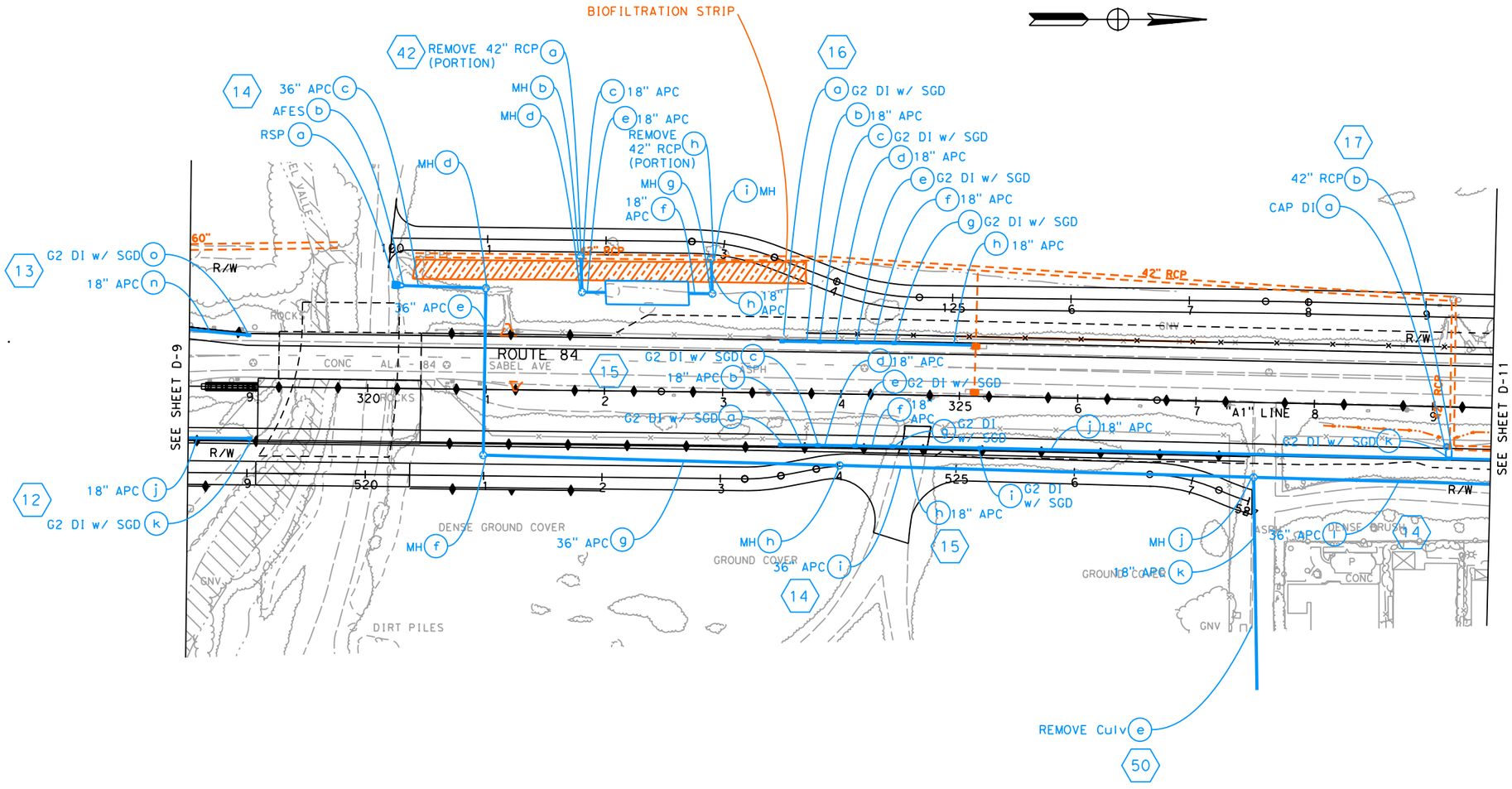

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1"=50'

D-10

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BORDER LAST REVISED 3/1/2007

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EA 297601

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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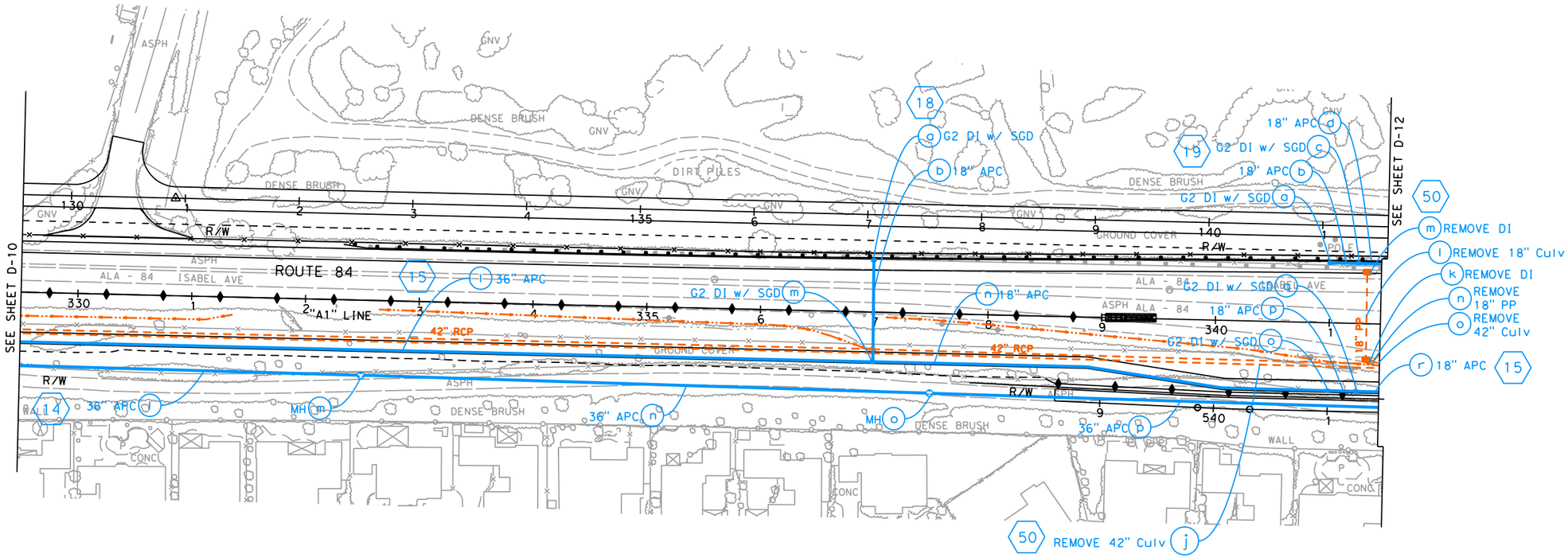
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET D-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1"=50'

D-11

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

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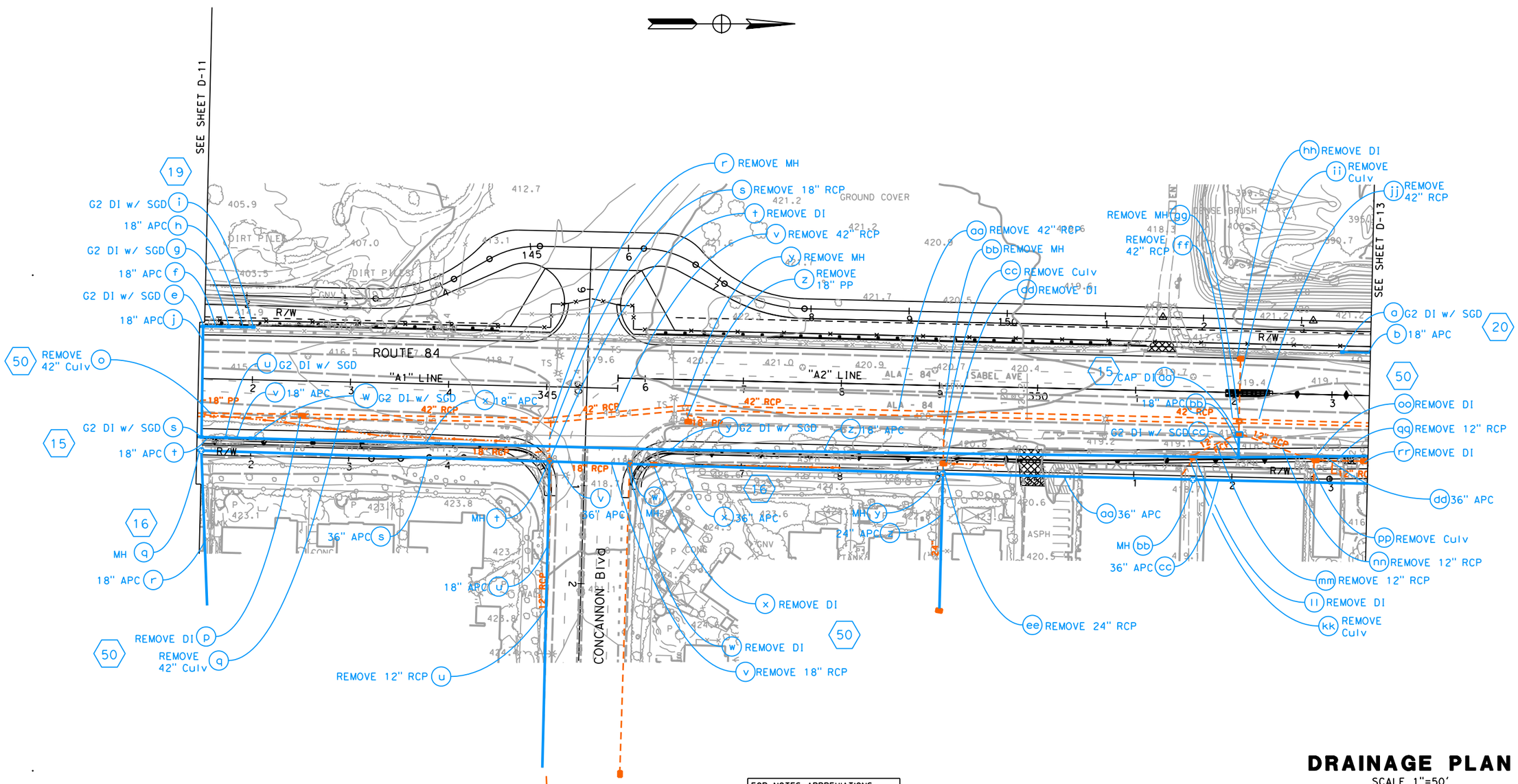

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DRAINAGE PLAN

SCALE 1"=50'

D-12

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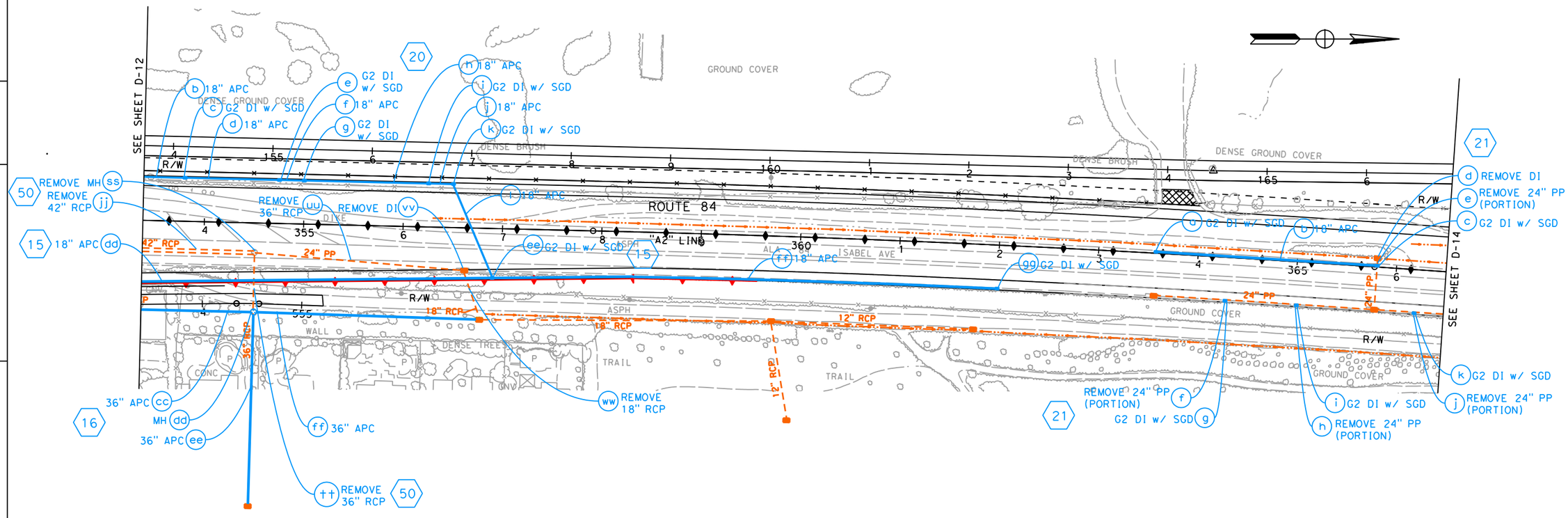

DRAINAGE PLAN

SCALE 1"=50'

D-13

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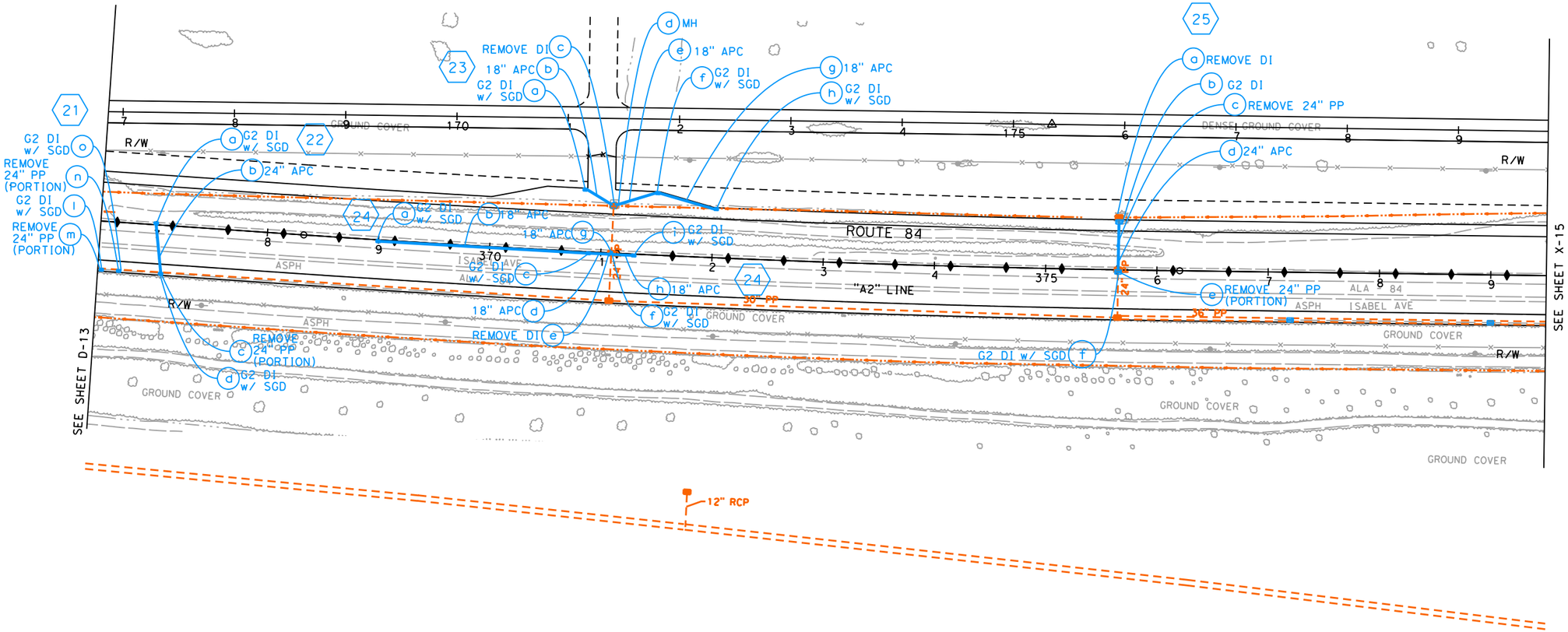

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DRAINAGE PLAN

SCALE 1"=50'

D-14

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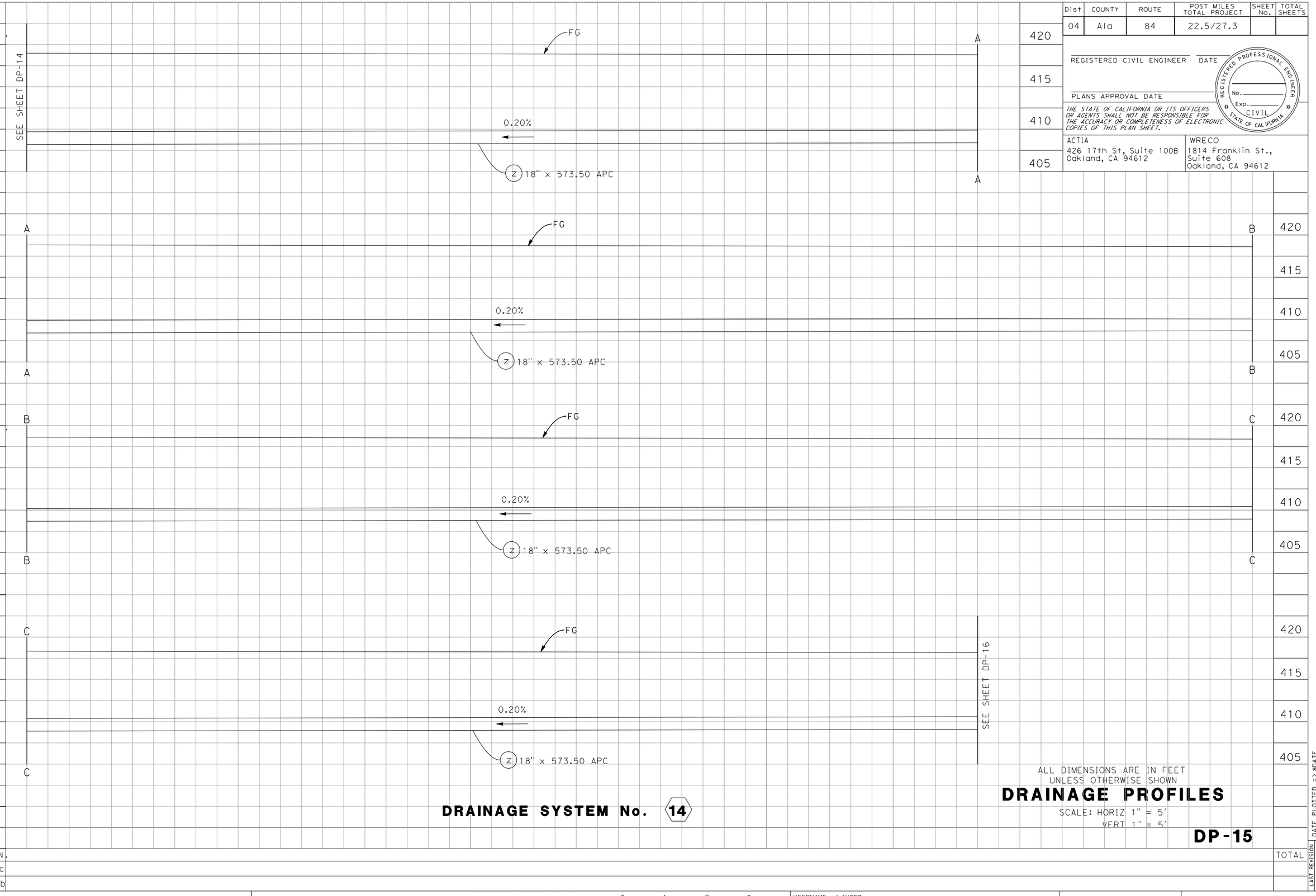

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DRAINAGE SYSTEM No. 14

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-15

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DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-16

DRAINAGE SYSTEM No. 14

STATION			TOTAL
CY	Exc		
	Emb		

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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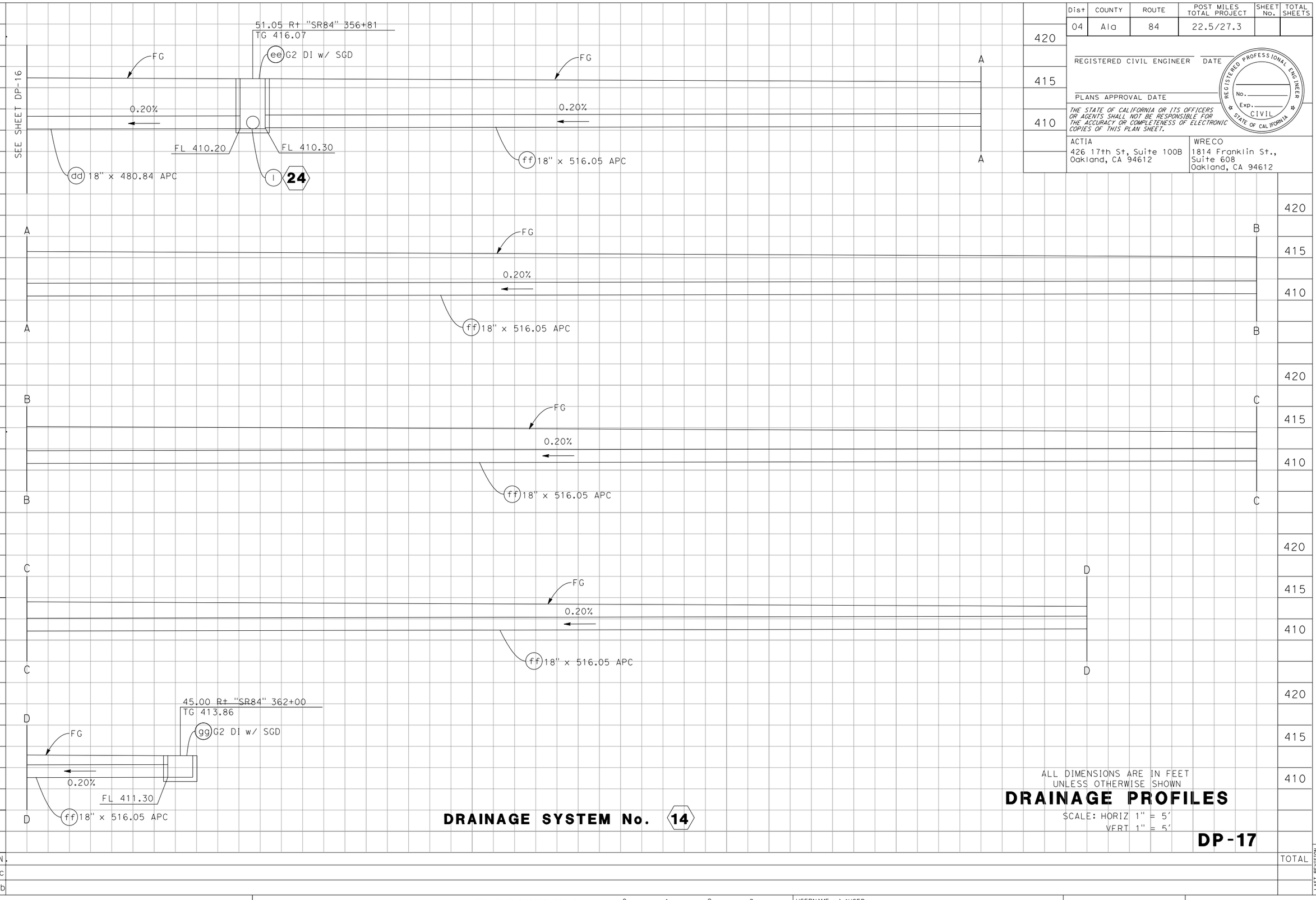

ALL DIMENSIONS ARE IN FEET
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DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-17

DRAINAGE SYSTEM No. 14

STATION
CY Exc
CY Emb
TOTAL

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	ALA	84	22.5/27.3		

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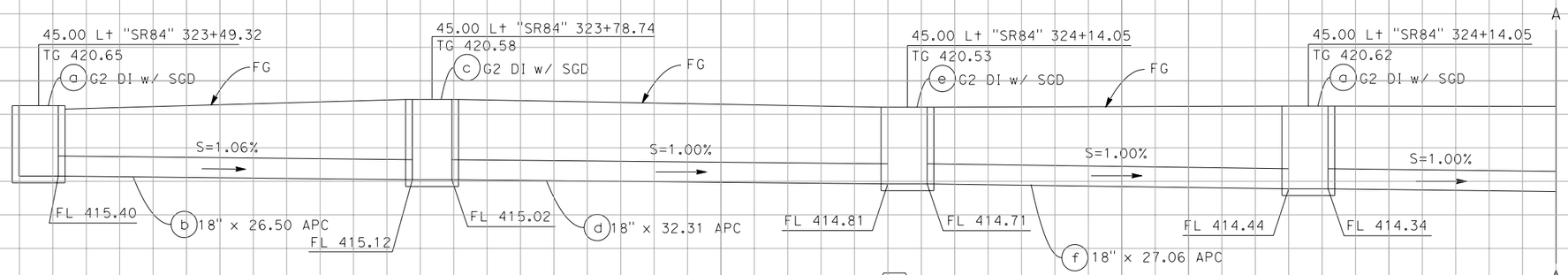
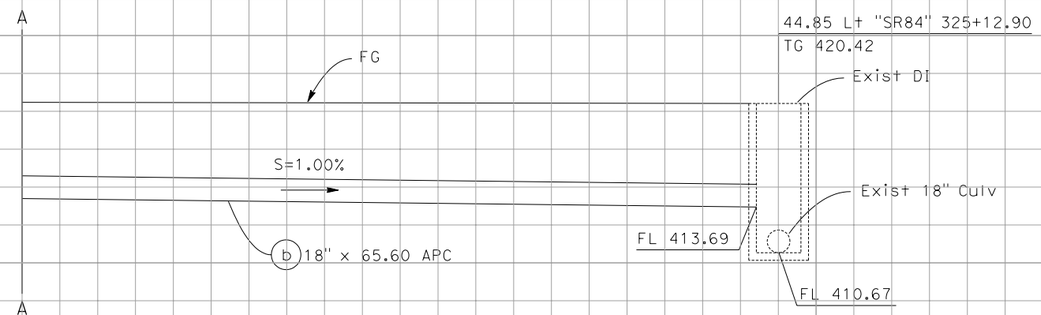


DRAINAGE SYSTEM No. 15



DRAINAGE SYSTEM No. 15

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DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-18

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STATION		TOTAL
CY	Exc	
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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85.71 Lt "SR84" 320+99.27
RIM 410.52
MH d

87.00 Lt "SR84" 328+00
86.92 Lt "SR84" 330+05
AFES b
RSP a
FG
0.10%
FL 402.19
36" x 69.22 APC c
FL 402.25
IDENTICAL

85.71 Lt "SR84" 320+99.27
RIM 410.52
MH f
d
FG
FG
FG
0.09%
FL 402.25
36" x 135.40 APC e
FL 402.47
IDENTICAL

f
FG
A
FL 402.47
36" x 301.33 APC g
A
FG
A
SEE SHEET DP-10
36" x 301.33 APC g

ALL DIMENSIONS ARE IN FEET
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DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DRAINAGE SYSTEM No. 16

DP-19

STATION
CY Exc
CY Emb
TOTAL

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64.00 Rt "SR84" 323+99.98
RIM 418.43
MH (h)
FG
SEE SHEET DP-9
36" x 301.33 APC (g)
FL 402.94
36" x 350.51 APC (i)
36" x 350.51 APC (i)
36" x 350.51 APC (i)
73.00 Rt "SR84" 327+50.49
RIM 422.45
(j) MH
SEE SHEET DP-11
FL 403.25
A
420
415
410
405
400
425

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DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-20

DRAINAGE SYSTEM No. 16

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STATION
CY Exc
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TOTAL

LAST REVISION DATE PLOTTED => $DATE
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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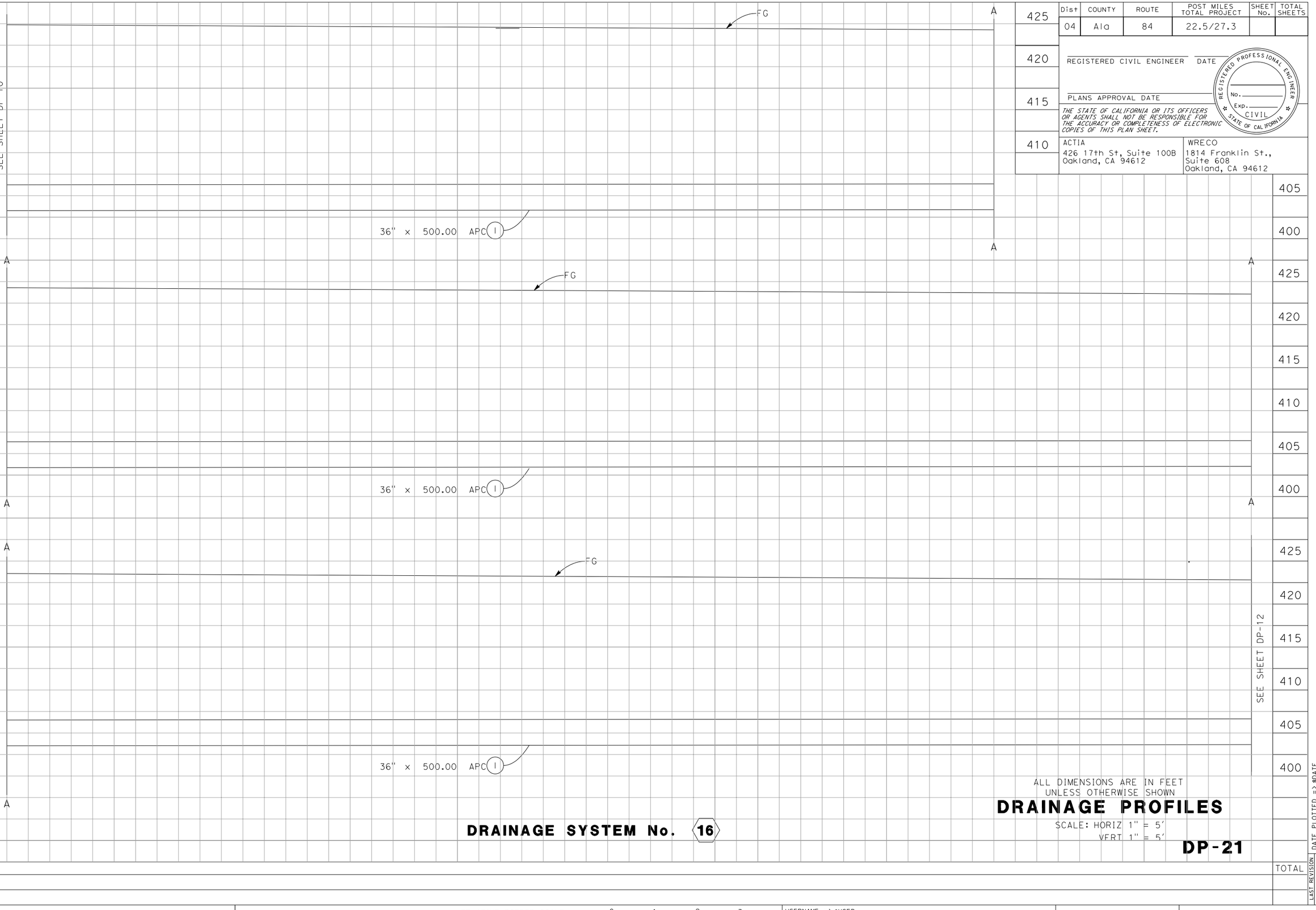

ALL DIMENSIONS ARE IN FEET
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DRAINAGE SYSTEM No. 16

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-21

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66.08 Rt "SR84" 332+50.53
RIM 4XX.XX

(m) MH

FG

SEE SHEET DP-10

36" x 500.00 APC (l)

FL 403.80

36" x 500.00 APC (n)

36" x 500.00 APC (n)

SEE SHEET DP-13

A

B

425 420 415 410 405 400

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DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-22

DRAINAGE SYSTEM No. 16

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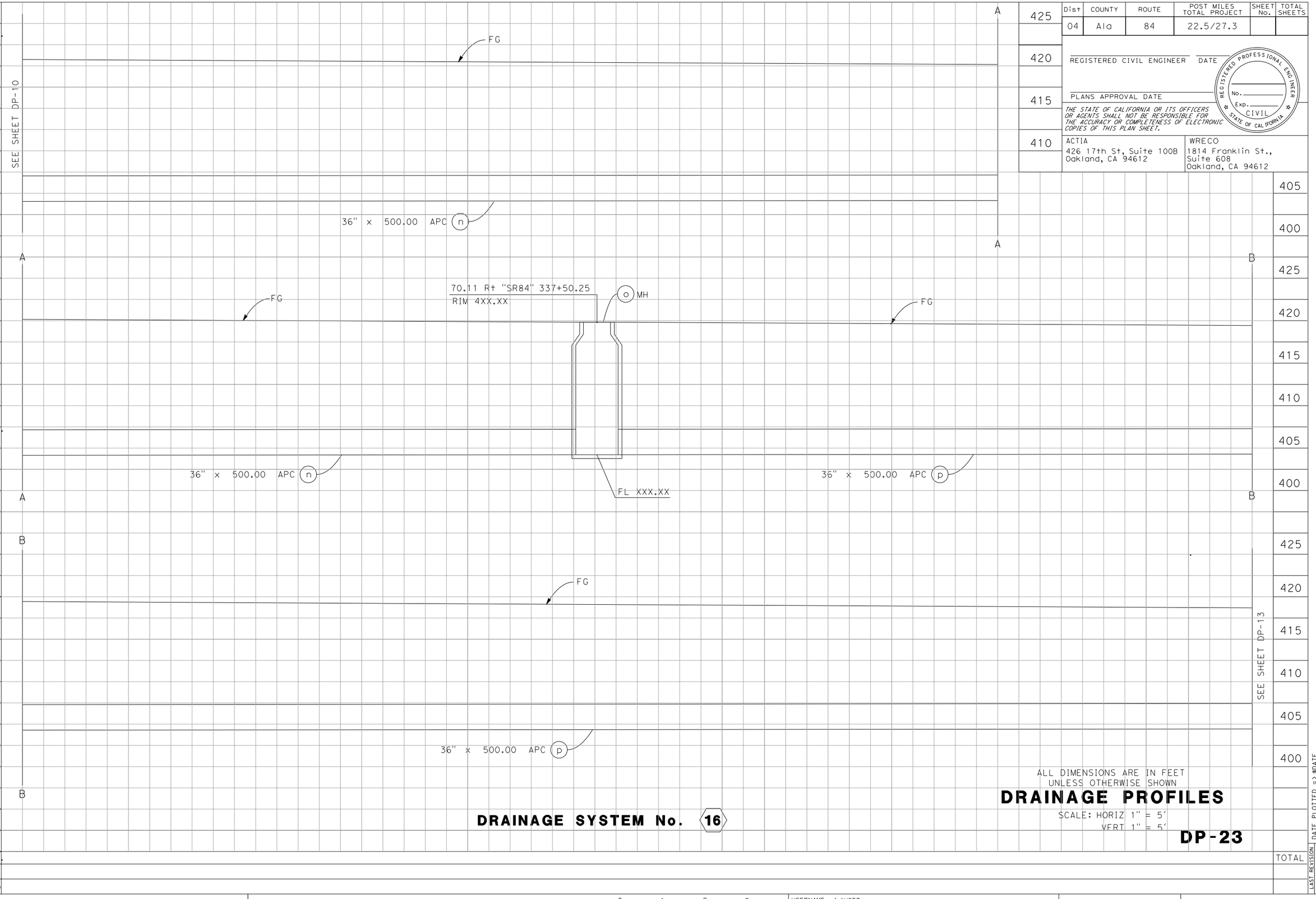

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DRAINAGE SYSTEM No. 16

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-23

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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SEE SHEET DP-12

SEE SHEET DP-13

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DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-24

STATION | TOTAL

CY Exc
CY Emb

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

IDENTICAL, SEE SHEET DP-XX

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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WRECO
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54.30 Rt "SR84" 329+15.08

CAP GCP DI (a)

IDENTICAL, SEE SHEET DP-XX

(a) G2 DI w/ SGD

(h) 17

DRAINAGE SYSTEM No. 17

46.89 Lt "SR84" 337+00

(a) G2 DI w/ SGD

A

(b) XX x 89.13 XXX

A

DRAINAGE SYSTEM No. 18

A

IDENTICAL, SEE SHEET DP-XX

17 (i) (j)

(b) XX x 89.13 XXX

A

DRAINAGE SYSTEM No. 18

54.00 Lt "SR84" 341+00

(a) G2 DI w/ SGD

54.52 Lt "SR84" 341+50

(c) G2 DI w/ SGD

54.93 Lt "SR84" 342+00

G2 DI w/ SGD (e)

(b) XX x 47.05 XXX

(d) XX x 47.05 XXX

DRAINAGE SYSTEM No. 19

IDENTICAL

(c)

IDENTICAL, SEE SHEET DP-XX

14 (m)

(f) XX x 107.97 XXX

DRAINAGE SYSTEM No. 19

1.00 Lt "SR84" 363+58

(a) G2 DI w/ SGD

B

B

(b) XX x 220.05 XXX

1.00 Lt "SR84" 365+81

(a) G2 DI w/ SGD

B

B

(b) XX x 220.05 XXX

DRAINAGE SYSTEM No. 21

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-25

415
410
405

REVISED BY | DATE REVISED

J. ABRAMS | A. OCHOA

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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STATION | TOTAL

CY Exc | Emb

LAST REVISION 00-00-00 DATE PLOTTED => $DATE TIME PLOTTED => $TIME

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => $USER
DGN FILE => $REQUEST

CU 00000

EA 000000

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

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Suite 608
Oakland, CA 94612

87.37 Rt "SR84" 346+11

Exist 18" RCP

A — A

(a) XX x 292.05 XXX

B — B

415

410

405

(a) XX x 292.05 XXX

89.78 Rt "SR84" 349+06

(b) MH

C — C

(a) XX x 292.05 XXX

(a) XX x 371.49 XXX

D — D

(c) XX x 371.49 XXX

(c) XX x 371.49 XXX

SEE SHEET DP-18

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DRAINAGE SYSTEM No. 20

DP-26

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

			TOTAL
STATION			
CY	Exc		
	Emb		

LAST REVISION 00-00-00 | DATE PLOTTED => $DATE | TIME PLOTTED => $TIME

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

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Oakland, CA 94612

89.71 R+ "SR84" 352+80.44

(d) MH

SEE SHEET DP-18

(c) XX x 371.49 XXX

A

A

(e) XX x 177.33 XXX

89.35 R+ "SR84" 354+59.72

(f) MH

B

415

410

405

A

A

(e) XX x 177.33 XXX

(g) XX x 222.33 XXX

B

B

C

C

(g) XX x 222.33 XXX

DRAINAGE SYSTEM No. 20

85.12 R+ "SR84" 356+85

(h) MH

45.00 L+ "SR84" 356+91

(a) G2 D1 w/ SGD

IDENTICAL, SEE SHEET DP-XX

(v) 17

C

C

(g) XX x 222.33 XXX

(b) XX x 90.05 XXX

DRAINAGE SYSTEM No. 20

DRAINAGE SYSTEM No. 21

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-27

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Caltrans

STATION | TOTAL

CY Exc | Emb

LAST REVISION | DATE PLOTTED => $DATE | TIME PLOTTED => $TIME
00-00-00

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USERNAME => $USER
DGN FILE => $REQUEST

CU 00000

EA 000000

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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PLANS APPROVAL DATE

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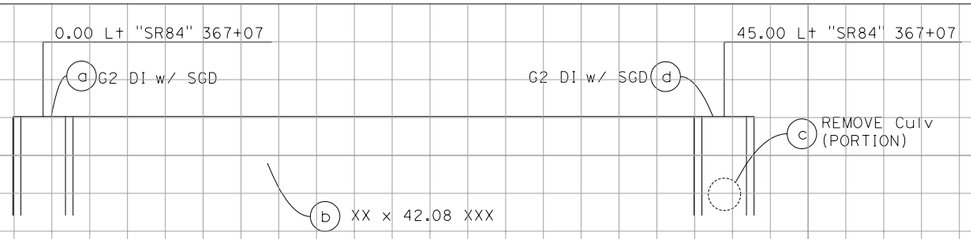

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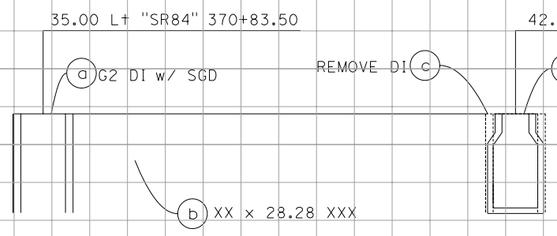

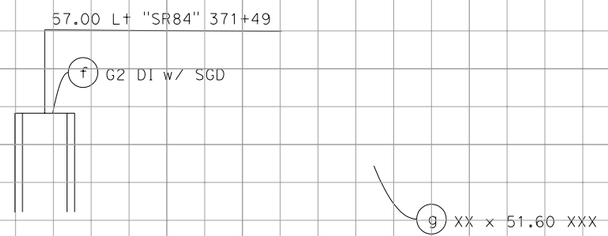

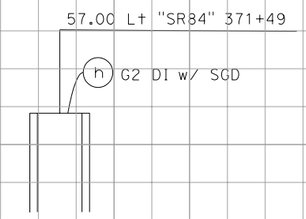

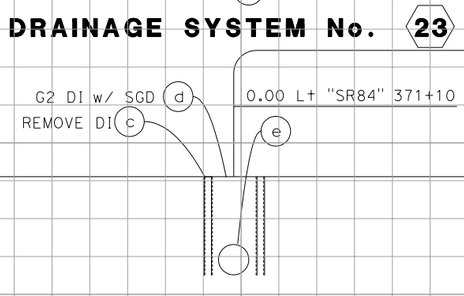

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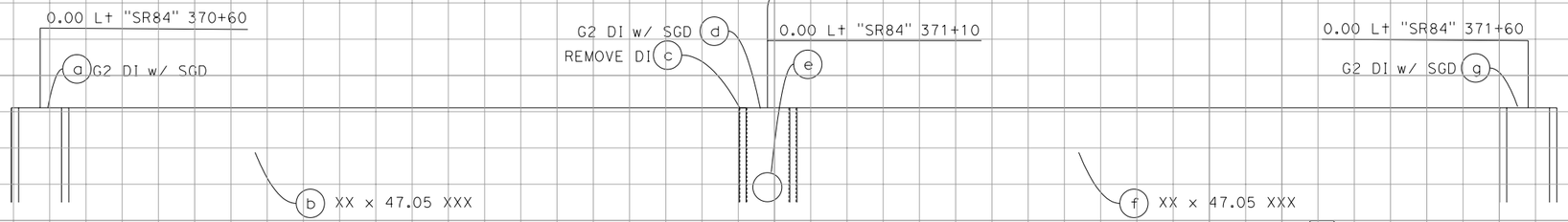

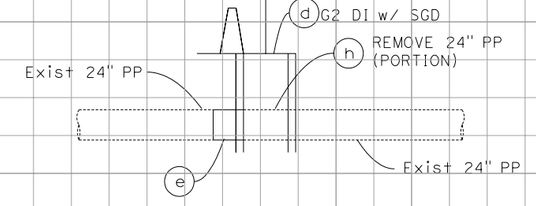

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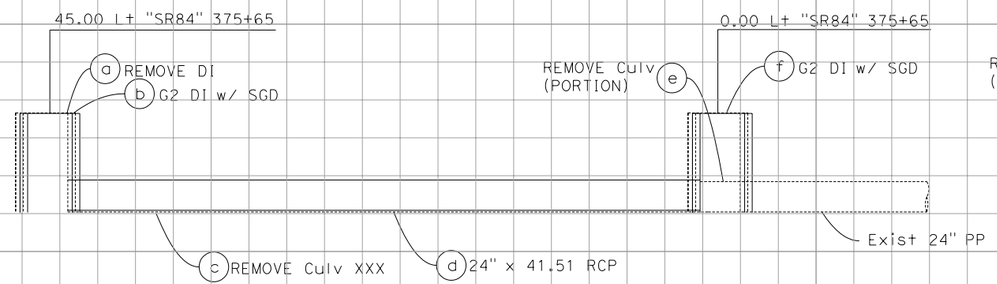

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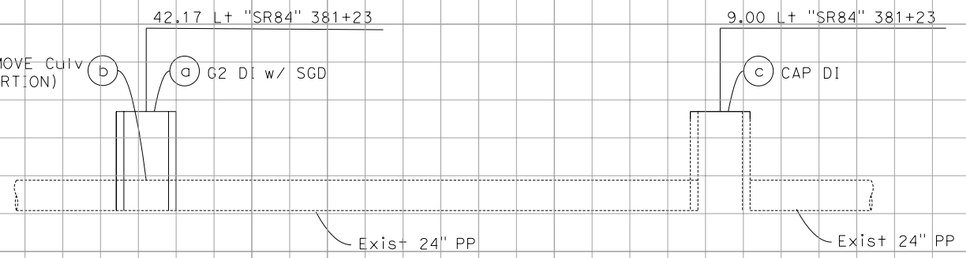

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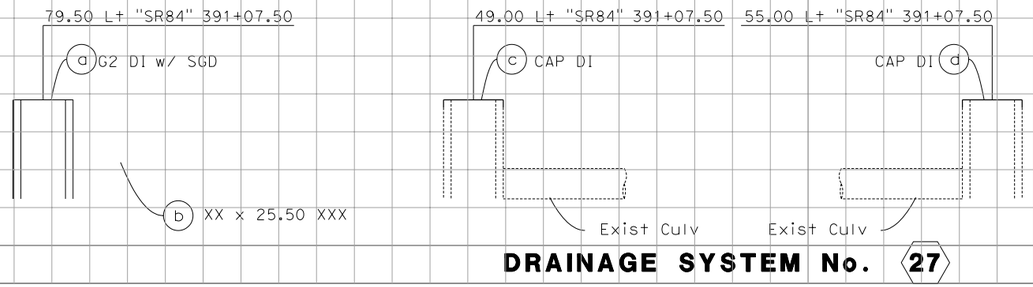
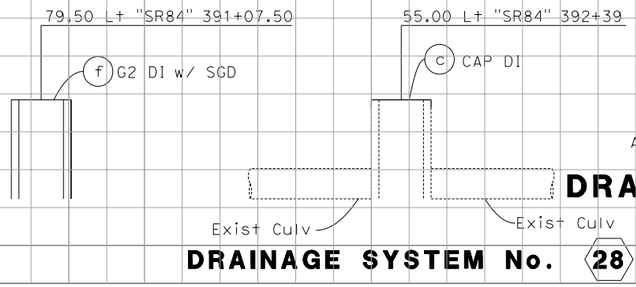


DRAINAGE SYSTEM No. 27



DRAINAGE SYSTEM No. 28

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-28

STATION			TOTAL
CY	Exc		
	Emb		

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY: J. ABRAMS
CHECKED BY: A. OCHOA

REVISED BY | DATE REVISED

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Caltrans

LAST REVISION DATE PLOTTED => $DATE
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BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => $USER
DGN FILE => $REQUEST

CU 00000

EA 000000

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

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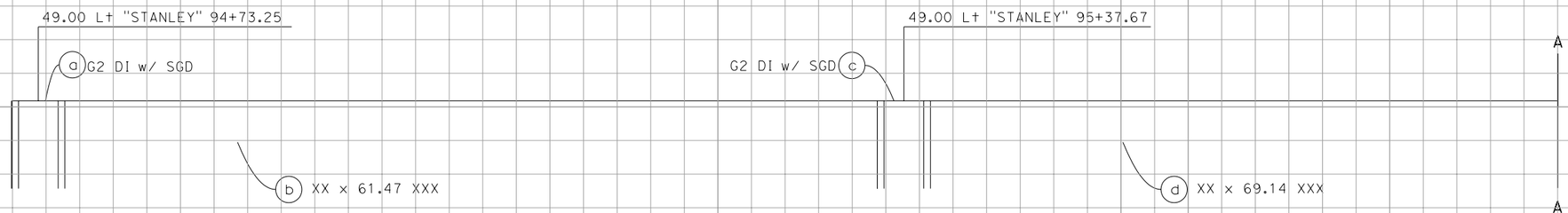

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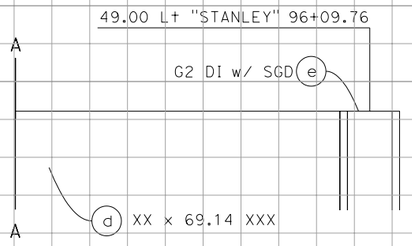

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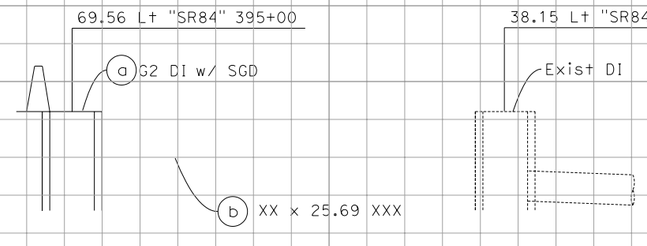

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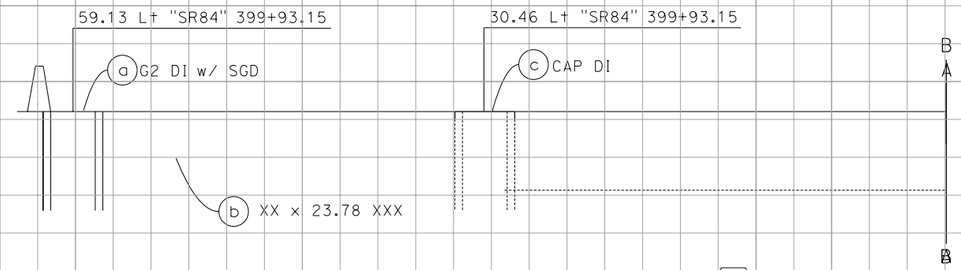

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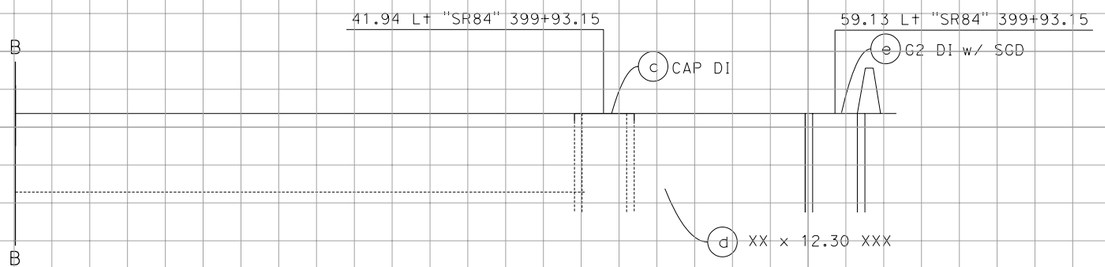

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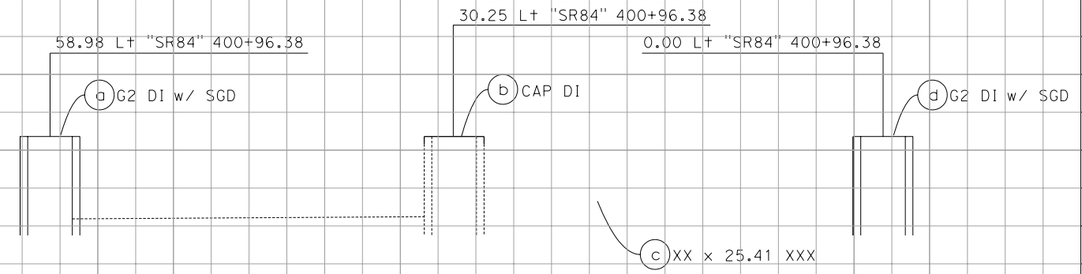

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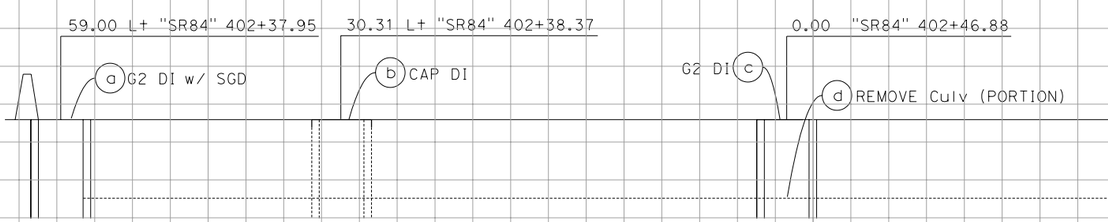

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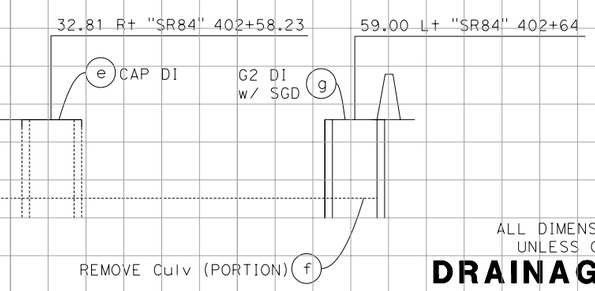

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-29

REVISED BY	DATE REVISED
J. ABRAMS	A. OCHOA

CALCULATED-DESIGNED BY

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

STATION

CY Exc

Emb

415 410 405 415 410 405

TOTAL

LAST REVISION 00-00-00 DATE PLOTTED => $DATE TIME PLOTTED => $TIME

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => $USER
DGN FILE => $REQUEST

CU 00000

EA 000000

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.5/27.3		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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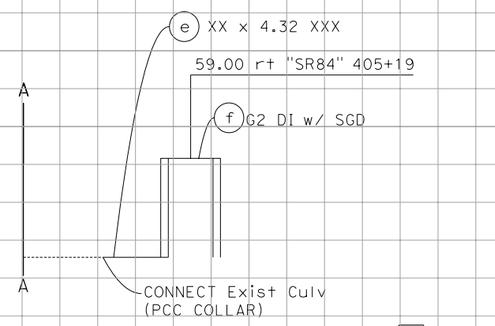
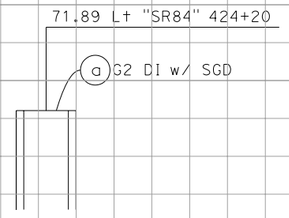
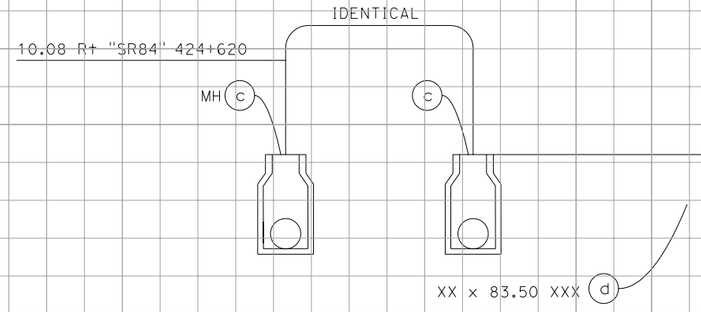
DRAINAGE SYSTEM No. 34

DRAINAGE SYSTEM No. 34







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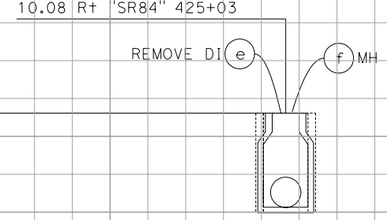

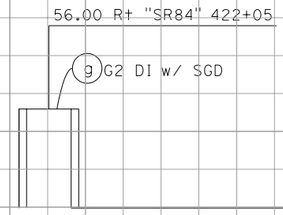

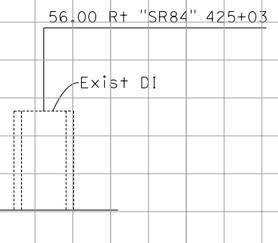

B
C
C
D
A
B
C
D
C
D

DRAINAGE SYSTEM No. 35

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-30

STATION		TOTAL
CY	Exc	
	Emb	

LAST REVISION | DATE PLOTTED => $DATE
00-00-00 | TIME PLOTTED => $TIME

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => $USER
DGN FILE => $REQUEST

CU 00000

EA 000000

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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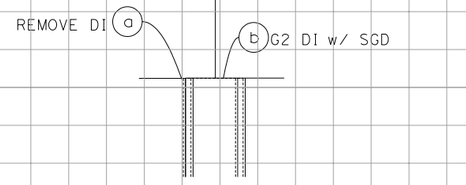
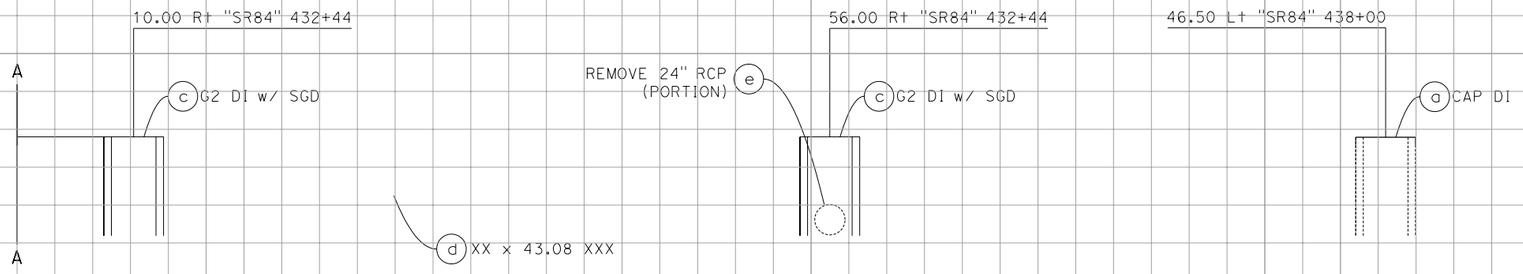
DRAINAGE SYSTEM No. 36



DRAINAGE SYSTEM No. 37

DRAINAGE SYSTEM No. 38



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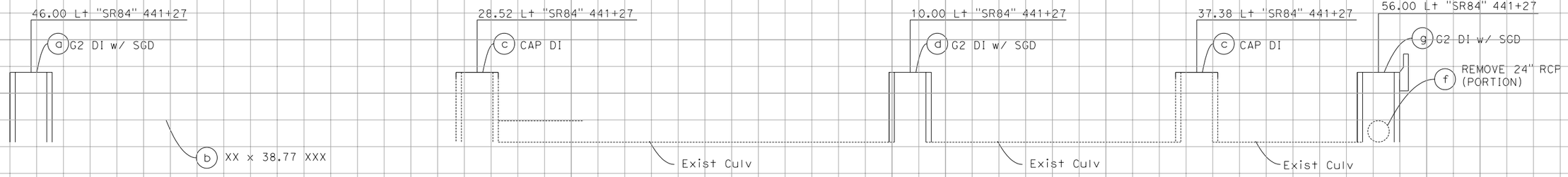

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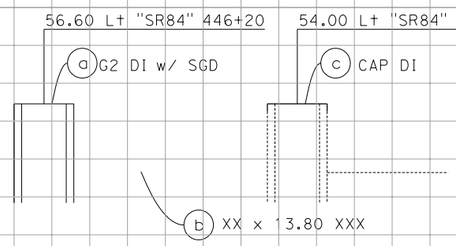

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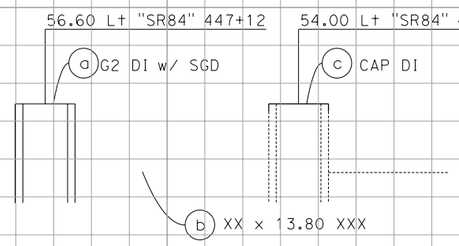

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE: HORIZ 1" = 5'
VERT 1" = 5'

DP-31

STATION | TOTAL

CY Exc | Emb

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BORDER LAST REVISED 3/1/2007 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => $USER | DGN FILE => $REQUEST | CU 00000 | EA 000000

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA,
CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
3. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.
4. CONTRACTOR IS RESPONSIBLE TO PROVIDE POSITIVE DRAINAGE FROM ALL ROADWAY AREA AT ALL TIMES.
5. LOCATIONS OF EXISTING DRAINAGE FACILITIES ARE APPROXIMATE. VERIFY LOCATION AND ELEVATION OF EXISTING DRAINAGE FACILITIES PRIOR TO MODIFYING.
6. CALTRANS DISTRICT HYDRAULICS RESERVES THE RIGHT TO REQUEST THAT DRAINAGE STRUCTURES BE "CAST-IN-PLACE" WHERE THE PRE-CAST OPTION IS NOT DEEMED TO BE APPROPRIATE. IF PRE-CAST STRUCTURES ARE USED, CONTRACTOR SHALL FIELD VERIFY ALL EXISTING PIPES PRIOR TO CASTING STRUCTURES.

LEGEND:

- Exist STORM DRAIN
- PROPOSED STORM DRAIN
- GUTTER/DITCH FLOW LINE
- (No.) DRAINAGE SYSTEM No.
- (h) DRAINAGE UNIT
- GRADE TO DRAIN
- INLET
- Exist DI
- CAP DI
- AUSTIN VAULT SAND FILTER

ABBREVIATIONS:

COL	CITY OF LIVERMORE
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA
ASP	ALTERNATIVE SLOTTED PIPE
TC	TOP OF COVER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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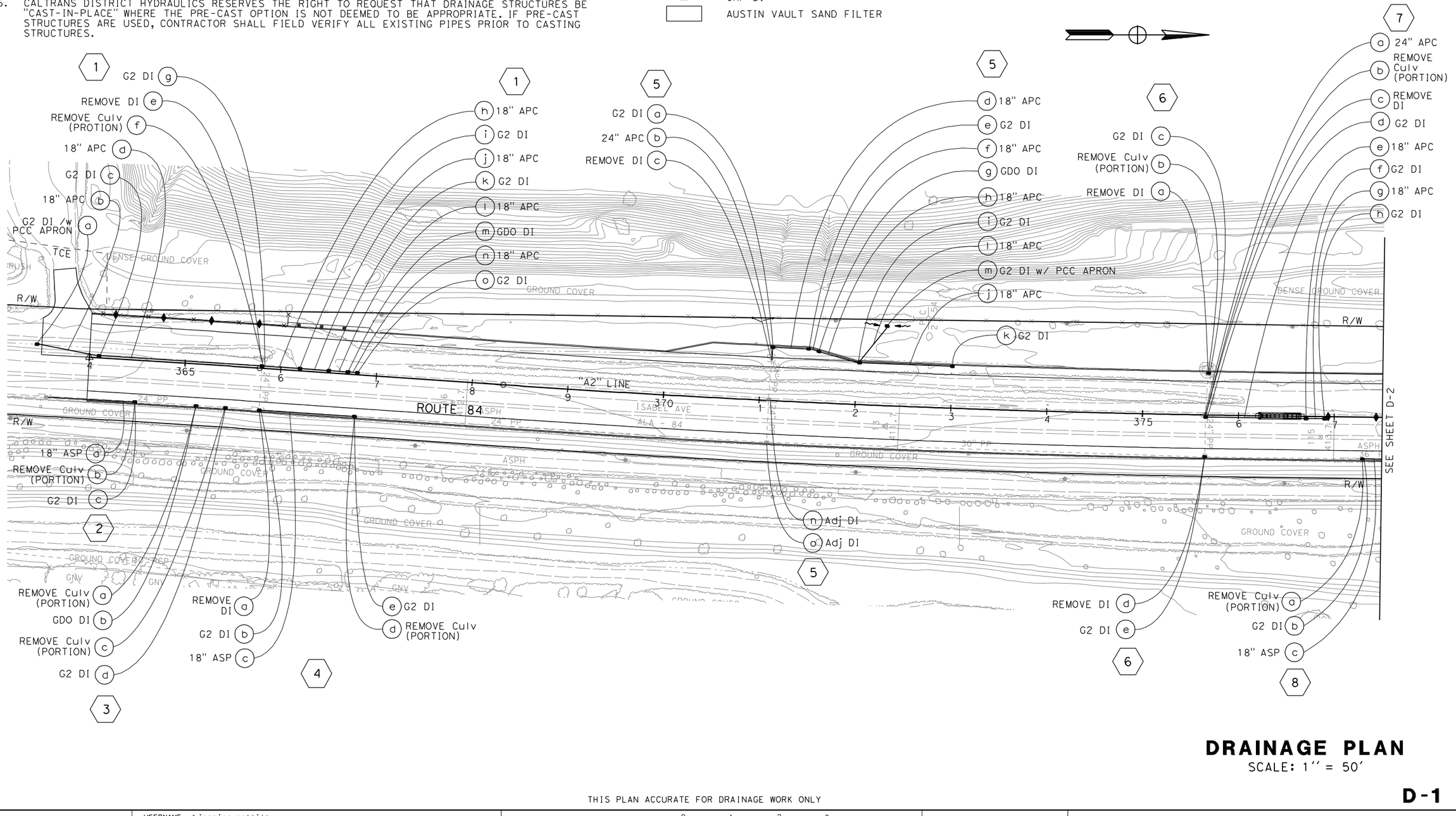

DRAINAGE PLAN

SCALE: 1'' = 50'

D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

REVISED BY	DATE REVISED
JP	1/11/11

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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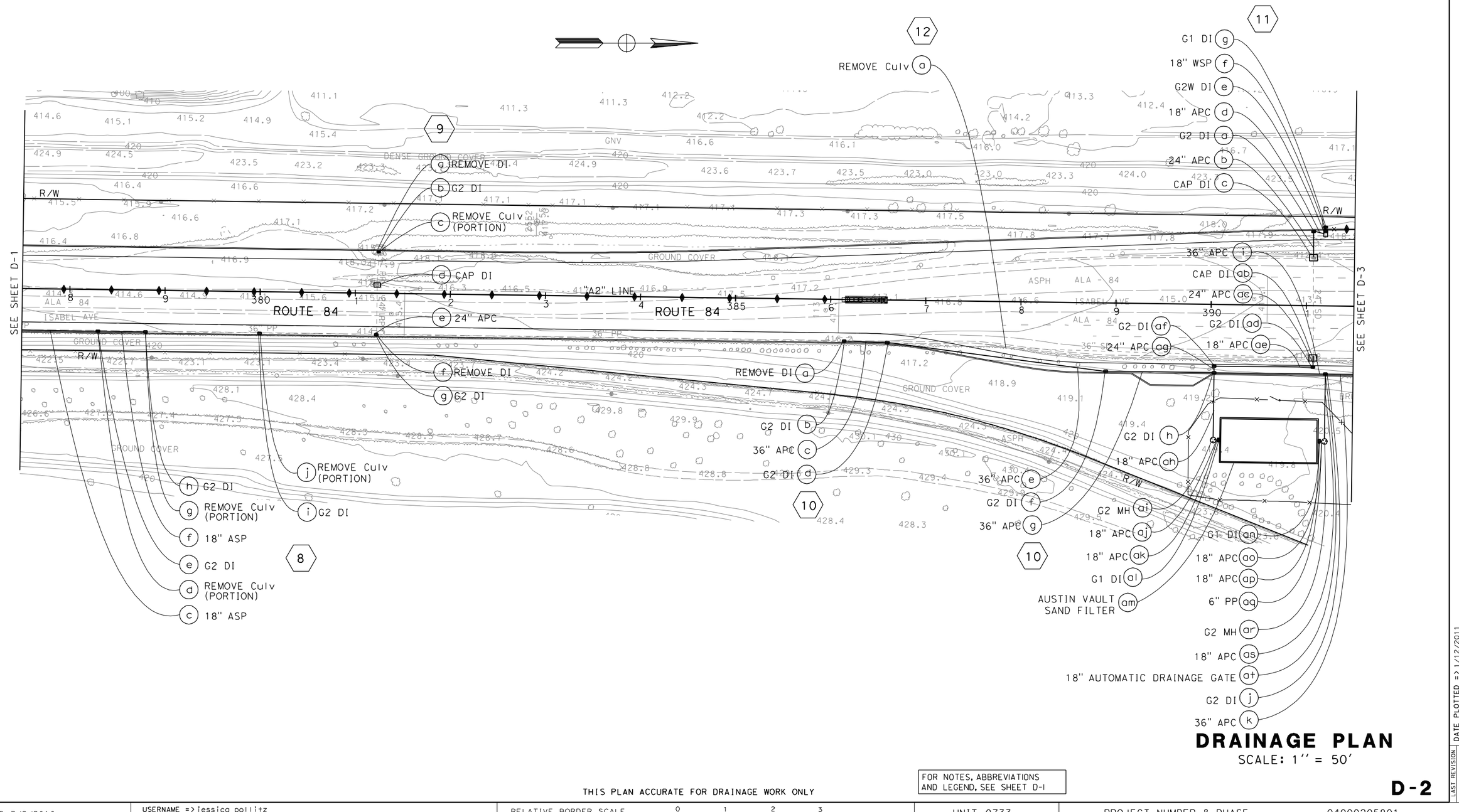

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
IRENE LIU	ANALETTE OCHOA	JP	1/11/11

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Anlette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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ANALETTE OCHOA — CHECKED BY
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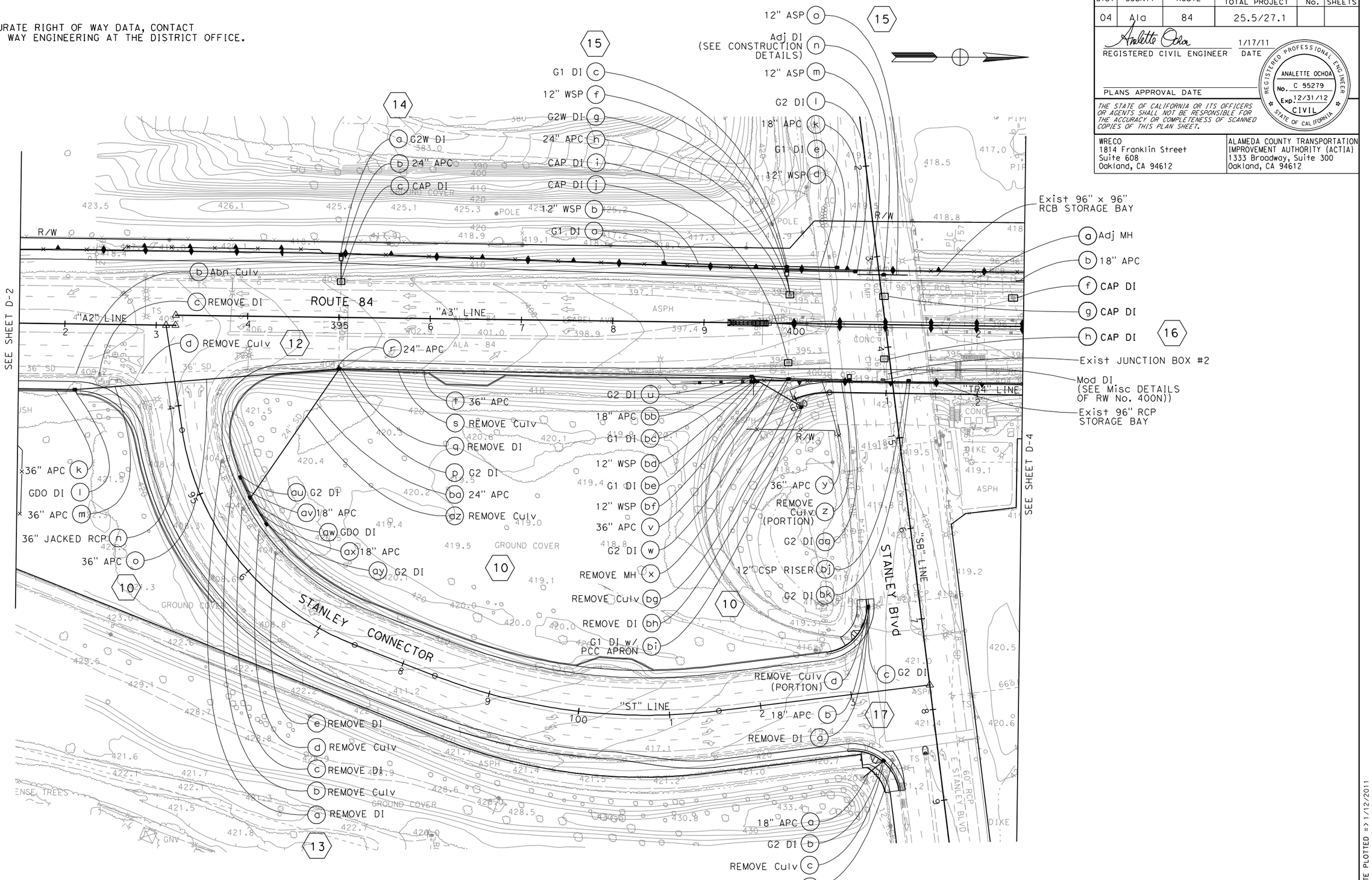

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-3

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Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
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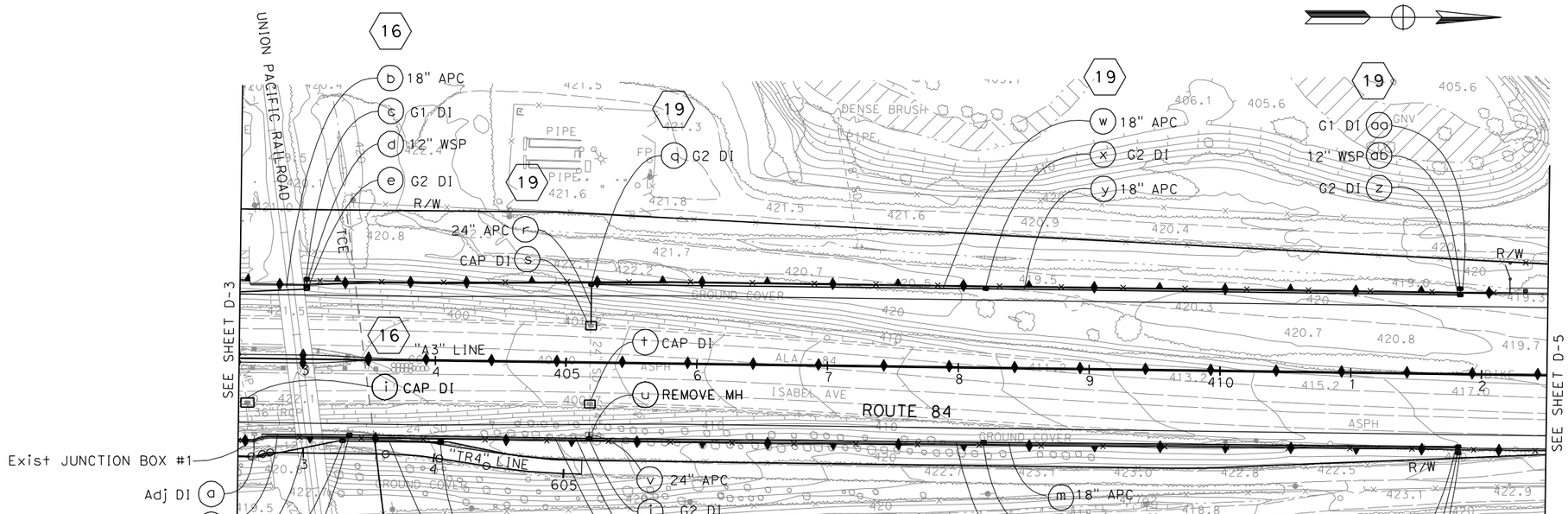

DRAINAGE PLAN
SCALE: 1'' = 50'

D-4

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

	REVISED BY	DATE REVISED
	JP	10/19/10

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CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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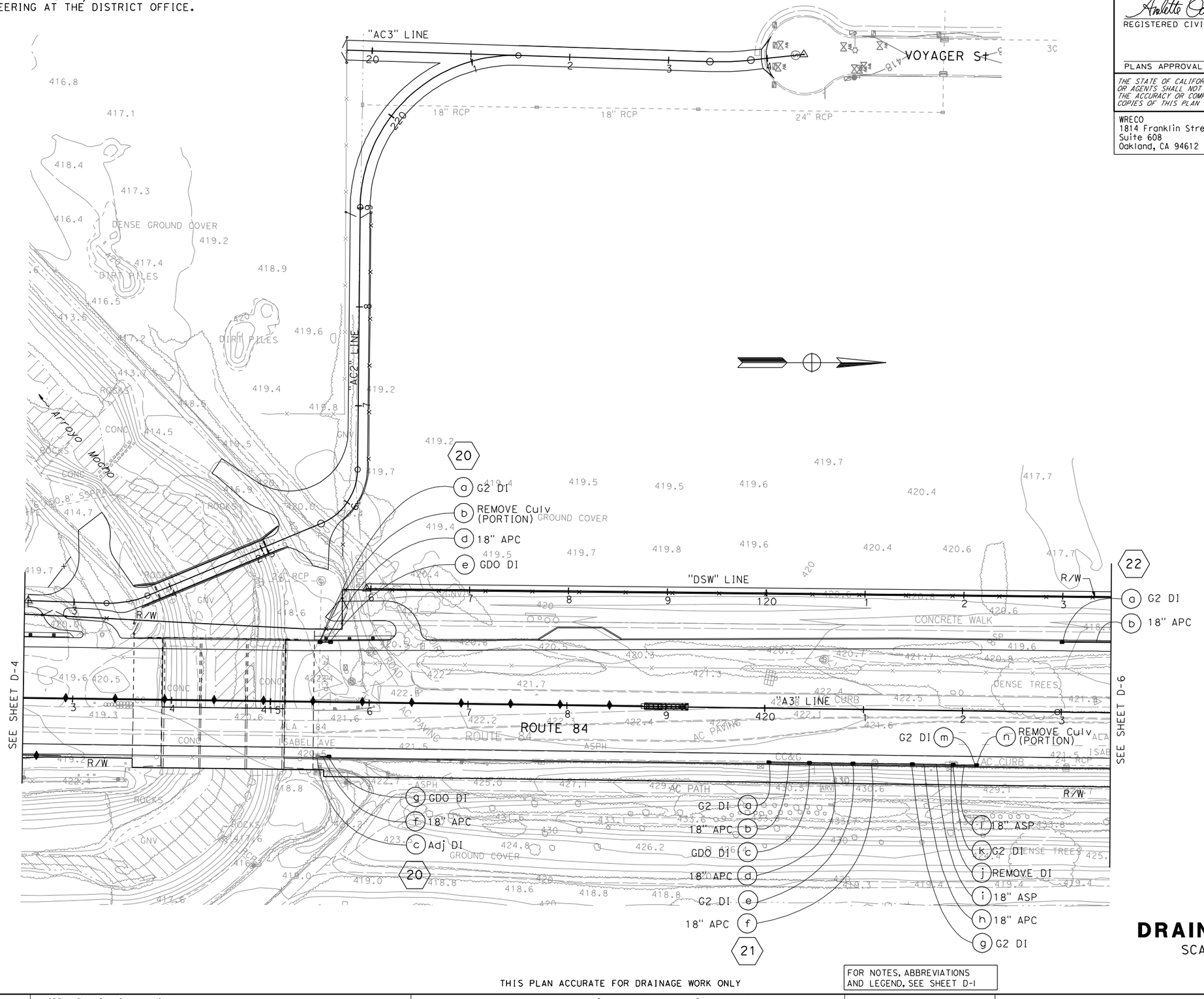

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-5

REVISED BY	DATE REVISED
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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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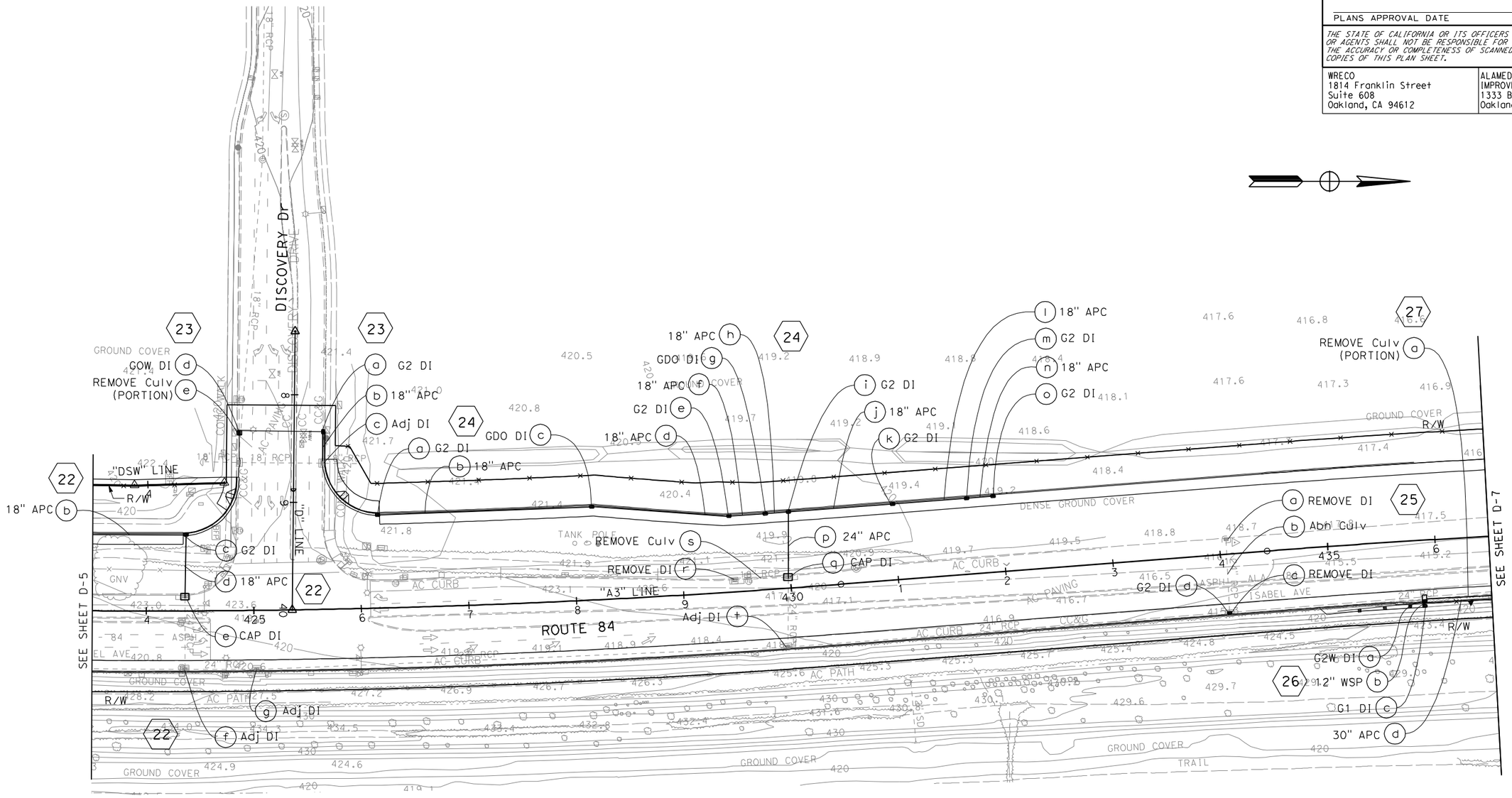

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-6

	REVISED BY	DATE REVISED
CALCULATED-DESIGNED BY	IRENE LIU	
CHECKED BY	ANALETTE OCHOA	
CONSULTANT FUNCTIONAL SUPERVISOR	JP	1/11/11
	HAN-BIN LIANG	

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
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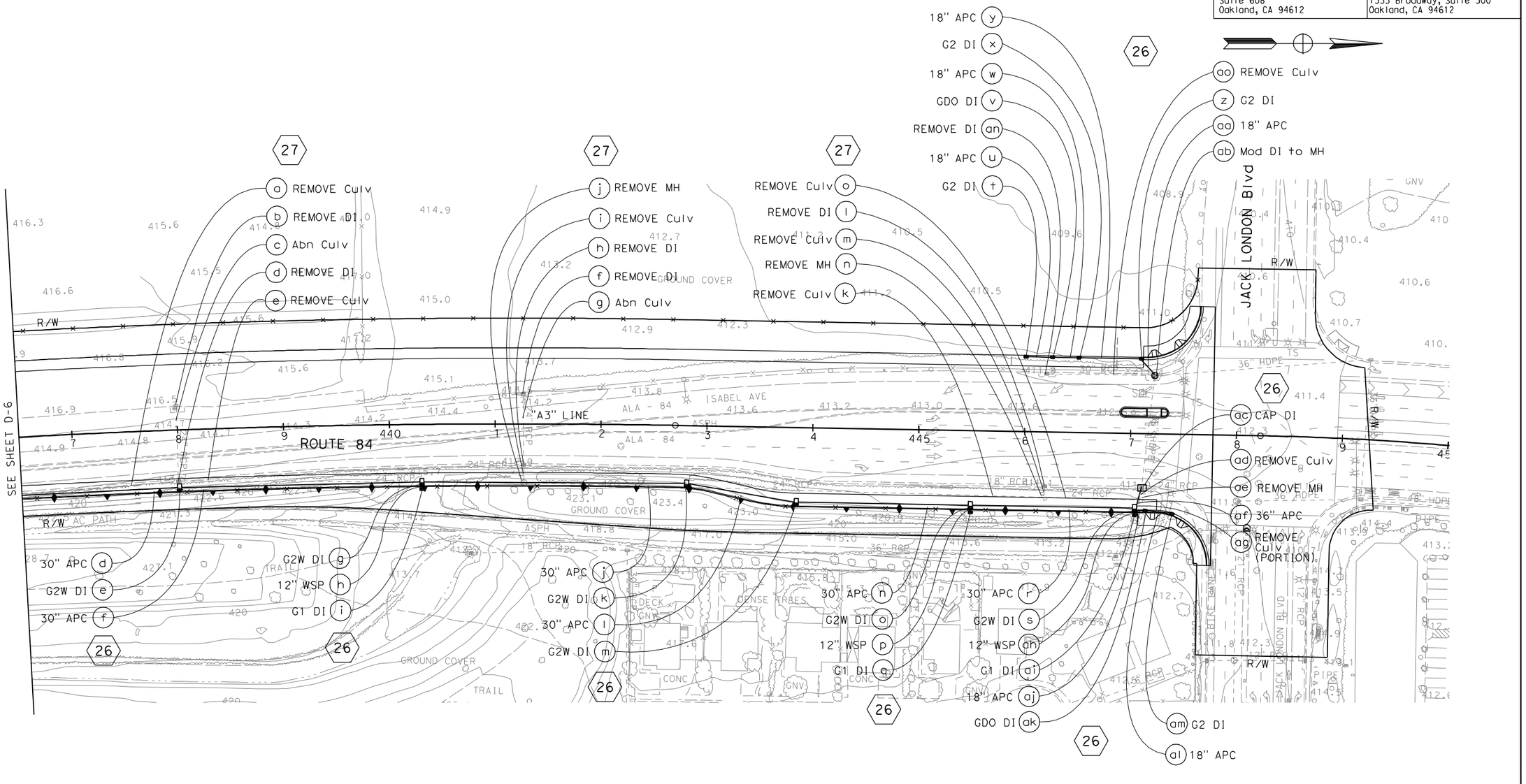

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-7

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	JP
CHECKED BY	ANALETTE OCHOA	DATE REVISED	1/11/11

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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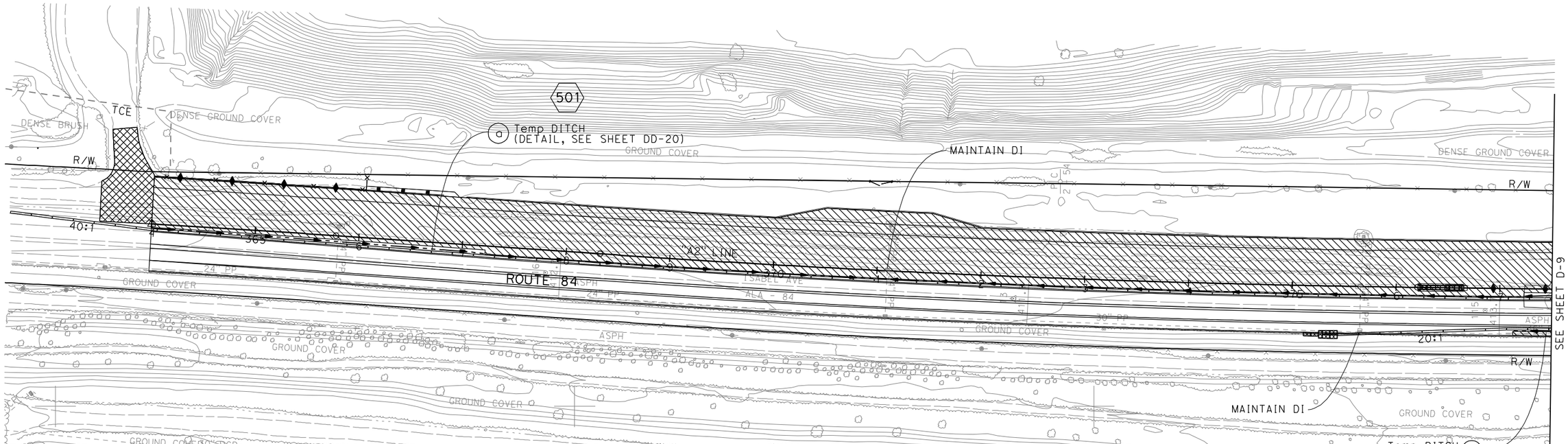
LEGEND:

- TEMPORARY RAILING (TYPE K)
- CONSTRUCTION THIS STAGE
- HMA OVERLAY CONFORM THIS STAGE
- TEMPORARY CONSTRUCTION THIS STAGE

NOTES:

1. CONTRACTOR WILL NOT REMOVE EXISTING OUTFALLS BEFORE NEW OUTFALLS HAVE BEEN CONSTRUCTED TO TAKE ITS PLACE.
2. FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
3. MAINTAIN DI IS ONLY FOR STAGE 1 OF CONSTRUCTION. THE FINAL CONSTRUCTION SHALL BE DONE ACCORDING TO THE DRAINAGE PLANS.
4. CONTRACTOR SHALL SUBMIT TEMPORARY DRAINAGE PROPOSAL TO THE ENGINEER FOR APPROVAL.



DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

D-8

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
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CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa 1/17/11
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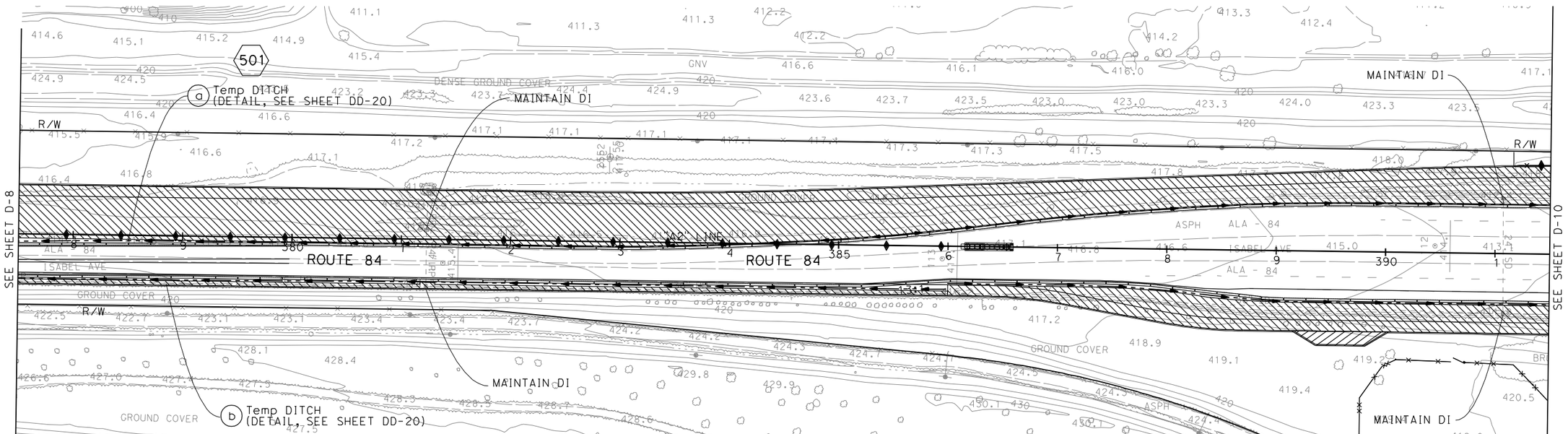

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-9

REVISED BY	DATE REVISED
JP	1/11/11

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ANALETTE OCHOA — CHECKED BY
HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR

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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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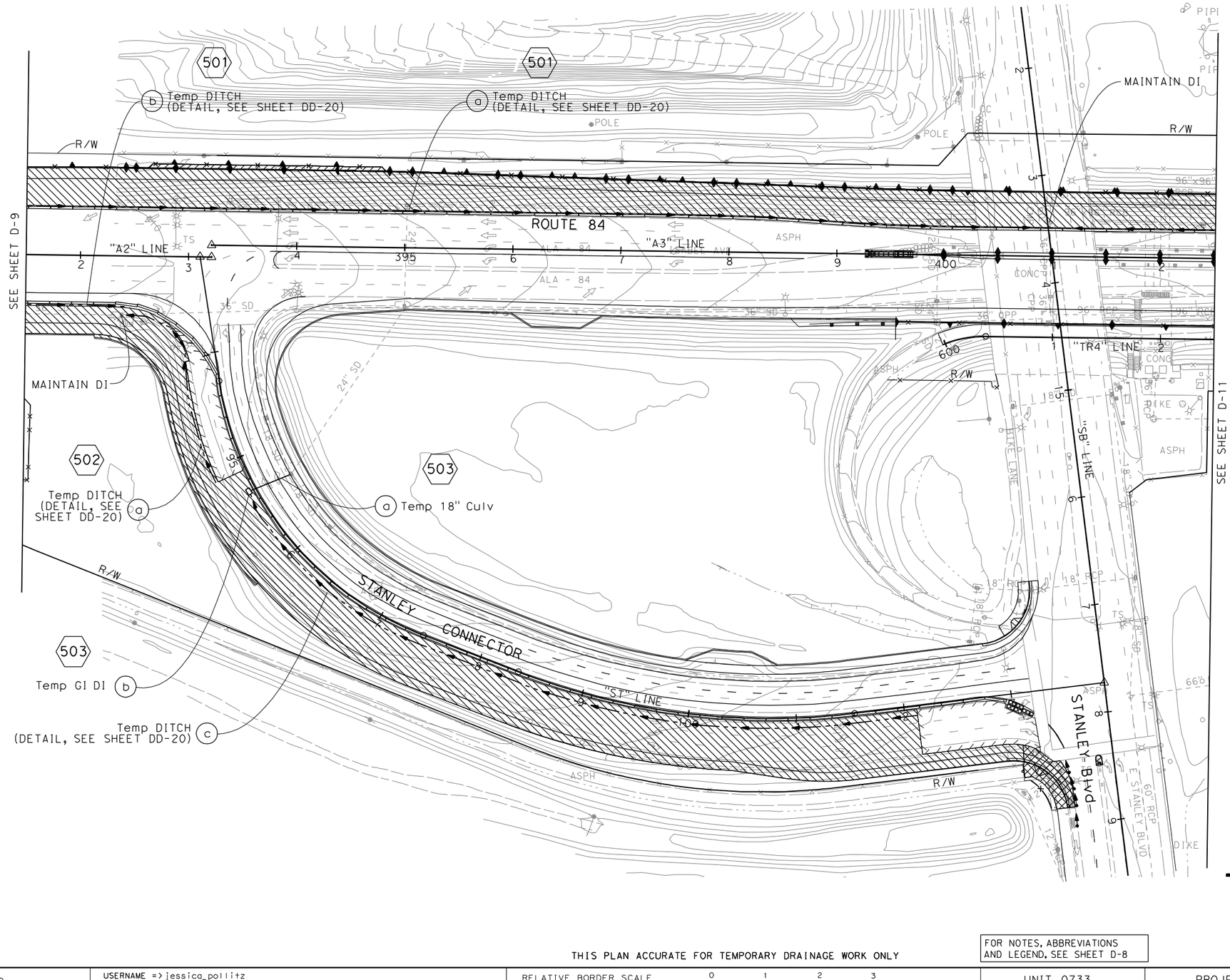

DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR TEMPORARY DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-10

REVISED BY	DATE REVISED
JL	1/11/11

CALCULATED-DESIGNED BY: ALVIN YIM
CHECKED BY: ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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No. C 55279
Exp. 12/31/12
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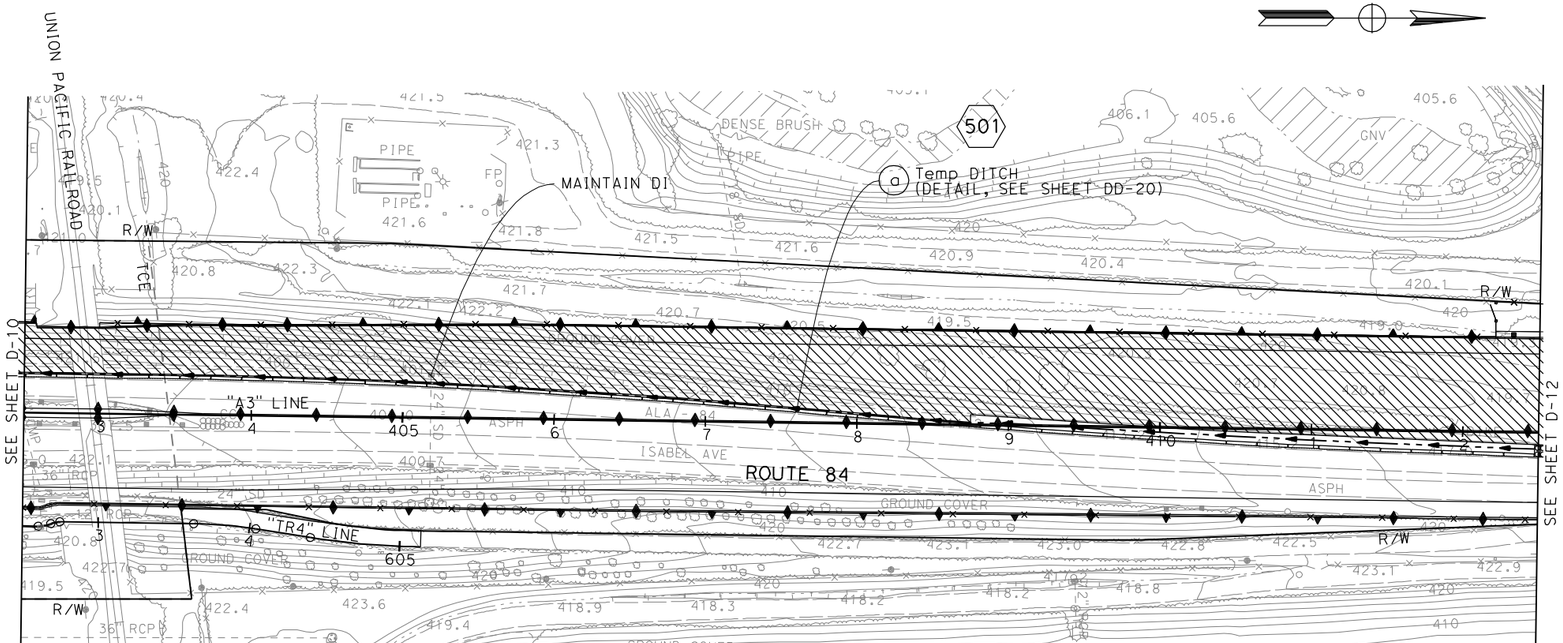

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-11

REVISED BY	JP		
DATE REVISED	10/19/11		
IRENE LIU			
ANALETTE OCHOA			
CALCULATED-DESIGNED BY			
CHECKED BY			
SUPERVISOR			
CONSULTANT FUNCTIONAL	HAN-BIN LIANG		

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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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Analette Ochoa 1/17/11
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Exp. 12/31/12
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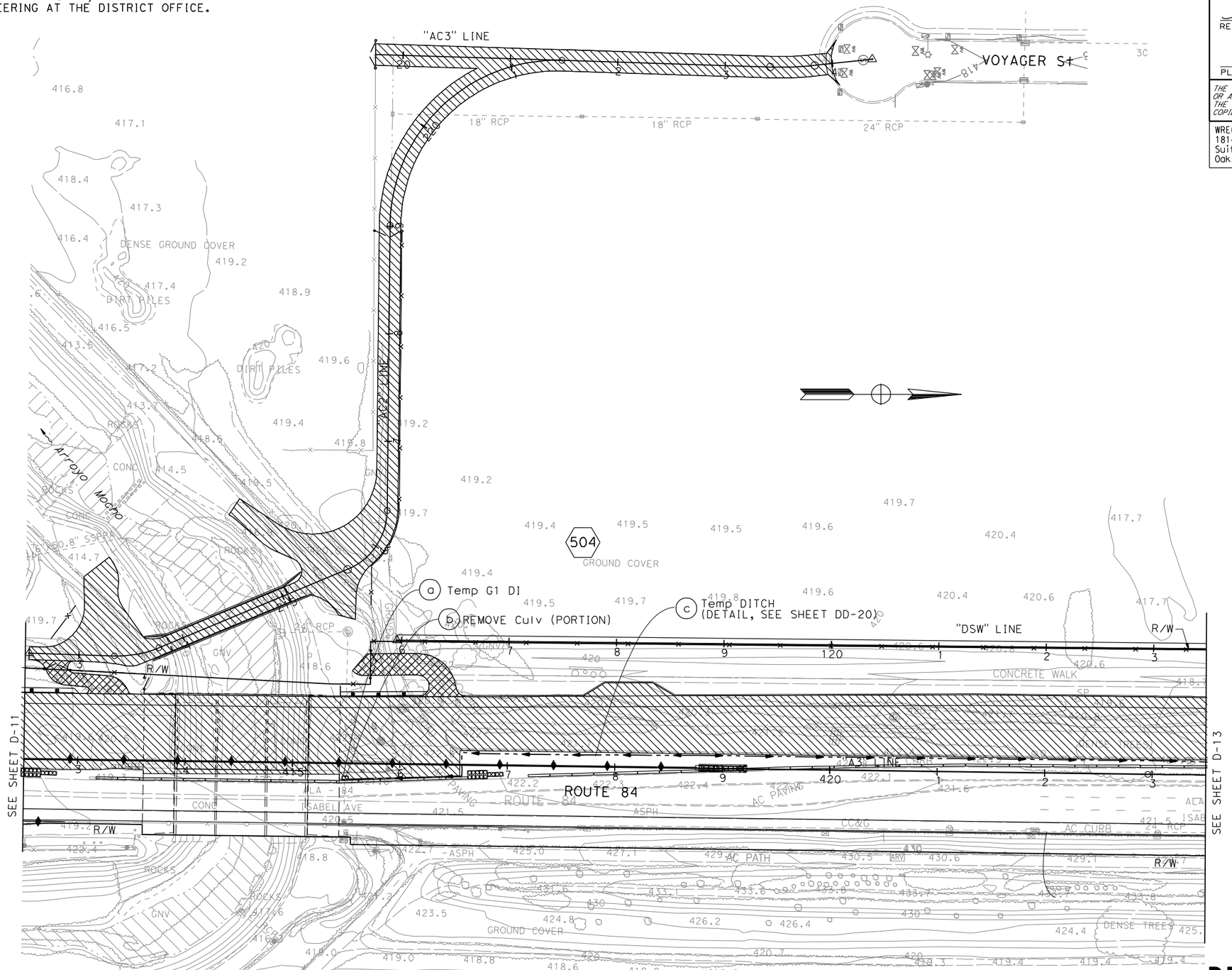

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-12

CALCULATED-DESIGNED BY	JP	1/11/11	
CHECKED BY	IRENE LIU	ANALETTE OCHOA	

REVISED BY | DATE REVISED

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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BORDER LAST REVISED 7/2/2010

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DGN FILE => ...\dwg\seg a\pl\429760ea012.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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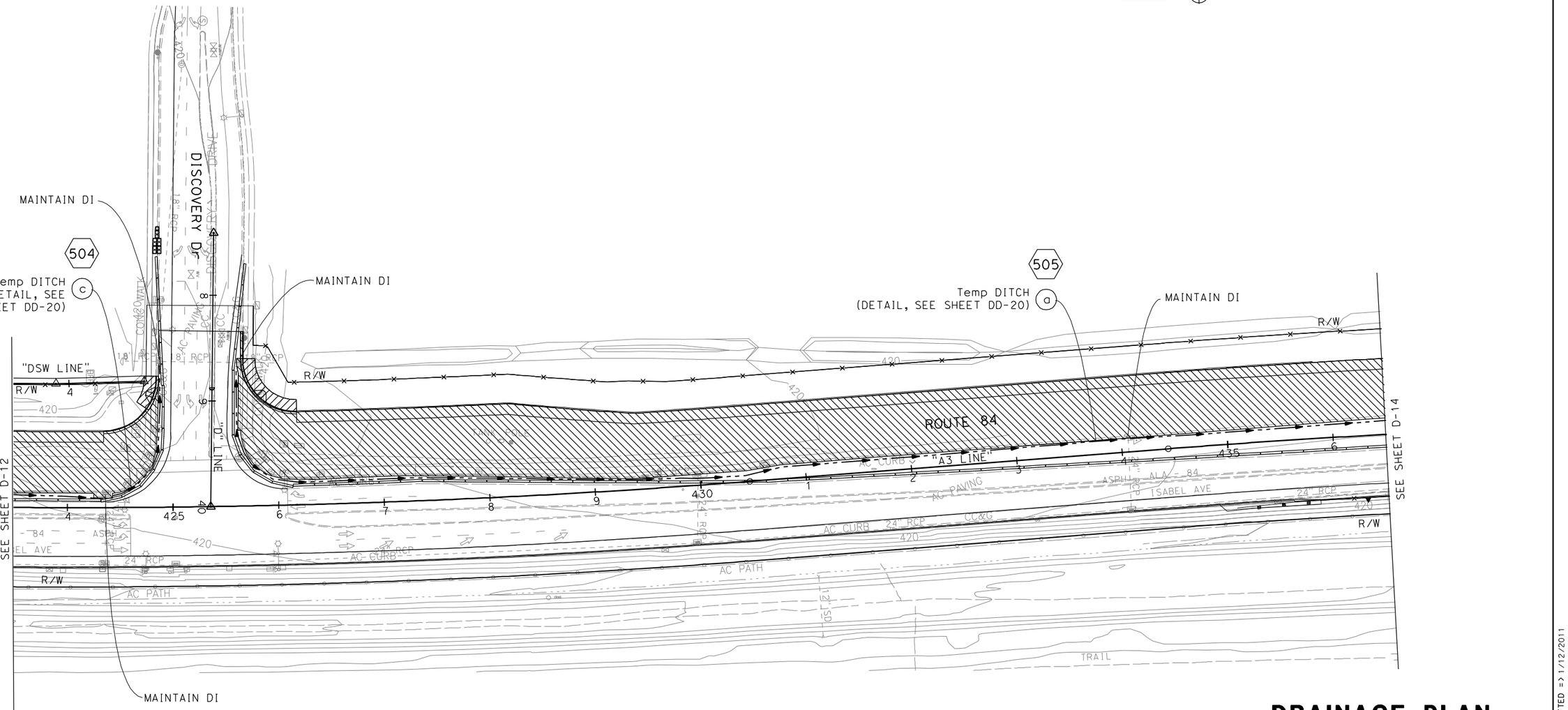

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-13

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

REVISED BY	DATE REVISED
JP	1/11/11

LAST REVISION
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TIME PLOTTED => 6:26:53 PM
10-19-10

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DGN FILE => ...\dwg\seg a\p1\429760ea013.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
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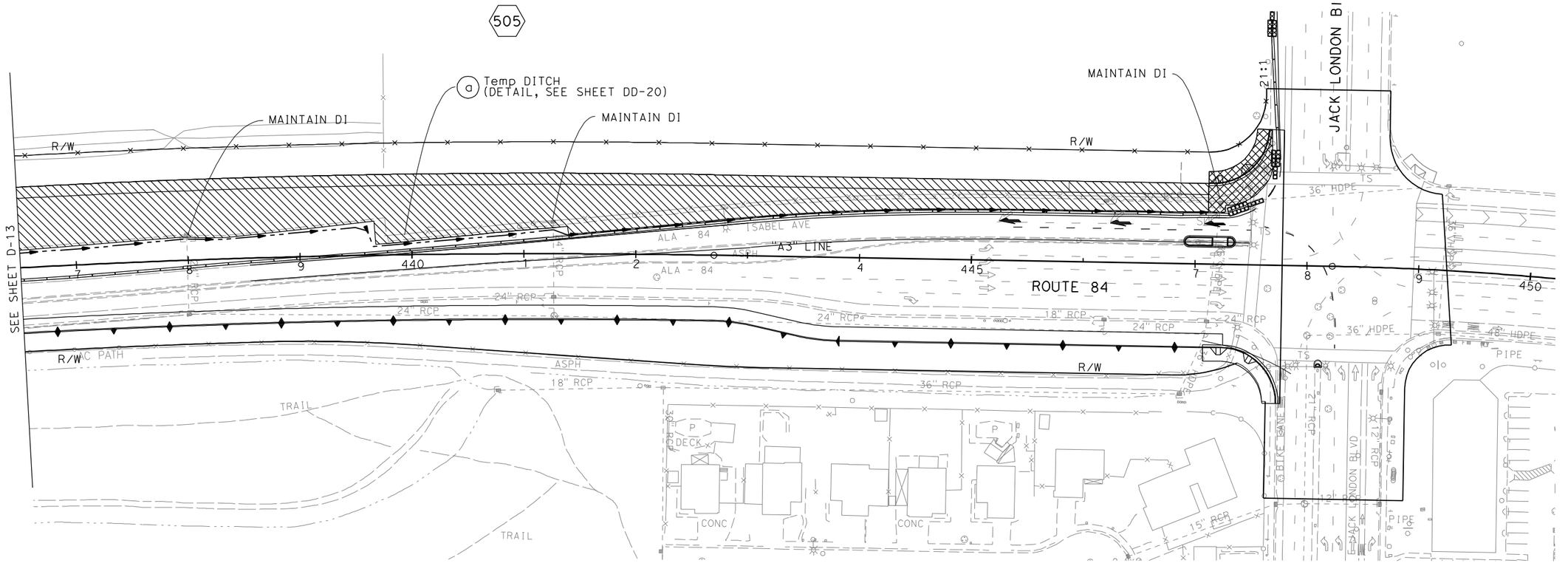

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

D-14

THIS PLAN IS FOR TEMPORARY DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

CALCULATED-DESIGNED BY	REVISED BY	JP
CHECKED BY	DATE REVISED	1/11/11
IRENE LIU		
ANALETTE OCHOA		

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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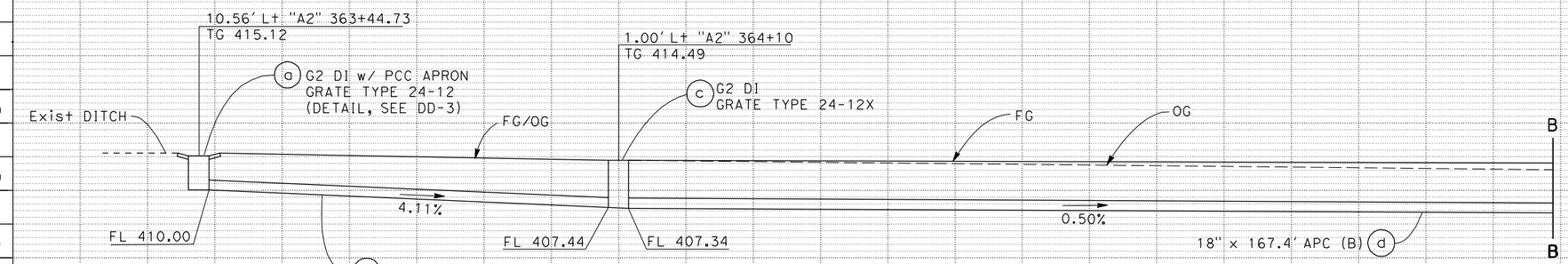
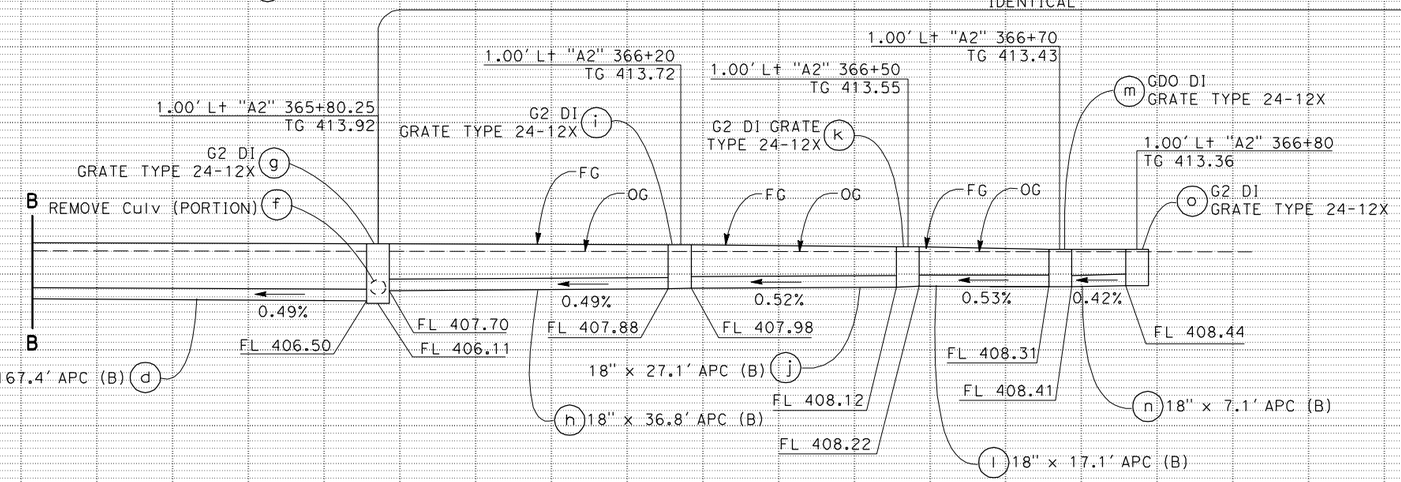
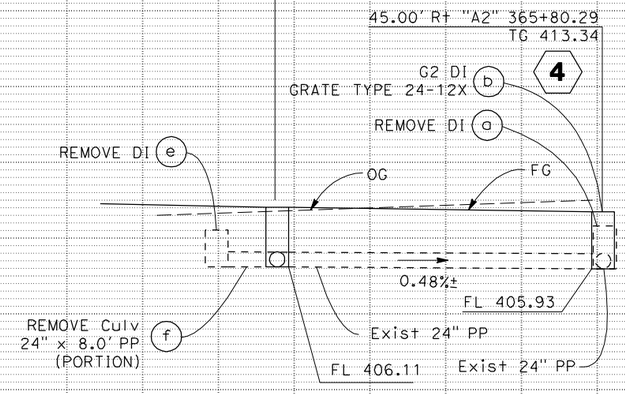
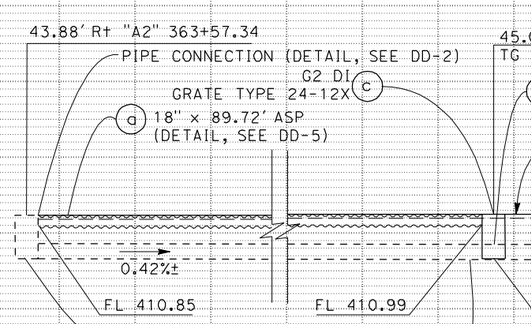


IDENTICAL





DRAINAGE SYSTEM No. 1



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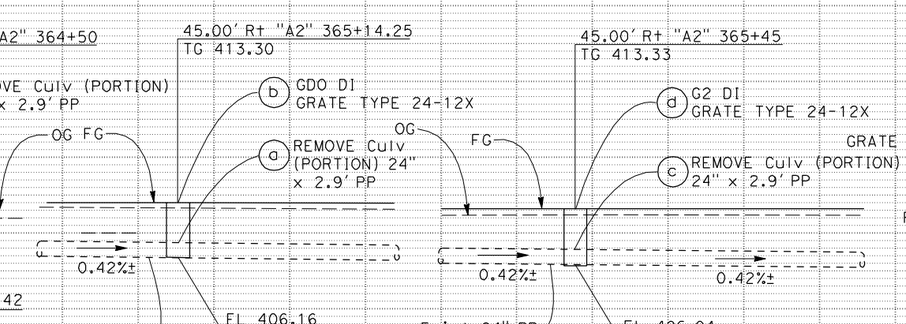
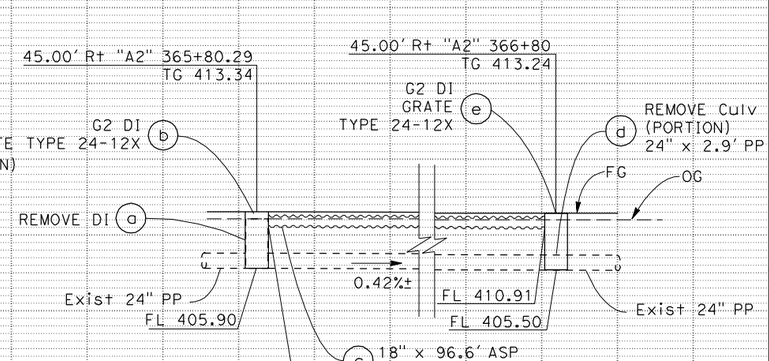


DRAINAGE SYSTEM No. 3



DRAINAGE SYSTEM No. 4

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-1

REVISED BY	DATE REVISED
IL	1/11/11
IRENE LIU	ANALETTE OCHOA

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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DATE PLOTTED => 1/12/2011
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BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\dwg\seg a\prof\429760ib001.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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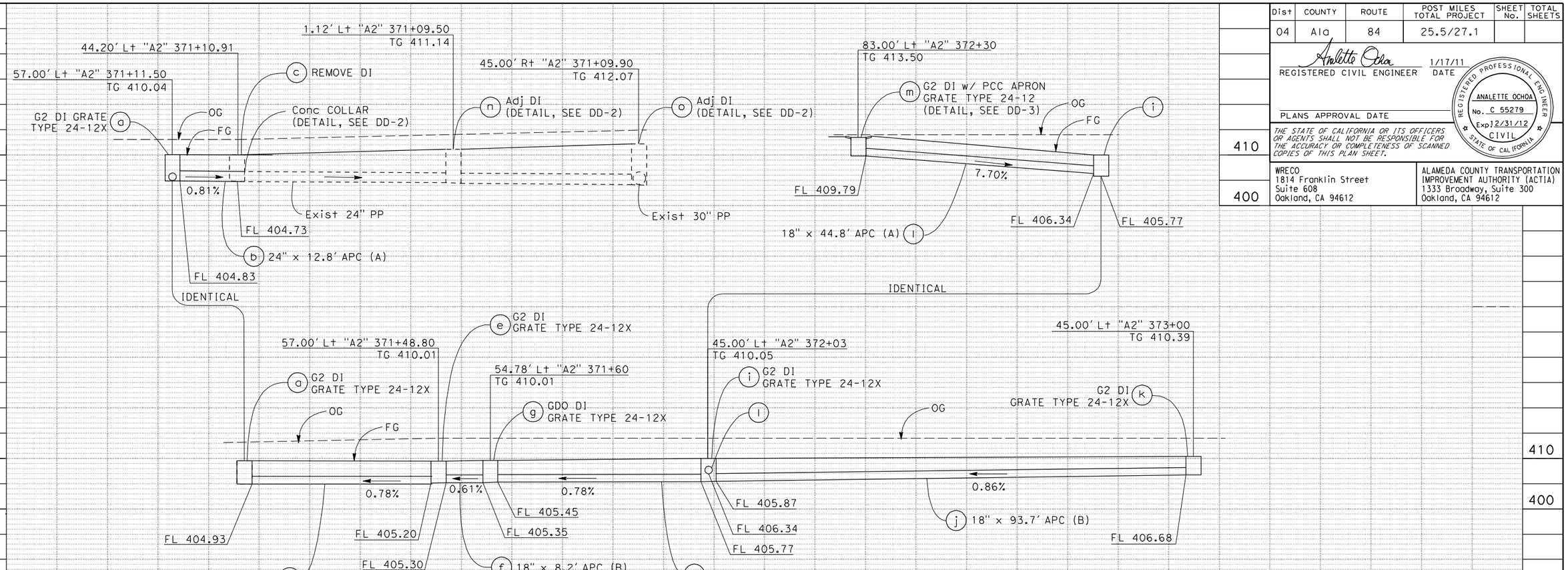

DRAINAGE SYSTEM No. 5

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-2

REVISED BY	DATE REVISED
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

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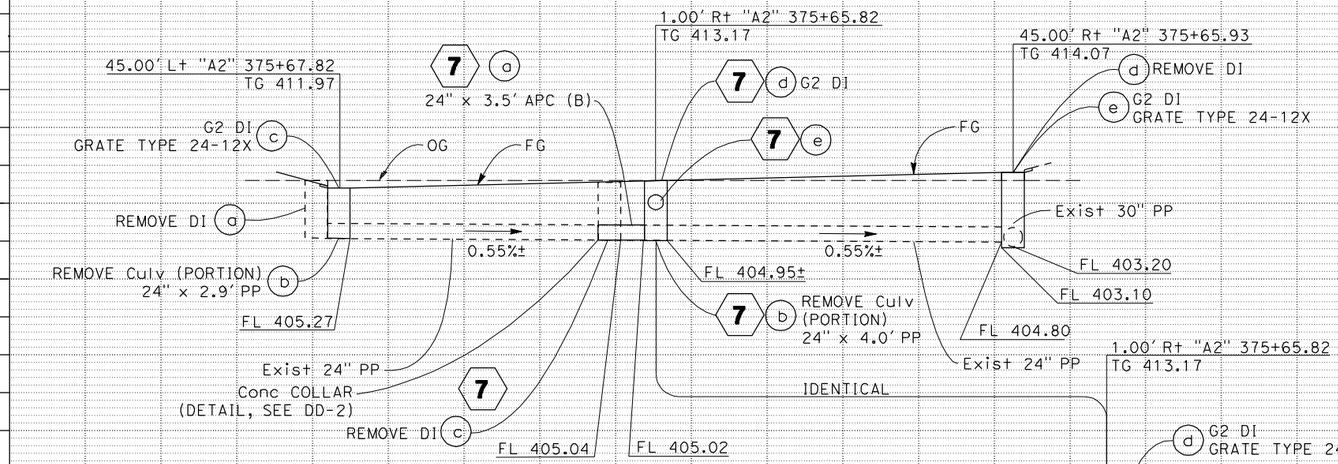
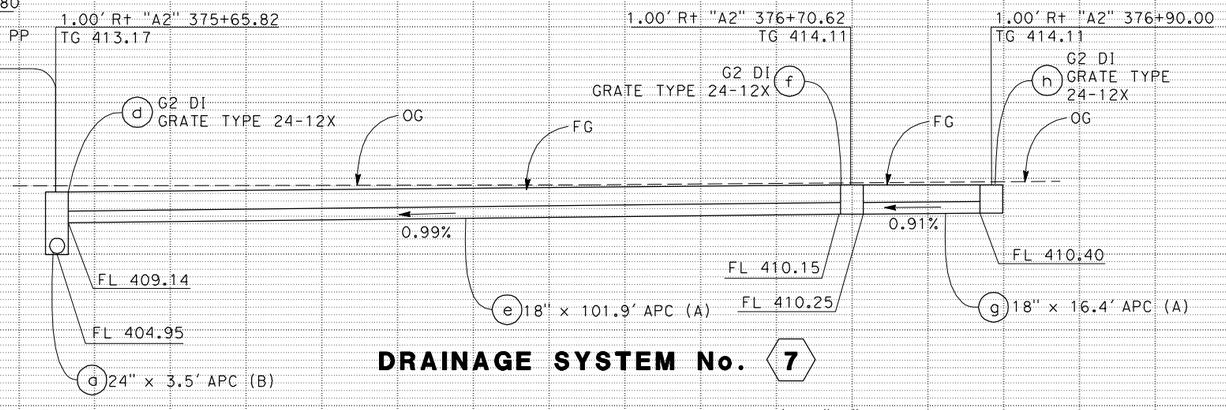
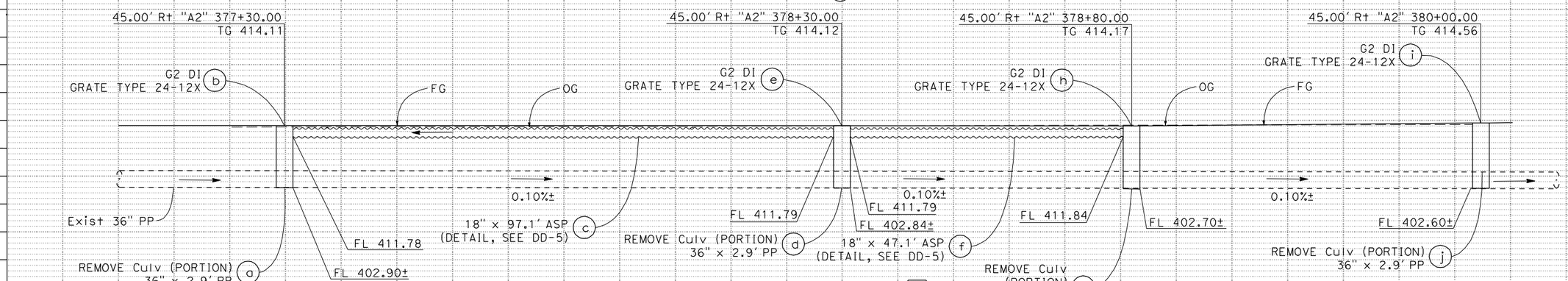


DRAINAGE SYSTEM No. 6



DRAINAGE SYSTEM No. 7



DRAINAGE SYSTEM No. 8

DRAINAGE SYSTEM No. 9

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-3

IL — 1/11/11 — REVISED BY / DATE REVISED
IRENE LIU — ANALETTE OCHOA — CALCULATED-DESIGNED BY / CHECKED BY
HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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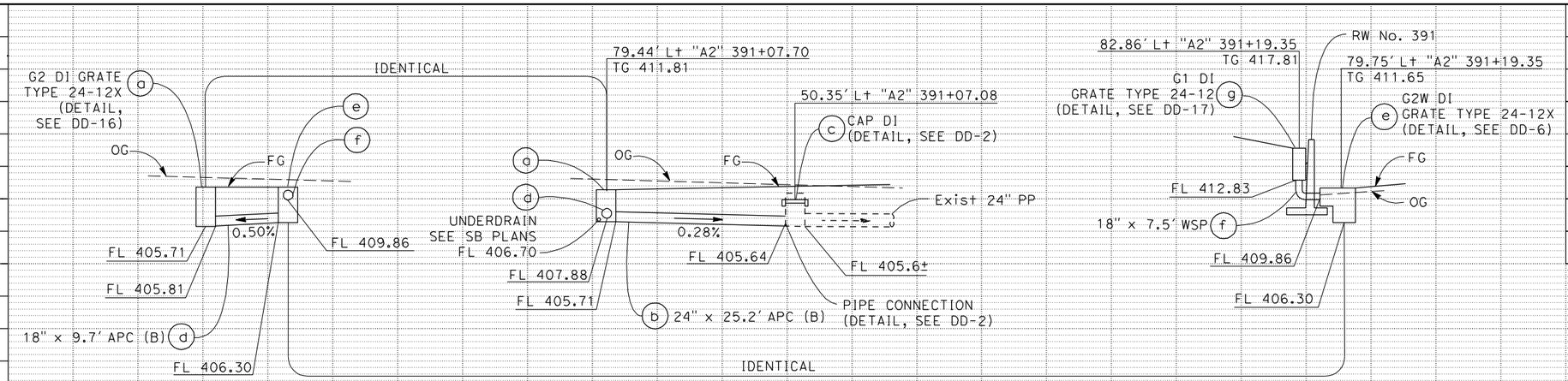
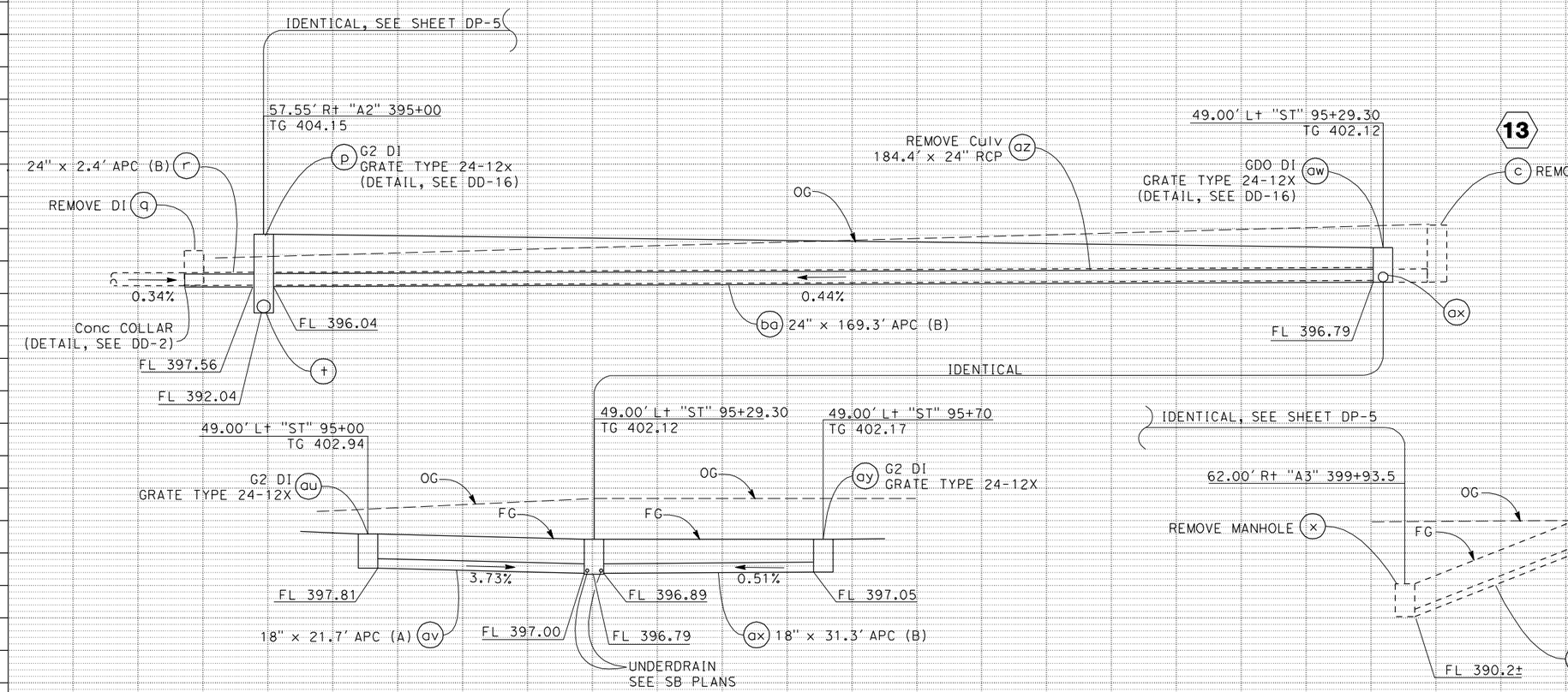


DRAINAGE SYSTEM No. 11



DRAINAGE SYSTEM No. 10

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-4

LAST REVISION 10-19-10 — DATE PLOTTED => 1/12/2011 — TIME PLOTTED => 6:32:59 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\dwg\seg a\prof\429760ib004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

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CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

REMOVE DI (a)
45.00' Rt "A2" 386+14.60
TG 416.67
(b) G2 DI GRATE TYPE 24-12X
45.86' Rt "A2" 386+60
TG 416.59
(d) G2 DI GRATE TYPE 24-12X
OG
FG
(c) 36" x 42.6' APC (A)
(e) 36" x 228.6' APC (A)
0.59%
0.50%
Exist 36" PP
FL 401.7±
FL 401.45
FL 401.35

A
A

IDENTICAL, SEE SHEET DP-6
73.00' Rt "A2" 390+04
TG 413.44
73.00' Rt "A2" 388+90
TG 414.71
(f) G2 DI GRATE TYPE 24-12X
(h) G2 DI GRATE TYPE 24-12X
(g) 36" x 111.1' APC (A)
FL 400.20
FL 400.10
FL 399.54
FL 404.05
FL 399.44
(ah)
36" x 113.1' APC (A) (i)
FL 403.48
FL 394.12

IDENTICAL, SEE SHEET DP-6
73.00' Rt "A2" 391+21
TC 411.71
(j) G2 DI GRATE TYPE 24-12X
36" x 87.8' APC (A) (k)
57.55' Rt "A3" 395+00
TC 404.15
IDENTICAL, SEE SHEET DP-4
REMOVE DI (q)
G2 DI (p)
UNDERDRAIN SEE SB PLANS FL 399.42
(r)
FL 392.56
FL 392.14
FL 392.04

B
B

73.00' Rt "A2" 392+11.70
TC 410.08
"ST" LINE
GDO DI GRATE TYPE 24-12X (DETAIL, SEE DD-16) (l)
UNDERDRAIN SEE SB PLANS FL 404.48
66.45' Rt "A2" 392+72.26
70.72' Rt "A3" 393+48.62
(o) 36" x 151.1' APC (A)
62.00' Rt "A3" 400+95
TG 394.60
0.50%
0.79%
FL 393.68
FL 393.58
36" x 87.8' APC (A) (k)
0.50%
36" x 59.3' APC (A) (m)
0.50%
JACKED 36" x 76.6' RCP (n)

C
C

IDENTICAL, SEE SHEET DP-6
59.88' Rt "A3" 399+53.02
TG 395.38
(u) G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-16)
IDENTICAL, SEE SHEET DP-4
62.00' Rt "A3" 399+93.50
TG 394.95
(w) G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-16)
(x) REMOVE MH
62.00' Rt "A3" 400+60
TG 394.64
G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-3, DD-16) (aa)
62.00' Rt "A3" 401+25
TG 394.63
(bk) G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-3)
Exist 36" RCP
Mod DI (SEE Misc DETAIL OF RW No. 400N)
UNDERDRAIN SEE SB PLANS FL 390.65
UNDERDRAIN SEE SB PLANS FL 390.21
OG
FG
0.79%
0.48%
0.53%
0.34%±
36" x 449.8' APC (A) (t)
REMOVE Culv 488.9' x 36" RCP (s)
FL 388.48
FL 388.38
36" x 33.6' APC (A) (v)
FL 388.12
Exist 24" SD
FL 388.22
36" x 63.6' APC (A) (y)
REMOVE Culv (PORTION) 64.1' x 36" RCP (z)
FL 387.78
FL 387.63
FL 387.53
Exist 36" CPP
Exist JUNCTION BOX
FL 391.63
(bj) 12" x 2.1' CSP RISER (DETAIL, SEE DD-16)
Exist 96" RCP STORAGE BAY

DRAINAGE SYSTEM No. 10

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-5

LAST REVISION 10-19-10
DATE PLOTTED => 1/12/2011
TIME PLOTTED => 6:33:02 PM

BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
DGN FILE => ...\dwg\seg a\prof\429760ib005.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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IRENE LIU | ANALETTE OCHOA — CALCULATED-DESIGNED BY | CHECKED BY
HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

IDENTICAL, SEE SHEET DP-5

73.00' Rt "A2" 390+04
TG 413.44

G2 DI (h)
GRATE TYPE 24-12X

64.75' Rt "A2" 390+04
TC 413.85

G2 DI (af)
GRATE TYPE 24-12X
(DETAIL, SEE DD-16)

OG

FG

(ae)

UNDERDRAIN
SEE SB PLANS
FL 407.95

0.50%

FL 404.28

24" x 4.0' APC (B) (ag)

FL 404.26

FL 404.05

FL 399.44

(i)

142.50' Rt "A2" 390+04
TC 413.00

G2 MH (ai)
FRAME & COVER TYPE U45
(DETAIL, SEE DD-4)

0.50%

FL 399.10

(ah) 18" x 68.0' APC (B)

IDENTICAL, SEE SHEET DP-5

73.00' Rt "A2" 391+21
TC 411.7

142.50' Rt "A2" 391+21
TC 413.00

G2 MH (ar)
FRAME & COVER
TYPE U45
(DETAIL, SEE DD-4)

OG

FG

G2 DI (j)

(k)

(at) 18" AUTOMATIC DRAINAGE GATE
(DETAIL, SEE DD-19)

0.50%

FL 394.12

FL 394.22

(as) 18" x 68.0' APC (B)

FL 394.56

IDENTICAL

142.50' Rt "A2" 390+09.53
TC 409.84

(ai)

(ak) 18" x 3.1' APC (B)

OG

FG

(al) G2 DI
GRATE TYPE 24-12
(DETAIL, SEE DD-17)

(ah)

0.46%

FL 406.13

FL 406.11

0.46%

FL 399.10

FL 399.00

Beg CHAMBER
FL 389.48

FL 398.97

(aj) 18" x 6.5' APC (B)

IDENTICAL

142.50' Rt "A2" 391+15.47
TC 409.84

18" x 3.1' APC (B) (ao)

G2 DI (an)
GRATE TYPE 24-12
(DETAIL, SEE DD-17)

FG

0.46%

FL 406.13

FL 400.89

FL 394.89

END CHAMBER
FL 394.72

0.46%

FL 406.11

FL 400.56

0.46%

(as)

AUSTIN VAULT
SAND FILTER
TYPE S-15000-6
(DETAIL, SEE DD-7
TO DD-15, DD-18)

(am)

18" x 6.5' APC (B) (ap)

6" x 6.5' PP (aq)

FL 394.56

FL 394.86

IDENTICAL

(ar) G2 MH

64.13' Rt "A3" 399+53.02
TG 395.50

IDENTICAL, SEE SHEET DP-5

59.88' Rt "A3" 399+53.02
TG 395.38

G2 DI (u)
GRATE TYPE 24-12X

OG

(bc)

G1 DI
GRATE
TYPE
24-12

(bd)

(bb)

FL 392.35

(v)

FL 388.38

FL 392.60

FL 392.50

18" x 2.9' APC (A) w/ Conc Bkf
(DETAIL, SEE DD-4) (bb)

5.17%

FL 392.50

FL 392.60

RW No. 400N
RETURN WALL
TYPE 1

91.50' Rt "A3" 400+07.92
TG 404.33

G1 DI
w/ PCC APRON
GRATE TYPE 24-12 (bi)
(DETAIL, SEE DD-3)

64.13' Rt "A3" 399+58.99
TG 402.35

(be) G1 DI GRATE
TYPE 24-12X
(DETAIL,
SEE DD-17)

OG

FG

1.93%

FL 399.35

FL 400.33

(bf) 12" x 50.8' WSP
(DETAIL, SEE DD-3)

(bd) 12" x 9.9' WSP

IDENTICAL

64.75' Rt "A2" 390+04
TC 413.85

(af) G2 DI

OG

FG

0.50%

FL 404.38

FL 404.28

(ae) 18" x 100.9' APC (B)

64.60' Rt "A2" 391+07.78
TC 412.35

54.81' Rt "A2" 391+07.63
TC 412.60

(ad) G2 DI
GRATE TYPE 24-12X

CAP DI (ab)
(DETAIL, SEE DD-2)

FG

(ac)

0.50%±

0.58%

FL 404.88

FL 404.98

Exist 24" PP

FL 405.04

64.60' Rt "A2" 391+07.78
TC 412.35

(ad)

OG

FL 404.98

(ac) 24" x 10.4' APC (B)

PIPE CONNECTION (DETAIL, SEE DD-2)

DRAINAGE SYSTEM No. 10

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-6

LAST REVISION 10-19-10
DATE PLOTTED => 1/12/2011
TIME PLOTTED => 6:33:06 PM

BORDER LAST REVISED 7/2/2010
USERNAME => jessica_pollitz
DGN FILE => ...\dwg\seg a\prof\429760ib006.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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IL 1/11/11 — REVISED BY / DATE REVISED
IRENE LIU / ANALETTE OCHOA — CALCULATED-DESIGNED BY / CHECKED BY
HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

64.77' Lt "A3" 398+55.02
TG 410.22
G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17) (a)
FG
OG
FL 406.72
0.50%
0.50%
0.51%
0.51%
12" x 132.1' WSP (b)
FL 406.06
FL 406.17

62.27' Lt "A3" 399+90
TG 409.87
G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17) (c)
IDENTICAL
62.13' Lt "A3" 400+45
TG 409.91
(e) G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17)
12" x 47.1' WSP (d)
FL 406.41
FL 405.96
12" x 16.5' WSP (DETAIL, SEE DD-3) (f)
FL 389.19
UNDERDRAIN SEE SB PLANS FL 390.02

RW No. 400S
59.12' Lt "A3" 399+90
TG 395.08
(k) OG
FG
FL 393.90
0.25%
FL 389.03
(h) 24" x 23.9' APC (B)
FL 389.09
G2W DI GRATE TYPE 24-12X (g)
(DETAIL, SEE DD-6, DD-16)

(i) CAP DI (DETAIL, SEE DD-2)
42.87' Rt "A3" 399+93.20
31.47' Lt "A3" 399+93.20
"A3" LINE
CAP DI (DETAIL, SEE DD-2) (j)
OG
FG
FL 389.03±
PIPE CONNECTION (DETAIL, SEE DD-2)
Exist 24" SD
Exist 24" SD

IDENTICAL
59.00' Lt "A3" 400+65
TG 394.83
(g) G2 DI
(h) FG
OG
(l) G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-16)
0.26%
FL 389.37
18" x 67.1' APC (B) (k)
UNDERDRAIN SEE SB PLANS FL 389.71
FL 389.19
FL 389.09

DRAINAGE SYSTEM No. 15

54.90' Lt "A3" 400+95
TG 394.75
(n) Adj DI (SEE CONSTRUCTION DETAILS, SHEET DD-2)
54.90' Lt "A3" 401+25
TG 394.78
54.90' Lt "A3" 400+67.00
TG 395.04
OG
(o) 12" x 24.9' ASP (DETAIL, SEE DD-5)
FG
FG
FL 392.92
12" x 27.6' ASP (DETAIL, SEE DD-5) (m)
FL 392.92
Exist 96" x 96" RCB STORAGE BAY

DRAINAGE SYSTEM No. 15

50.53' Lt "A3" 401+96.40
(a) Adj MH (DETAIL, SEE DD-5)
OG
PIPE CONNECTION (DETAIL, SEE DD-2)
FG
2.30%
FL 389.49
FL 390.84
(b) 18" x 58.7' APC (A)
Exist 96" x 96" RCB STORAGE BAY

59.82' Lt "A3" 403+01
TG 412.97
G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17) (c)
RW No. 403
56.33' Lt "A3" 403+01
TG 396.20
OG
FL 409.97
(e) G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-16)
12" x 17.1' WSP (DETAIL, SEE DD-3, DD-17) (d)
UNDERDRAIN SEE SB PLANS
FL 391.23
FL 390.84
IDENTICAL

DRAINAGE SYSTEM No. 16

69.56' Lt "A3" 395+01.52
TG 403.88
(c) CAP DI (DETAIL, SEE DD-2)
G2W DI GRATE TYPE 24-12X (DETAIL, SEE DD-6, DD-16) (a)
OG
39.13' Lt "A3" 395+01.90
FG
UNDERDRAIN SEE SB PLANS
FL 398.09
0.26%
FL 397.97
24" x 26.7' APC (B) (b)
FL 397.91
Exist 24" SD
FL 397.9±
PIPE CONNECTION (DETAIL, SEE DD-2)

DRAINAGE SYSTEM No. 14

57.93' Rt "SB" 16+79.51
TG 419.31
(c) G2 DI GRATE TYPE 24-12X
REMOVE DI (a)
CONCRETE COLLAR (DETAIL, SEE DD-2)
OG
FG
0.26%±
0.26%±
Exist 18" RCP
18" x 1' APC (B) (b)
0.26%
FL 411.6±
(d) REMOVE Culv (PORTION) 18" x 1' SD

DRAINAGE SYSTEM No. 17

IDENTICAL
51.70' Rt "SB" 18+50.16
61.08' Rt "SB" 18+49.79
TG 419.88
58.30' Rt "ST" 18+53
(d) REMOVE DI
G2 DI GRATE TYPE 24-12X (b)
PIPE CONNECTION (DETAIL, SEE DD-2)
OG
FG
Exist DI
Exist 12" RCP
0.26%
Exist DI
Exist 12" RCP
FL 416.50
FL 416.43
FL 416.2±
(c) REMOVE Culv 12" x 36.2' RCP
(a) 18" x 27.7' APC (B)

DRAINAGE SYSTEM No. 18

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-7

LAST REVISION | DATE PLOTTED => 1/12/2011
10-19-10 | TIME PLOTTED => 6:33:13 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\dwg\seg a\prof\429760ib007.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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62.17' Rt "A3" 403+30.00
75.70' Rt "A3" 402+62.09
TG 404.34
Exist DI
9.10%
FL 404.29
FL 404.39
9.10%
FL 398.26
PIPE CONNECTION (DETAIL, SEE DD-2)
Exist 12" RCP
FL 398.1±
(e) G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17)
(d) 12" x 66.3' WSP
62.47' Rt "A3" 404+05
TG 408.12
(g) G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17)
0.71%
FL 404.90
12" x 72.1' WSP (f)
57.80' Rt "A3" 402+62.48
TG 395.67
Adj DI (a) (DETAIL, SEE DD-2, DD-17)
FL 382.62
PIPE CONNECTION (DETAIL, SEE DD-2)
FL 389.2
0.46%
(b) 24" x 69.6' APC (B)
59.00' Rt "A3" 403+35
TG 396.53
OG
(c) G2 DI GRATE TYPE 24-12X
FG
FL 389.52
FL 389.62
1.20%
(h) 24" x 180.6' APC (A)
A
A

59.00' Rt "A3" 405+18.50
TG 400.24
G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-16) (j)
(v)
FG
OG
REMOVE Culv 24" x 249.0' RCP (i)
UNDERDRAIN SEE SB PLANS UD FL 395.56
FL 391.79
FL 391.89
(k) 18" x 298.6' APC (B)
0.47%
58.15' Rt "A3" 408+20
TG 408.53
G2 DI GRATE TYPE 24-12X (l)
FL 393.29
FL 393.39
B
B

56.52' Rt "A3" 411+83
TG 415.95
G2 DI GRATE TYPE 24-12X (n)
4.86%
FL 410.90
18" x 360.1' APC (A) (m)
B
B

IDENTICAL
28.45' Lt "A3" 405+18.62
G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-16) (q)
61.00' Lt "A3" 405+18.50
TG 400.25
FG
(w)
UNDERDRAIN SEE SB PLANS UD FL 395.54
FL 394.93
0.98%
(s) CAP DI (DETAIL, SEE DD-2)
OG
FL 394.5±
FL 394.65
PIPE CONNECTION (DETAIL, SEE DD-2)
(r) 24" x 28.5' APC (A)
31.33' Rt "A3" 405+18.55
CAP DI (DETAIL, SEE DD-2) (t)
0.64%±
REMOVE MH (u)
OG
FG
(j)
CONCRETE COLLAR (DETAIL, SEE DD-2)
24" x 3.0' APC (A) (v)
1.00%
FL 391.79
FL 393.68
C
C

IDENTICAL
IDENTICAL
OG
(q)
FG
2.57%
FL 395.36
(w) 18" x 298.6' APC (A)
62.00' Lt "A3" 408+20
TG 408.52
G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-16) (x)
UNDERDRAIN SEE SB PLANS UD FL 403.39
FL 403.02
FL 403.12
C
C

OG
FG
2.14%
(y) 18" x 362.1' APC (A)
62.00' Lt "A3" 411+83
TG 415.89
G2 DI GRATE TYPE 24-12X (z)
FL 410.88
(ab)

60.08' Rt "A3" 411+83
IDENTICAL
(n)
G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17) (p)
FL 415.45
FL 411.52
(o) 12" x 10.3' WSP

65.47' Lt "A3" 411+83
TG 418.70
G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17) (aa)
FL 415.70
12" x 10.5' WSP (ab)
(z)
FL 411.50
IDENTICAL

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 19

DP-8

REVISED BY	DATE REVISED
IL	1/11/11

IRENE LIU
ANALETTE OCHOA
CALCULATED-DESIGNED BY
CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 10-19-10
DATE PLOTTED => 1/12/2011
TIME PLOTTED => 6:33:20 PM

BORDER LAST REVISED 7/2/2010
USERNAME => jessica_pollitz
DGN FILE => ...\dwg\seg a\prof\429760ib008.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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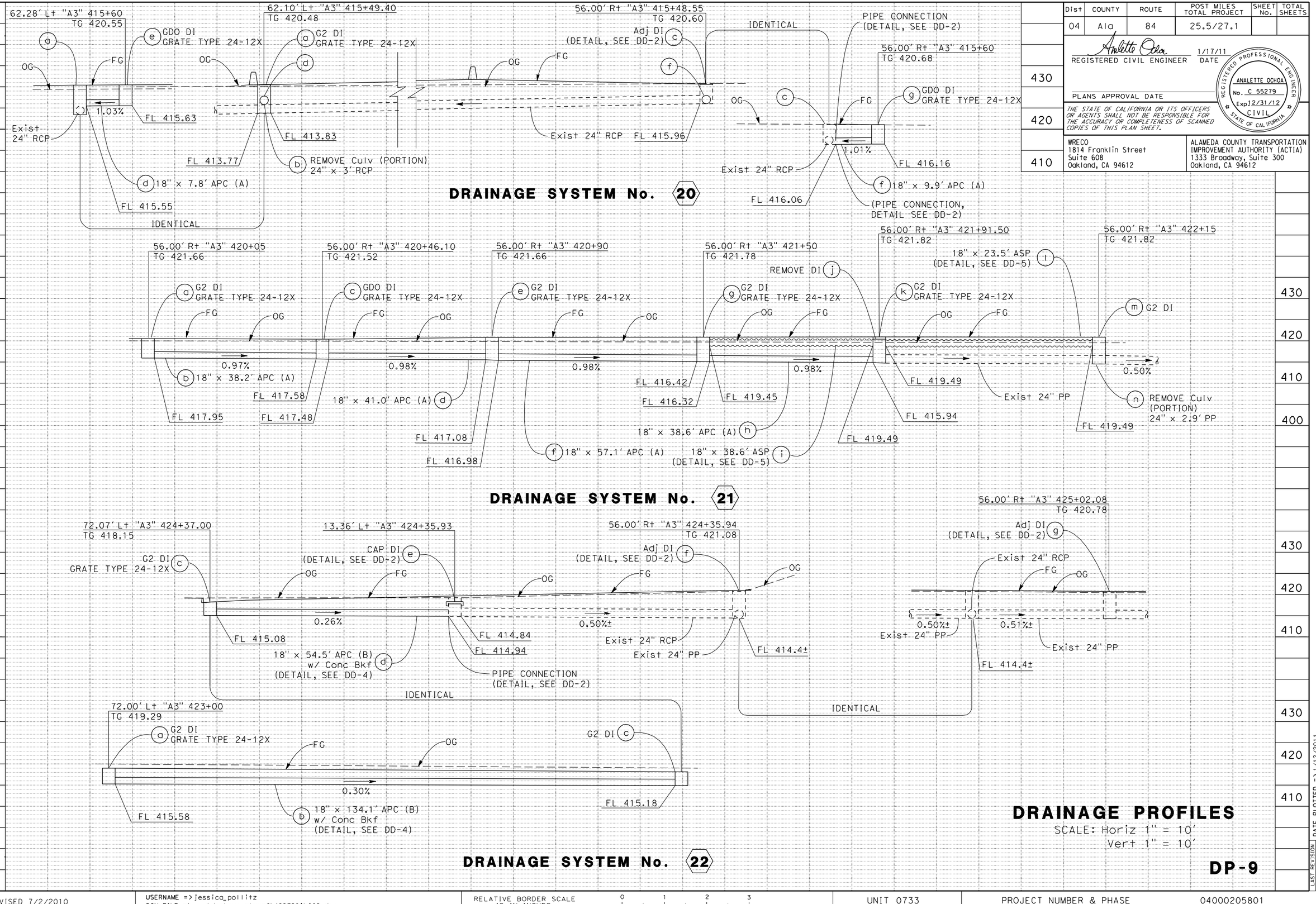
REVISED BY	DATE REVISED
IL	1/11/11

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
SUPERVISOR: HAN-BIN LIANG
CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION



DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-9

LAST REVISION DATE PLOTTED => 1/12/2011
TIME PLOTTED => 6133:25 PM
10-19-10

BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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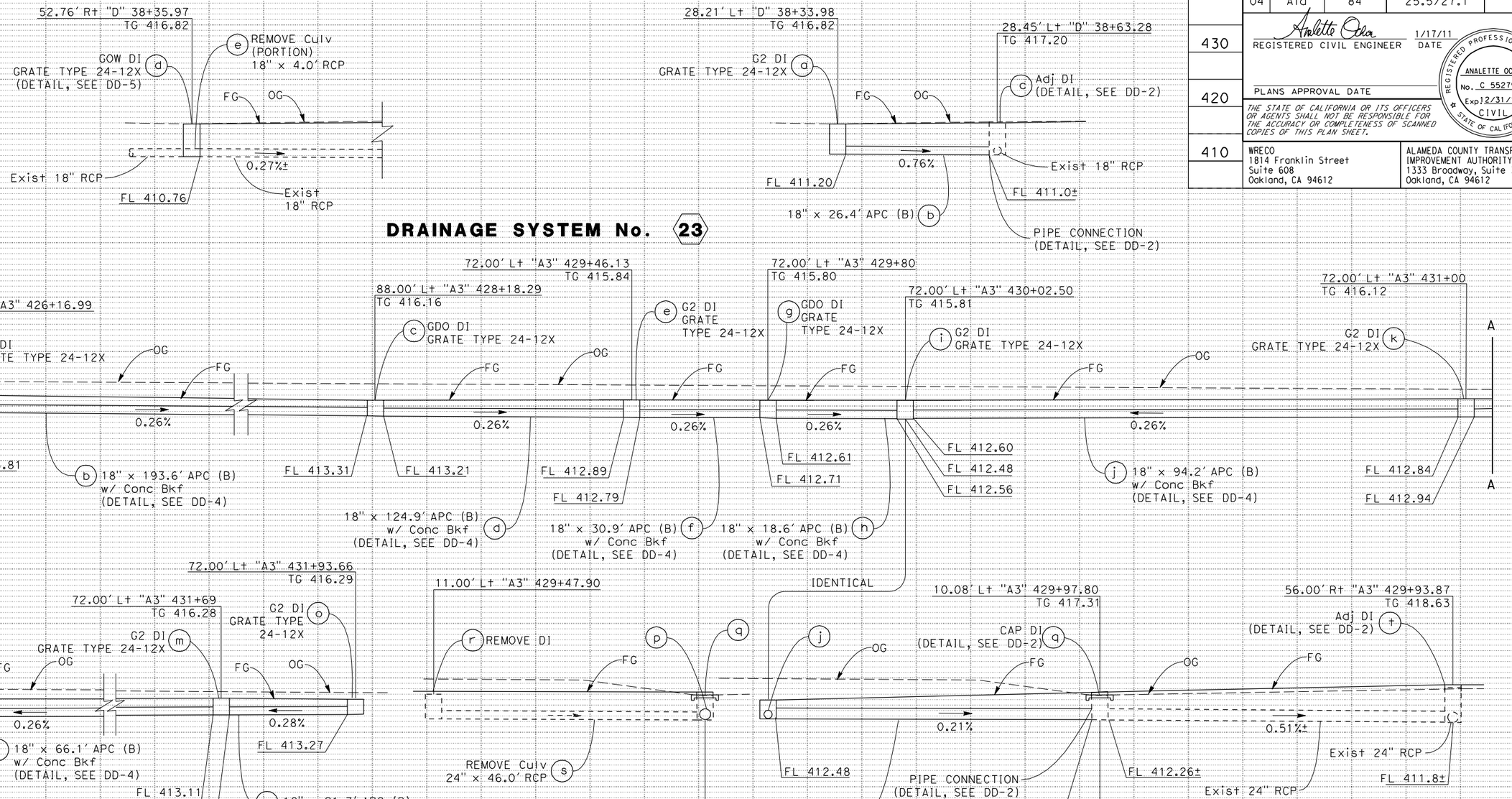
ANALETTE OCHOA — CHECKED BY

HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR

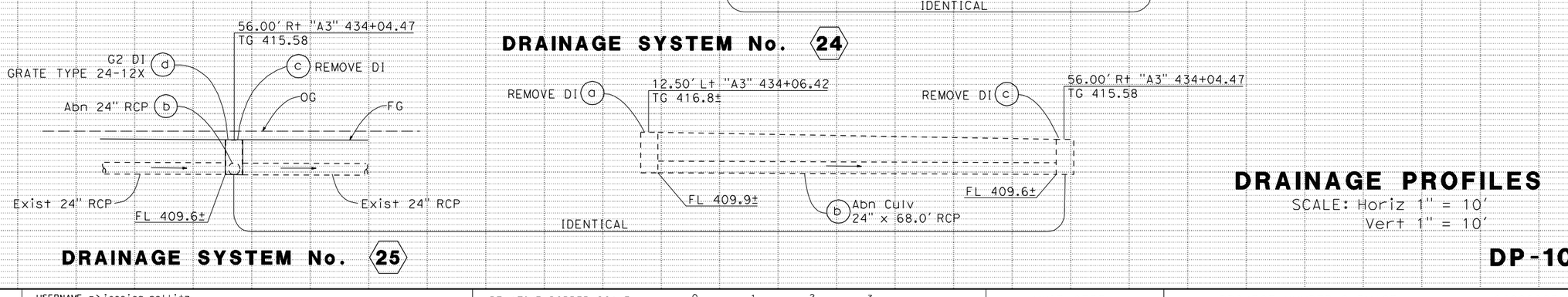
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

DRAINAGE SYSTEM No. 23



DRAINAGE SYSTEM No. 24



DRAINAGE SYSTEM No. 25

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-10

LAST REVISION | DATE PLOTTED => 1/12/2011
10-19-10 | TIME PLOTTED => 6:33:31 PM

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

ANALETTE OCHOA No. C 55279 Exp 12/31/12 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

IDENTICAL, SEE SHEET DP-12

58.00' Rt "A3" 435+86.40
TG 414.60

Exist 24" PP

(a) G2W DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-6)

FG

OG

0.54%±

FL 408.50

0.50%

(d) 30" x 208.7' APC (A)

58.00' Rt "A3" 438+00
TC 414.02

(e) G2W DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-6)

FG

OG

0.50%

FL 407.45

FL 407.35

A

A

IDENTICAL, SEE SHEET DP-12

58.00' Rt "A3" 440+30.00
TG 412.45

(g) G2W DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-6)

OG

FG

0.50%

(f) 30" x 225.8' APC (A)

FL 406.21

FL 406.11

0.50%

(j) 30" x 246.8' APC (A)

OG

FG

0.50%

B

B

58.39' Rt "A3" 442+81.48
TC 412.57

(k) G2W DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-6)

B

0.50%

FL 404.77

FL 404.87

(l) 30" x 102.1' APC (A)

FL 404.16

FL 404.26

74.00' Rt "A3" 443+85.43
TG 411.97

(m) G2W DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-6)

OG

FG

0.50%

(n) 30" x 161.6' APC (A)

IDENTICAL, SEE SHEET DP-12

74.00' Rt "A3" 445+50
TG 411.46

(o) G2W DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-6)

FG

OG

0.50%

FL 403.35

FL 403.25

(r) 30" x 156.5' APC (A)

74.00' Rt "A3" 447+15.15
TG 410.84

74.00' Rt "A3" 447+04.99
TG 410.87

(s) G2W DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-6, DD-16)

OG

FL 402.47

FL 396.49

(af)

76.50' Rt "A3" 447+40
TG 410.95

(am) G2 DI
GRATE TYPE 24-12X

(ak) GDO DI
GRATE TYPE 24-12X

18" x 22.5' APC (A) (al)

FG

OG

2.84%

FL 405.27

FL 405.17

FL 405.91

(aj) 18" x 7.2' APC (A)

1.94%

FL 405.03

IDENTICAL, SEE SHEET DP-12

72.00' Lt "A3" 447+09.09
TG 411.69

55.11' Lt "A3" 447+21.92
TC 412.22

(z) G2 DI
GRATE
TYPE 24-12X

FG

OG

(ab) Mod DI TO MH
(DETAIL, SEE DD-4, DD-6)

FG

OG

2.02%

FL 405.67

18" x 17.3' APC (A) (aa)

Exist 36" HDPE PIPE

PIPE CONNECTION
(DETAIL, SEE DD-2)

FL 405.32

FL 395.76

FL 395.66

Exist 36" HDPE PIPE

REMOVE MH (ae)

CAP DI (ac)
(DETAIL, SEE DD-2)

FL 396.39

PIPE CONNECTION
(DETAIL SEE DD-2)

0.51%

REMOVE Culv,
24" x 7.3' RCP (ad)

36" x 19.5' APC (A) (af)

IDENTICAL

(s)

(aj)

RW No. 437

77.13' Rt "A3" 447+04.99
TG 414.71

(ai) G1 DI
GRATE TYPE 24-12
(DETAIL, SEE DD-17)

OG

FL 410.71

(ah) 12" x 5.6' WSP
(DETAIL, SEE DD-3)

FL 409.43

0.52%±

UNDERDRAIN
SEE SB PLANS
UD FL 406.27

Exist 36" HDPE PIPE

(ag) REMOVE Culv (PORTION)
36" x 9.4' HDPE PIPE

FL 396.49

IDENTICAL

55.11' Lt "A3" 447+21.92
TG 412.22
Mod DI TO MH

55.07' Lt "A3" 446+19.82
TG 409.6±

(ab)

(an) REMOVE DI

(ao) REMOVE Culv
30" x 102.0' RCP

FL 403.2±

FL 409.1±

FL 395.66

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 26

DP-11

LAST REVISION DATE PLOTTED => 1/12/2011
TIME PLOTTED => 6:33:37 PM

BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
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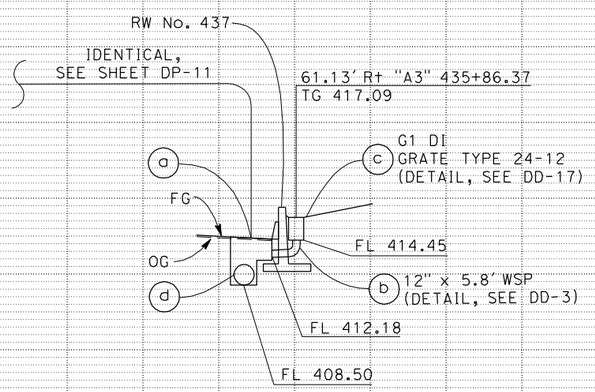
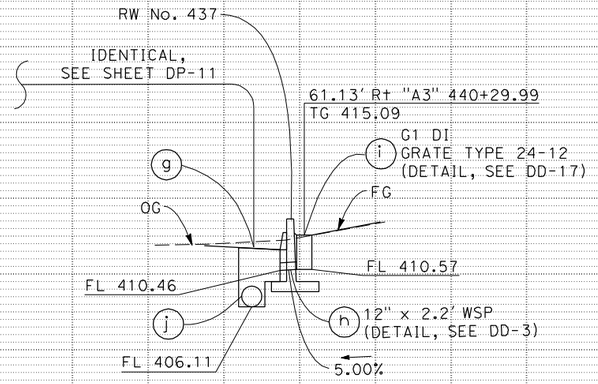
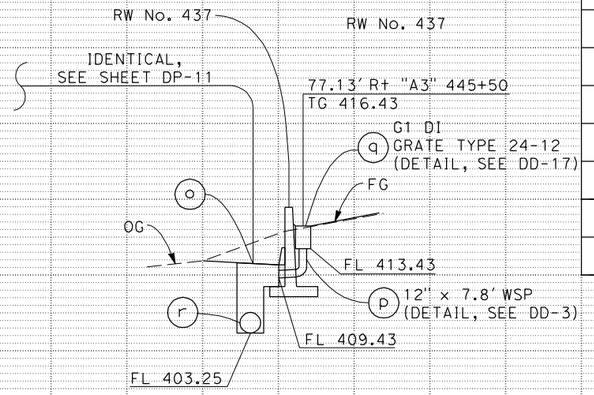
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

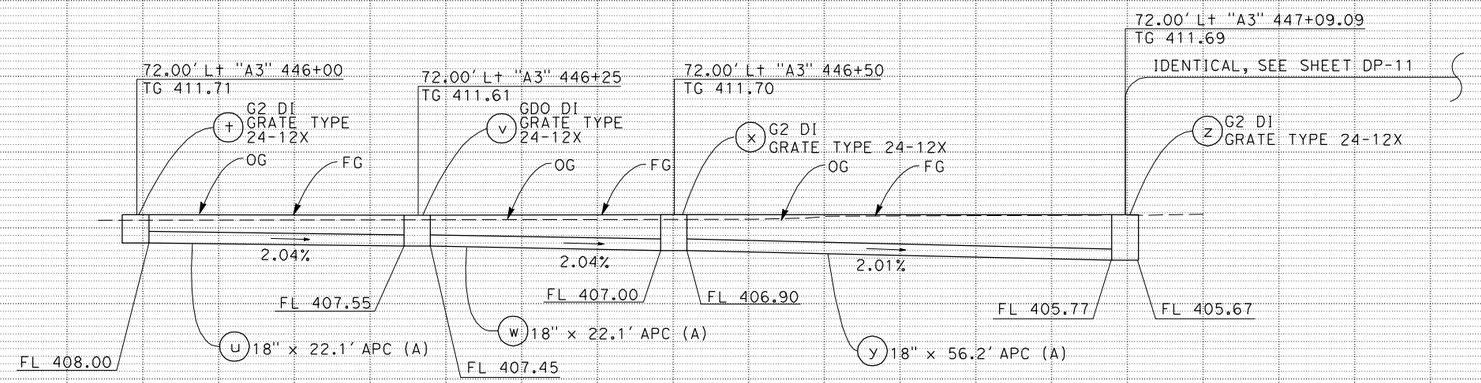
UNIT 0733

PROJECT NUMBER & PHASE 04000205801









DRAINAGE SYSTEM No. 26

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-12

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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REVISED BY: IL — DATE REVISED: 1/11/11
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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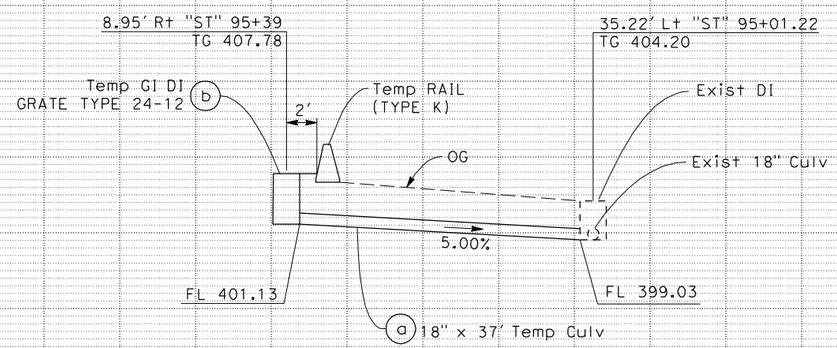
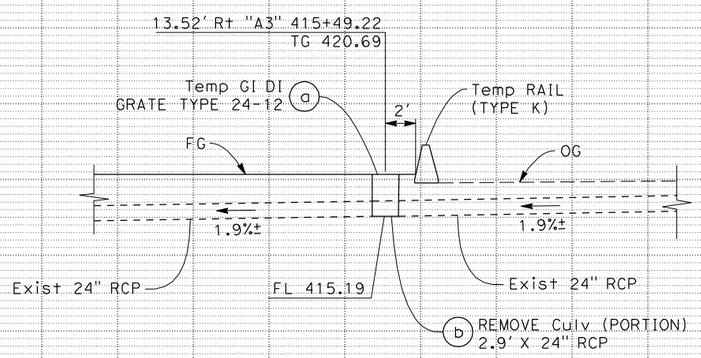


DRAINAGE SYSTEM No. 503



DRAINAGE SYSTEM No. 504

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp 12/31/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-13

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CALCULATED-DESIGNED BY
CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
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BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\dwg\seg a\prof\429760ib013.dgn
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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

North Segment Utility Plans, U-1 to U-9

September 2010 South Segment Utility Plans, U-1 to U-13, U-21 to U-23

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp. 06-30-12 — CIVIL — STATE OF CALIFORNIA

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

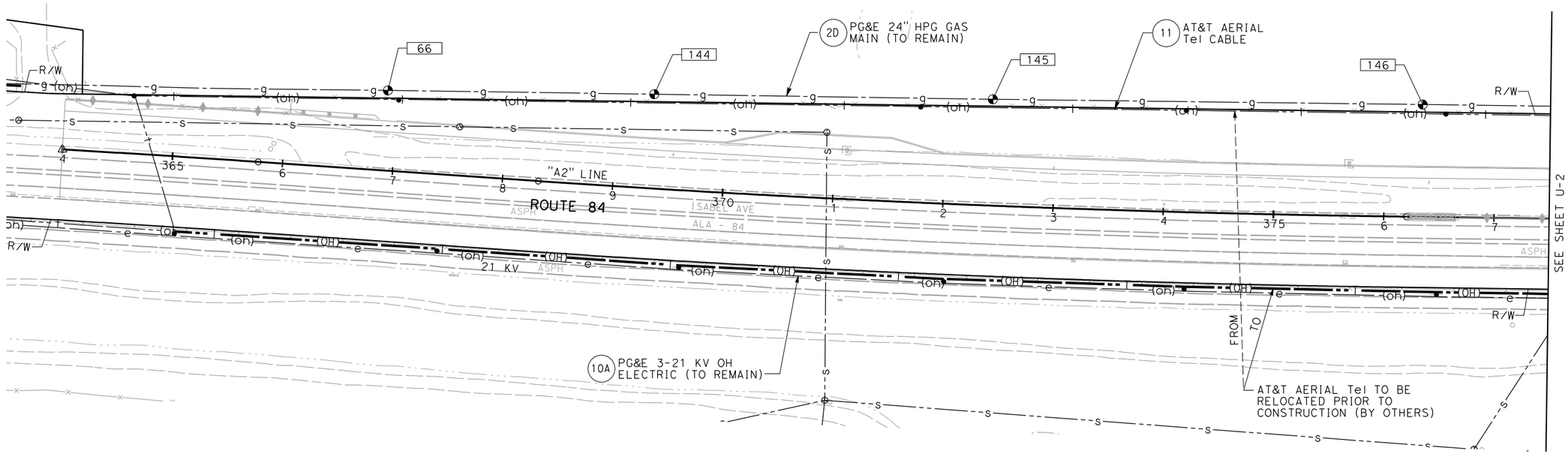
——-e——— ———(oh)——	Exist ELECTRICAL OVERHEAD LINE
——E——— ———(OH)——	PROPOSED ELECTRICAL OVERHEAD LINE
——-e——— ———-e———	Exist ELECTRICAL LINE
———tv——— ———tv———	Exist TELEVISION LINE
———tc——— ———tc———	Exist TELECOMMUNICATION
———w——— ———w———	Exist WATER LINE
——rcw——— ———rcw———	Exist RECLAIMED WATER
——-g——— ———-g———	Exist GAS LINE
——-s——— ———-s———	Exist SANITARY SEWER
——-t——— ———-t———	Exist Tel LINE
——-T——— ———-T———	PROPOSED TELEPHONE LINE
——RCW——— ———RCW———	PROPOSED RECLAIMED WATER
ETS	ELECTROLYSIS TEST STATION
	POTHOLE LOCATION
No.	POTHOLE NUMBER
(No.)	UTILITY NUMBER

NOTES:

1. LOCATIONS OF UTILITY FACILITIES SHOWN ON THESE PLANS ARE APPROXIMATE AND SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
2. UTILITY OWNERSHIP ON THIS PROJECT:
   GAS - PACIFIC GAS & ELECTRIC
   WATER - CITY OF LIVERMORE
   ELECTRIC - PACIFIC GAS & ELECTRIC
   FIBER OPTICS - MCI
   SEWER - CITY OF LIVERMORE
   CABLE TELEVISION - COMCAST
   TELEPHONE - AT&T
3. ALL ELEVATIONS SHOWN REFER TO THE TOP OF PIPE ELEVATION UNLESS OTHERWISE INDICATED.
4. THE EXISTING SANITARY SEWER FACALITIES SHOWN ON THESE PLANS ARE FOR INFORMATION ONLY, SEE SANITARY SEWER PLANS FOR MODIFICATIONS AND/OR NEW SEWER FACILITIES.

ABBREVIATIONS:

CALWATER	CALIFORNIA WATER SERVICE COMPANY
F/O	FIBER OPTIC CABLE
GST	GST TELECOMMUNICATIONS
HPG	HIGH PRESSURE GAS/HIGH RISK
JTR	JOINT TRENCH
JTP	JOINT TRANSMISSION POLE
KV	KILOVOLTS
LIV	CITY OF LIVERMORE
LP	LOW PRESSURE GAS/LOW RISK
MCI	MCI TELECOMMUNICATIONS
PG&E	PACIFIC GAS & ELECTRIC
TV	CABLE TELEVISION
UG	UNDERGROUND
UNK	UNKNOWN
UPRR	UNION PACIFIC RAILROAD
ZONE 7	ZONE 7 WATER AGENCY



POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-66	24" GAS - PG&E	2067887.867	6183771.007	4.08	409.69
PH-144	24" GAS - PG&E	2068129.428	6183774.412	5.42	408.07
PH-145	24" GAS - PG&E	2068436.503	6183779.028	5.75	407.22
PH-146	24" GAS - PG&E	2068826.303	6183783.777	4.58	409.65

UTILITY PLAN

SCALE: 1" = 50'

U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY

CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: SK
DATE REVISED: 10/20/10
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLING INFORMATION

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-147	24" GAS - PG&E	2069159.647	6183788.209	4.83	411.77
PH-148	24" GAS - PG&E	2069564.775	6183793.886	4.75	412.10
PH-149	24" GAS - PG&E	2070042.408	6183800.681	6.58	411.39

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

10/21/10
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Sang Kim
No. 66289
Exp 06-30-12
CIVIL
STATE OF CALIFORNIA

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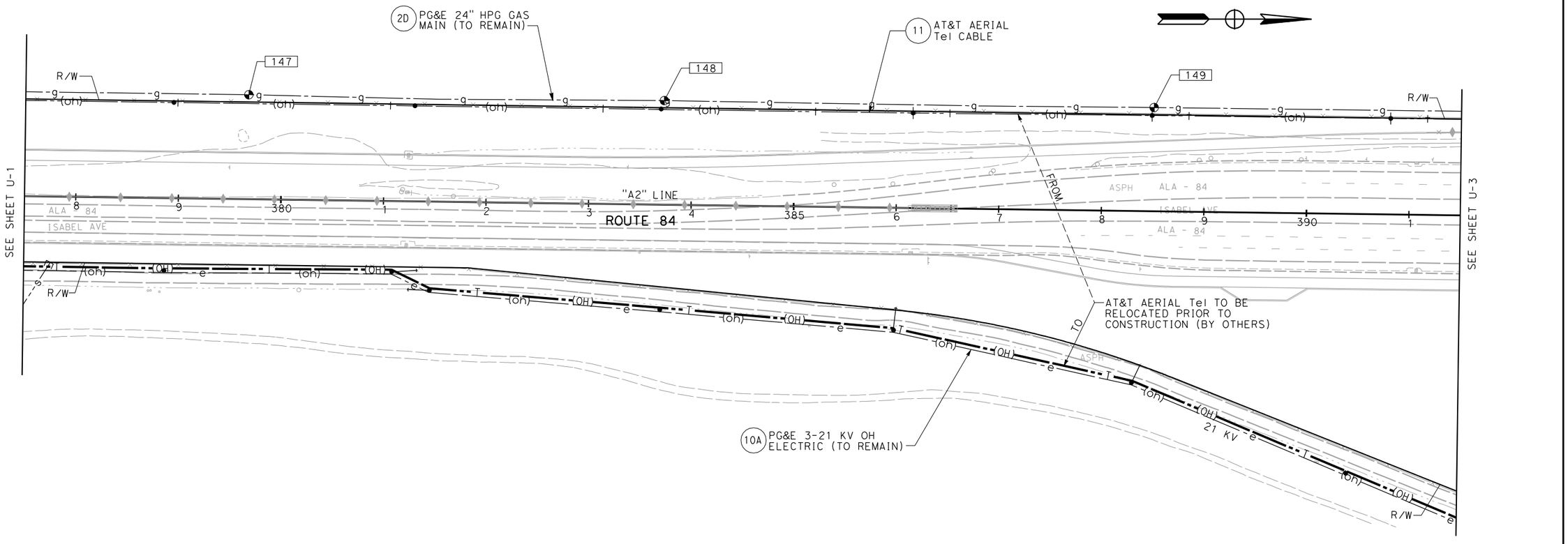

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY

UTILITY PLAN
SCALE: 1" = 50'

U-2

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CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: ELIE ABI-JAOUDE

REVISED BY	DATE REVISED
SK	10/20/10

BORDER LAST REVISED 7/2/2010

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DGN FILE => ...\0400020580ka002.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

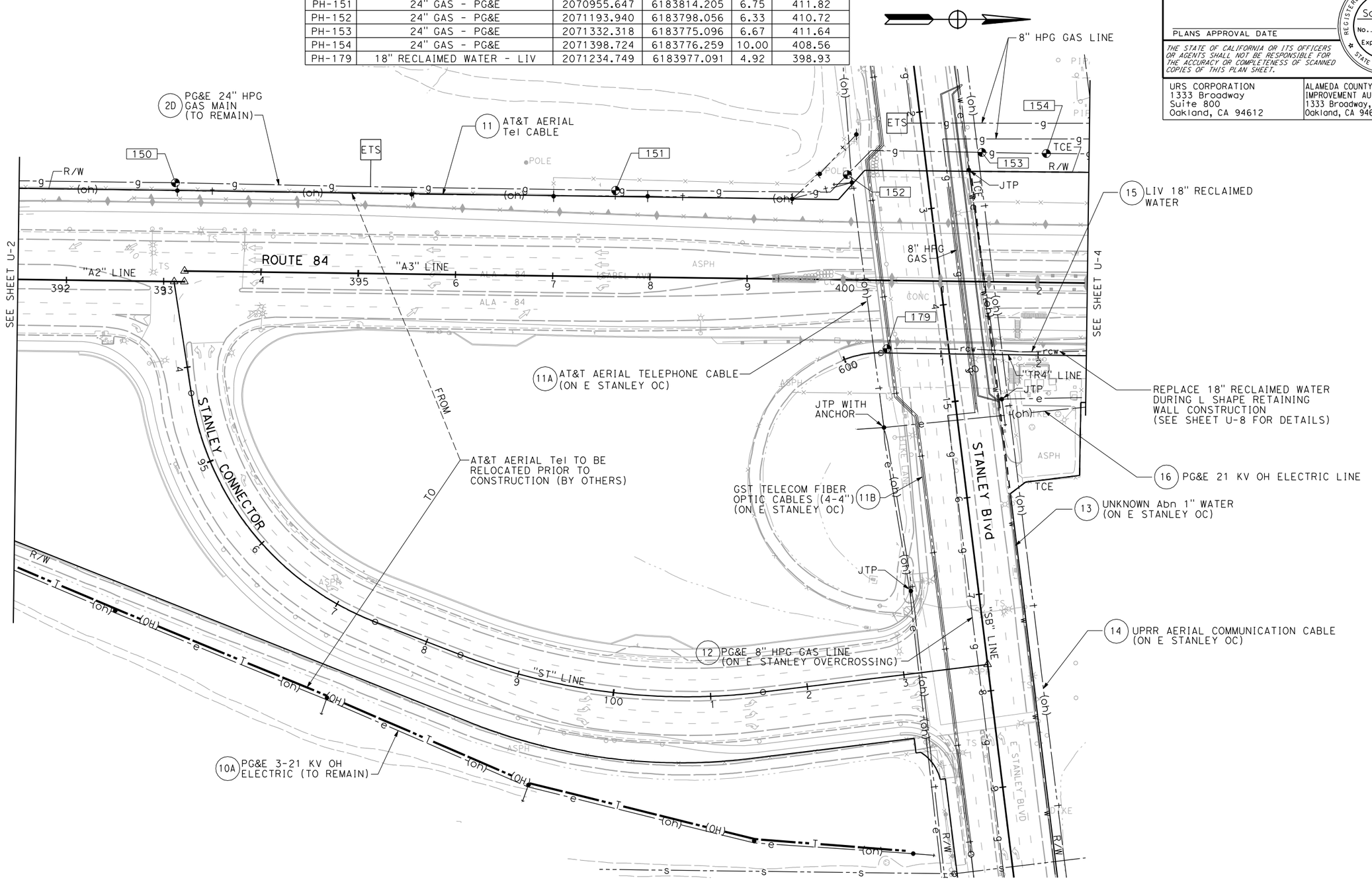
UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLING INFORMATION

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-150	24" GAS - PG&E	2070502.906	6183806.377	3.58	415.15
PH-151	24" GAS - PG&E	2070955.647	6183814.205	6.75	411.82
PH-152	24" GAS - PG&E	2071193.940	6183798.056	6.33	410.72
PH-153	24" GAS - PG&E	2071332.318	6183775.096	6.67	411.64
PH-154	24" GAS - PG&E	2071398.724	6183776.259	10.00	408.56
PH-179	18" RECLAIMED WATER - LIV	2071234.749	6183977.091	4.92	398.93



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-3

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

10/21/10
REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER
Sang Kim
No. 66289
Exp 06-30-12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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REVISED BY	DATE REVISED
SK	10/20/10

CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

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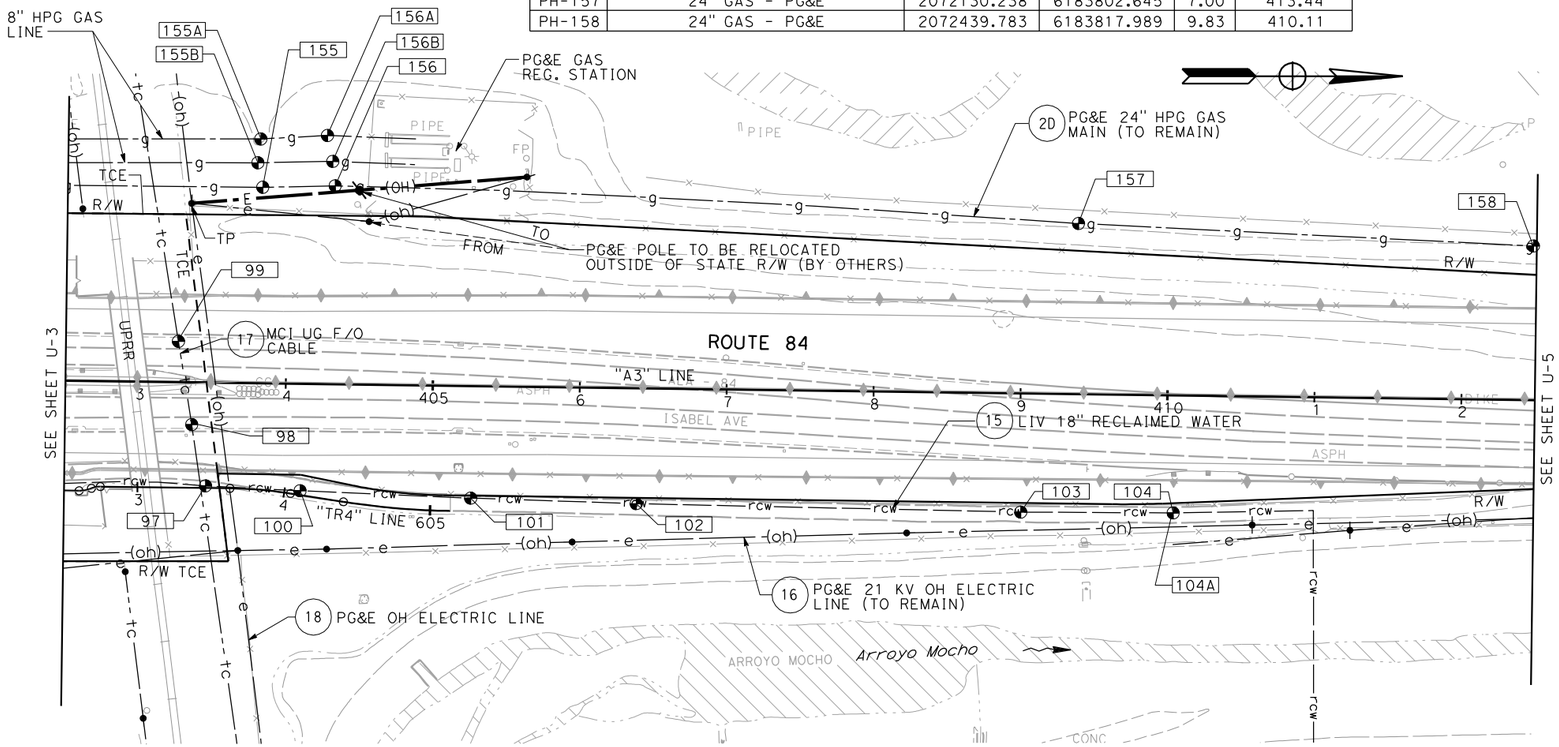
FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLING INFORMATION

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-97	18" RECLAIMED WATER - LIV	2071536.203	6183981.170	3.42	402.49
PH-98	F/O TELECOM CABLE - MCI	2071526.836	6183939.476	33.00	364.13
PH-99	F/O TELECOM CABLE - MCI	2071517.764	6183882.851	30.00	367.08
PH-100	18" RECLAIMED WATER - LIV	2071600.514	6183984.500	4.75	403.71
PH-101	18" RECLAIMED WATER - LIV	2071716.594	6183989.528	3.75	409.24
PH-102	18" RECLAIMED WATER - LIV	2071829.220	6183993.271	4.00	413.73
PH-103	18" RECLAIMED WATER - LIV	2072090.901	6183999.047	6.83	416.23
PH-104	18" RECLAIMED WATER - LIV	2072194.618	6183999.597	6.42	416.37
PH-104A	18" RECLAIMED WATER - LIV	2072194.725	6183999.635	4.92	417.94
PH-155	24" GAS - PG&E	NOT FOUND			
PH-155A	8" GAS	2071573.832	6183745.174	6.92	415.39
PH-155B	8" GAS	2071571.820	6183761.371	6.83	415.33
PH-156	24" GAS - PG&E	2071624.407	6183777.031	13.42	408.41
PH-156A	8" GAS	2071619.152	6183742.791	7.17	414.53
PH-156B	8" GAS	2071622.778	6183760.413	7.08	414.70
PH-157	24" GAS - PG&E	2072130.238	6183802.645	7.00	413.44
PH-158	24" GAS - PG&E	2072439.783	6183817.989	9.83	410.11



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-4

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-12 — CIVIL — STATE OF CALIFORNIA

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CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

REGISTERED CIVIL ENGINEER — 10/21/10 DATE

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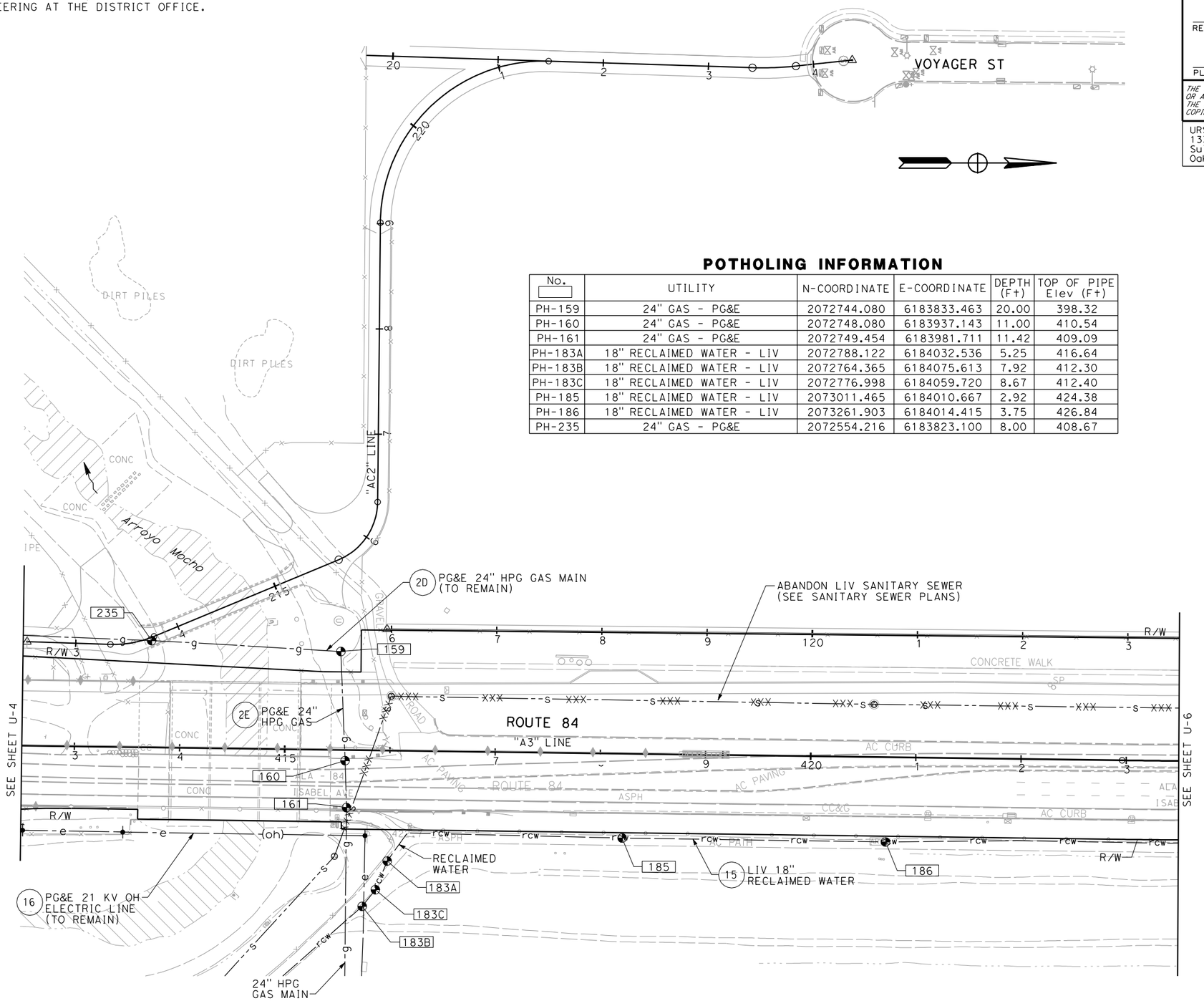
POTHOLING INFORMATION

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-159	24" GAS - PG&E	2072744.080	6183833.463	20.00	398.32
PH-160	24" GAS - PG&E	2072748.080	6183937.143	11.00	410.54
PH-161	24" GAS - PG&E	2072749.454	6183981.711	11.42	409.09
PH-183A	18" RECLAIMED WATER - LIV	2072788.122	6184032.536	5.25	416.64
PH-183B	18" RECLAIMED WATER - LIV	2072764.365	6184075.613	7.92	412.30
PH-183C	18" RECLAIMED WATER - LIV	2072776.998	6184059.720	8.67	412.40
PH-185	18" RECLAIMED WATER - LIV	2073011.465	6184010.667	2.92	424.38
PH-186	18" RECLAIMED WATER - LIV	2073261.903	6184014.415	3.75	426.84
PH-235	24" GAS - PG&E	2072554.216	6183823.100	8.00	408.67



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

UTILITY PLAN

SCALE: 1" = 50'

U-5

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CHECKED BY	ELIE ABI-JAOUDE	
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN	
REVISED BY	SK	
DATE REVISED	10/20/10	

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp. 06-30-12 — CIVIL — STATE OF CALIFORNIA

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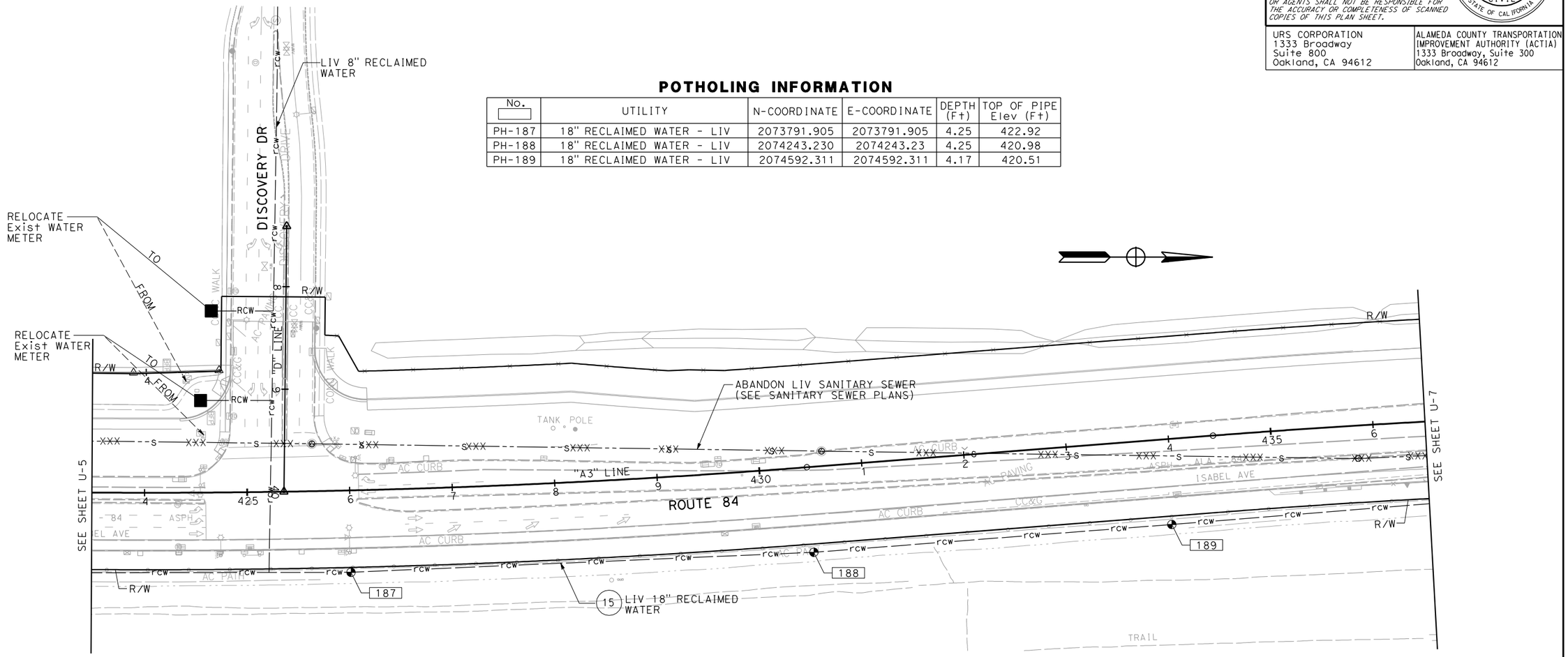
Oakland, CA 94612

POTHOLING INFORMATION

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-187	18" RECLAIMED WATER - LIV	2073791.905	2073791.905	4.25	422.92
PH-188	18" RECLAIMED WATER - LIV	2074243.230	2074243.23	4.25	420.98
PH-189	18" RECLAIMED WATER - LIV	2074592.311	2074592.311	4.17	420.51



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

UTILITY PLAN

SCALE: 1" = 50'

U-6

THIS PLAN ACCURATE FOR UTILITY WORK ONLY

CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN	
CALCULATED-DESIGNED BY	SANG KIM	REVISED BY: SK
CHECKED BY	ELIE ABI-JAOUDE	DATE REVISED: 10/20/10

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp. 06-30-12 — CIVIL — STATE OF CALIFORNIA

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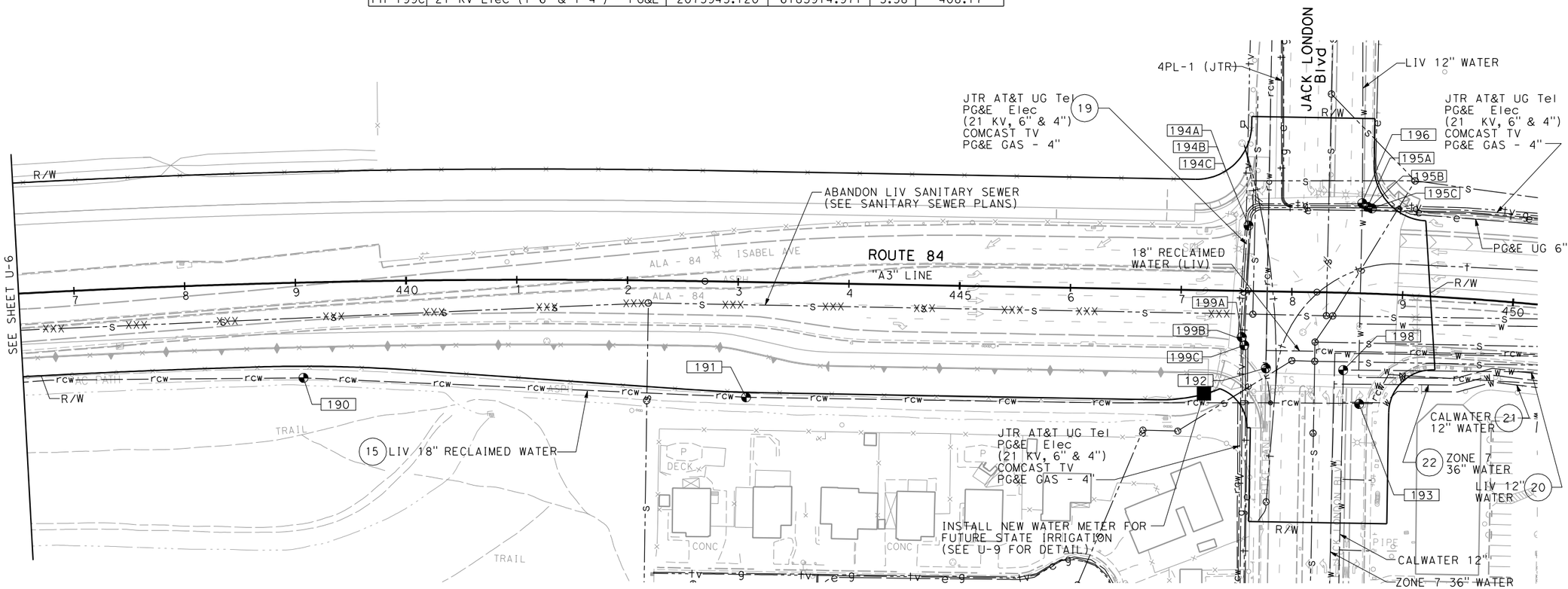
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

POTHOLING INFORMATION

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-190	18" RECLAIMED WATER - LIV	2075095.549	6183944.367	2.92	414.42
PH-191	18" RECLAIMED WATER - LIV	2075495.179	6183961.857	3.50	413.52
PH-192	18" RECLAIMED WATER - LIV	2075964.645	6183935.656	1.67	409.68
PH-193	18" RECLAIMED WATER - LIV	2076048.811	6183967.935	7.75	403.53
PH-194A	4" GAS - PG&E	2075948.940	6183806.752	4.08	407.40
PH-194B	CABLE TV - COMCAST	2075948.940	6183806.752	4.33	407.15
PH-194C	21 KV Elect (1-6" & 1-4")	2075948.940	6183806.752	5.33	406.15
PH-195A	4" GAS - PG&E	2076056.408	6183789.852	3.08	407.34
PH-195B	CABLE TV - COMCAST	2076060.338	6183791.284	2.92	407.50
PH-195C	21 KV Elect (1-6" & 1-4")	2076056.408	6183789.852	4.33	406.09
PH-196	12" WATER - LiV	2076051.686	6183786.542	5.50	405.12
PH-198	12" WATER - CALWATER	NOT FOUND			
PH-199A	4" GAS - PG&E	2075945.120	6183914.971	3.25	408.50
PH-199B	CABLE TV - COMCAST	2075942.765	6183907.467	4.75	407.00
PH-199C	21 KV Elec (1-6" & 1-4") - PG&E	2075945.120	6183914.971	3.58	408.17



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-7

REVISED BY	DATE REVISED
SK	10/20/10

CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION: 10-21-10
DATE PLOTTED => 1/13/2011
TIME PLOTTED => 1:26:24 PM

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Sang Kim — No. 66289 — Exp. 06-30-12 — CIVIL — State of California

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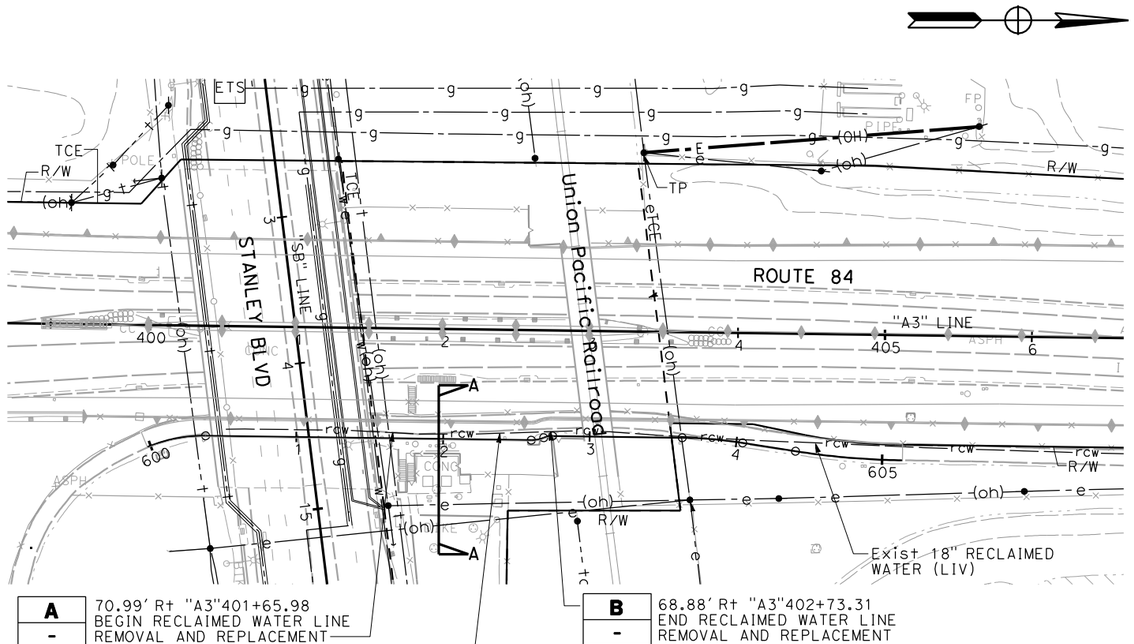
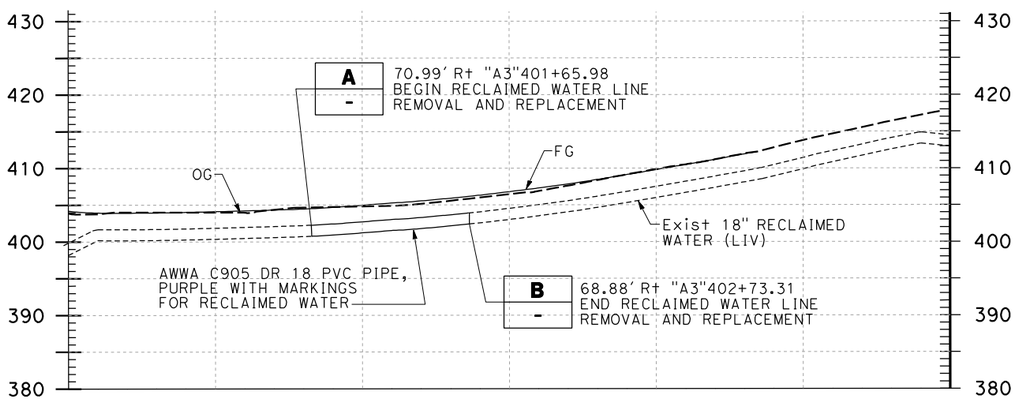
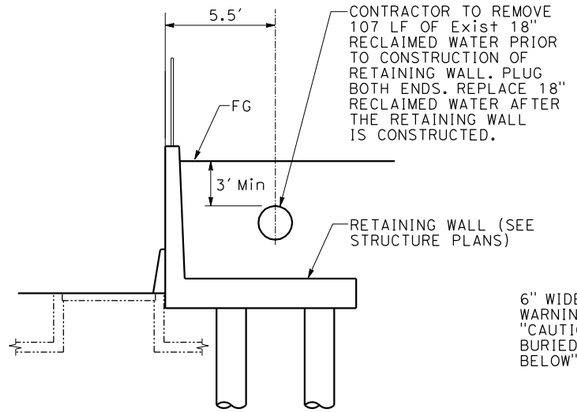


PLAN
SCALE: 1" = 50'

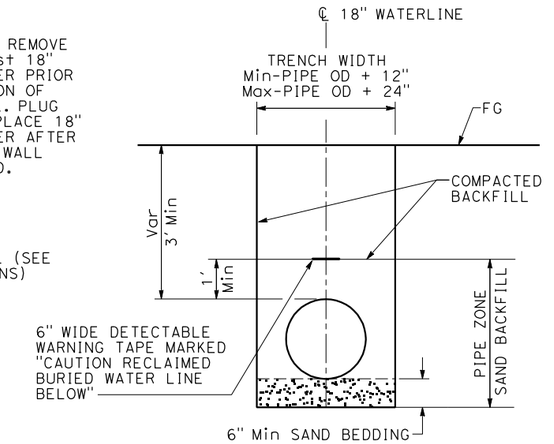


PROFILE
SCALE: Horiz 1" = 50'
Vert 1" = 10'

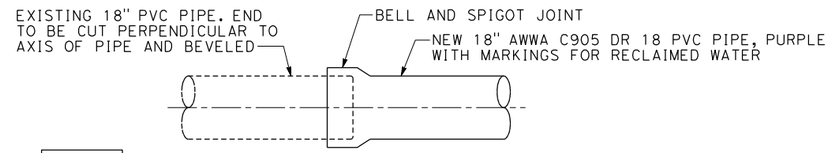
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1



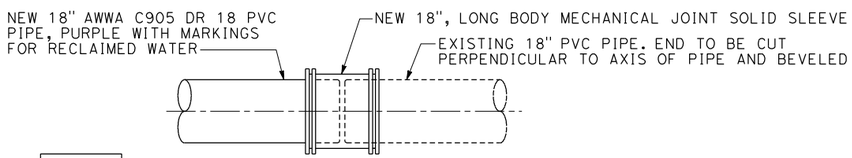
SECTION A-A
NO SCALE



TRENCH DETAIL
NO SCALE



A — **CONNECTION AT BEGINNING OF NEW PIPE**



B — **CONNECTION AT END OF NEW PIPE**

UTILITY PLAN AND PROFILE
CITY OF LIVERMORE
18" RECLAIMED WATER REPLACEMENT
SCALE: AS SHOWN

U-8

THIS PLAN ACCURATE FOR UTILITY WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CALCULATED-DESIGNED BY	SANG KIM	REVISED BY	SK
CONSULTANT FUNCTIONAL SUPERVISOR	CHECKED BY	ELIE ABI-JAOUDE	DATE REVISED	10/20/10
RAMSEY J. HISSEN				

LAST REVISION: DATE PLOTTED => 1/13/2011 TIME PLOTTED => 1:26:30 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp. 06-30-12 — CIVIL — STATE OF CALIFORNIA

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UTILITY INFORMATION

UTILITY No.	SHEET No.	OWNER	DESCRIPTION	LOCATION
2D	U-1 TO U-5	PG&E	24" HPG GAS	"A2" 364+00 TO "A3" 415+60
2E	U-5	PG&E	24" HPG GAS	"A3" 415+60
10A	U-1 TO U-3	PG&E	3-21 KV OH ELECTRIC LINE	"A2" 364+00 TO "A3" 400+80
11	U-1 TO U-3	AT&T	AERIAL Tel CABLE	"A2" 364+70 TO "A3" 400+00
11A	U-3	AT&T	AERIAL Tel CABLE (ON EAST STANLEY Blvd OC)	"A3" 400+20
11B	U-3	GST	UG TELECOM FIBER OPTIC CABLES (ON EAST STANLEY Blvd OC)	"A3" 400+40
12	U-3	PG&E	8" HPG GAS (ON EAST STANLEY Blvd OC)	"A3" 401+20
13	U-3	UNKNOWN	Abn 1" WATER (ON EAST STANLEY Blvd OC)	"A3" 401+40
14	U-3	UPRR	AERIAL COMMUNICATION CABLE (ON EAST STANLEY Blvd OC)	"A3" 401+50
15	U-3 TO U-7	LIV	18" RECLAIMED WATER	"A3" 400+30 TO 450+00
16	U-3 TO U-5	PG&E	21 KV OVERHEAD ELECTRIC LINE	"A3" 400+20 TO 415+80
17	U-4	MCI	UG F/O CABLE	"A3" 403+30
18	U-4	PG&E	OH ELECTRIC LINE	"A3" 403+50
19	U-7	PG&E, AT&T, COMCAST	JTR 1-6" & 1-4" 21 KV ELECTRIC, 4" GAS, 6-4" TELEPHONE, 1-4" & 1-6" CABLE TELEVESION	"A3" 447+60 TO "A3" 450+00
20	U-7	LIV	12" WATER	"A3" 448+60 TO "A3" 450+00
21	U-7	CALWATER	12" WATER	"A3" 448+50 TO "A3" 450+00
22	U-7	ZONE 7	36" WATER	"A3" 448+40 TO "A3" 450+00

UTILITY PLAN

U-9

CALCULATED-DESIGNED BY	SANG KIM	REVISED BY	SK
CHECKED BY	ELIE ABI-JAOUDE	DATE REVISED	10/20/10

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp. 06-30-10 — CIVIL — STATE OF CALIFORNIA

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FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

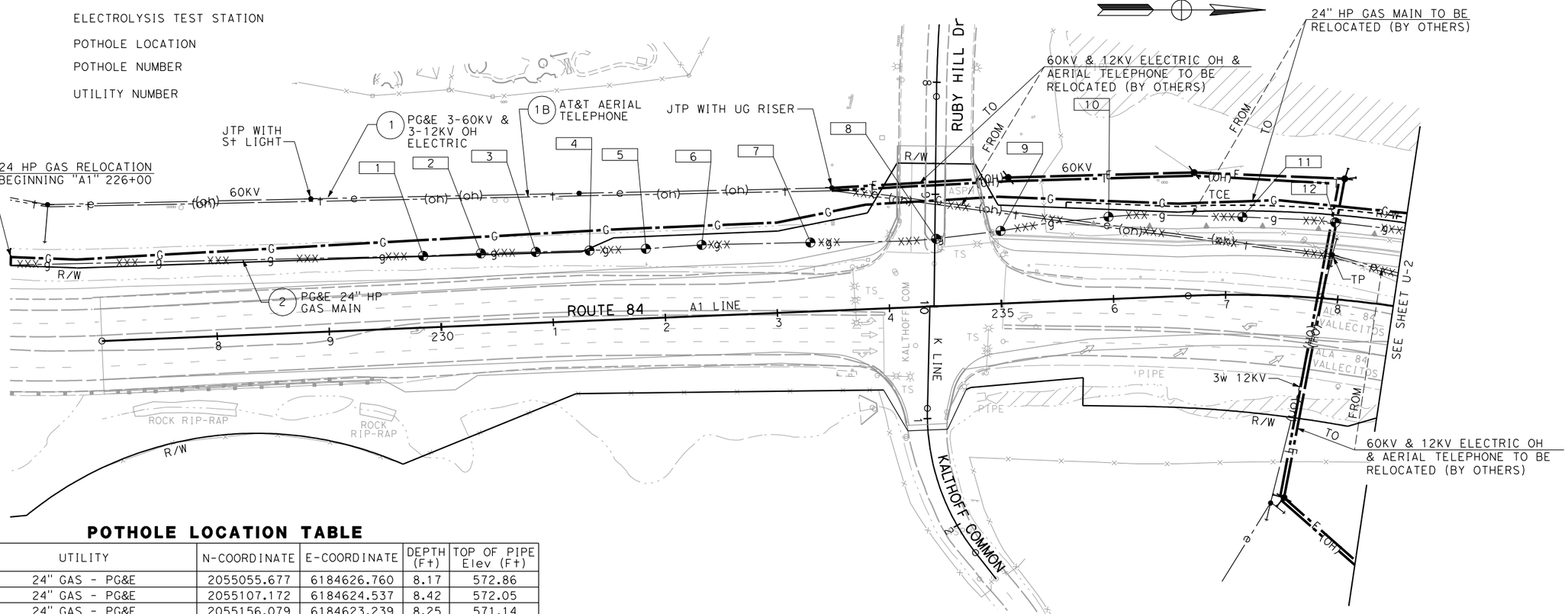
——-e——(oh)——	Exist ELECTRICAL OVERHEAD LINE
——-E——(OH)——	PROPOSED ELECTRICAL OVERHEAD LINE
——-e——-e——	Exist ELECTRIC
——fo——(oh)——	Exist FIBER OPTIC OVERHEAD LINE
——tv——tv——	Exist TELEVISION LINE
——tc——(oh)——	Exist TELECOMMUNICATION OVERHEAD LINE
——w——w——	Exist WATER LINE
——rcw——rcw——	Exist RECLAIMED WATER
——-g——-g——	Exist GAS LINE
——-G——-G——	PROPOSED GAS LINE
——-s——-s——	Exist SANITARY SEWER
——-t——-t——	Exist TELEPHONE LINE
——-T——-T——	PROPOSED TELEPHONE LINE
// // // //	ABANDONED UTILITY LINE
XXX XXX XXX XXX	ABANDON UTILITY LINE
ETS	ELECTROLYSIS TEST STATION
⊕	POTHOLE LOCATION
No.	POTHOLE NUMBER
(No.)	UTILITY NUMBER

NOTES:

1. LOCATIONS OF UTILITY FACILITIES SHOWN ON THESE PLANS ARE APPROXIMATE AND SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
2. UTILITY OWNERSHIP ON THIS PROJECT:
   GAS - PACIFIC GAS & ELECTRIC
   WATER - CITY OF LIVERMORE, CALWATER, ZONE 7, CITY OF PLEASANTON.
   ELECTRIC - PACIFIC GAS & ELECTRIC
   TELEPHONE - AT&T
   FIBER OPTICS - COMCAST, MCI
   SEWER - CITY OF LIVERMORE
   CABLE - COMCAST
3. ALL ELEVATIONS SHOWN REFER TO THE TOP OF PIPE ELEVATION UNLESS OTHERWISE INDICATED.
4. THE EXISTING SANITARY SEWER FACALITIES SHOWN ON THESE PLANS ARE FOR INFORMATION ONLY, SEE SANITARY SEWER PLANS FOR MODIFICATIONS AND/OR NEW SEWER FACILITIES.

ABBREVIATIONS:

ZONE 7	ZONE 7 WATER
TV	CABLE TELEVISION
UP	UNION GAS PACIFIC
HP	HIGH PRESSURE GAS/HIGH RISK
LP	LOW PRESSURE GAS/LOW RISK
TP	TRANSMISSION POLE
JT	JOINT TRENCH
JTP	JOINT TRANSMISSION POLE
SOPP	SOLELY OWN POWER POLE
UG	UNDERGROUND
PG&E	PACIFIC GAS & ELECTRIC
LIV	CITY OF LIVERMORE
UNK	UNKNOWN
CALWATER	CALIFORNIA WATER SERVICE Co.
F/O	FIBER OPTIC CABLE
PL	PLASTIC
COP	CITY OF PLEASANTON
DIP	DUCTILE IRON PIPE



POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-1	24" GAS - PG&E	2055055.677	6184626.760	8.17	572.86
PH-2	24" GAS - PG&E	2055107.172	6184624.537	8.42	572.05
PH-3	24" GAS - PG&E	2055156.079	6184623.239	8.25	571.14
PH-4	24" GAS - PG&E	2055204.000	6184622.000	8.33	570.57
PH-5	24" GAS - PG&E	2055254.270	6184620.424	10.25	568.82
PH-6	24" GAS - PG&E	2055304.033	6184616.951	11.42	567.65
PH-7	24" GAS - PG&E	2055400.975	6184614.811	13.00	564.01
PH-8	24" GAS - PG&E	2055513.151	6184611.524	6.46	559.90
PH-9	24" GAS - PG&E	2055570.536	6184604.491	5.00	561.07
PH-10	24" GAS - PG&E	2055666.816	6184591.907	8.58	566.90
PH-11	24" GAS - PG&E	2055786.178	6184592.084	6.92	568.56
PH-12	24" GAS - PG&E	2055868.959	6184596.870	6.42	569.69

UTILITY PLAN

SCALE: 1"=50'

U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

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CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
CALCULATED-DESIGNED BY: SANG KIM — CHECKED BY: BEN RAZEGHI
REVISED BY — DATE REVISED

LAST REVISION: DATE PLOTTED => 9/16/2010; TIME PLOTTED => 11:45:17 AM; 08-31-10

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp. 06-30-10 — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

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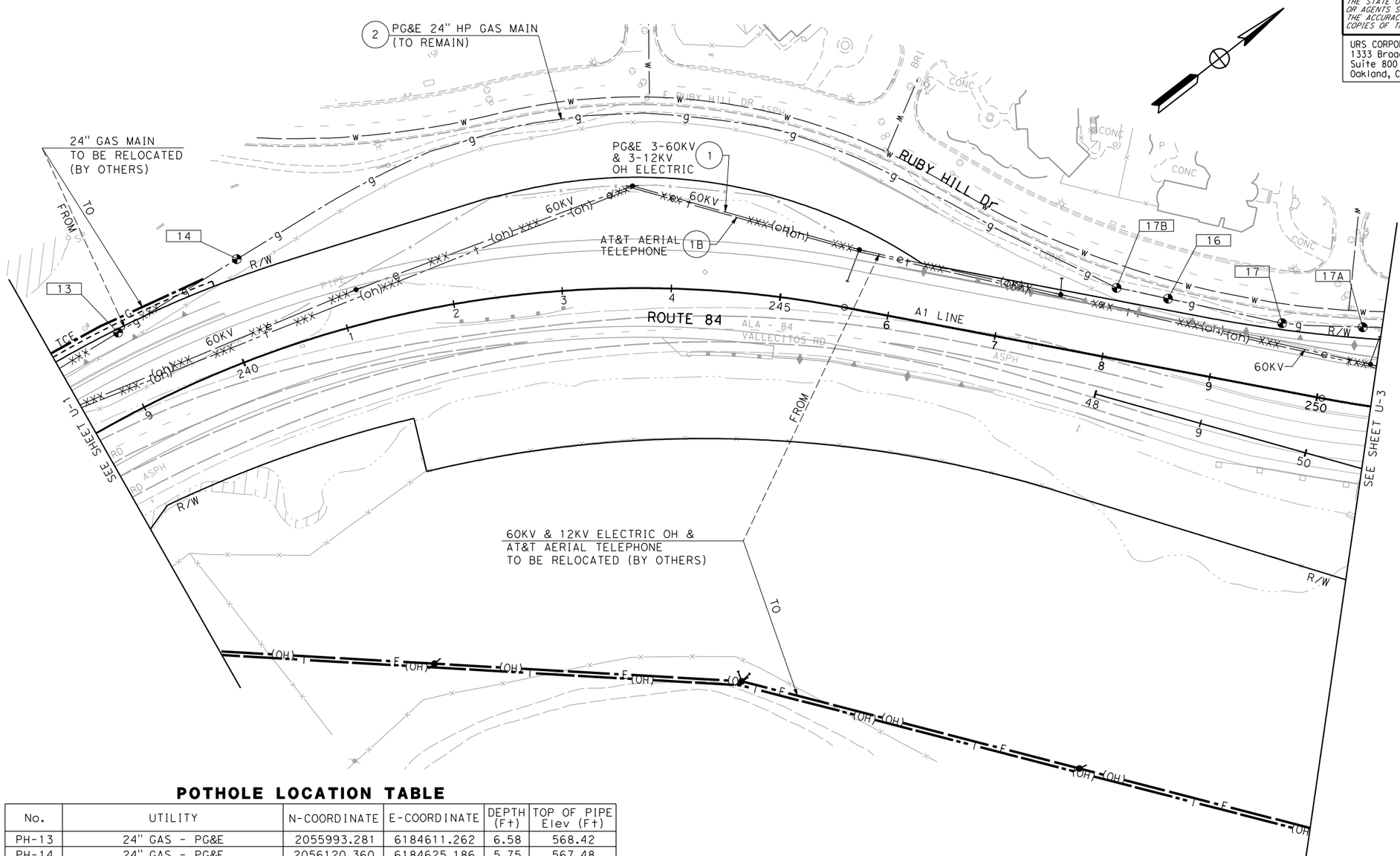

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-13	24" GAS - PG&E	2055993.281	6184611.262	6.58	568.42
PH-14	24" GAS - PG&E	2056120.360	6184625.186	5.75	567.48
PH-16	24" GAS - PG&E	2056769.979	6185178.723	4.67	552.61
PH-17B	24" GAS - PG&E	2056739.078	6185141.932	5.08	552.93
PH-17	24" GAS - PG&E	2056838.558	6185260.698	5.42	549.67
PH-17A	24" GAS - PG&E	2056894.520	6185309.109	4.08	549.01

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

UTILITY PLAN

SCALE: 1"=50'

U-2

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: BEN RAZEGHI
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

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LAST REVISION 08-31-10
DATE PLOTTED => 9/16/2010
TIME PLOTTED => 11:45:25 AM

BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\ka-utilities\429760ka002.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 04256
PROJECT NUMBER & PHASE 297601

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

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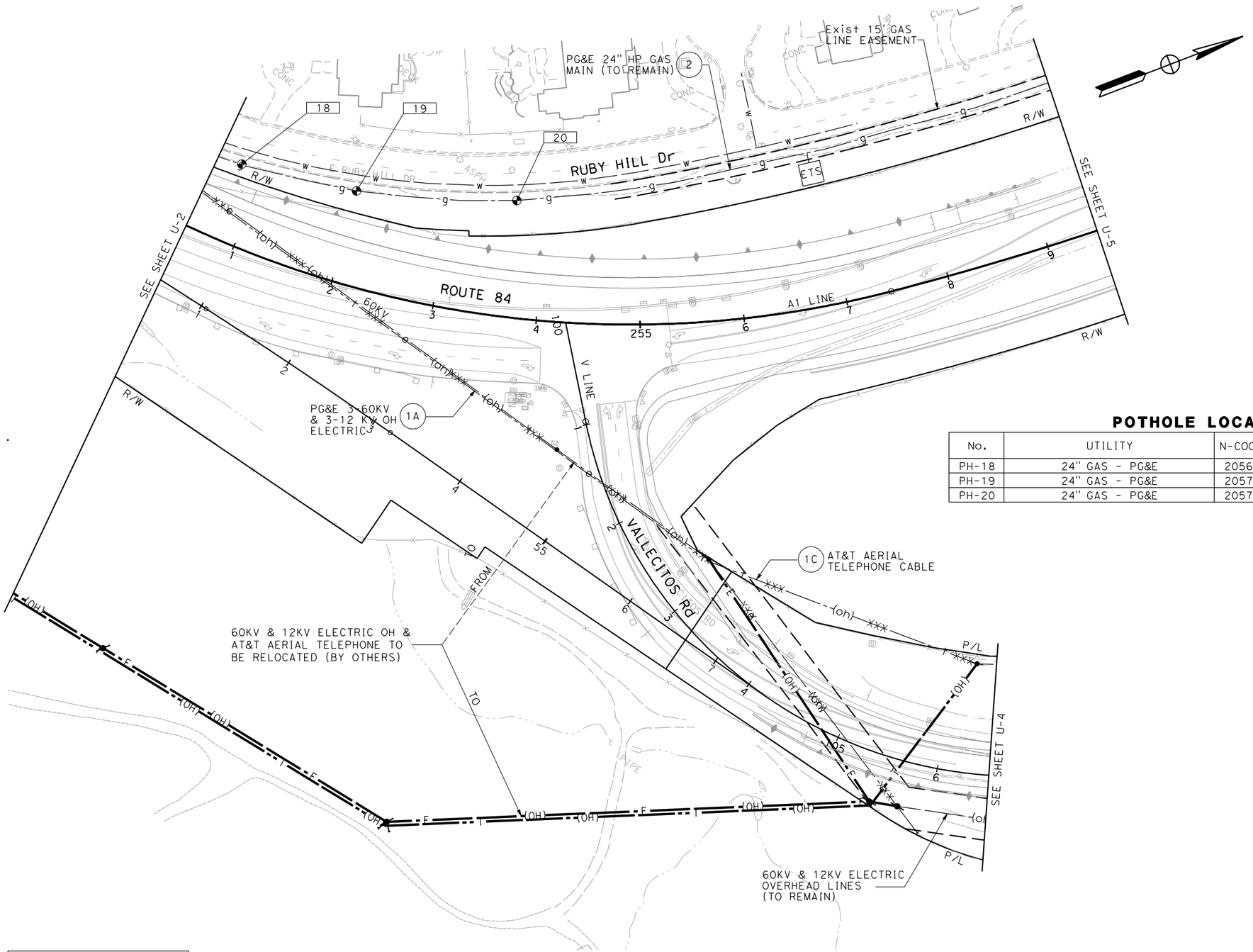

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-18	24" GAS - PG&E	2056926.568	6185334.991	4.42	547.78
PH-19	24" GAS - PG&E	2057020.174	6185398.537	5.67	542.98
PH-20	24" GAS - PG&E	2057160.648	6185462.252	4.83	539.09

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-3

	REVISED BY	DATE REVISED
CALCULATED-DESIGNED BY	SANG KIM	
CHECKED BY	BEN RAZEGHI	
CONSULTANT FUNCTIONAL SUPERVISOR	BEN RAZEGHI	

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

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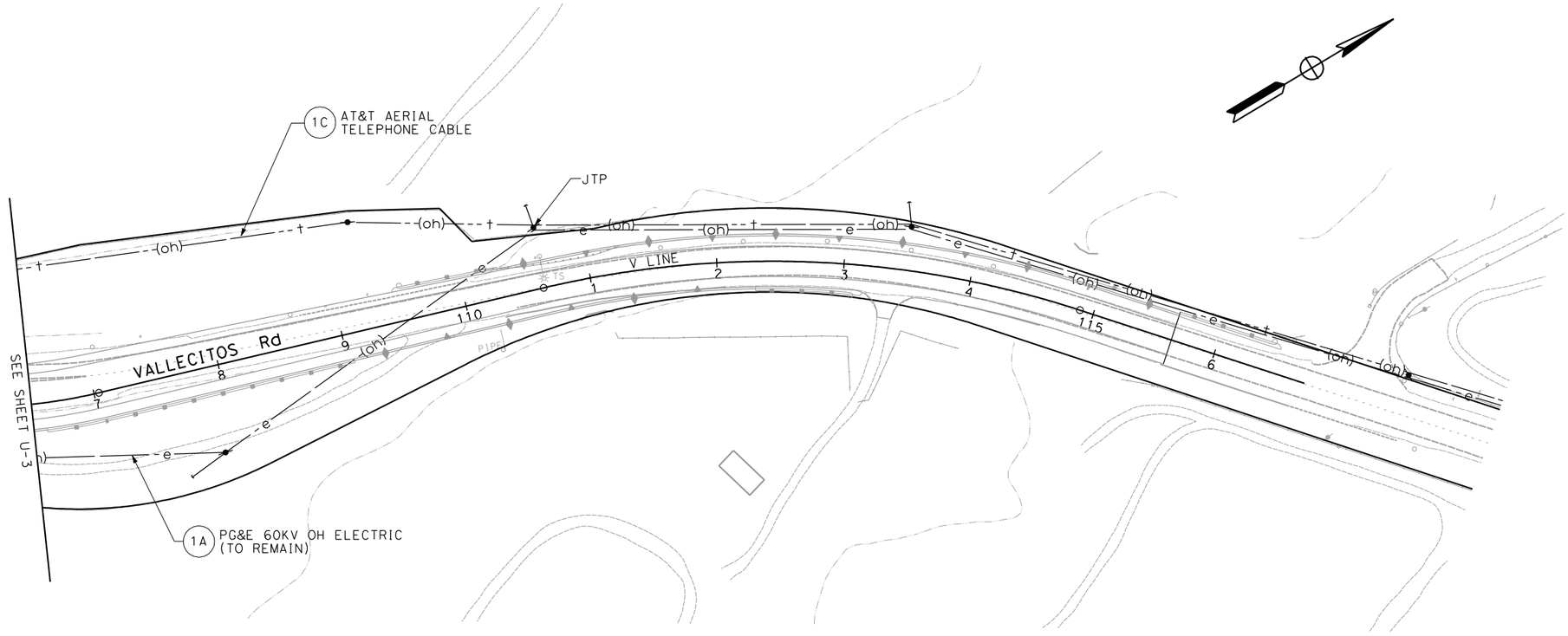

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-4

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans®

CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

CALCULATED-DESIGNED BY: SANG KIM — CHECKED BY: BEN RAZEGHI

REVISED BY	DATE REVISED

LAST REVISION: DATE PLOTTED => 9/16/2010; TIME PLOTTED => 11:45:34 AM
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

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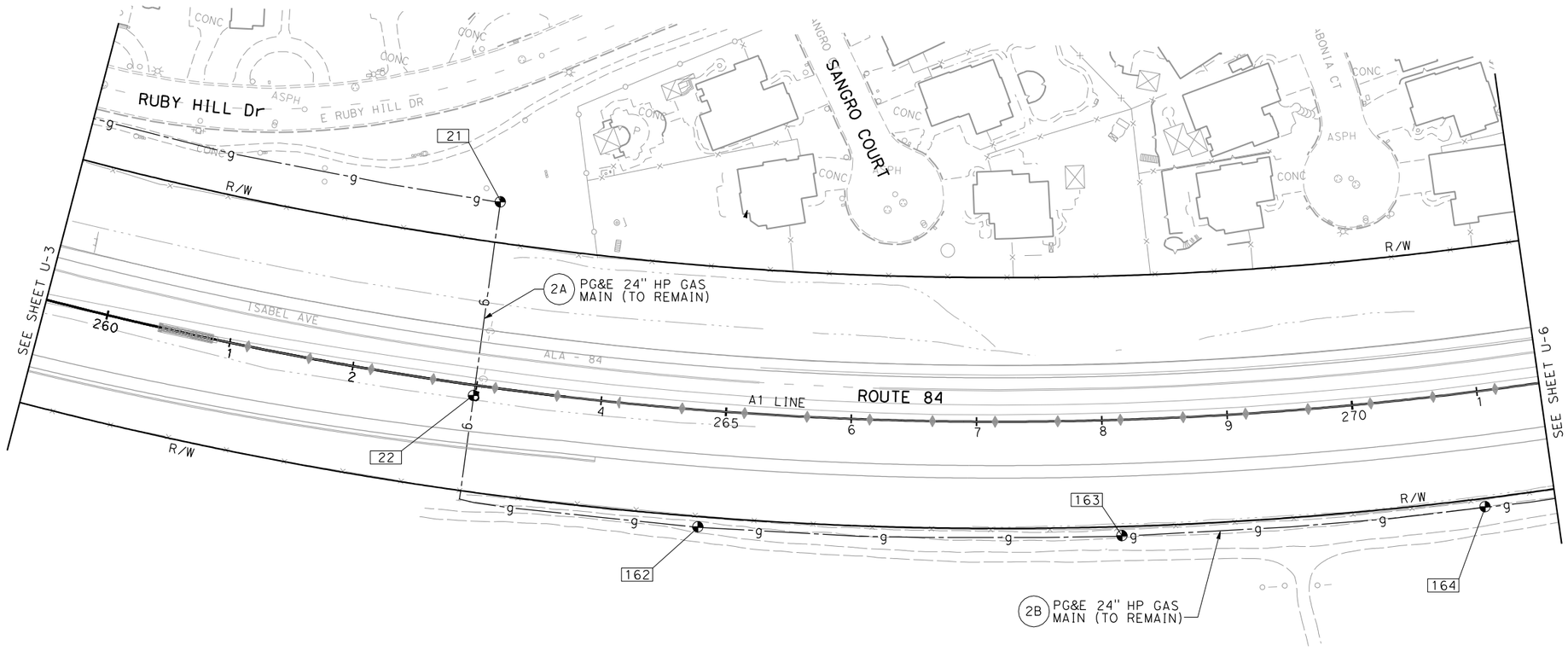
1333 Broadway, Suite 300
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-21	24" GAS - PG&E	2058008.267	6185537.753	6.42	512.28
PH-22	24" GAS - PG&E	2058019.488	6185693.188	9.00	506.88
PH-162	24" GAS - PG&E	2058216.265	6185758.402	7.75	499.21
PH-163	24" GAS - PG&E	2058548.635	6185694.971	8.33	421.31
PH-164	24" GAS - PG&E	2058827.174	6185612.19	6.25	473.23



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN
SCALE: 1"=50'

U-5

REVISED BY | DATE REVISED
SANG KIM | BEN RAZEGHI
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 08-31-10
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BORDER LAST REVISED 7/2/2010 | USERNAME => madhu_thummaluru | DGN FILE => ...\ka-utilities\429760ka005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

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FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

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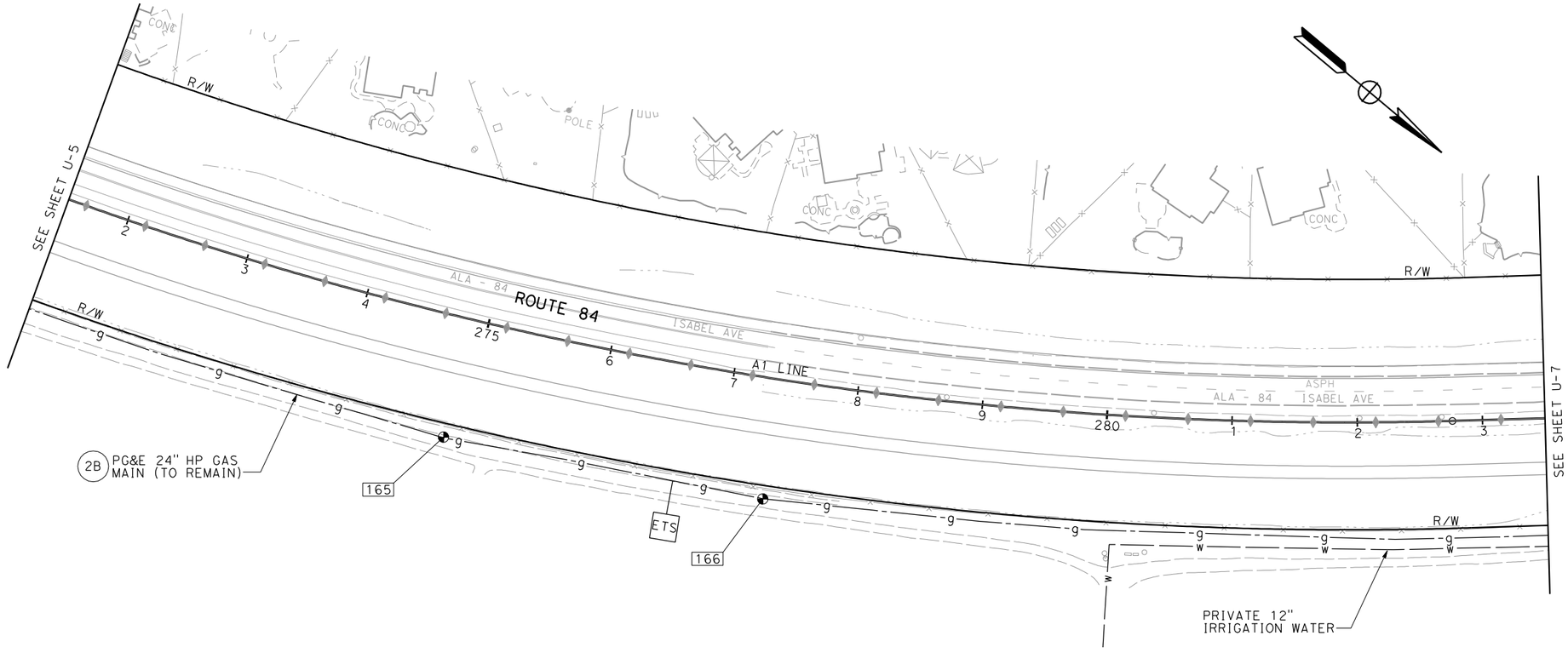
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-165	24" GAS - PG&E	2059200.325	6185459.844	5.58	465.33
PH-166	24" GAS - PG&E	2059427.086	6185333.021	7.75	458.27



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-6

REVISED BY | DATE REVISED

CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: BEN RAZEGHI
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 08-31-10
DATE PLOTTED => 9/16/2010
TIME PLOTTED => 11:45:42 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => madhu_thummaluru | DGN FILE => ...\ka-utilities\429760ka006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

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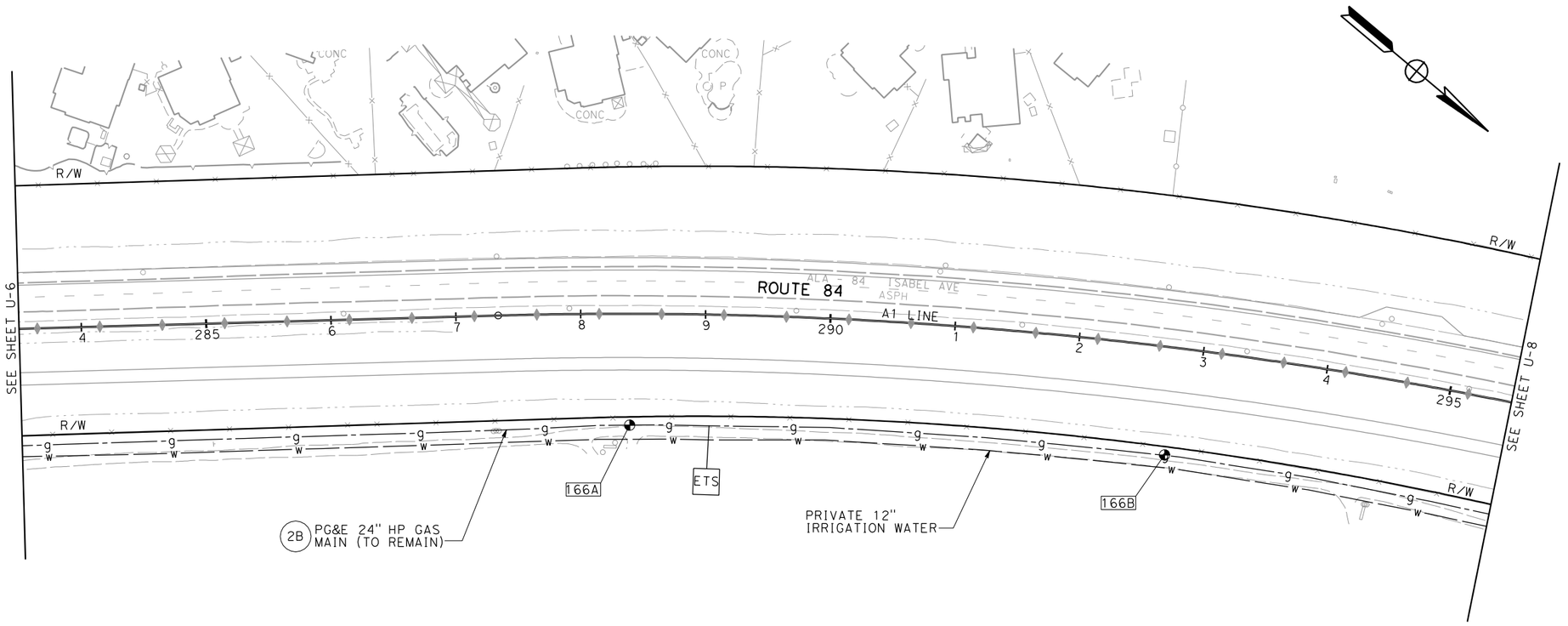
1333 Broadway, Suite 300
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-166A	24" GAS - PG&E	2060288.412	6184626.857	6.42	438.65
PH-166B	24" GAS - PG&E	2060631.869	6184369.807	6.33	432.68



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-7

CALCULATED-DESIGNED BY: SANG KIM
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CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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TIME PLOTTED => 11:45:45 AM

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 04256
PROJECT NUMBER & PHASE 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

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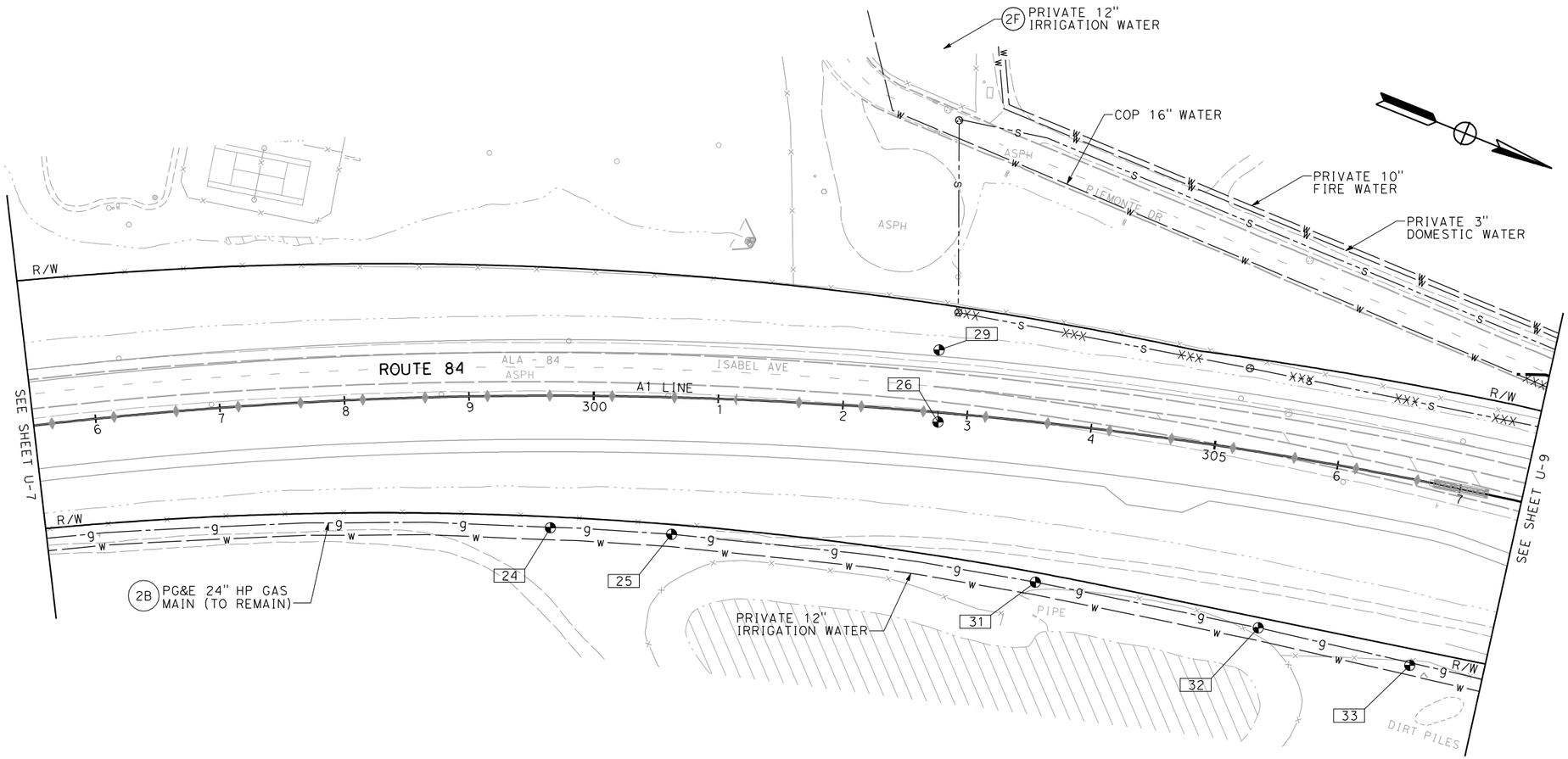
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-24	24" GAS - PG&E	2061232.470	6184079.626	5.25	425.25
PH-25	24" GAS - PG&E	2061324.733	6184048.299	4.33	424.88
PH-26	PRIVATE 12" IRRIGATION	2061489.100	6183884.730	2.20	428.43
PH-29	PRIVATE 12" IRRIGATION	2061468.260	6183830.783	2.80	427.70
PH-31	24" GAS - PG&E	2061609.630	6183974.641	5.00	422.84
PH-32	24" GAS - PG&E	2061788.998	6183941.656	5.50	421.96
PH-33	24" GAS - PG&E	2061913.000	6183924.000	8.17	422.13



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

CALCULATED-DESIGNED BY: SANG KIM

CHECKED BY: BEN RAZEGHI

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LAST REVISION: 08-31-10

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

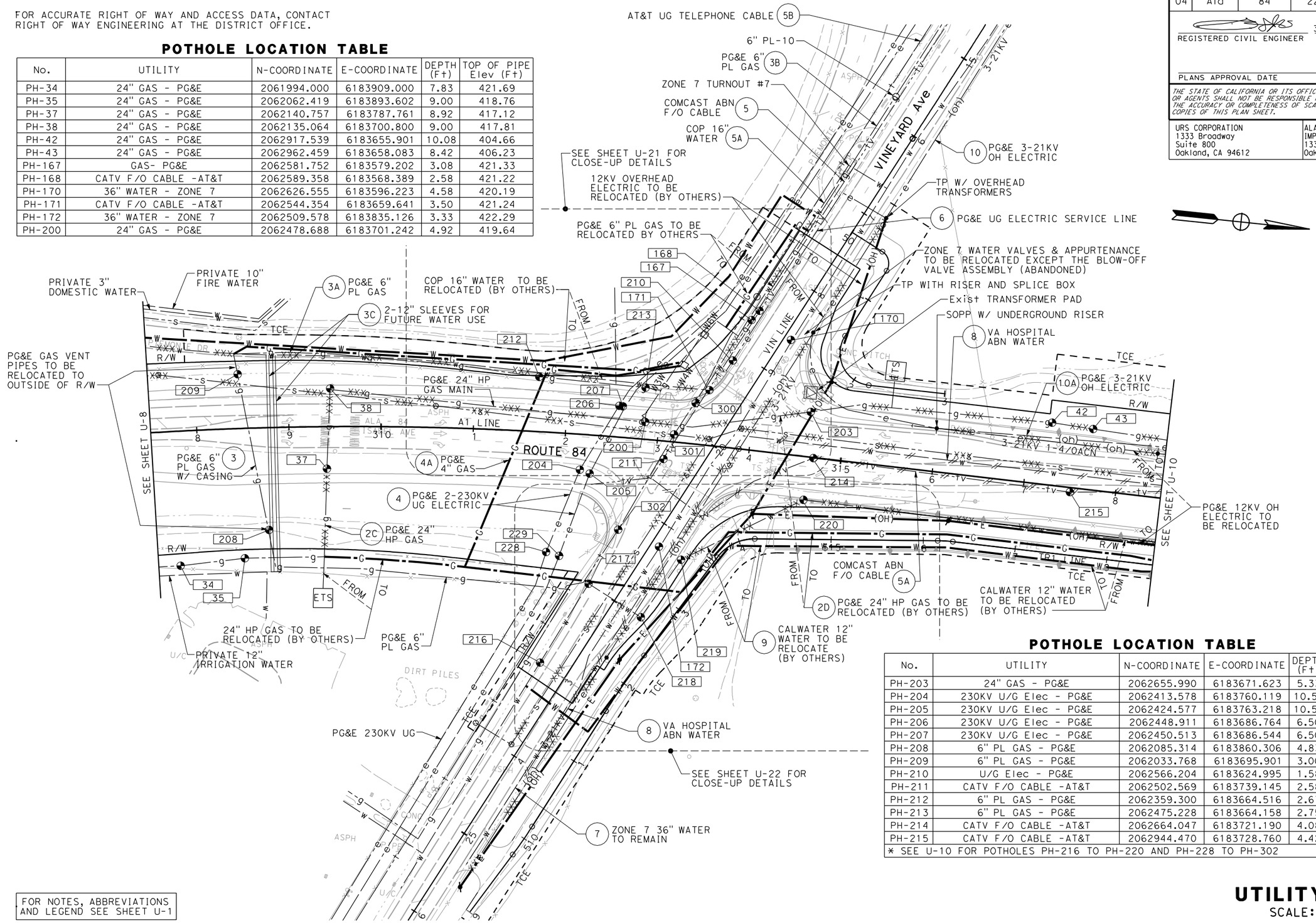
UNIT 04256

PROJECT NUMBER & PHASE 297601

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-34	24" GAS - PG&E	2061994.000	6183909.000	7.83	421.69
PH-35	24" GAS - PG&E	2062062.419	6183893.602	9.00	418.76
PH-37	24" GAS - PG&E	2062140.757	6183787.761	8.92	417.12
PH-38	24" GAS - PG&E	2062135.064	6183700.800	9.00	417.81
PH-42	24" GAS - PG&E	2062917.539	6183655.901	10.08	404.66
PH-43	24" GAS - PG&E	2062962.459	6183658.083	8.42	406.23
PH-167	GAS- PG&E	2062581.752	6183579.202	3.08	421.33
PH-168	CATV F/O CABLE -AT&T	2062589.358	6183568.389	2.58	421.22
PH-170	36" WATER - ZONE 7	2062626.555	6183596.223	4.58	420.19
PH-171	CATV F/O CABLE -AT&T	2062544.354	6183659.641	3.50	421.24
PH-172	36" WATER - ZONE 7	2062509.578	6183835.126	3.33	422.29
PH-200	24" GAS - PG&E	2062478.688	6183701.242	4.92	419.64



POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-203	24" GAS - PG&E	2062655.990	6183671.623	5.33	418.64
PH-204	230KV U/G Elec - PG&E	2062413.578	6183760.119	10.50	413.95
PH-205	230KV U/G Elec - PG&E	2062424.577	6183763.218	10.50	413.92
PH-206	230KV U/G Elec - PG&E	2062448.911	6183686.764	6.50	418.84
PH-207	230KV U/G Elec - PG&E	2062450.513	6183686.544	6.50	418.88
PH-208	6" PL GAS - PG&E	2062085.314	6183860.306	4.83	420.84
PH-209	6" PL GAS - PG&E	2062033.768	6183695.901	3.00	422.26
PH-210	U/G Elec - PG&E	2062566.204	6183624.995	1.58	422.41
PH-211	CATV F/O CABLE -AT&T	2062502.569	6183739.145	2.58	422.32
PH-212	6" PL GAS - PG&E	2062359.300	6183664.516	2.67	422.08
PH-213	6" PL GAS - PG&E	2062475.228	6183664.158	2.75	422.67
PH-214	CATV F/O CABLE -AT&T	2062664.047	6183721.190	4.08	420.40
PH-215	CATV F/O CABLE -AT&T	2062944.470	6183728.760	4.42	418.71
* SEE U-10 FOR POTHOLES PH-216 TO PH-220 AND PH-228 TO PH-302					

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-9

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

Sang Kim No. 66289 Exp 06-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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1333 Broadway, Suite 300
Oakland, CA 94612

REVISED BY	DATE REVISED
SANG KIM	
CALCULATED-DESIGNED BY	CHECKED BY
BEN RAZEGHI	
CONSULTANT FUNCTIONAL SUPERVISOR	
BEN RAZEGHI	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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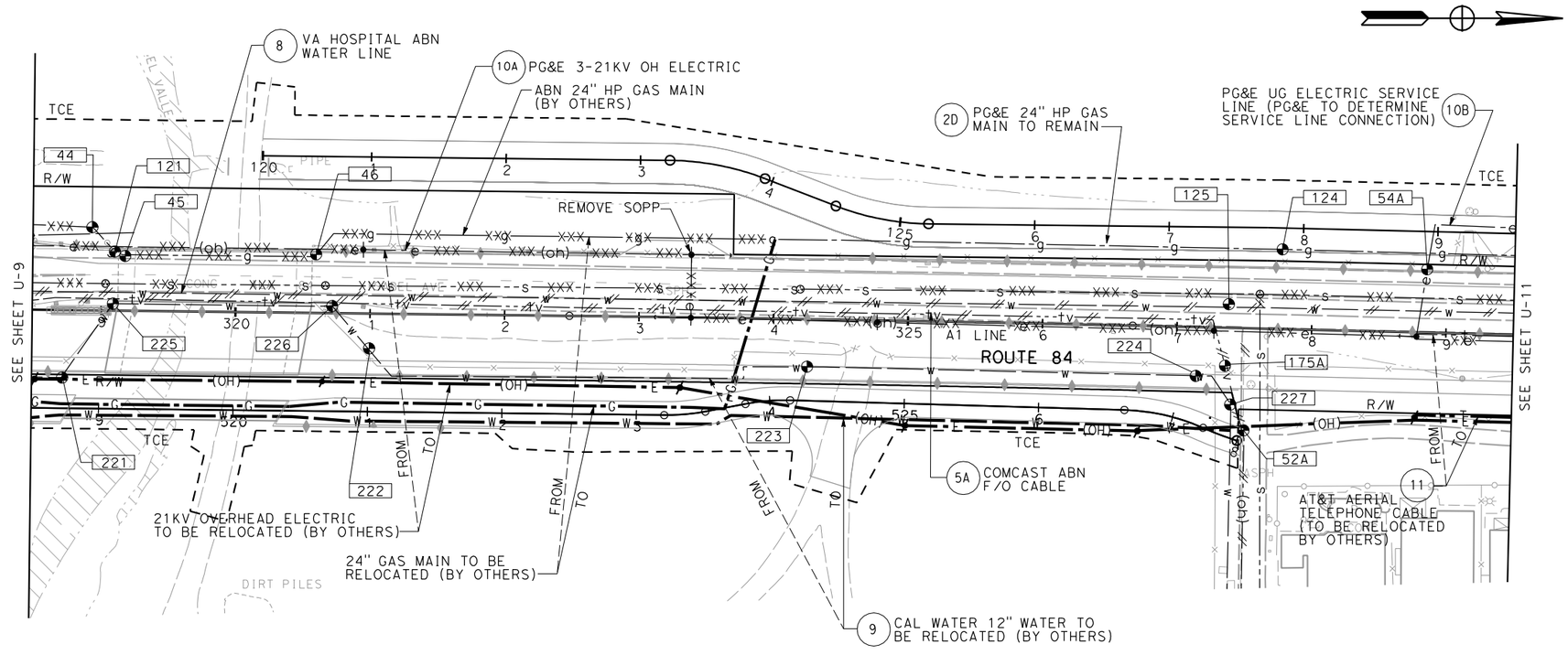
FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-44	24" GAS - PG&E	2063089.000	6183665.000	9.17	408.55
PH-45	24" GAS - PG&E	2063111.869	6183685.027	0.25	419.12
PH-46	24" GAS - PG&E	2063253.826	6183683.843	4.92	417.35
PH-52A	CATV F/O CABLE -AT&T	2063943.158	6183814.723	3.83	418.79
PH-54A	U/G Elec - PG&E	2064079.750	6183694.917	2.58	419.63
PH-121	24" GAS - PG&E	2063104.156	6183681.720	5.79	417.41
PH-124	24" GAS - PG&E	2063972.208	6183680.122	7.00	416.98
PH-125	12" WATER	NOT SURVEYED	NOT SURVEYED	4.00	
PH-175A	CATV F/O CABLE -AT&T	2063929.448	6183766.646	3.50	419.00
PH-216	12" WATER-CAL WATER	2062392.881	6183972.764	4.67	421.09
PH-217	12" WATER-CAL WATER	2062436.005	6183882.150	3.92	421.46
PH-218	12" WATER-CAL WATER	2062496.209	6183912.319	3.42	421.32
PH-219	12" WATER-CAL WATER	2062533.035	6183845.756	4.25	420.59
PH-220	12" WATER-CAL WATER	2062658.212	6183767.209	3.08	419.12
PH-221	12" WATER-CAL WATER	2063256.397	6183722.409	3.08	416.68
PH-222	12" WATER-CAL WATER	2063293.268	6183753.737	3.17	408.29
PH-223	12" WATER-CAL WATER	2063618.824	6183765.336	4.00	414.98
PH-224	12" WATER-CAL WATER	2063907.778	6183774.193	4.00	418.26
PH-225	12" WATER-CAL WATER	2063103.777	6183720.426	5.25	419.19
PH-226	12" WATER-CAL WATER	2063265.809	6183722.209	3.17	418.35
PH-227	12" WATER-CAL WATER	2063933.441	6183795.470	3.50	418.79
PH-228	230KV U/G Elec - PG&E	2062386.538	6183852.726	5.17	419.62
PH-229	230KV U/G Elec - PG&E	2062400.990	6183855.344	4.58	420.19
PH-300	U/G TELEPHONE - AT&T	2062530.842	6183675.177	9.33	415.67
PH-301	U/G TELEPHONE - AT&T	2062511.202	6183711.386	8.50	416.76
PH-302	U/G TELEPHONE - AT&T	2062461.736	6183820.431	2.25	422.97



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-10

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

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CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: BEN RAZEGHI
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

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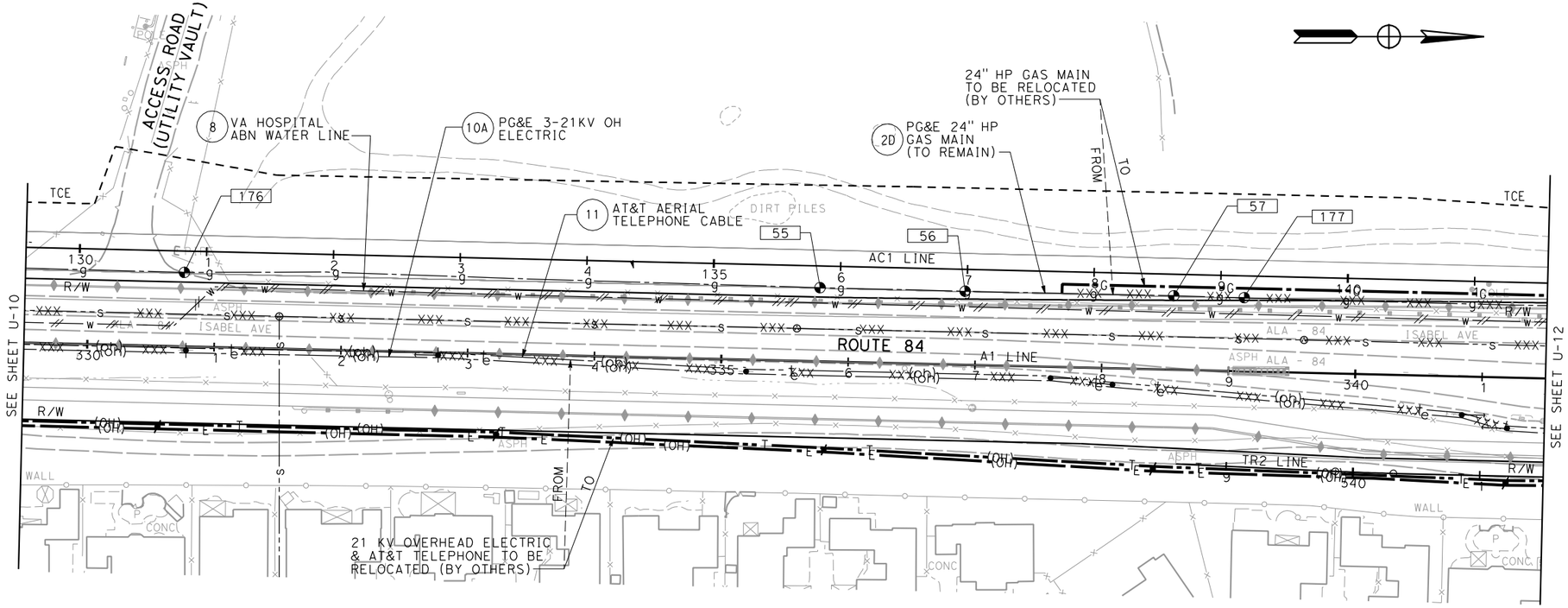
1333 Broadway, Suite 300
Oakland, CA 94612

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-55	24" GAS - PG&E	2064771.366	6183700.128	3.33	414.31
PH-56	24" GAS - PG&E	2064885.784	6183702.926	3.67	413.03
PH-57	24" GAS - PG&E	2065050.263	6183706.494	3.17	413.01
PH-176	24" GAS - PG&E	2064270.178	6183688.076	3.50	418.56
PH-177	24" GAS - PG&E	2065105.865	6183708.015	3.08	412.83



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-11

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: BEN RAZEGHI
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

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Caltrans

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BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\ka-utilities\429760ka011.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 04256
PROJECT NUMBER & PHASE 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

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PLANS APPROVAL DATE

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Oakland, CA 94612

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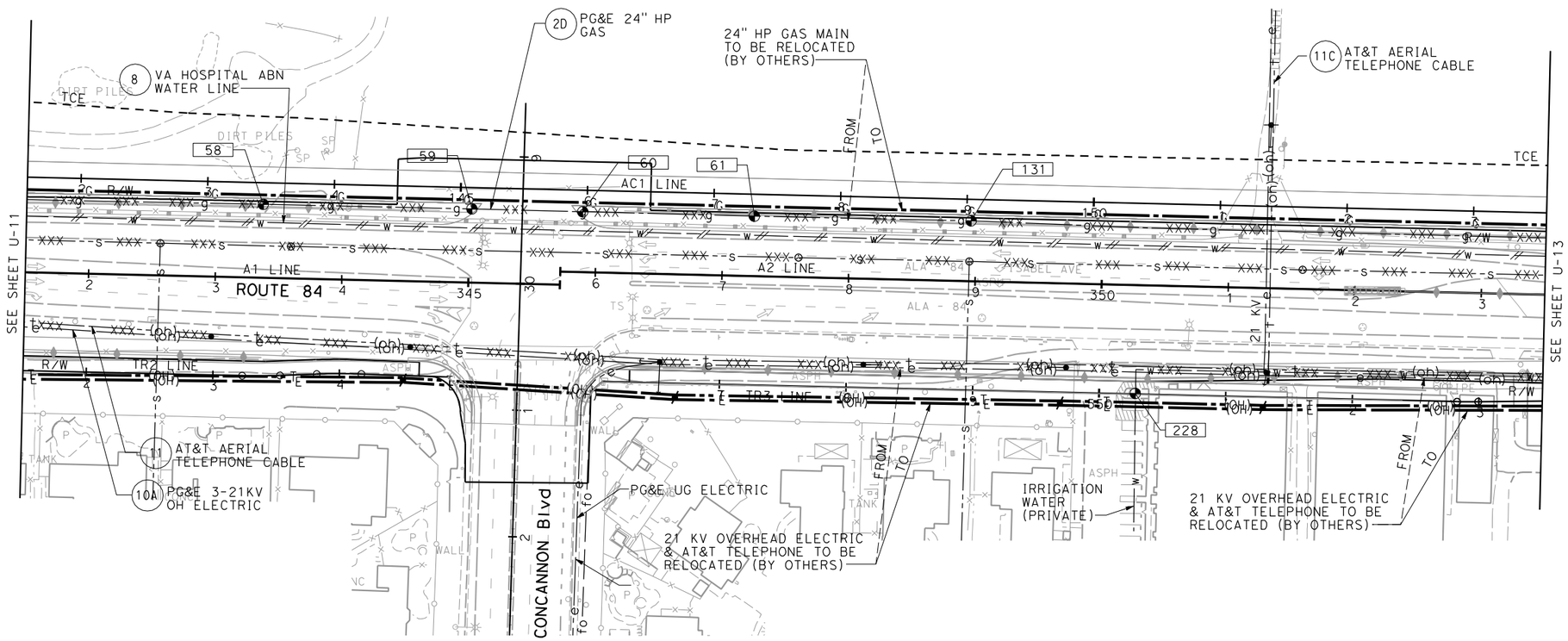
FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-58	24" GAS - PG&E	2065531.282	6183718.014	3.75	410.50
PH-59	24" GAS - PG&E	2065696.035	6183721.594	3.33	415.28
PH-60	24" GAS - PG&E	2065783.584	6183723.846	2.92	416.68
PH-61	24" GAS - PG&E	2065919.138	6183727.337	3.58	418.51
PH-131	24" GAS - PG&E	2066090.306	6183731.028	3.08	417.81
PH-228	IRRIGATION WATER-PRIVATE	NOT FOUND			



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=50'

U-12

	REVISED BY	DATE REVISED
CALCULATED-DESIGNED BY	SANG KIM	
CHECKED BY	BEN RAZEGHI	
CONSULTANT FUNCTIONAL SUPERVISOR	BEN RAZEGHI	

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

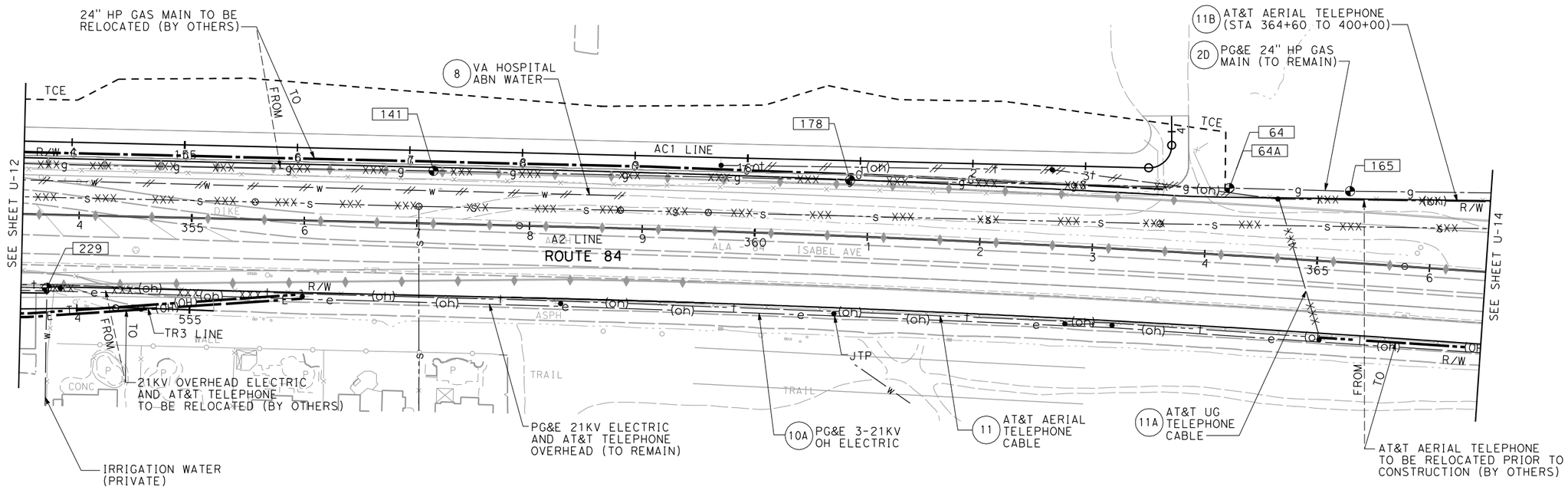
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-64	24" GAS - PG&E	2067614.572	6183766.284	5.50	407.50
PH-64A	6"-10" STEEL PIPE - Unknown	2067614.572	6183766.284	4.25	408.76
PH-165	24" GAS - PG&E	2067721.687	6183769.059	4.25	408.58
PH-141	24" GAS - PG&E	2066908.128	6183750.927	4.08	410.86
PH-178	24" GAS - PG&E	2067277.889	6183759.277	3.08	409.76



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN
SCALE: 1"=50'

U-13

CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: BEN RAZEGHI
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

REVISED BY	DATE REVISED

LAST REVISION: 08-31-10
DATE PLOTTED => 9/16/2010
TIME PLOTTED => 11:46:20 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => madhu_thummaluru | DGN FILE => ...\ka-utilities\429760ka013.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

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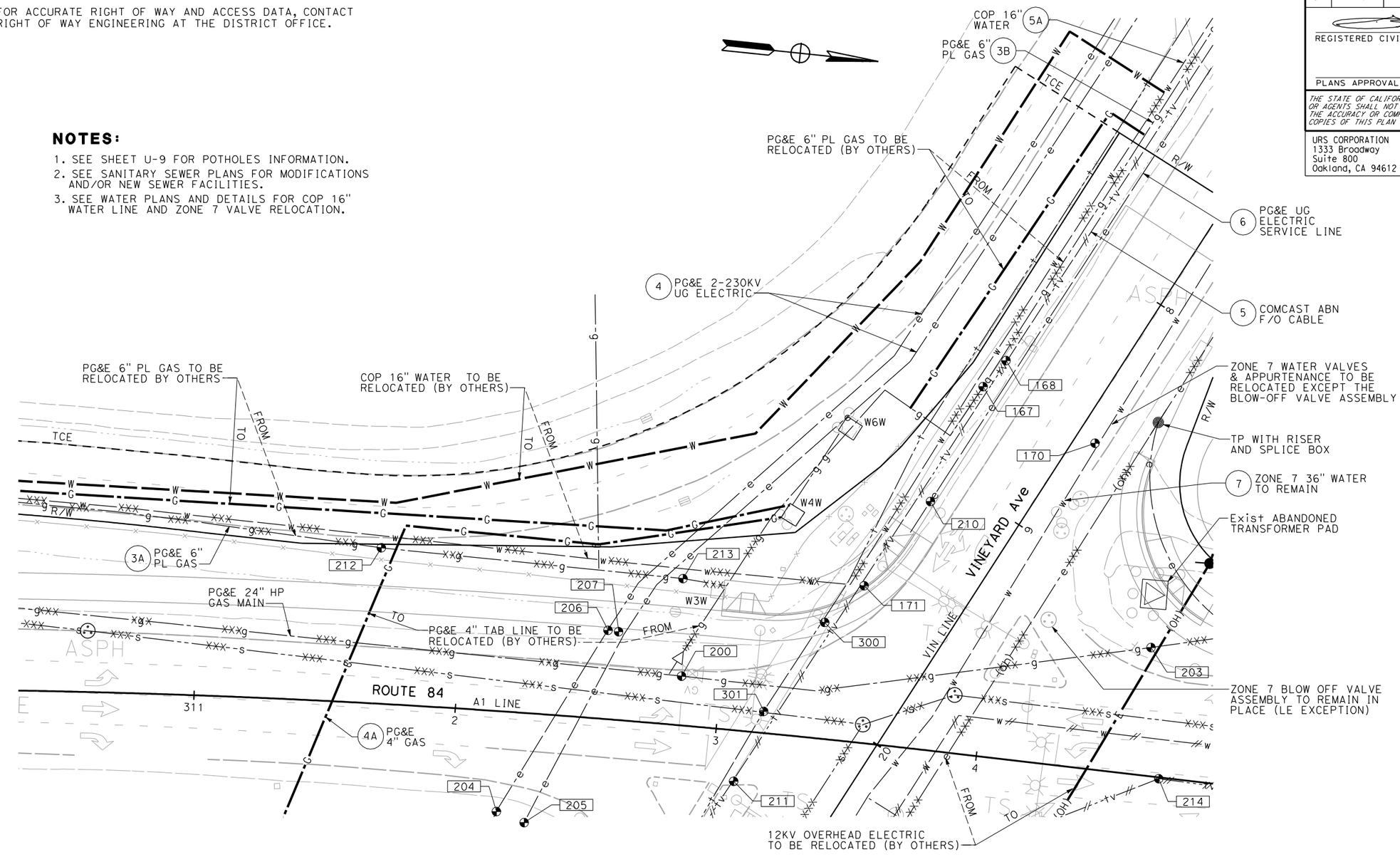
URS CORPORATION 1333 Broadway Suite 800 Oakland, CA 94612	ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA) 1333 Broadway, Suite 300 Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. SEE SHEET U-9 FOR POTHOLES INFORMATION.
2. SEE SANITARY SEWER PLANS FOR MODIFICATIONS AND/OR NEW SEWER FACILITIES.
3. SEE WATER PLANS AND DETAILS FOR COP 16" WATER LINE AND ZONE 7 VALVE RELOCATION.



ROUTE 84 / VINEYARD Ave INTERSECTION (WEST)

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN

SCALE: 1"=20'

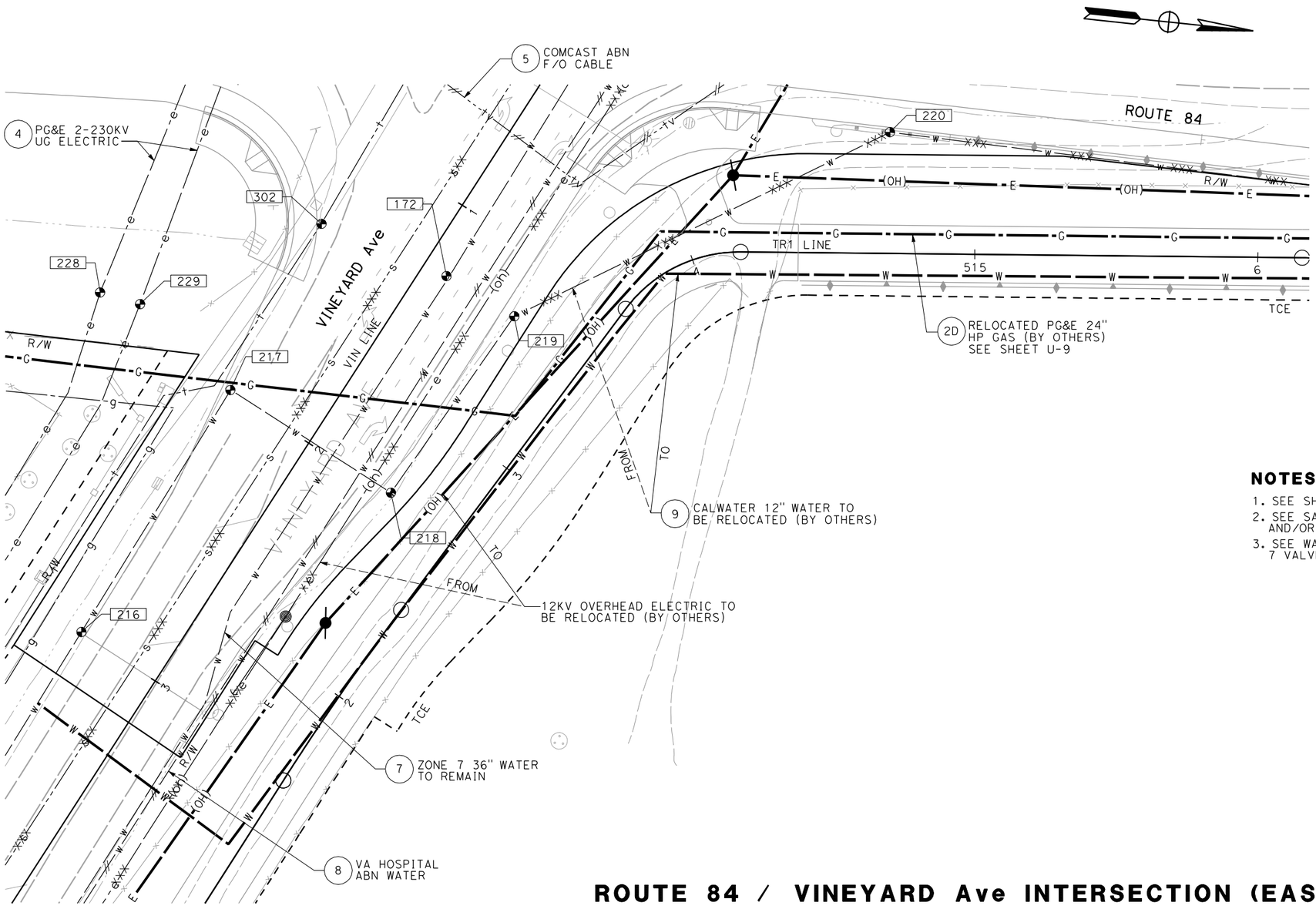
U-21

REVISED BY				
DATE REVISED				
CALCULATED-DESIGNED BY	SANG KIM			
CHECKED BY	BEN RAZEGHI			
CONSULTANT FUNCTIONAL SUPERVISOR	BEN RAZEGHI			
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Gatzars			

LAST REVISION: DATE PLOTTED => 9/16/2010 TIME PLOTTED => 11:47:00 AM 08-31-10

BORDER LAST REVISED 7/2/2010 | USERNAME => madhu_thummaluru DGN FILE => ...\ka-utilities\429760ka021.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



NOTES:

1. SEE SHEET U-9 FOR POTHOLES INFORMATION.
2. SEE SANITARY SEWER PLANS FOR MODIFICATIONS AND/OR NEW SEWER FACILITIES.
3. SEE WATER PLANS AND DETAILS FOR ZONE 7 VALVE & APPURTENANCE RELOCATION.

ROUTE 84 / VINEYARD Ave INTERSECTION (EAST)

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET U-1

THIS PLAN ACCURATE FOR UTILITY WORK ONLY.

UTILITY PLAN
SCALE: 1"=20'

U-22

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
CALCULATED-DESIGNED BY: SANG KIM
CHECKED BY: BEN RAZEGHI
REVISED BY
DATE REVISED

LAST REVISION 08-31-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 11:47:05 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => madhu_thummaluru | DGN FILE => ...\ka-utilities\429760ka022.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER — 3/12/10 DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-10 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

UTILITY INFORMATION

UTILITY No.	SHEET No.	OWNER	DESCRIPTION	LOCATION
1	U-1, U-2	PG&E	3-60KV & 3-12KV Overhead Electric Line	"A1" 227+00 to 250+40
1A	U-3, U-4	PG&E	3-60KV & 3-12KV Overhead Electric Line	"A1" 250+45 to "A" 116+00
1B	U-1, U-2	AT&T	Aerial Telephone Cable	"A1" 227+00 to 250+40
1C	U-3, U-4	AT&T	Aerial Telephone Cable	"A1" 250+45 to "A" 116+00
2	U-1, U-2, U-3, U-5	PG&E	24" HP Gas	"A1" 226+00 to 263+00
2A	U-5	PG&E	24" HP Gas	"A1" 263+00
2B	U-5 to U-9	PG&E	24" HP Gas	"A1" 263+00 to 309+40
2C	U-9	PG&E	24" HP Gas	"A1" 209+40
2D	U-9 to U-18	PG&E	24" HP Gas	"A1" 209+40 to "A3" 415+60
2E	U-18	PG&E	24" HP Gas	"A3" 415+60
2F	U-8	Private (Ruby Hill)	12" Irrigation Water	"A1" 302+85
3	U-9	PG&E	6" Plastic Gas w/ Casing	"A1" 208+60
3A	U-9	PG&E	6" Plastic Gas	"A1" 208+40 to 313+00
3B	U-9	PG&E	6" Plastic Gas	"VIN" 19+20 to 15+00
3C	U-9	Private (Ruby Hill)	2-12" Sleeves For Future Water Use (Not Located)	"A1" 308+85
4	U-9	PG&E	2-230KV UG Electric Line	"A1" 312+40
4A	U-9	PG&E	4" Gas	"A1" 311+50
5	U-9	Comcast	Abandoned Fiber Optic Cable	"VIN" 20+80 to 15+00
5A	U-9	City of Pleasanton	16" CIP Water	"A1" 307+25 to "VIN" 17+31
5B	U-9	AT&T	Underground Telephone Cable	"VIN" 15+00 to 26+00
6	U-9	PG&E	Underground Electric Service Line	"VIN" 16+90 to 18+80
7	U-9	Zone 7 Water Agency	36" Water	"A1" 313+80
8	U-9 to U-13	VA Hospital	Abandoned Water	"A1" 312+00 to "A2" 359+00
9	U-9, U-10	CalWater	12" Water	"A1" 310+00 to 327+40
10	U-9	PG&E	3-21KV Overhead Electric Line	"VIN" 25+50 to 15+00
10A	U-9 to U-16	PG&E	3-21KV Overhead Electric Line	"A1" 316+00 to "A3" 400+80
11	U-10 U-13	AT&T	Aerial Telephone Cable	"A1" 328+80 to "A2" 365+00
11A	U-13	AT&T	Underground Telephone Cable	"A2" 364+85
11B	U-13 to U-16	AT&T	Aerial Telephone Cable	"A2" 364+70 to "A3" 400+00
12	U-16	AT&T	Aerial Telephone Cable on East Stanley BLVD. Overcrossing	"A3" 400+20
13	U-16	GST	Underground Telecom Fiber Optic Cable on East Stanley BLVD. Overcrossing	"A3" 400+40
14	U-16	PG&E	8" HP Gas on East Stanley BLVD. Overcrossing	"A3" 401+20
15	U-16	Unknown	Abandoned 1" Water on East Stanley BLVD. Overcrossing	"A3" 401+40
16	U-16	Union Pacific	Aerial Communication Cable on East Stanley BLVD. Overcrossing	"A3" 401+50
17	U-16 to U-20	City of Livermore	18" Reclaimed Water	"A3" 400+30 to 450+00
18	U-16 to U-18	PG&E	21KV Overhead Electric Line	"A3" 400+20 to 415+80
19	U-17	MCI	Underground Fiber Optic Cable	"A3" 403+30
20	U-17	PG&E	Overhead Electric Line	"A3" 403+50
21	U-20	PG&E, AT&T, Comcast	JT 1-6" & 1-4" 21KV Electric, 4" Gas, 6-4" Telephone, 1-4" & 1-6" Cable TV	"A3" 447+60 to "A3" 450+00
22	U-20	City of Livermore	12" Water	"A3" 448+60 to "A3" 450+00
23	U-20	CalWater	12" Water	"A3" 448+50 to "A3" 450+00
24	U-20	Zone 7 Water Agency	36" Water	"A3" 448+40 to "A3" 450+00

REVISED BY | DATE REVISED
SANG KIM | BEN RAZEGHI
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

LAST REVISION 08-31-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 11:47:09 AM

UTILITY PLAN

U-23

BORDER LAST REVISED 7/2/2010 | USERNAME => madhu_thummaluru | DGN FILE => ...\ka-utilities\429760kc001d.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

URS

Page 1 of ____

Job ROUTE 9A EXPRESSWAY WIDENING Project No. 28649640.00006 Sheet ____ of ____

Description MAXIMUM ROADWAY SETTLEMENT Computed by M. LARSON Date 03/25/08

Checked by A. Moore Date ____

Reference

ESTIMATE SETTLEMENT NEAR STA 242+00

1. ASSUME 4' OF NEW FILL, FULL WIDTH OF ROADWAY, 200' LONG, BETWEEN STATIONS 241+00 & 243+00

2. BORINGS NB02, RB03, NB03 (FURTHEST)

   NB02 WAS DRILLED IN FILL? ON SIDE SLOPE & IS NOT REPRESENTATIVE OF CONDITIONS OUT IN ROADWAY, ∴ DO NOT USE.

3. RB03 EXTENDS TO 10', FROM 5' TO 10', N >> 50+ BPF, & IS INCOMPRESSIBLE. THE UPPER 5' HAS N VALUES SOMEWHAT COMPARABLE TO NB03.

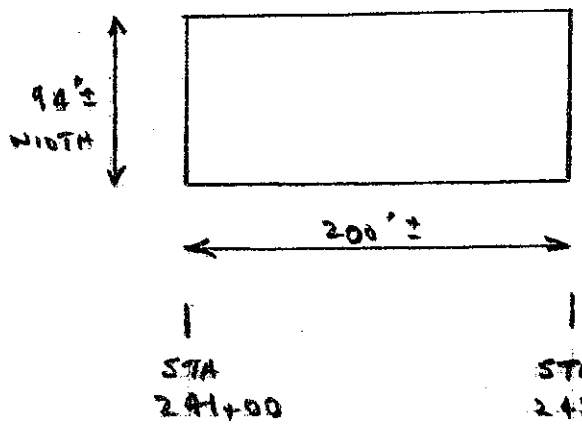
   ∴ USE NB03 FOR ESTIMATING SETTLEMENT.

4. ASSUME CONSOLIDATION SETTLEMENT OF CLAY LAYERS IN NB03 IS NEGLIGIBLE FOR TWO REASONS:
   - DEEP GROUNDWATER
   - HARD CLAY

   ASSUME CL BEHAVES SIMILAR TO ML

5. USE SCHMERTMANN METHOD, DM 7.1 - PAGE 220

FOOTPRINT:



B = 94'

$\frac{B}{2}$ = 47'

2B = 188'

LOGGED BY: C.Rambo	BEGIN DATE: 12-14-07	COMPLETION DATE: 12-14-07	BOREHOLE LOCATION (Lat/Long or North/East and Datum): 37° 38' 8.67" / -121° 48' 3.12" NAD83
DRILLING CONTRACTOR: Pitcher Drilling			BOREHOLE LOCATION (Offset, Station, Line): 27.8' Lt Sta 245+90.1 ML
DRILLING METHOD: Rotary Wash			DRILL RIG: Failing 1500
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140lb/30in - Auto
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING Not measured; AFTER DRILLING (DATE)

HOLE ID: NB03
SURFACE ELEVATION: 539.3 ft NAVD 88
BOREHOLE DIAMETER: 4-7/8 inch
HAMMER EFFICIENCY, ERI:
TOTAL DEPTH OF BORING: 80.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY SILT (ML); stiff; brown; moist; with asphalt concrete chunks (FILL).												
	1				1	13	41	55							4" solid flight augered to 7 feet.
537.30	2					19		33 =		0.9 x		41			
	3		Lean CLAY with GRAVEL (CL); brown; moist.			22									
535.30	4							67 =		0.8 x		28			
	5		At 5 ft, with increase in sand content.		2	6	28	65		6	123				
533.30	6		CLAYEY SAND with GRAVEL (SC); dense; brown; moist.			11									
	7		At 7 ft, with cobbles.			17									Dry to 7 feet; began rotary wash.
531.30	8														
	9							67 =		0.8 x		80			
529.30	10		At 10 ft, becomes very dense.		3	26	84	70							
	11					44									
527.30	12		SILT (ML); very stiff; brown; moist; trace GRAVEL.			40									
	13														
525.30	14							43 =		0.8 x		54			
	15				4	11	54	80		18	114	UC = 3.6			
523.30	16					23									
	17					31									
521.30	18														
	19							40 =		0.8 x		50			
519.30	20		At 20 ft, becomes hard; brown to grayish brown with balck speckling; black speckling.		5	12	50	85		19	112	UC = 5.9			
	21					21									
517.30	22					29									
	23														
515.30	24														
	25														

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ CT SACTO 053107.GDT 3/6/08

URS
San Jose Office
55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: BORING RECORD				HOLE ID: NB03
DIST. 04	COUNTY Alameda	ROUTE 84	POSTMILE 22.5/27.3	EA 04-28649640
PROJECT OR BRIDGE NAME: Route 84 Expressway Widening				
BRIDGE NUMBER	PREPARED BY: M.Thummaluru		DATE: 12-14-07	SHEET: 1 of 3

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		At 25 ft, grades to silty clay (CL-ML).		6	12 23 33	56	85		18	113	UC = 5.7		
513.30	26													
	27						45 = .8 × 56							
511.30	28													
	29						49 = .8 × 61							
509.30	30				7	15 26 35	61	65		18	114	UC = 9.9		
	31													
507.30	32													Drilling fluid seeped through casing annulas to ground surface.
	33													
505.30	34		SANDY lean CLAY (CL); hard; dark brown; moist; trace fine GRAVEL; gray mottling and some black speckling.				53 = .8 × 66							Extra casing added.
	35				8	15 28 38	66	80		16	117	UC = 8.1		
503.30	36													
	37		At 37 ft, with increase in gravel content.											
501.30	38													
	39						50+							
499.30	40		CLAYEY SAND with GRAVEL (SC); very dense; reddish brown; moist; fine GRAVEL.		9	39 65 88/3"		50						Sampler advanced 15 in.
	41													
497.30	42		N > 50 BPF											
	43		INCOMPRESSIBLE											
495.30	44						50+							
	45				10	44 57 121	178	35						
493.30	46													
	47													
491.30	48													
	49						50+							
489.30	50				11	54 50/2"		45						Sampler advanced 6 in.
	51													
487.30	52													
	53													
485.30	54													
	55													

(continued)

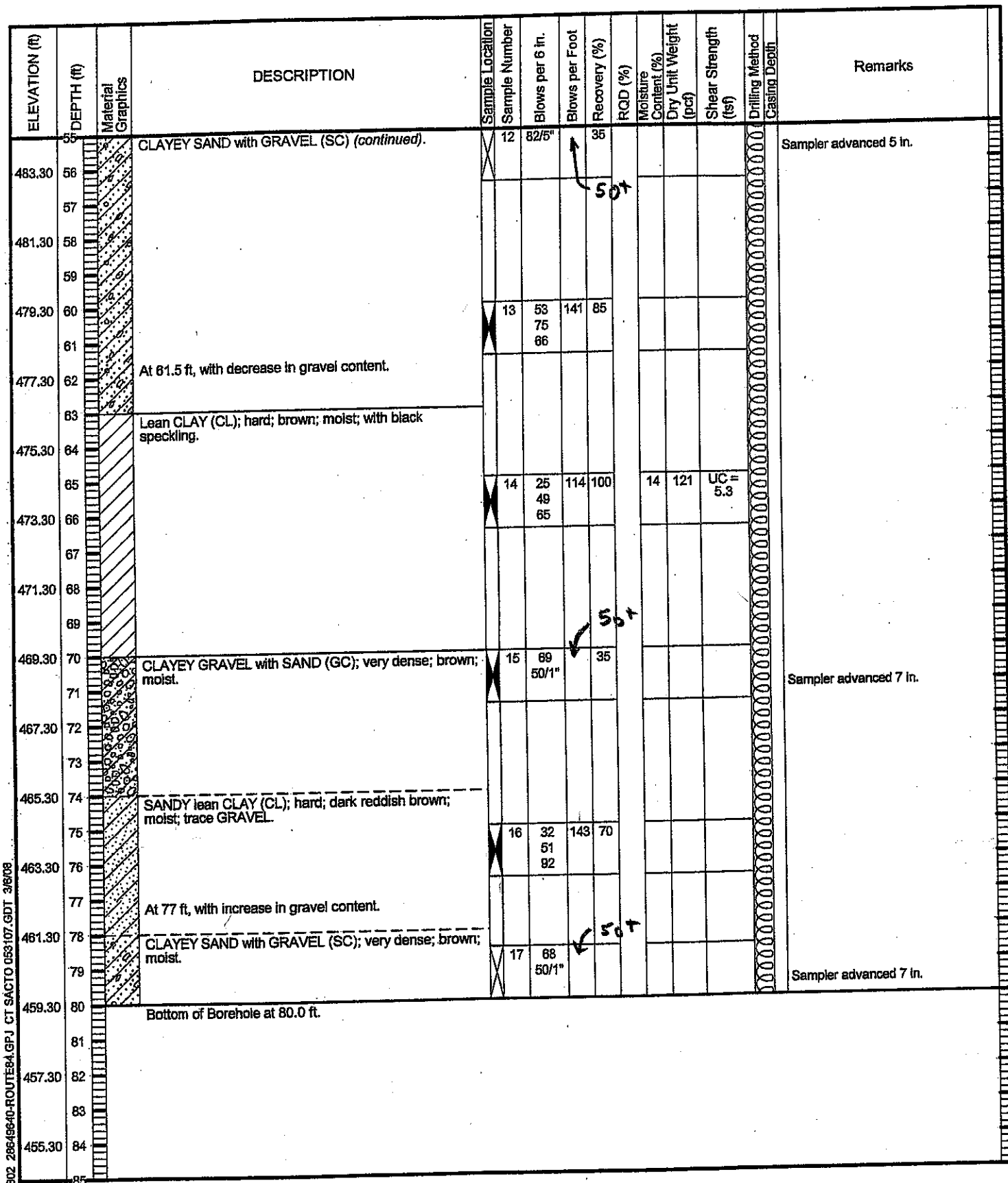
URS BORING RECORD 200802 28649640-ROUTE84.GPJ CT SACTO 053107.GDT 3/6/08

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: BORING RECORD				HOLE ID: NB03
DIST.: 04	COUNTY: Alameda	ROUTE: 84	POSTMILE: 22.5/27.3	EA: 04-28649640
PROJECT OR BRIDGE NAME: Route 84 Expressway Widening				
BRIDGE NUMBER	PREPARED BY: M.Thummaluru		DATE: 12-14-07	SHEET: 2 of 3



URS BORING RECORD 200602 28649640-ROUTE84.GPJ CT SACTO 053107.GDT 3/6/08

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: BORING RECORD				HOLE ID: NB03
DIST.: 04	COUNTY: Alameda	ROUTE: 84	POSTMILE: 22.5/27.3	EA: 04-28649640
PROJECT OR BRIDGE NAME: Route 84 Expressway Widening				
BRIDGE NUMBER	PREPARED BY: M.Thummaluru		DATE: 12-14-07	SHEET: 3 of 3

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M.Thummaluru	11-27-07	11-27-07	37° 38' 6.51" / -121° 48' 4.68" NAD83	RB03
DRILLING CONTRACTOR: Exploration Geoservices, Inc			BOREHOLE LOCATION (Offset, Station, Line): 27.6' Rt Sta 243+42.4 ML	SURFACE ELEVATION: 547.8 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: Mobile B53	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), CA (2.44")			SPT HAMMER TYPE: 140lb/30in - Wirewinch	HAMMER EFFICIENCY, ERI
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING Dry; AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING: 10.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		SANDY lean CLAY (CL); very stiff; yellowish brown; moist.					21	18	18	126			
	1				1	9 12 14	26	80		11	116	UC = 2.1		Bag sample 1 to 5 feet.
545.80	2													
	3								22	23	18	x28		
543.80	4				2	7 13 15	28	90		7	120			
	5		SILTY GRAVEL with SAND (GM); very dense; light brownish yellow; moist.		3	32 77/4"		56						Sampler advanced 10 in.
541.80	6							50+						
	7		CLAYEY GRAVEL with SAND (GC); very dense; light brownish yellow; moist.											
539.80	8													
	9				4	33 42 108	150	95						
537.80	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.											
	11													
535.80	12													
	13													
533.80	14													
	15													
531.80	16													
	17													
529.80	18													
	19													
527.80	20													
	21													
525.80	22													
	23													
523.80	24													
	25													

INCOMPRESSIBLE
N >> 50+ BPF

URS BORING RECORD 2009b02 28649640-ROUTE84.GPJ CT SACTO 053107.GDT 3/6/08

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				RB03
DIST. 04	COUNTY Alameda	ROUTE 84	POSTMILE 22.5/27.3	EA 04-28649640
PROJECT OR BRIDGE NAME: Route 84 Expressway Widening				
BRIDGE NUMBER	PREPARED BY M.Thummaluru		DATE 12-3-07	SHEET 1 of 1

URS

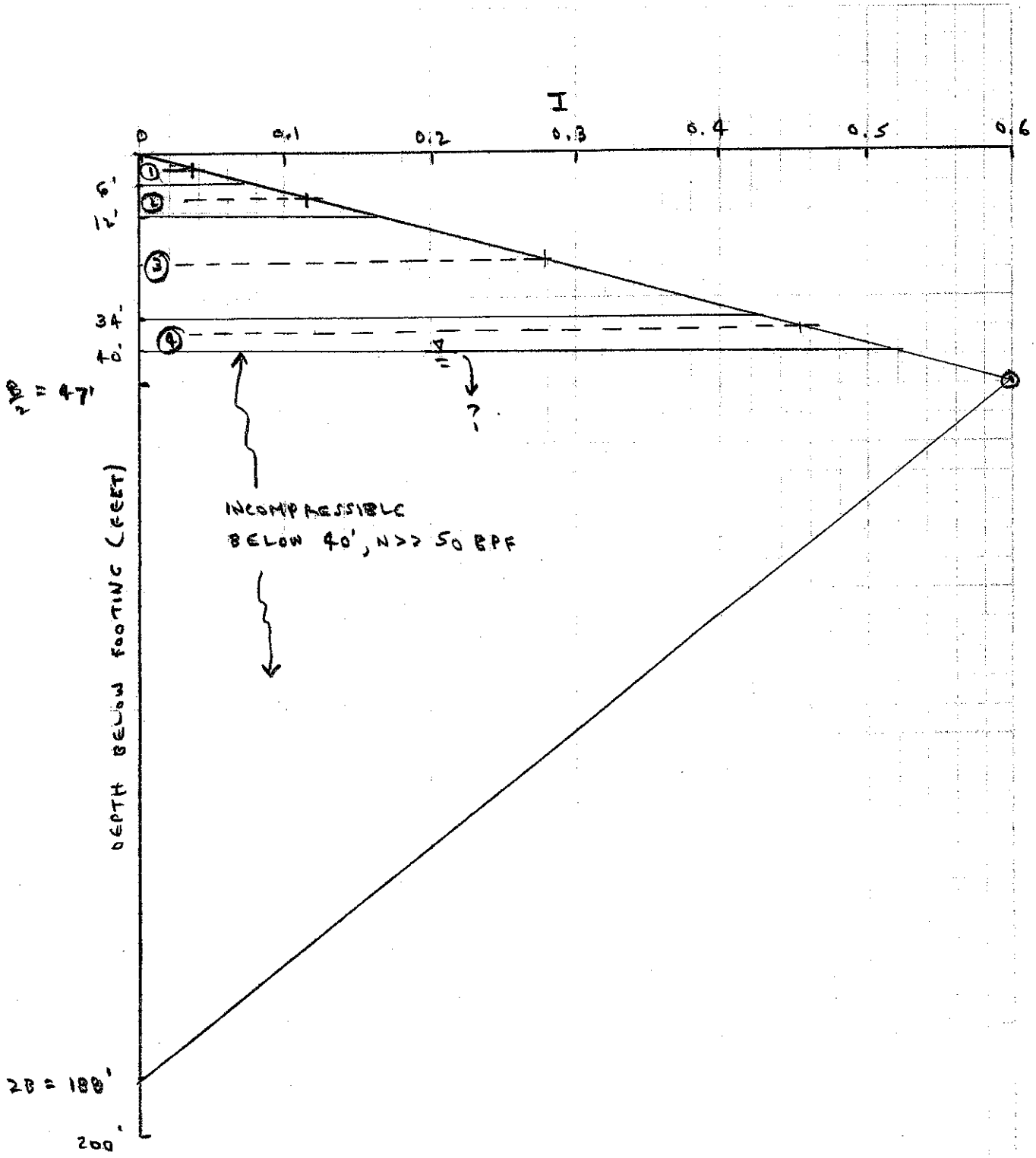
Page 6 of ____

Job ROUTE 84 | Project No. 28649640 | Sheet ____ of ____

Description MAXIMUM ROADWAY SETTLEMENT | Computed by M. LARSON | Date 03/25/09

Checked by A. Moore | Date ____

Reference



LAYER	①	0 – 6'	6'
	②	6' – 12'	6'
	③	12' – 34'	22'
	④	34' – 40'	6'

Job ROUTE 84 Project No. 28649640 Sheet ____ of ____

Description MAXIMUM ROADWAY SETTLEMENT Computed by M. LARSON Date 03/25/09

Checked by A. MOORE Date ____

Reference

LAYER	ΔZ (FEET)	(INCH)	N	E_s/N (TSF)	I_z	E_s (TSF)	$\frac{I_z}{E_s}\Delta z$ (IN./TSF)
①	6	72	22	4	0.032	88	0.0262
②	6	72	22*	4	0.11	88	0.0900
③	22	264	40	4	0.20	160	0.4620
④	6	72	50	4	0.45	200	0.1620

$\Sigma = 0.7402$

* CONSERVATIVE

$$\text{TOTAL} = \Delta H = C_1 C_2 \Delta p \sum \left(\frac{I_z}{E_s}\right) \Delta z$$

Δp = 4' OF SOIL / PAVEMENT $= (4\ \text{FT})\left(\frac{130\ \text{LBS}}{\text{FT}^3}\right) = 520$ PSF

$\Delta p = \frac{520}{2{,}000} = 0.26$ TSF

$$\Delta H = C_1 C_2 \left(0.26\ \text{TSF}\right)\left(0.7402\ \frac{\text{INCH}}{\text{TSF}}\right)$$

$\Delta H = C_1 C_2\ 0.192$ INCH

$C_1 = 1 - 0.5\left(\frac{p_o}{\Delta p}\right)$; $C_1 \geq 0.5$ $\quad p_o = 0$, $\Delta p = 0.26$ TSF

$C_1 = 1 - 0.5(0) = 1 - 0 = 1.00$

$C_2 = 1 + 0.2 \log\left(\frac{t}{0.1}\right)$ SAY $t = 1$ YEAR

$C_2 = 1 + 0.2 \log(10 \times 1.0) = 1 + 0.2 \log 10 = 1 + 0.2(1.0)$

$C_2 = 1 + 0.2 = 1.20$

$\Delta H = 0.192(1.0)(1.20) = 0.23$ IN.

SAY $\Delta H < 1/4$ INCH.

6. CROSS CHECK USING BDS, NOV. 2003 - BASED ON VERY STIFF CLAY/SILT & DENSE SAND & GRAVEL

FROM PAGE 4-20

$$S_e = \left\{ q_0 (1-\nu^2) \sqrt{A} \right\} / E_s \beta_z$$

$E_s = 2{,}000$ KSF

$\beta_z = 1.09$ $\quad \frac{L}{B} = \frac{200}{94} \cong 2$ $\quad \nu = 0.4$

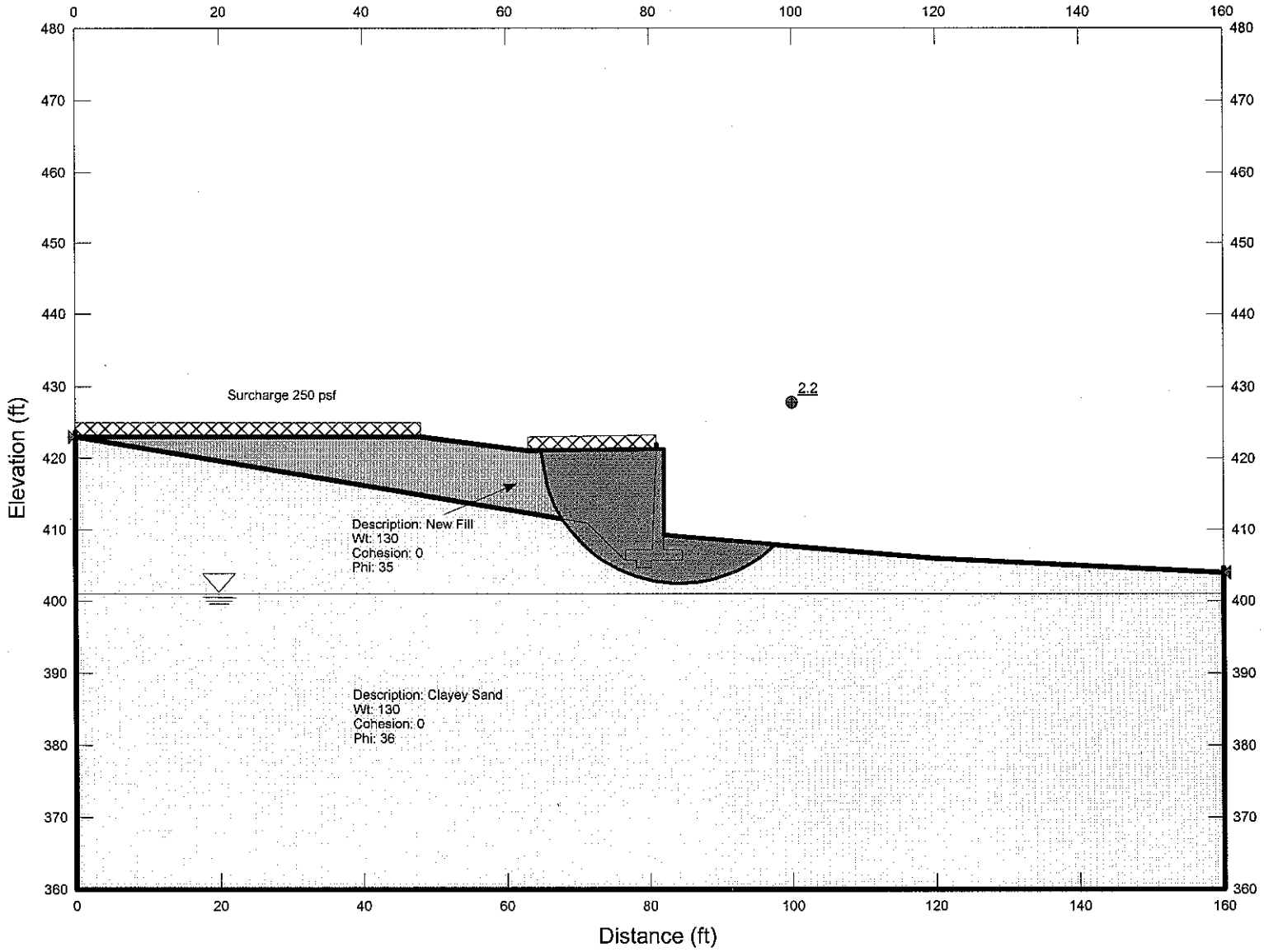
$A = (94)(200)\ FT^2 = 18{,}800\ FT.^2$

$q_0 = (4\ FT)\left(130 \frac{LBS}{FT.^3}\right) = 520 \frac{LBS}{FT^2} = 0.520$ KSF ✓

$$S_e = \left\{ 0.520\ \text{KSF} (1 - .4^2) \sqrt{18{,}800\ FT.^2} \right\} / (2{,}000\ \text{KSF})(1.09)$$

$$S_e = \left\{ 0.520 (1 - .16) (137.11\ FT) \right\} / 2{,}180$$

$$S_e = \frac{59.8896}{2{,}180}\ FT = 0.0275\ FT. = 0.33\ IN \cong 1/3\ \text{INCH}$$



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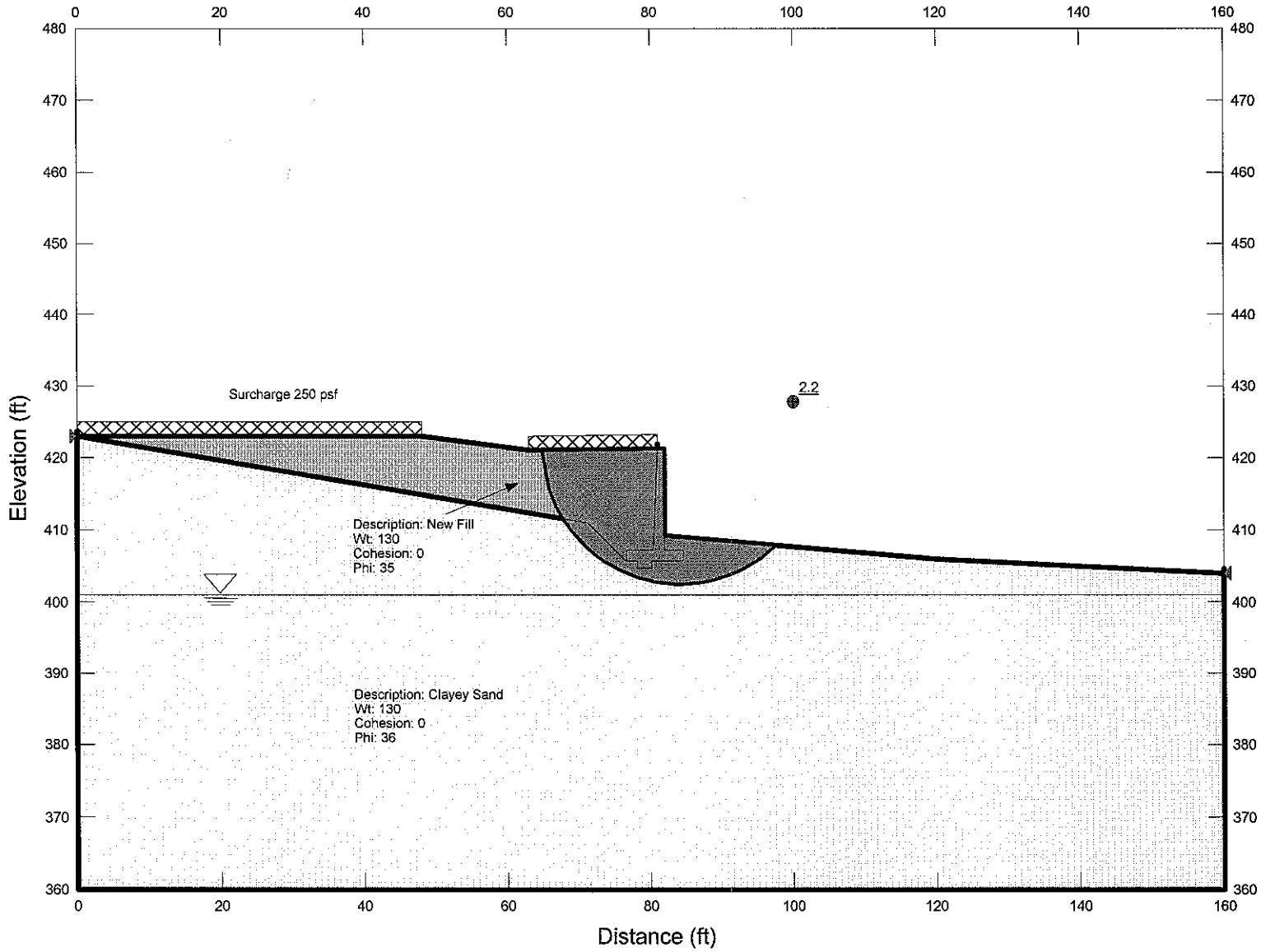
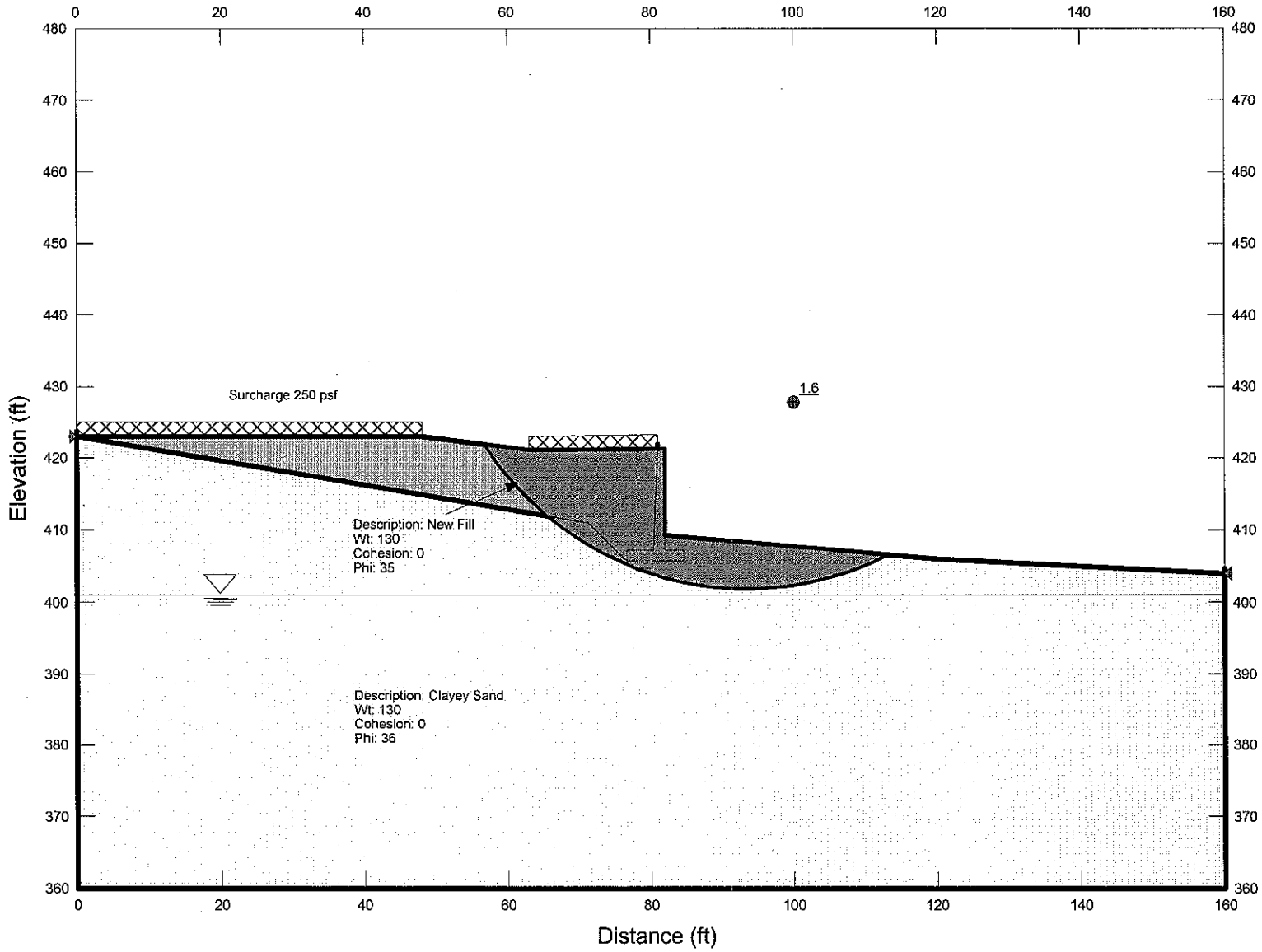
PROJECT No	CALCULATED BY
28649640	S. Manoharan
Date	CHECKED BY
March 11, 2009	Stephen Huang

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – END OF CONSTRUCTION
RW 314 (A1-Sta.# 318+60)

FIGURE



URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – LONG TERM **RW 314 (A1-Sta.# 318+60)**	**FIGURE**
	Date March 11, 2009	CHECKED BY Stephen Huang		



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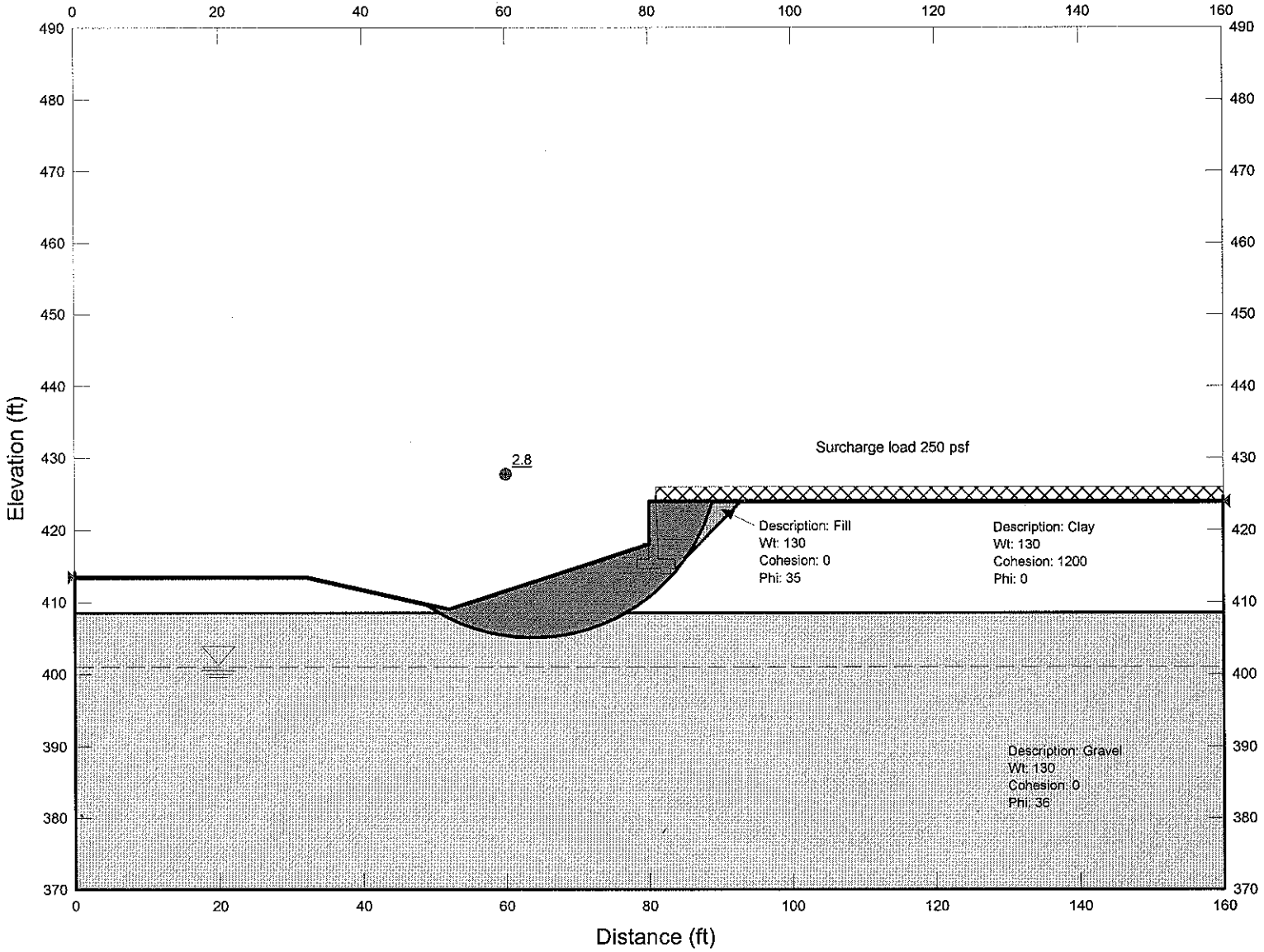
	Date March 11, 2009	CHECKED BY Stephen Huang	

FIGURE



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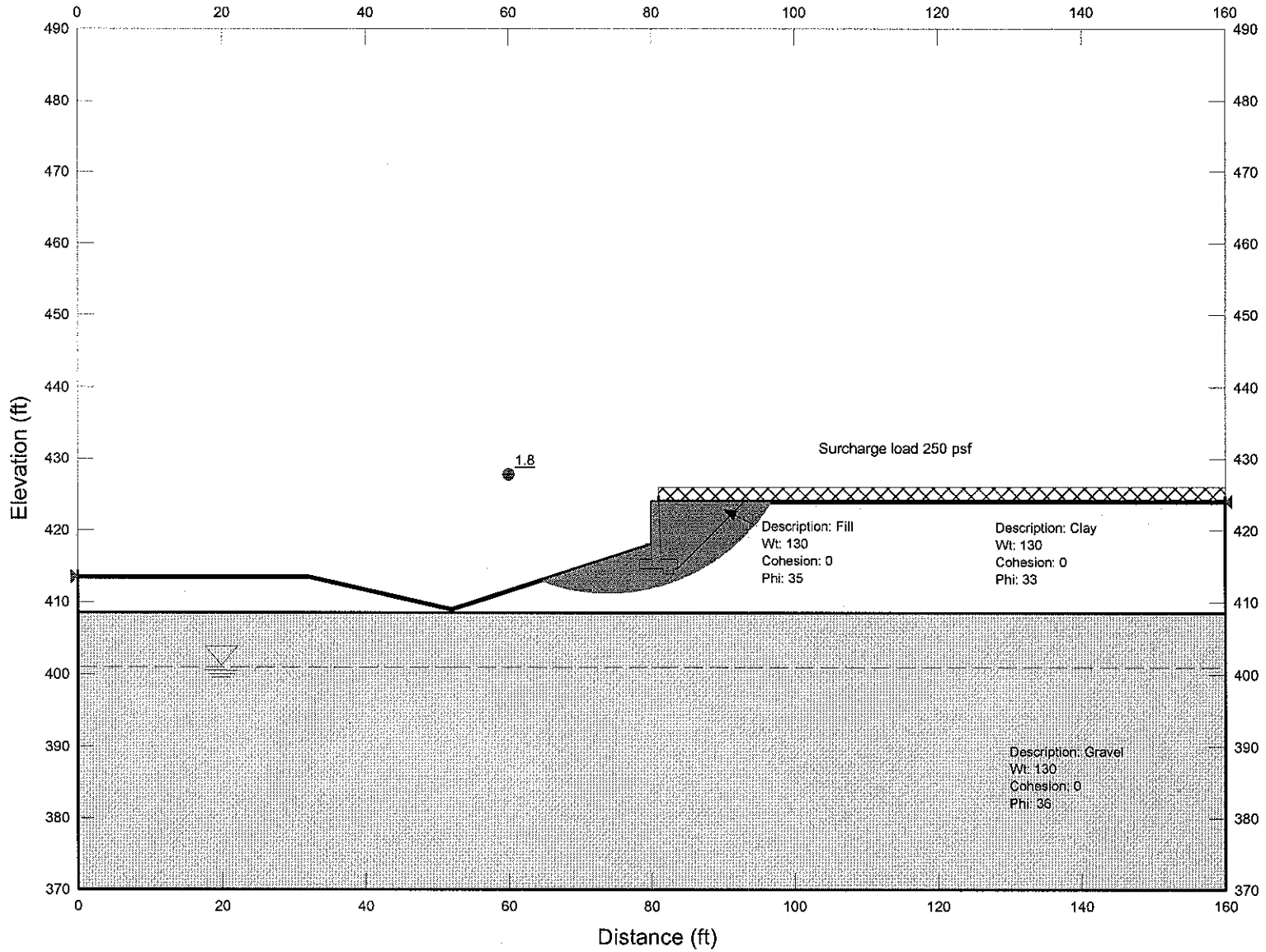
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – END OF CONSTRUCTION **RW 317 (A1-Sta.# 317+50)**
Date March 11, 2009	CHECKED BY Stephen Huang	

FIGURE



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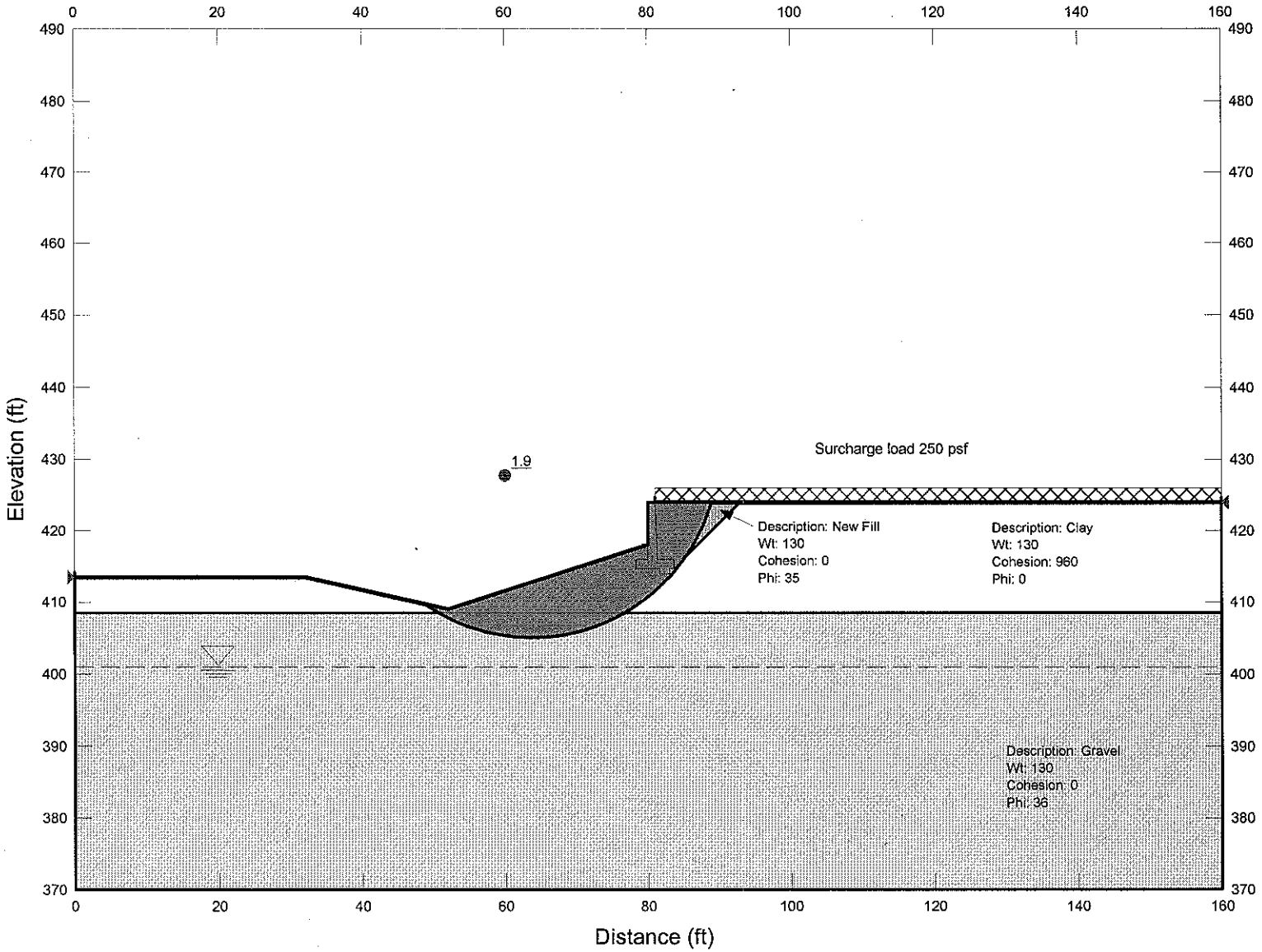
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – LONG TERM **RW 317 (A1-Sta.# 317+50)**
Date March 11, 2009	CHECKED BY Stephen Huang	

FIGURE



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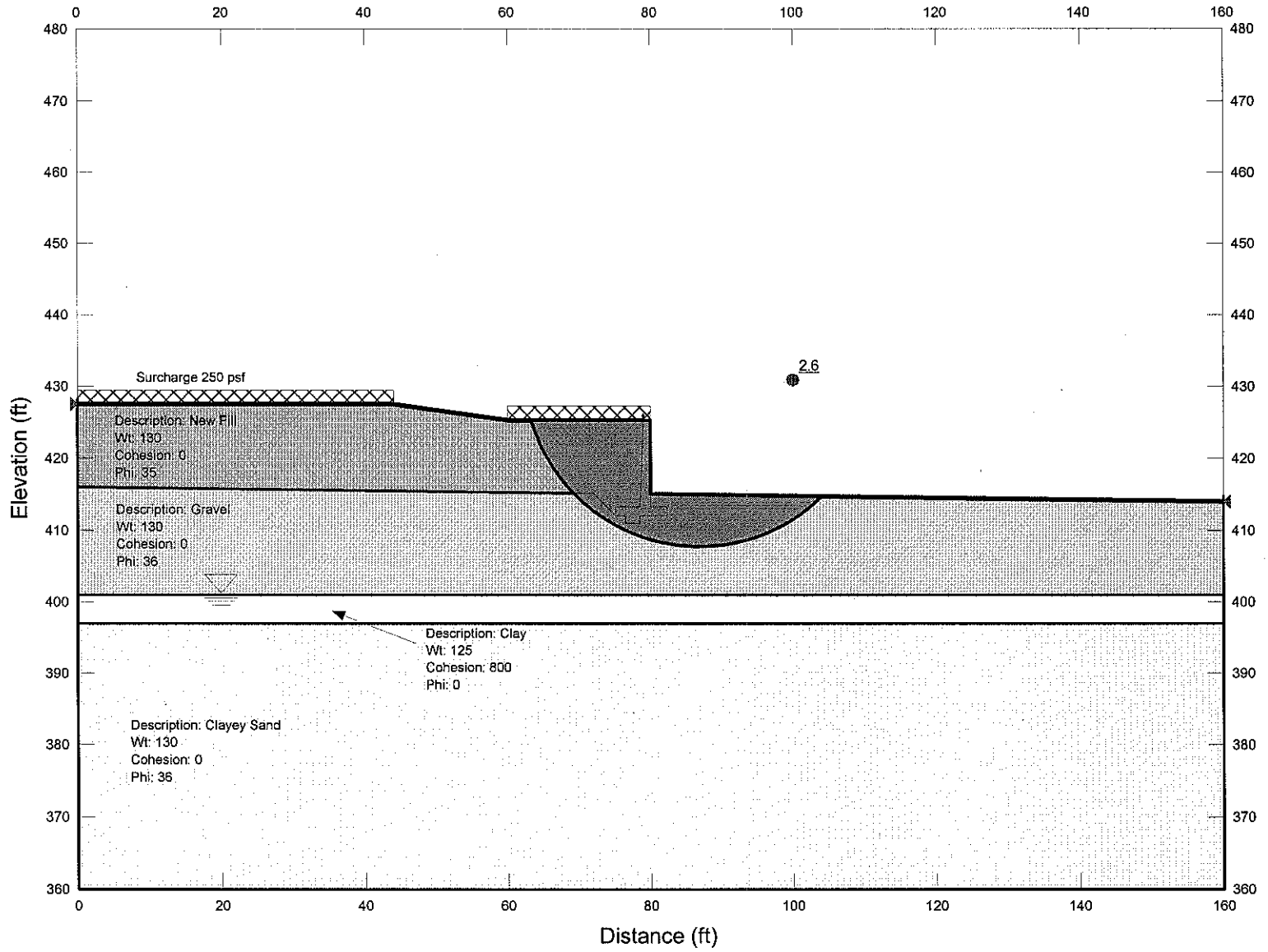
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 317 (A1-Sta.# 317+50)

FIGURE



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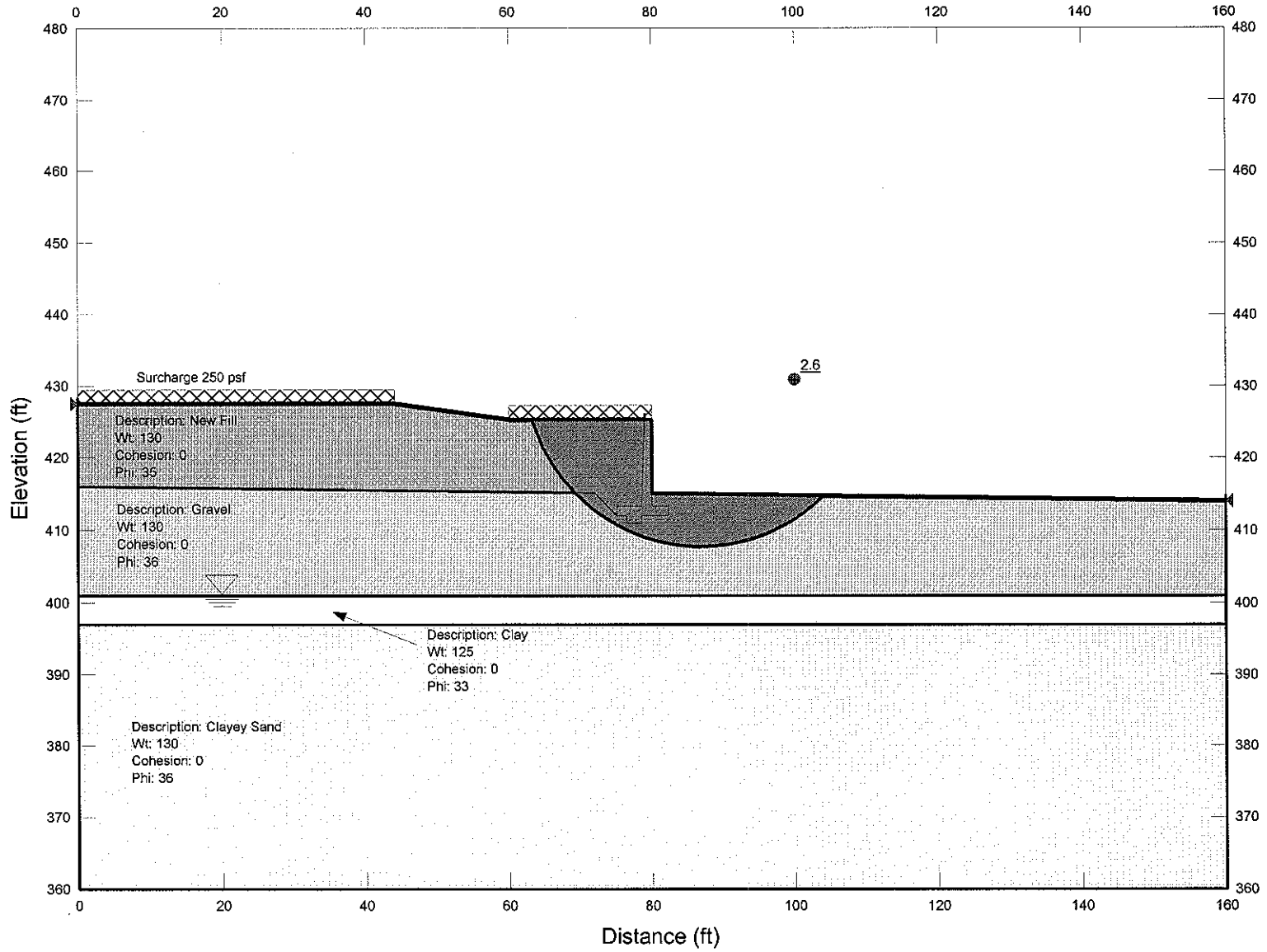
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – END OF CONSTRUCTION
RW 320 (A1-Sta.# 320+50)

FIGURE



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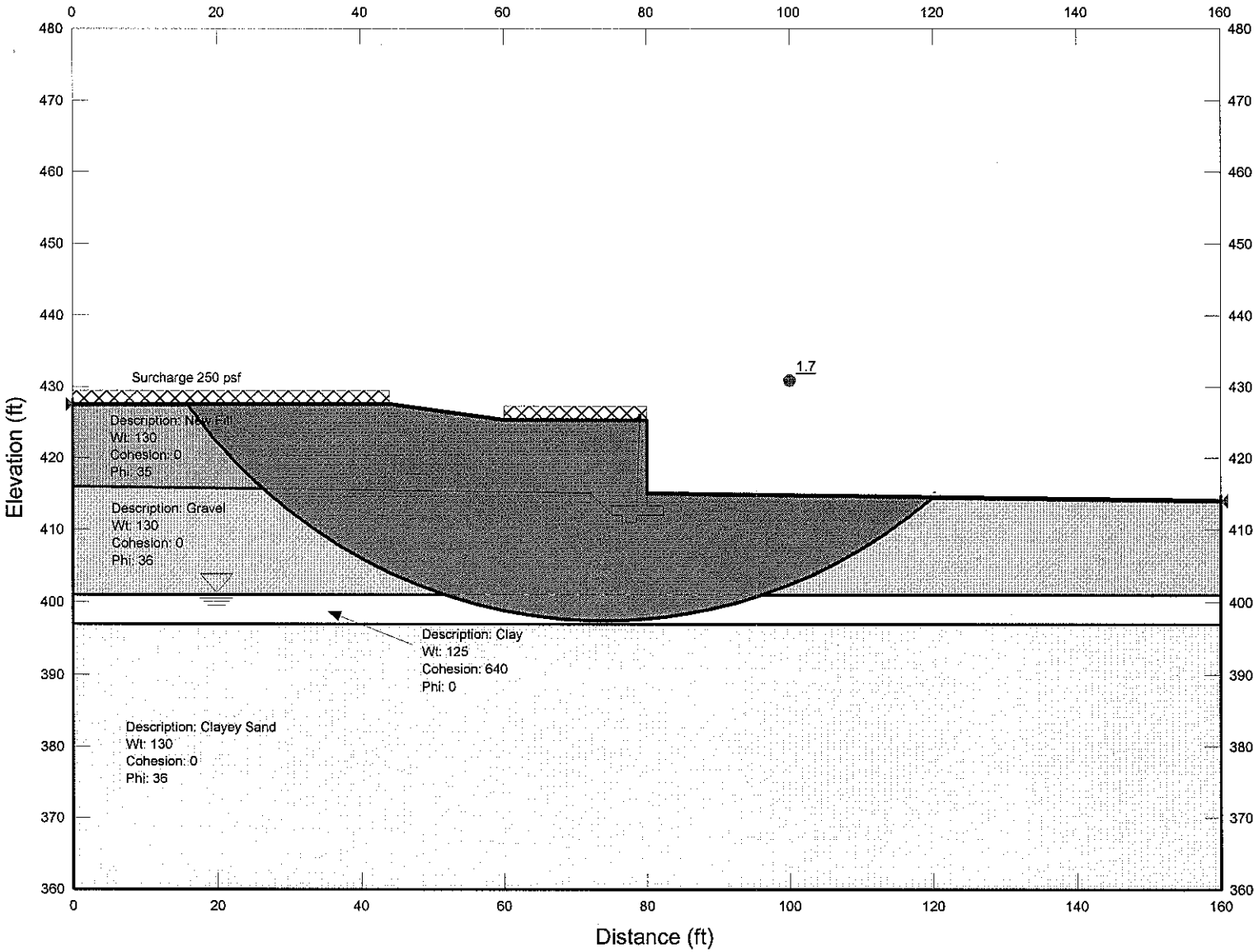
Date	CHECKED BY
March 11, 2009	Stephen Huang

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 320 (A1-Sta.# 320+50)

FIGURE



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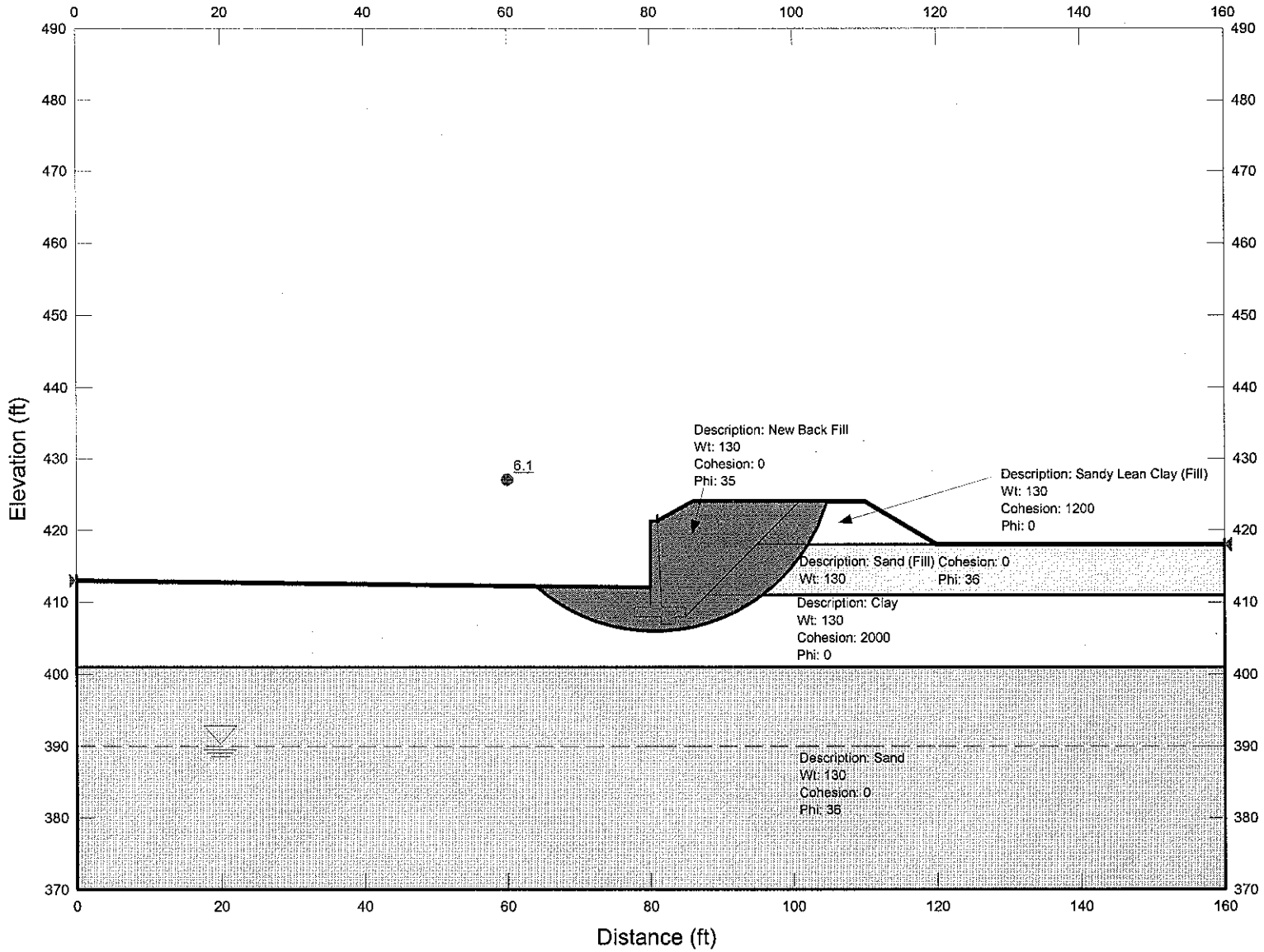
Date March 11, 2009	CHECKED BY Stephen Huang	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 320 (A1-Sta.# 320+50)

FIGURE



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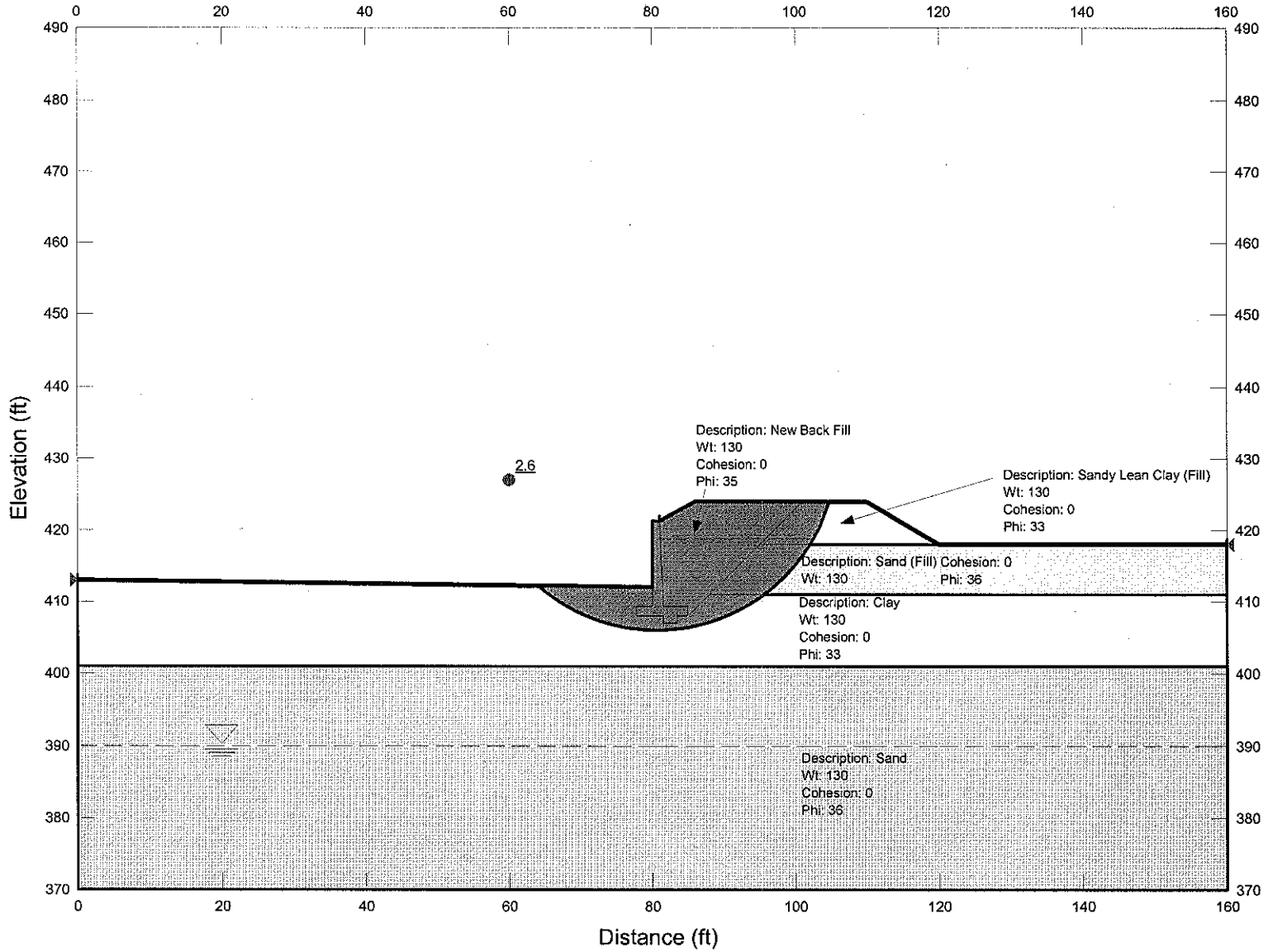
	Date March 11, 2009	CHECKED BY Stephen Huang	

FIGURE



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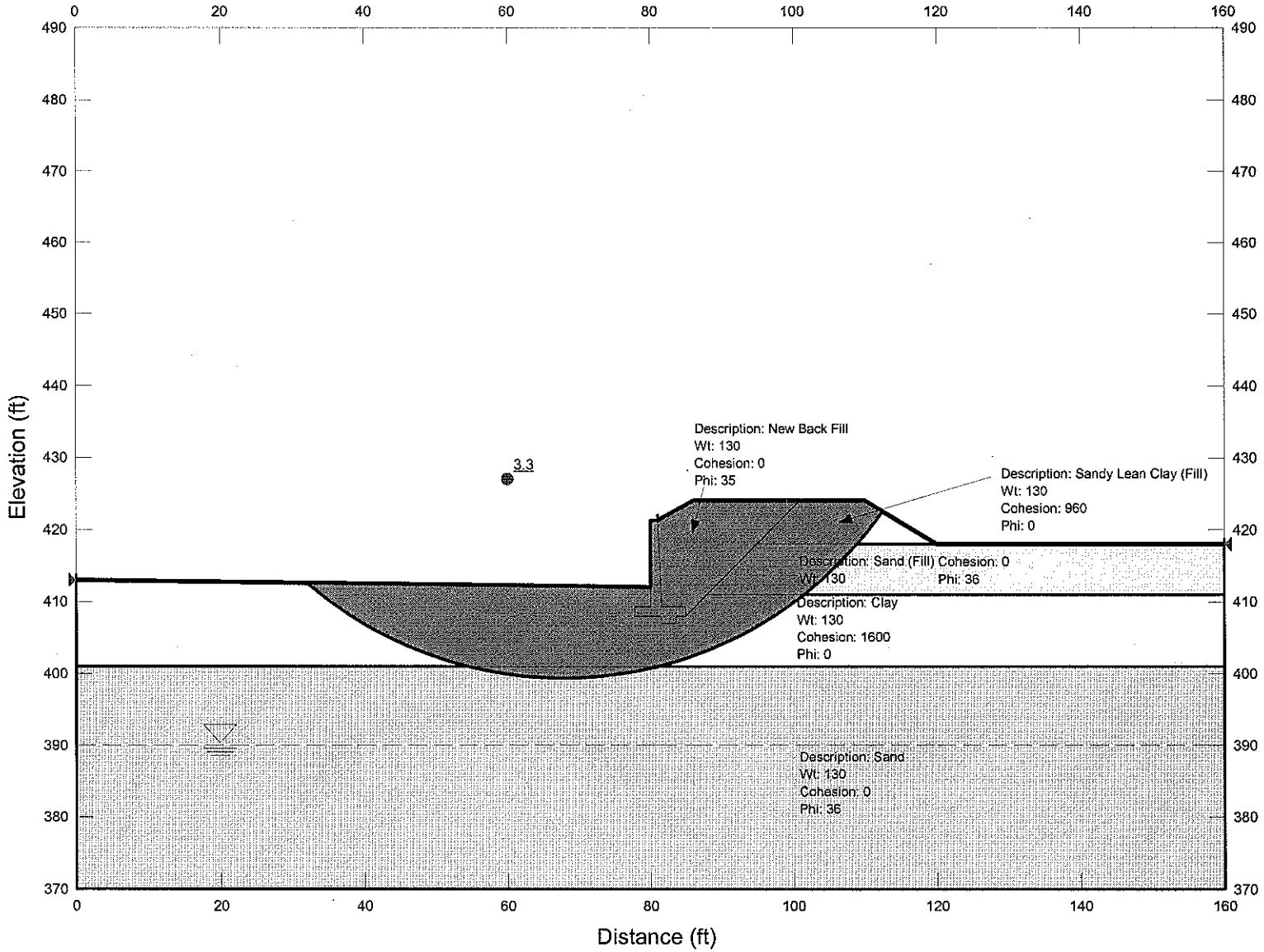
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 437 (A3-Sta.# 442+50)

FIGURE



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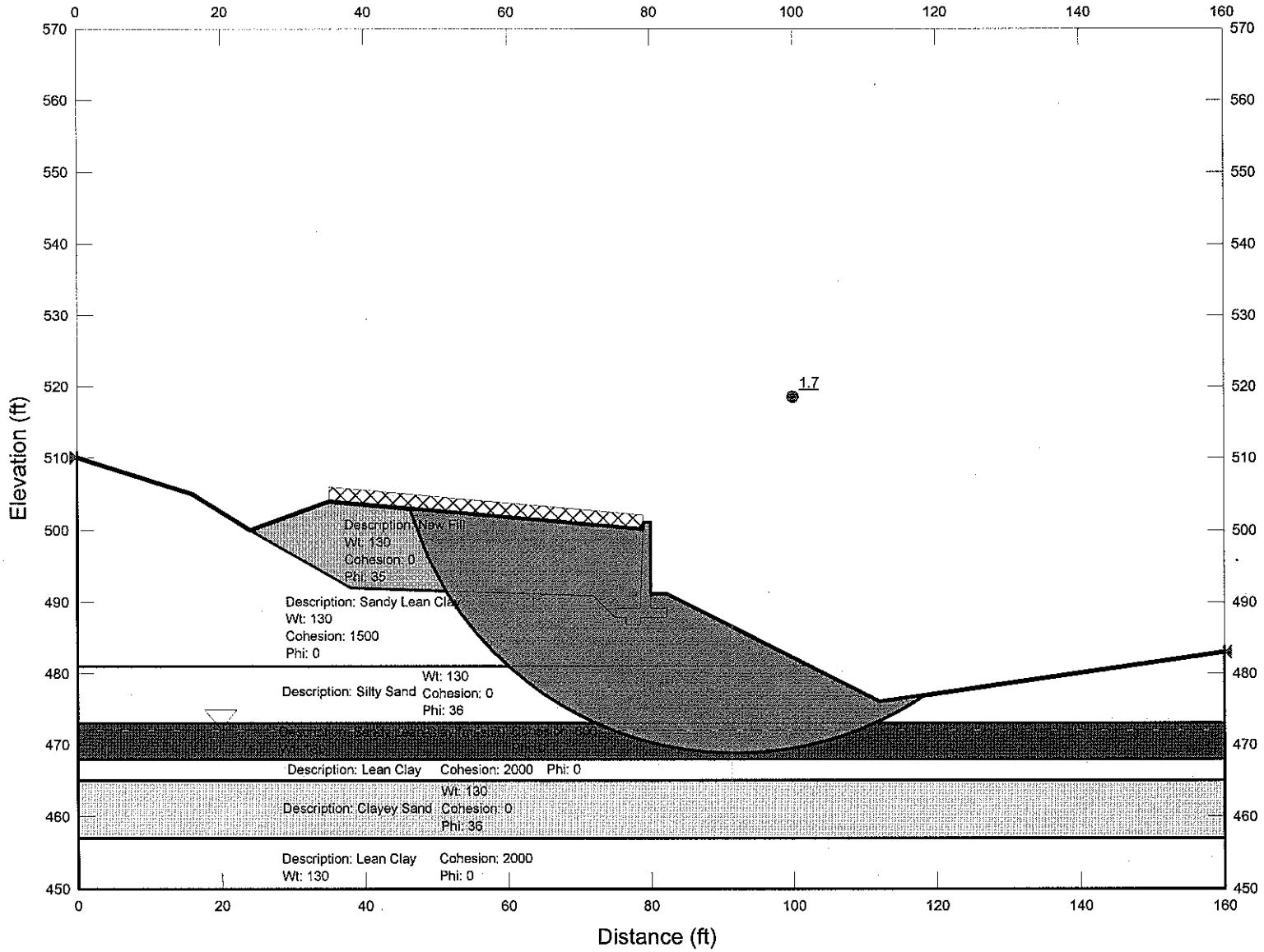
Date March 11, 2009	CHECKED BY Stephen Huang	

FIGURE



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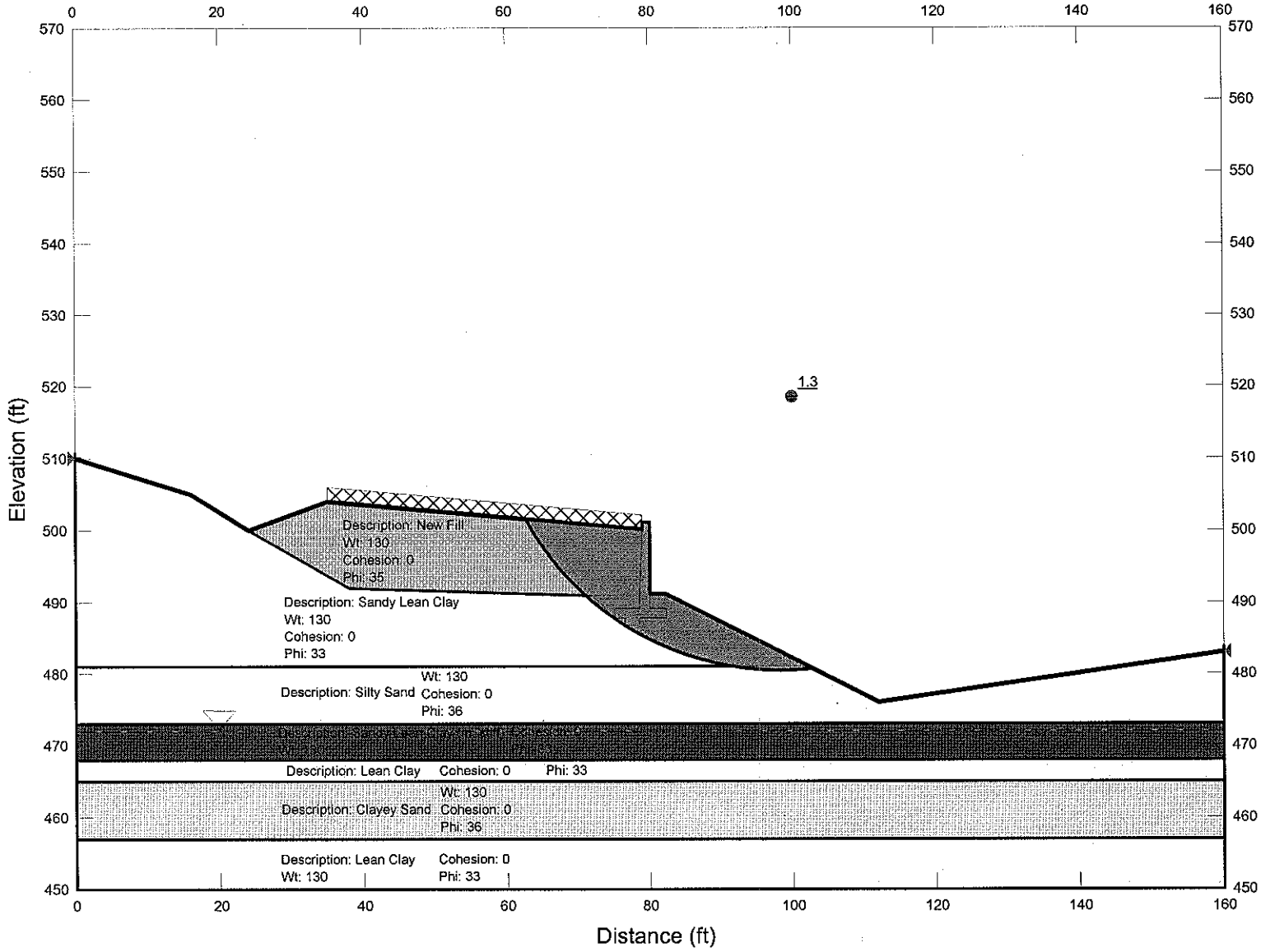
	Date February 26, 2009	CHECKED BY Stephen Huang	

FIGURE



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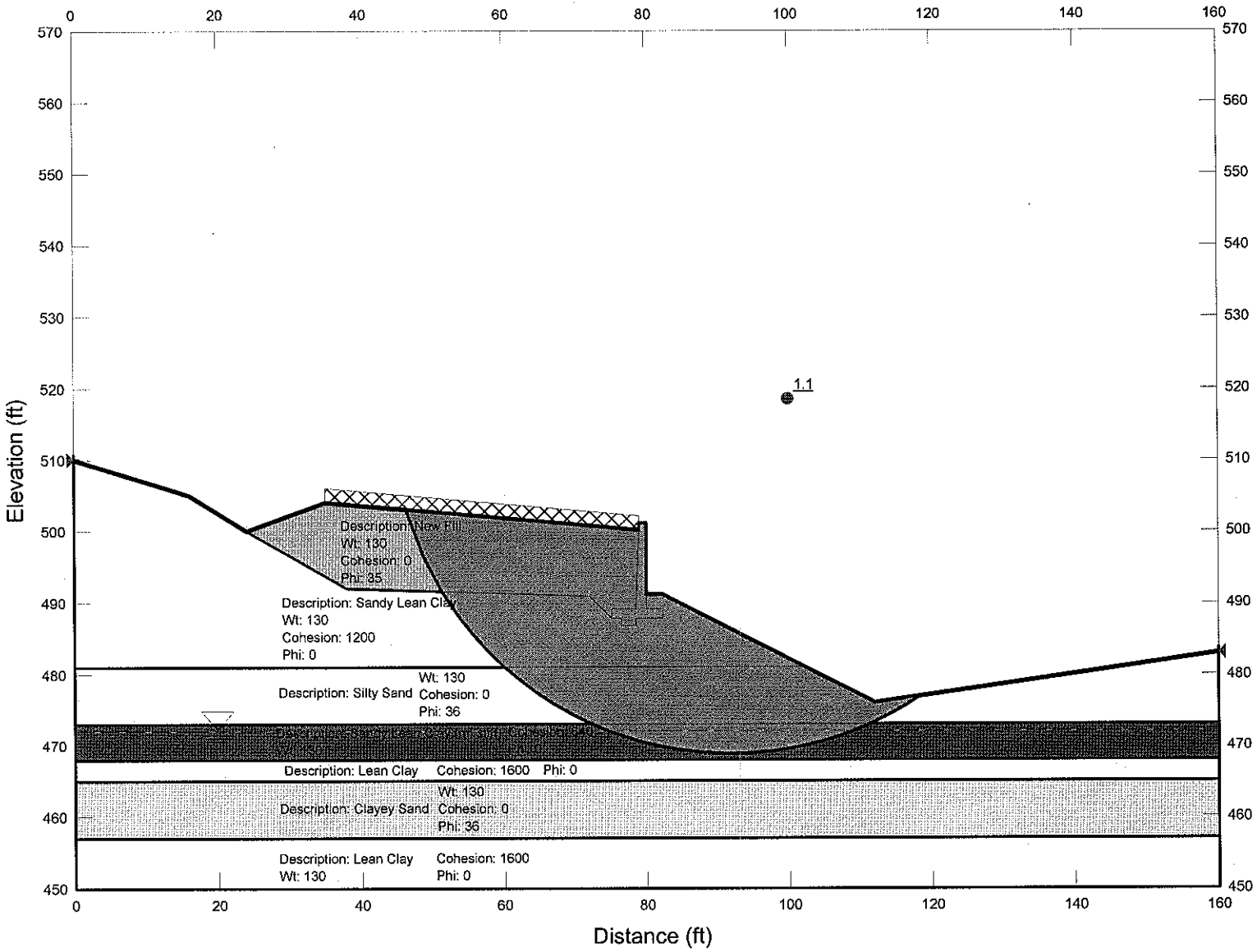
Date February 26, 2009	CHECKED BY Stephen Huang	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 109 (V-Sta.# 110+00)

FIGURE



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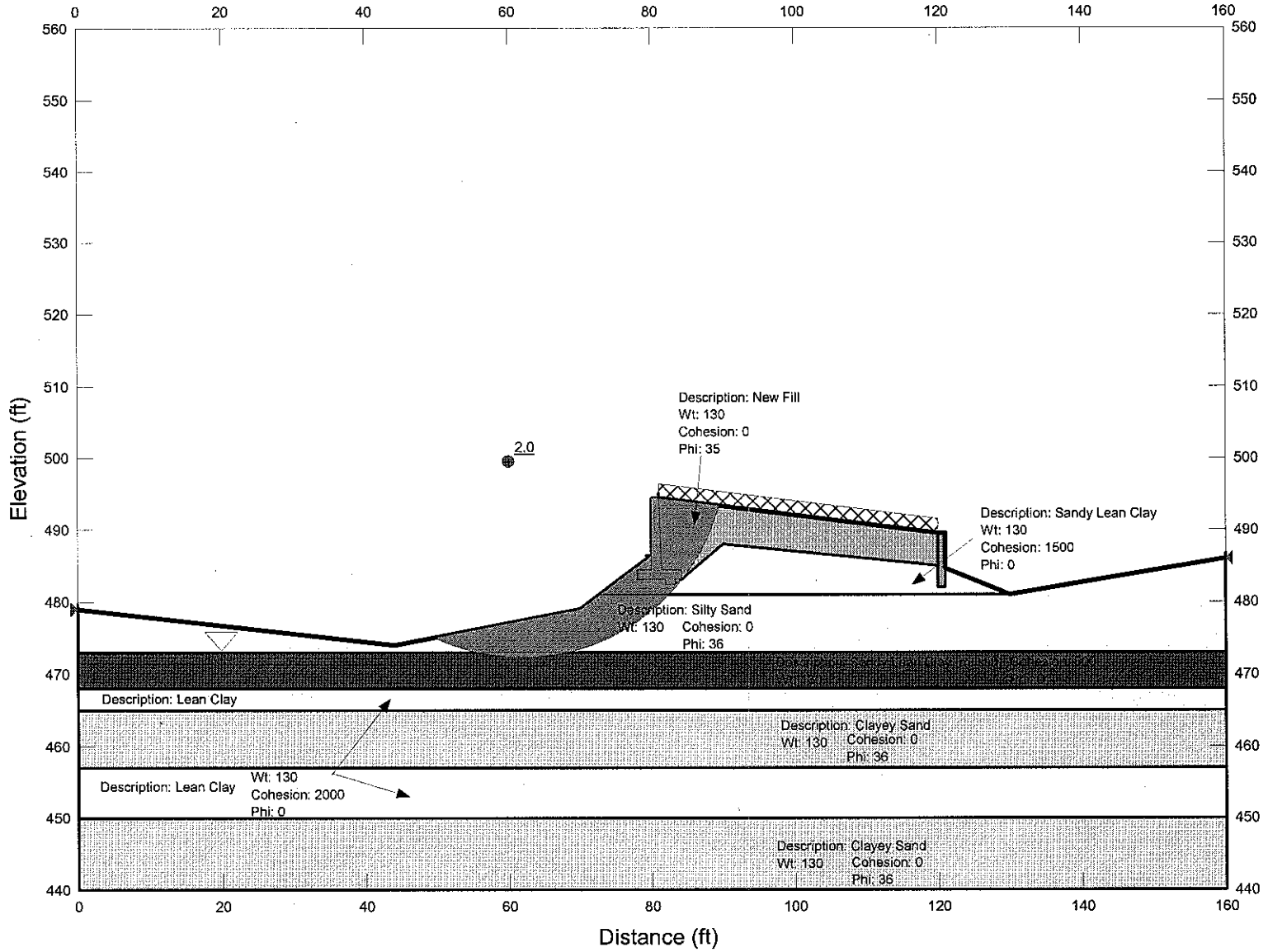
Date February 26, 2009	CHECKED BY Stephen Huang

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 109 (V-Sta.# 110+00)

FIGURE



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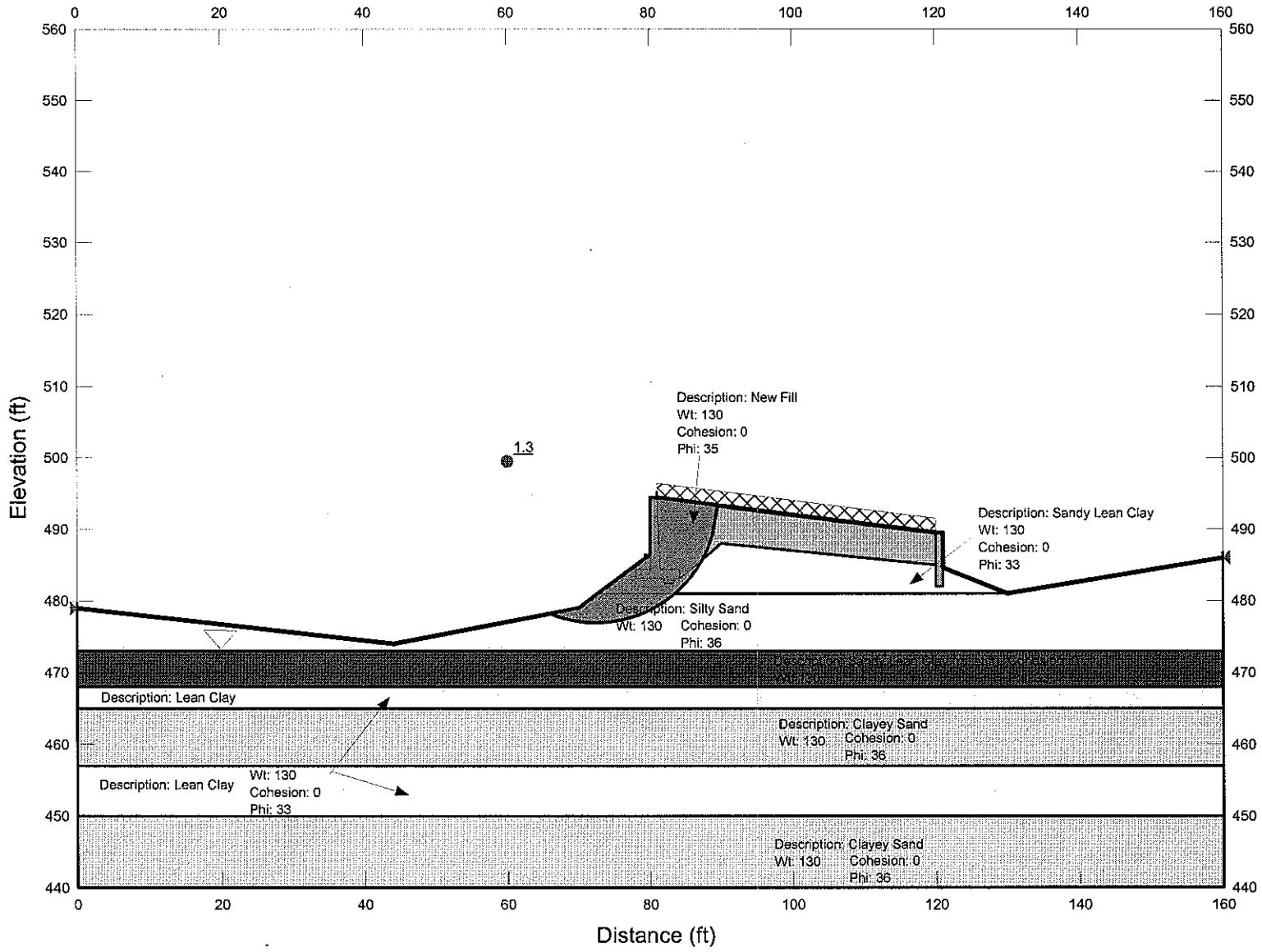
	Date February 26, 2009	CHECKED BY Stephen Huang		



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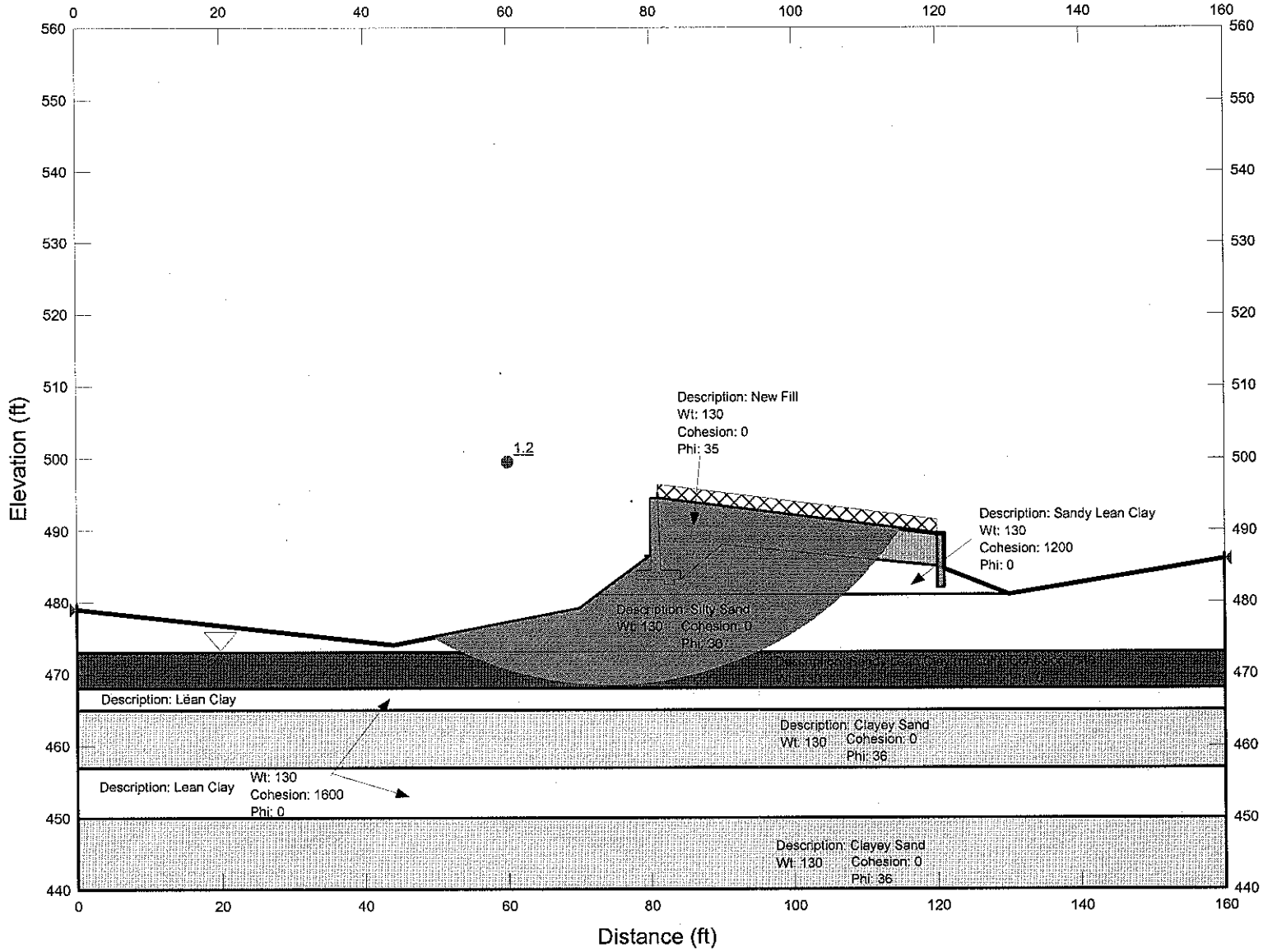
Date February 26, 2009	CHECKED BY Stephen Huang	

FIGURE



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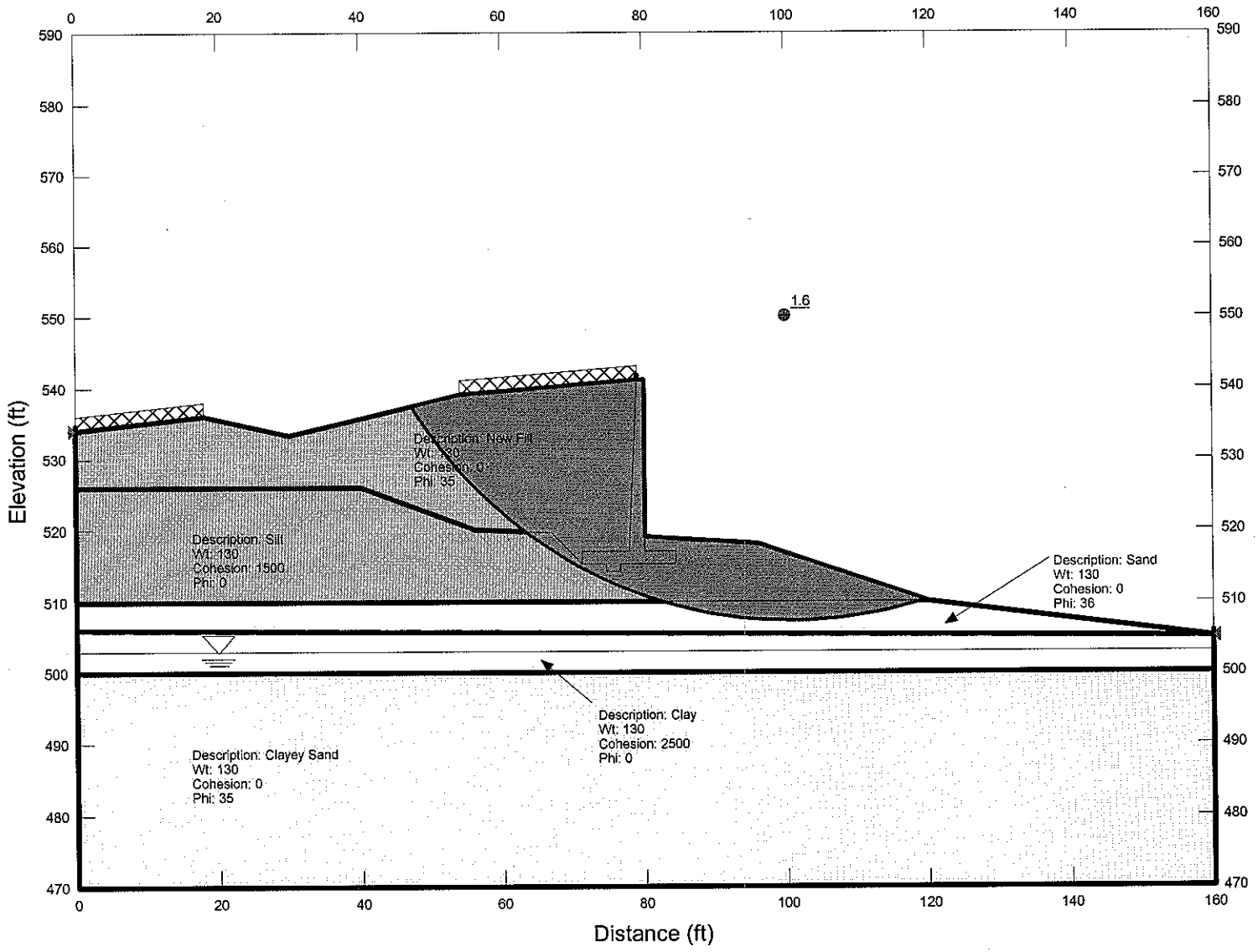
Date February 26, 2009	CHECKED BY Stephen Huang	

FIGURE



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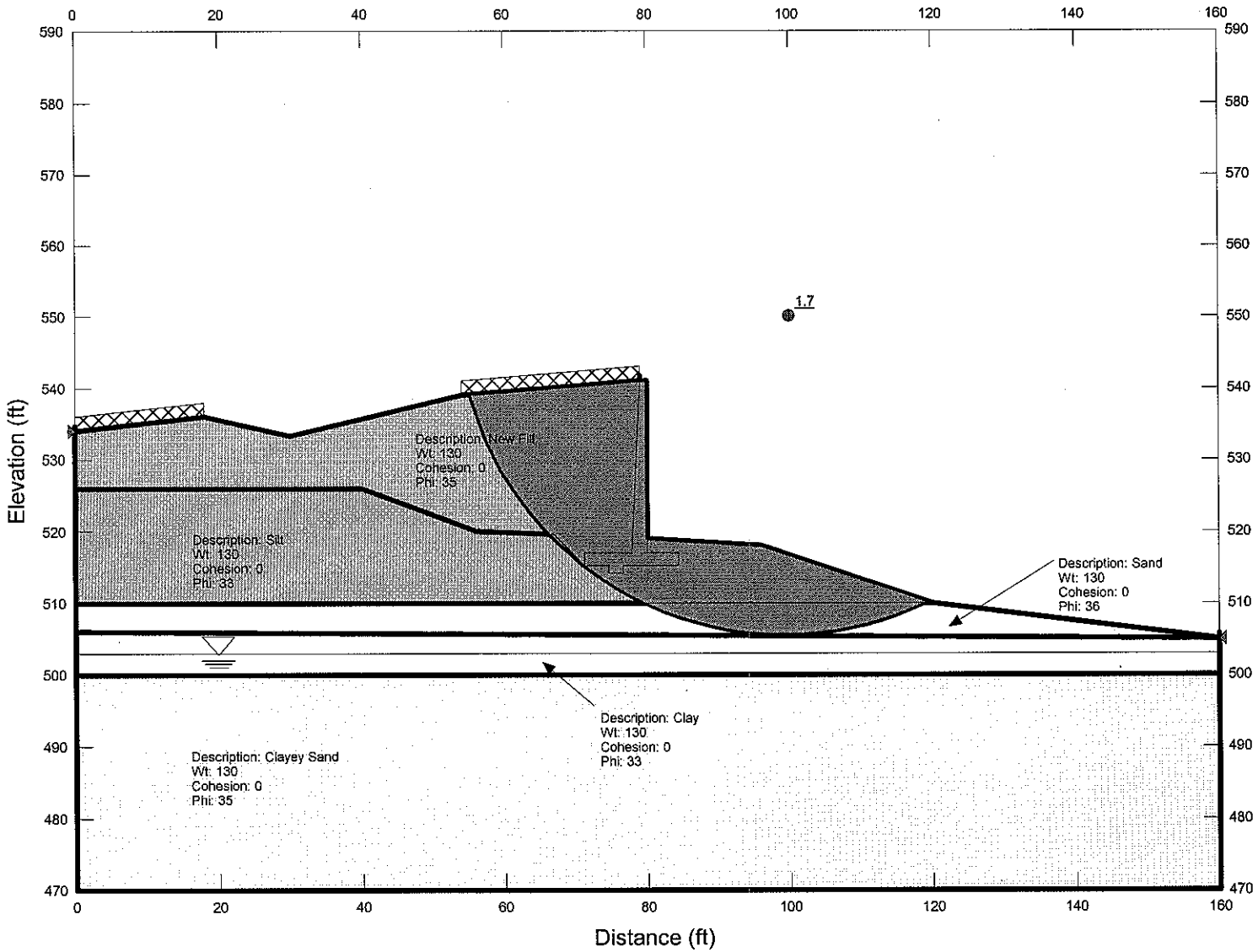
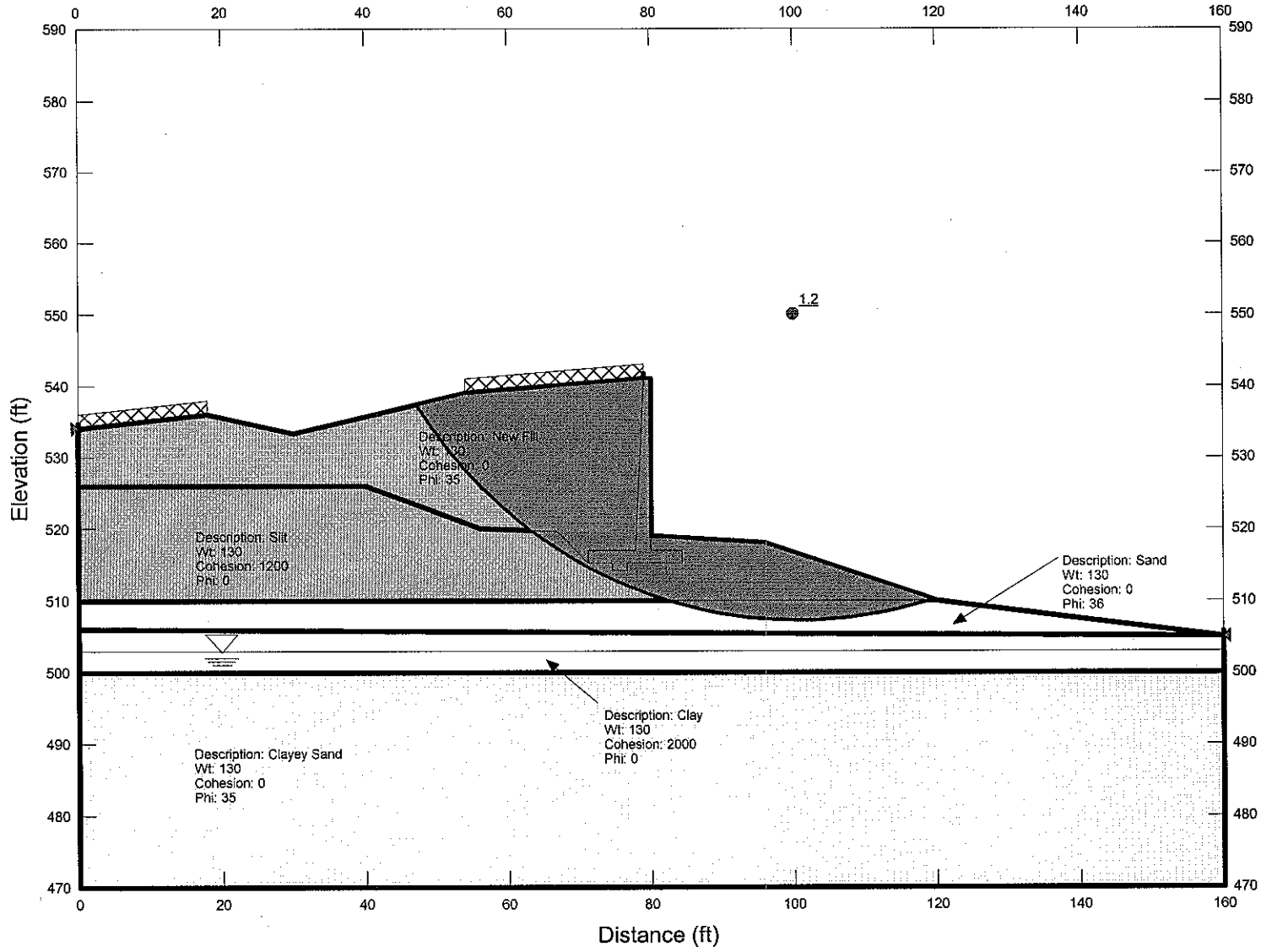
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – END OF CONSTRUCTION **RW 245 (VEX-Sta.# 55+50)**
Date February 26, 2009	CHECKED BY Stephen Huang	

FIGURE



URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – LONG TERM **RW 245 (VEX-Sta.# 55+50)**	**FIGURE**
	Date February 26, 2009	CHECKED BY Stephen Huang		



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	Date February 26, 2009	CHECKED BY Stephen Huang		

URS

Job R84 Project No. 28649610 Page 01 of ____

Description RW236 Computed by Mano Sheet ____ of ____

Bearing Capacity Checked by MH Date 2/05/09

Date 02/16/09

Reference

Estimate Equivalent Fluid Pressure

See page 3 through 4..

Friction angle. Clay = 32°–33°

Sand = 40°

CL & SL use lower bound $\phi = 32^\circ$.

$\gamma_m = 130$ pcf

Active earth pressure coefficient K_a

According to "sheet-R-2" back slope is level ($\beta = 0$)

From Rankine equation

$$K_a = \tan^2(45 - \phi/2)$$

$$= \tan^2(45 - 32/2)$$

$$= 0.307 \cdot \checkmark$$

Equivalent Fluid Pressure (EFP) $= K_a \cdot \gamma_m$.

$= 0.307 \times 130$

$= 39.9$

$= 40$ pcf. ✓

URS

Job SR 84 | Project No. 28649040 | Page 2 of ____
Description RW 836 | Computed by Mano | Sheet ____ of ____
Bearing Capacity | Checked by MM | Date 2/10/09
Date 02/16/09
Reference

q_{ult}

Assume placed on native soil / existing fill material (NB01 & NB02)

$$q_{ult} = cN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$$

Design height = 12 ft

Toe pressure for H=12 = 2.8 ksf. ✓

$B \simeq 7$ ft. $D = 3$ ft.

$\gamma_m = 130$

Closest boring NB01 & NB02.

(1) Sandy Lean Clay & Lean Clay (Fill).

@ C = 1600, 3300 psf

assume c = 1500 psf ✓ conservatively. ✓ $\phi = 0$

$N_C = 5.53$ ✓ $N_q = 1$ ✓, $N_\gamma = 0$

$q_{ult} = cN_c + \gamma D N_q$

@ = 1500 x 5.53 + 130 x 3 x 1

= 8685 psf. $\Rightarrow q_{ult}/3 = 2.9 > 2.8$ ksf OK

(2) Assume placed on Sand, $c = 0$ $\phi = 40°$ — see page 3

Say $\phi = 33°$ for design. $N_q = 28$, $N_\gamma = 28$ ✓

$q_{ult} = 0 + 130 \times 3 \times 28 + 130 \times 3.5 \times 22$

= 23,660

Toe Pressure, 2.8 tsf, $< q_{ult}/3 = 7.9$ tsf. OK

URS

Page 2A of ____

Job R84 Project No. 28649640 Sheet ____ of ____

Description RW236 Computed by Mano Date 2/14/01

Bearing Capacity Checked by ____ Date ____

Reference

Summary.

Clay q_{ult} = 8685

Sand q_{ult} = 23,660

Say q_{ult} = 9000 psf for design

q_{all} = 9000/3 = 3000 psf.

URS

Job SR84 Project No. Page 3 of
Description RW 23C Computed by Sheet of
Checked by Date
Reference

Estimate Internal friction Angle

(1) Clays

PI's

NB02, Depth 5' PI = 10, CL – Fill
RB02, Depth 5' PI = 14, CL

} Page - 24

NB02, $\phi = 33^\circ$
RB02, $\phi = 32^\circ$

} Say $\phi = 32^\circ$ For CL $\Rightarrow \phi = 32^\circ$

} Page 12

(2) Sand

NB01 Only.

Depth (Ft)	σ_v (psf)	σ_v (ksf)	N_{cor} (Blow / foot)	D_r **	ϕ **
7	910	0.91	72 × 0.8 = 58	100	40
14	1820	1.82	97 × 0.8 = 78	100	40
22	2860	2.86	71 × 0.8 = 57	100	40

Summary

In Clays (CL), $\phi' = 32$

In Sands (SP), $\phi' = 40$

For CL & SP use lower bound $\phi' = 32^\circ$.

URS

Job SR84 Project No. Page 4 of
Description Type-1 Computed by Sheet of
RW236 Checked by Date
Date
Reference

Estimate γ_m

Boring No.	Depth (Ft)	γ_m (pcf)	Soil type
NB01	1.0	135	CL – Fill
NB02	10.0	136	CL – fill
RB02	5	139	CL

NB01 & NB02 are fill materials, RB02 – Road Boring.

Assume γ_m = 120 pcf.

Assume granular soil

from figure 2 of NAVFAC 7.2-62 ← Page 15

$K_A = \tan^2(45 - \phi/2)$

$= \tan^2(45 - 32/2)$

$= 0.307$

URS

Job R84 Project No. 28649640 Page 1 of ____

Description RW 314 Computed by Mano Sheet ____ of ____

Checked by MH Date 2/05/09

Date 02/19/09

Reference

RW No. 314 — Type 1 Wall (std)

According the "sheet R-3"

Maximum height of the wall = 16.5 ft.

Available borings — NB09, NB11 & NB12.

Wet Density

Sheet 1 of 1

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	[redacted]ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
NB09	1.0	22	19	3				5.1			
NB11	5.0				25.7	12	135	14.0	118	89	0.424
NB11	25.0						145	8.7	134	91	0.258
NB11	45.0						144	10.7	130	96	0.301

Footing → on Clayey Sand or Silty Gravel

Back of the wall is going to be fill material

Assume the fill material properties.

Friction angle, $\phi = 33.^\circ$

Unit Weight = 130 pcf.

Back fill slope ≃ level ($\beta = 0$)

$$K_a = \tan^2(45 - \phi/2)$$

$$= 0.295$$

Equivalent Fluid pressure = $K_a \gamma$

$$= 0.295 \times 130$$

$$= 38 \text{ pcf}$$

Caltrans 1d Plan

for $\phi = 33.4^\circ$

$\gamma = 120$, EFP = 36

for $\gamma = 130$

it friction Angle

34.5°

EFP = 36 pcf

Assume fill material

Friction Angle = 35°

Ground Water - table Summary

Boring **	G.S. Elev	GW. Depth	GW Elev	
NB 10	422	23.5	395.8	
NB 11	412	5	407	
NB 12	422	8	414	
NB 13	421	14	407	
NB 37	409	3.5	400.5	} New borings.
NB 38	404	3	401	
NB09	425	Dry	Dry upto 395ft.	

Say Ground Water Elevation 401 ft.

Bottom of Footing Elevation = 419 ft to 405.7 ft.

Estimate friction angle (Sand) $\gamma = 120$ ***

	depth	σ_v ksf	N corr.	Dr	ϕ ****
NB01	5	0.65	39	100	40°
NB11	10	1.3	52	100	40
NB12	10	1.3	104	100	40
	15	1.95	97 x 0.8 = 77	100	40

Sand = 40°

for design say $\phi = 35°$

** See page 5 *** see page 6 **** see page 7

Estimate $q_{ult} = cN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$

Assume Placed on Native soil NB09, NB11 & NB12

Clayey Sand & Silty Gravel, $c = 0$, $\phi = 35°$

BOFE ⇒ 419 to 405.7 ⇒ $D = 3$ ft (assume)

$N_q = 35$ ✓, $N_\gamma = 40$ ✓ $\gamma = 130$, Page 4.

Design height = 16 ft, toe Pressure = 3.5 ksf (case-1 Loading)

$B = 9$ ft.

$$q_{ult} = 0 + 130 \times 3 \times 35 + \frac{130 \times 9 \times 40}{2}$$

$$= 37,050 \text{ psf} \checkmark$$

(2) Water table above the footing level,

$c = 0$

$$q_{ult} = \gamma' D N_q + \frac{\gamma' B}{2} N_\gamma$$

$\phi = 35°$

$N_q = 35$, $N_\gamma = 40$

= Assum $\gamma_{sat} = 140$ pcf

$$q_{ut} = (140 - 62.4) 3 \times 35 + \frac{(140 - 62.4)}{2} \times 9 \times 40$$

$$= 22\,116 \text{ psf}$$

Consider the both case

Say $q_{ult} = 18000$ psf

$q_{all} = 6000$ psf.

URS

Job R84 Project No. 28649640 Page 1 of ____

Description RW317 - Type 1 std Wall Computed by Mano Sheet ____ of ____

Checked by MJJ Date 2/06/09

Date 02/19/09

Reference

Retaining Wall No. 317 — Type 1 Standard Wall

Long = 198 ft

Maximum height = 7.1 ft.

Design height = 8 ft.

Available Boring ⇒ NB10 & NB12

Ground Water Elevation — see page 21

NB10 = 398 ft., NB37 = 400.5 ft } Assume 401 ft

NB12 = 414 ft., NB38 = 401 ft }

Deepest foot Elevation = 414.72 ft.

According to "sheet R-4"

Back fill ⇒ Fill Material

Assume fill material Properties

γ = 130 pcf

Friction angle ϕ = 33°

Back slope = level.

$K_a = \tan^2(45 - \phi/2)$

= 0.295

Equivalent Fluid Pressure = $K_a \cdot \gamma$

= 0.295 × 130

= 38 pcf ← for Fill ϕ = 34

kFP = 36.7

Footing ⇒ on Lean Clay or Clayey Sand.

URS

Job SR 84 Project No. 28641640 Page 2 of ____

Description ____ Computed by Mano Sheet ____ of ____

Checked by MM Date 2/10/09

Date 02/19/09

Reference

Ground Water table Summary

Boring **	Elev	GW. Depth	GW Elev	
NB 10	422	23.5	395.8	
NB 11	412	5	407	
NB 12	422	8	414	
NB 13	421	14	407	
NB 37	404	3.5	400.5	} New borings.
NB 38	404	3	401	
NB09	425	Dry	Dry upto 395 ft.	

Say Ground Water Elevation 401 ft.

** see page

Estimate q_{ult}.

Assume Placed on Native soil (NB-10 & NB 12).

On Clay. (NB-10)

Low blow counts, No lab results for these Clay (NB-10)
med - stiff.

Assume $C = 1200$ psf, $\phi = 0$ ← See page 5

$N_c = 5.53$, $N_q = 1$

$$q_{ult} = CN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$$

$\frac{\gamma B}{2} \rightarrow 0$

$= 1200 \times 5.53 + 130 \times 3 \times 1$

$= 7{,}096$ psf.

Sand (NB-12)

water table is above the footing.

$C = 0$ $\phi° = 35°$ $\gamma_{sat} = 140$ $N_q = 35$ $N_\gamma = 40$

$B = 5.25$

$$q = \gamma' D N_q + \frac{\gamma' B}{2} N_\gamma$$

$= (140 - 62.4) 3 \times 35 + (140 - 62.4) \frac{5.25}{2} \times 40$

$= 16{,}296$ psf

[Toe pressure = 2.2 ksf for H = 3

Summary

Clay q_{ult} = 7000 psf

Sand q_{ult} = 16,000 psf

Say q_{ult} = 7000 psf. ← Lower bound.

$q_{all} = q_{ult}/3$ = 2,300 psf (Toe Pressur = 2.2)

URS

Job R&A | Project No. 28649640. | Page 1 of ____
Description RW320 – Type 1 Std Wall | Computed by Mano | Sheet ____ of ____
Checked by MM | Date 2/06/09 | Date 02/19/09
Reference

Retaining Wall No. 320 – Type 1 Standard Wall.

Long = 161.4 ft
Maximum height = 11.16 ft.
Design height = 12 ft.
Available boring = NB 14.
Ground water elevation => Dry upto 355 ft during drilling. – NB14
NB 37 = 400.5 ft, NB 38 = 401 ft.
assume Ground Water elevation = 411 ft.
Deepest foot elevation = 411.96 ≃ 412 ft.
Footing on => Silt/Silty Gravel.
"sheet R-5"
Back fill Material = Embankment Fill Material.
Assume γ = 130 pcf
Friction angle ϕ = 33°
Back slope => level
Active earth pressure coefficient $K_a = \tan^2(45-\phi/2)$
$K_a = 0.295$
Equivalent Fluid Pressure = $K_a\gamma$
= 0.295 × 130
= 38 pcf.

If fill material ϕ = 35°
K_a = 0.271
EFP = 35.2. γ = 130 pcf
meets Caltrans specification
Std plan EFP_{max} = 36

URS

Job R84 Project No. 28649640 Page 21 of ____

Description RW320 - Type 1 Computed by Mano Sheet ____ of ____

Checked by NL Date 12/17/09

Date 02/19/09

Reference

Estimate friction angle:

Silt (NAVFAC)

PI = 1 from page 4.

$\phi = 35°$

Gravel (NAVFAC)

@ 5 ft $\sigma = 0.65$ ksf $N_{corr} = 67 \times 0.8 = 53$

See page 5 $D_r = 100$ $\Rightarrow$ $\phi = > 45°$ ← Page 6.

Silt = 35°

Gravel = >45°

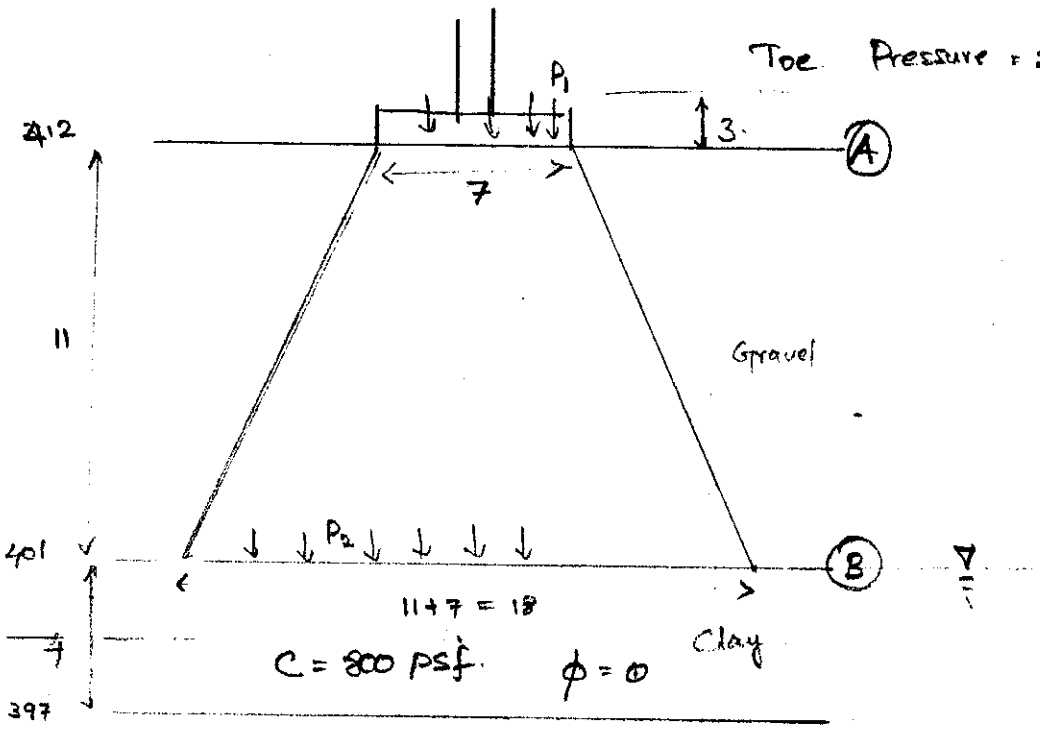
Say design $\phi = 33°$ for Silt/Gravel. ✓

URS

Job SR 84 | Project No. 28649640 | Page 3A of ____
Description RW820 | Computed by Mano | Sheet ____ of ____
Checked by MM | Date 2/19/09 | Date 02/19/09
Reference

Estimate q_{ult}.

Consider the medium firm Clay layer in NB14 (401 to 397 ft Elev.)
footing Elevation @ 412 ft (Conservative approach)



Consider the level at (B) (Top of clay layer)

$$(q_{ult})_B = CN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$$

$D = 11 + 3 = 14$

$N_c = 5.53$, $N_q = 1$ $N_\gamma = 0$

$$q_{ult\,B} = 800 \times 5.53 + 130 \times (14) \times 1$$
$$= 6,244 \text{ psf}$$

$$P_1 = P_2 \left(\frac{B+H}{B}\right)$$

$$q_{ult\,A} = \left(\frac{B+H}{B}\right) q_{ult\,B}$$
$$= \left(\frac{11+7}{7}\right) 6,244 = 16,056 \text{ psf}$$

URS

Page 3B of ____

Job SR84 Project No. 28649640 Sheet ____ of ____

Description RW820 Computed by Mano Date 2/10/09

Bearing Capacity. Checked by MM Date 02/19/09

Reference

Estimate q_{ult}.

Assume placed on Native Soil (NB14).

, $c = 0$, $\phi = 33°$

BOFE ⇒ 412 ft to 414.3 ft, Assume $D = 3$ ft.

$N_q = 28$, $N_\gamma = 28$ ——— Page 7

$\gamma_m = 130$ pcf, Design height $H = 12$ ft. $B \simeq 7$ ft

Toe Pressure = 2.8 ksf.

$$q_{ult} = 0 + 130 \times 3' \times 28 + \frac{130 \times 7 \times 28}{2}$$

$$= 23,660 \text{ psf}$$

Summary

Clay layer is in control of the bearing capacity.

$$(q_{ult})_{min} = 16,058 \text{ psf}$$

Say $q_{ult} = 15,000$ psf

$q_{all} = q_{ult}/3 = 5000$ psf

$q_{ult} = 15,000$ psf

$q_{all} = 5000$ psf

from:- An Introduction to Geotechnical Engineering, Holtz & Kovacs

Page 544.

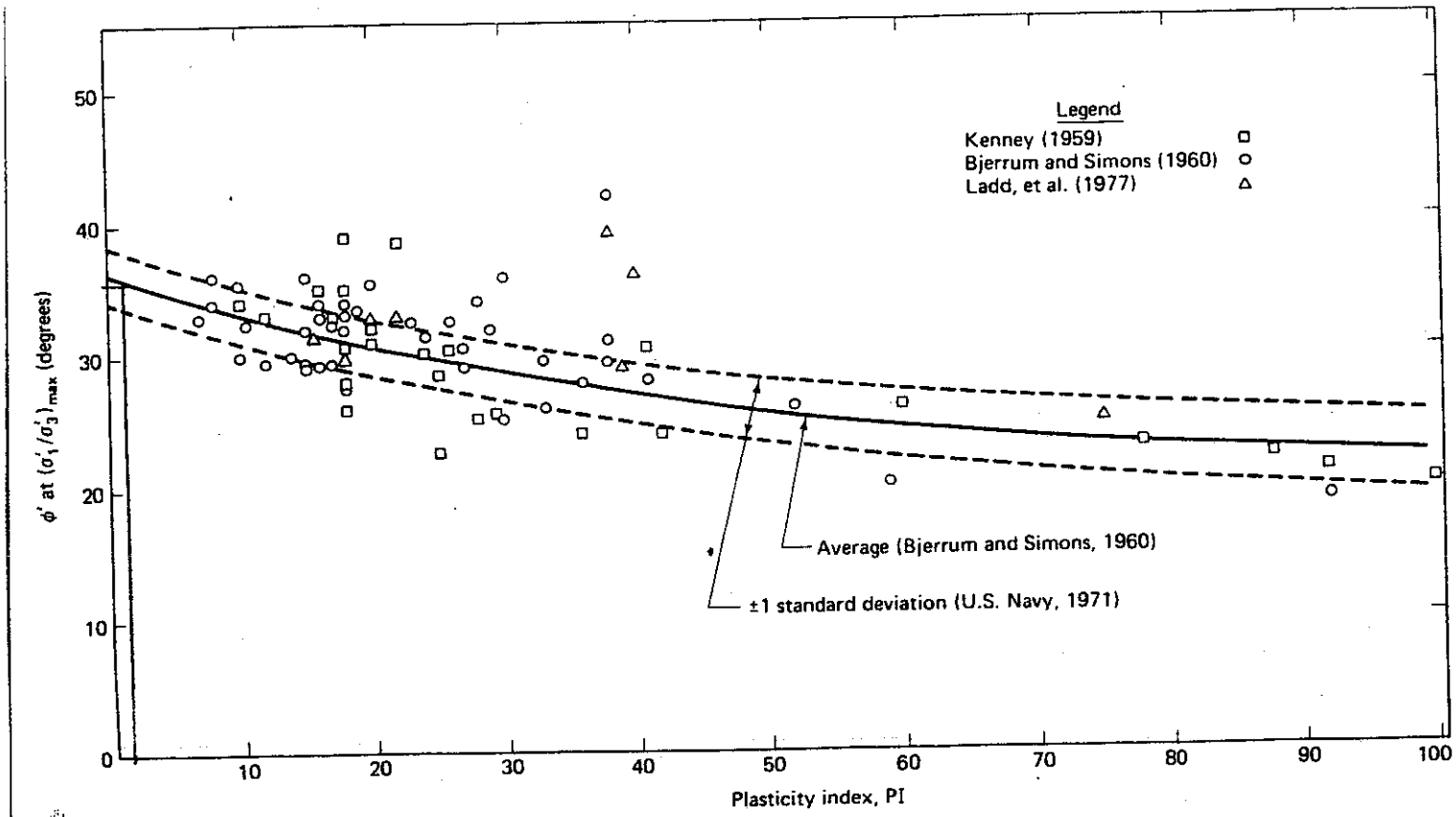


Fig. 11.27 Empirical correlation between ϕ' and PI from triaxial compression tests on normally consolidated undisturbed clays (after U.S. Navy, 1971 and Ladd et al., 1977)

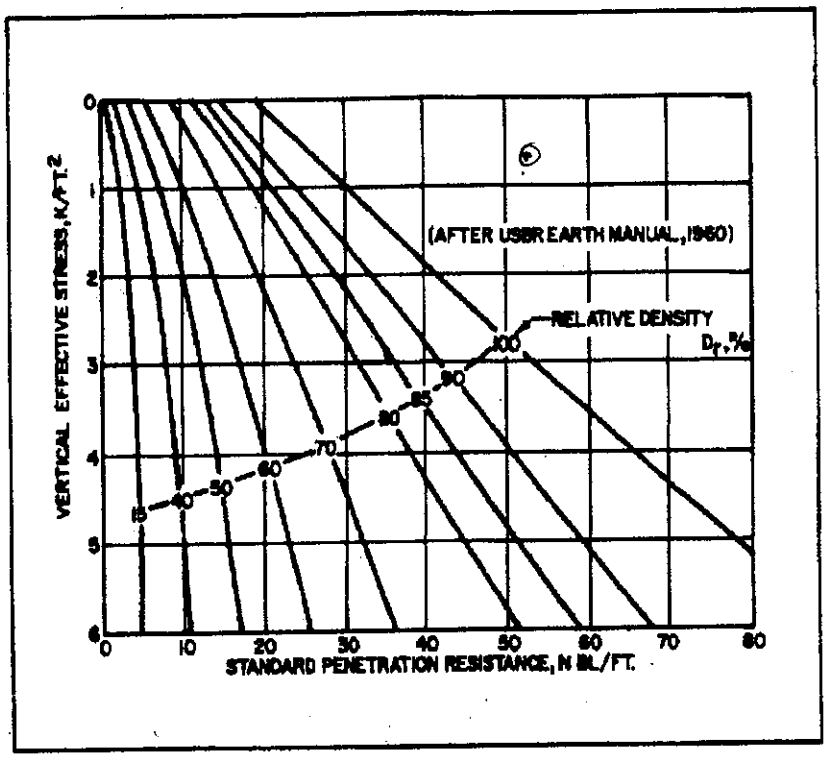


FIGURE 3
Correlations Between Relative Density and Standard Penetration Resistance in Accordance with Gibbs and Holtz

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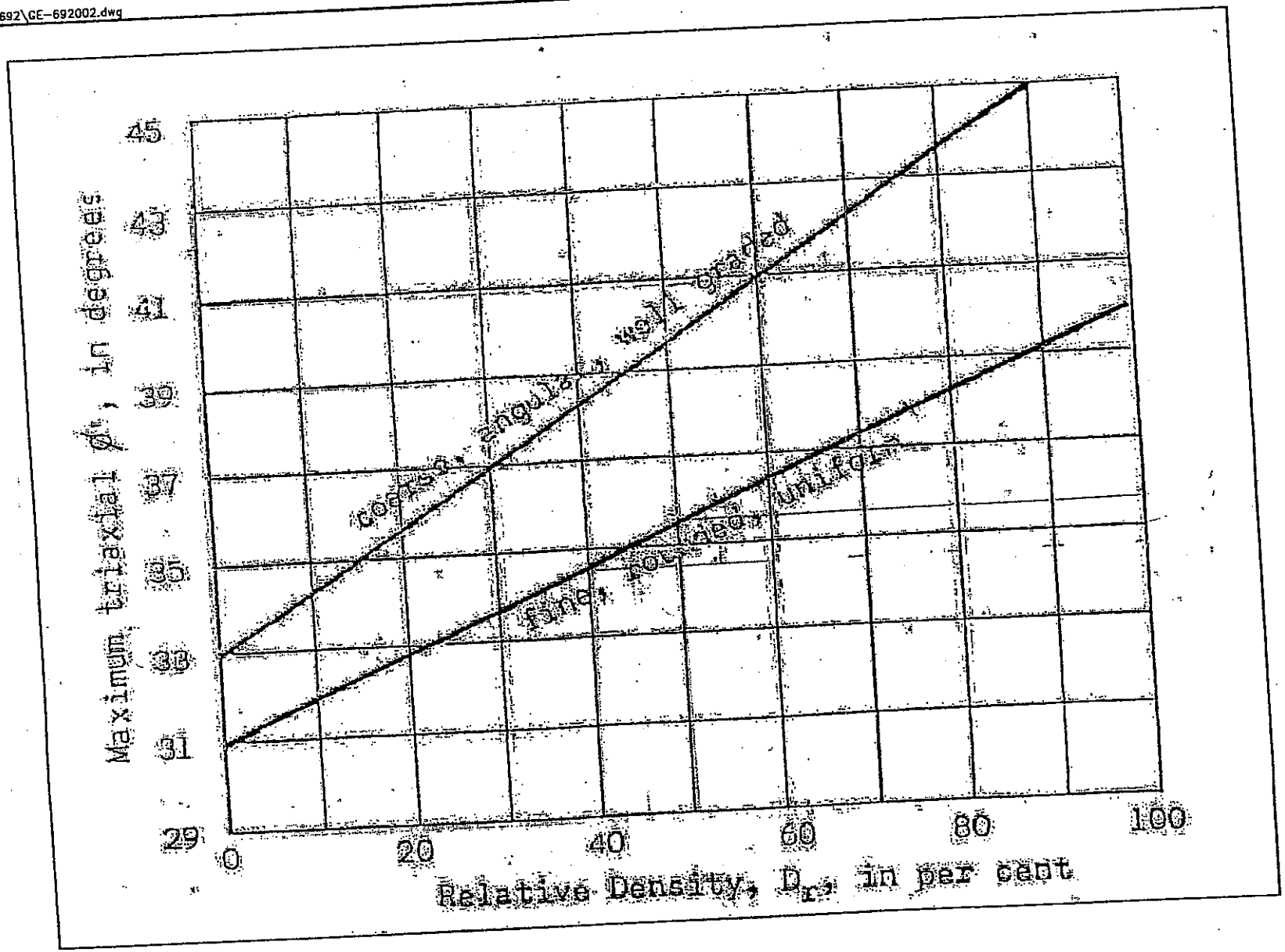


(AFTER SCHMERTMANN, 1975)

URS	Upper Llagas Creek Flood Protection Project Santa Clara County, CA	APPROXIMATE CORRELATION BETWEEN THE EFFECTIVE FRICTION ANGLE AND RELATIVE DENSITY FOR QUARTZ SANDS	NOT TO SCALE Figure 112 5/19/06

URS

Job R84 Project No. 2849640 Page 1 of ____

Description RW437 Computed by Mano Sheet ____ of ____

Checked by ____ Date 2/06/09

Date 02/19/09

Reference

Retaining Wall No. 437. – Type –1 standard Wall

Long = 1120 ft.

Maximum height = 10.6 ft

Design height = 12 ft.

Closest borings = NB25, NB25A, NB26, RB38, RB38A RB39 and RB40

Ground water elevation

All the above borings were dry during drilling. upto 380 ft

closest borg with GW reading ⇒ NB23 & 24 (Approximately 200 off away from wall

NB23 ⇒ 417 – 42.5 = 375 ft

NB24 ⇒ 417.5 – 26.5 = 391 ft.

Assume Ground water Elevation = 390 ft.

Deepest foot elevation = 408 ft.

Footing on ⇒ Silty, Clayey Sand or Lean Clay

Back fill Material ⇒ Native material.

Soil Properties were estimated from boring logs and lab results.

→ next page.

Summary

Clay = 33°

Sand = 38 to 40°

Say ϕ = 38° for design (lower bound)

Estimate Active earth Pressure Coefficient, Ka

Back slope ⇒ level

$K_a = \tan^2(45 - \phi/2)$

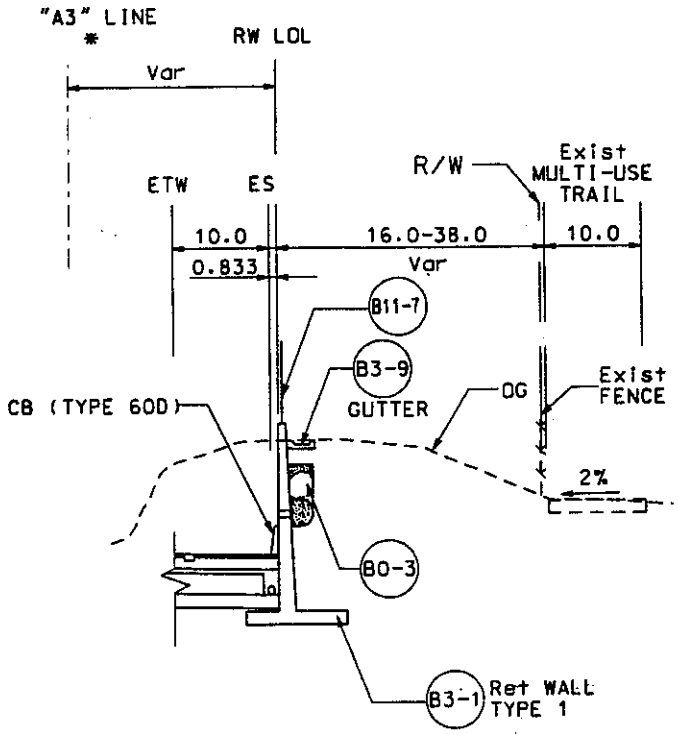
$K_a = 0.295$

Estimate Equivalent Fluid Pressure,

$= K_a \gamma$

$= 0.295 \times 130$

$= 38.4$ pcf



TYPICAL SECTION
NO SCALE

If $\phi = 35°$ ⇒ $K_a = 0.271$

EFP = 0.271×130

= 35.2 pcf

Wet Unit Weight γ_m, pcf

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	[redacted]	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)
NB25	3.5				137		SC-SM	6.9	128
NB25	8.5				135		CL	14.5	117
NB25	13.5	25	16	9			SC	7.3	129
NB25	18.5						SM	4.2	138
NB25A	13.5				131		CL	18.1	111
NB25A	18.5				137		CL	13.6	120
NB26	1.0				123		CL	6.4	116
NB26	8.5							2.7	124
NB26	18.5	21	19	2			ML	18.6	112
NB26	28.5							8.3	119
RB38	8.5				138		CL	14.7	120
RB39	1.0				128		SC-SM	4.2	123
RB39	5.0				134		CL	13.0	119
RB40	5.0	26	17	9	139		CL	15.8	120

γ_m = 123 — 139 pcf.

Say γ_m = 120 pcf for design.

Estimate Friction Angle.

Clay.

From RB40 @ 5, CL, PI = 9

ϕ = 33° ← Page 4. 4.

Sand.

Boring No.	Depth, ft	σ_v (ksf)	N_{corr}	D_r*	ϕ**
NB25	5	0.65	18 = 18	85	38
RB40	2	0.26	36 x 0.8 = 29	100	40
NB25A	10	1.3	43 x 0.8 = 34.	85	39

* See page 5

** See page 6

URS

Page 3A of ____

Job SR84 Project No. 28649640 Sheet ____ of ____

Description RW437 Computed by Mano Date 2/10/09

Bearing Capacity Checked by NU Date 12/19/09

Reference

Estimate q_{ult}

Assume placed on Native Soil. NB25, NB25A, RB38, Sand, or lean clay

Clay $\phi = 0$, $q_{ult} = cN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$.

c.

NB25	UC = 2.1 tsf	Say UC = 3000 psf = 1.5 tsf (conservative)
NB25A	= 1.5 tsf	
	2.2 tsf	
RB38	2.3 tsf	
RB37	2.0 tsf	

$C = \frac{2UC}{2}$ = 1500 psf. (conservative)

$N_c = 5.53$, $N_q = 1$, $N_\gamma = 0$ — Page 7

$D = 3$ ft.,

$q_{ult} = 5.53 \times 1500 + 130 \times 3 \times 1 + 0$

$= \underline{8,685}$ psf. ✓

Design H = 12 ft Toe Pressure = 2.8 ksf (case – 1 loading)

Above value is based on minimum cohesive value (1500)
If we select average C = 2000 psf

$q_{ult} = 11,450$

Sand $c = 0$ $\phi = 33°$, $B = 7$ ft

$N_q = 28$, $N_\gamma = 28$

$q_{ult} = 0 + 130 \times 3 \times 28 + \frac{130 \times 7}{2} \times 28$

$= \underline{23660}$ psf

Summary

Say $q_{ult} = 10500$ psf,

$q_{all} = 3500$ psf

From:- An Introduction to Geotechnical Engineering, Holtz & Kovacs

Page 544.

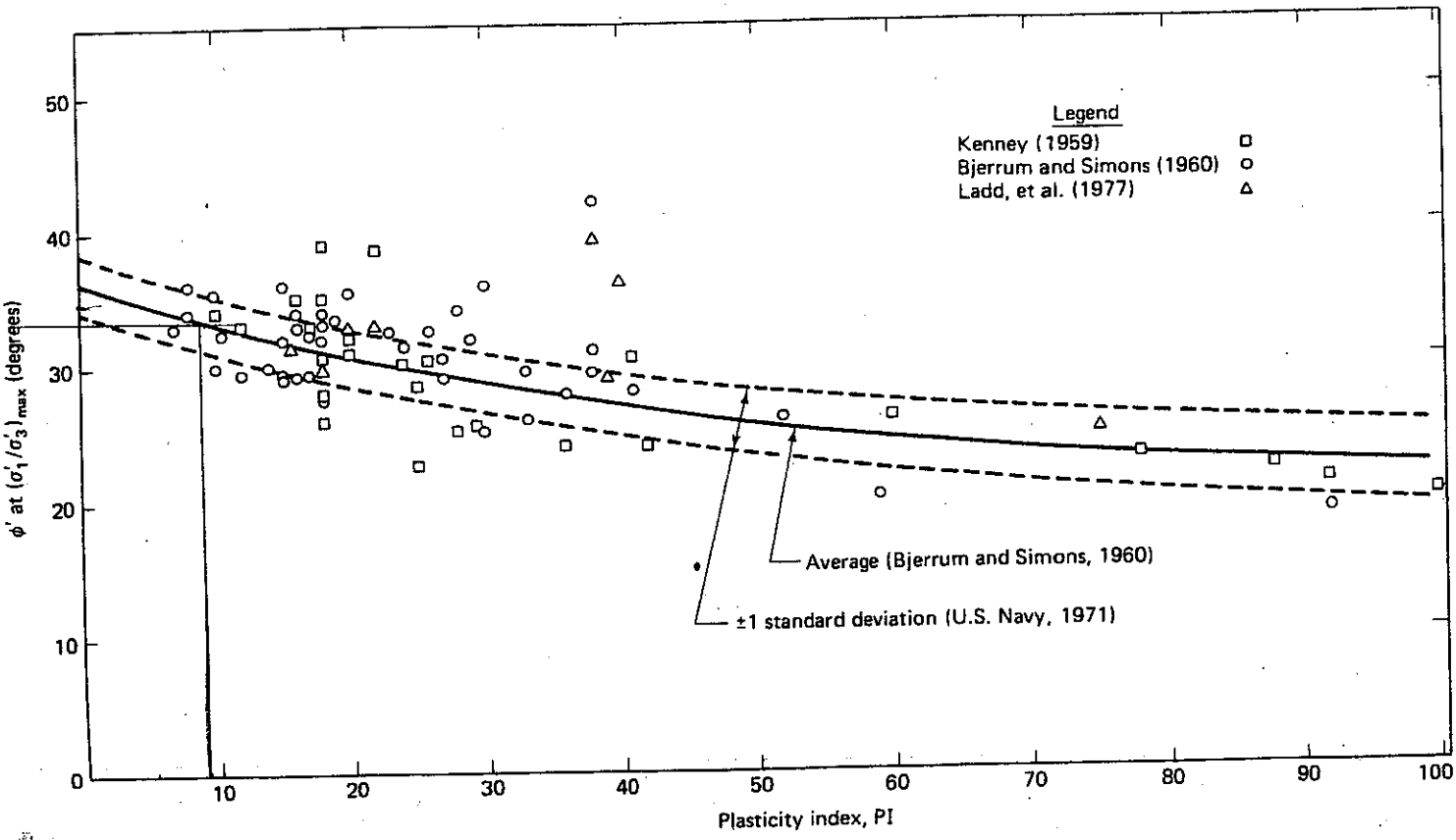


Fig. 11.27 Empirical correlation between ϕ' and PI from triaxial compression tests on normally consolidated undisturbed clays (after U.S. Navy, 1971 and Ladd et al. 1977).

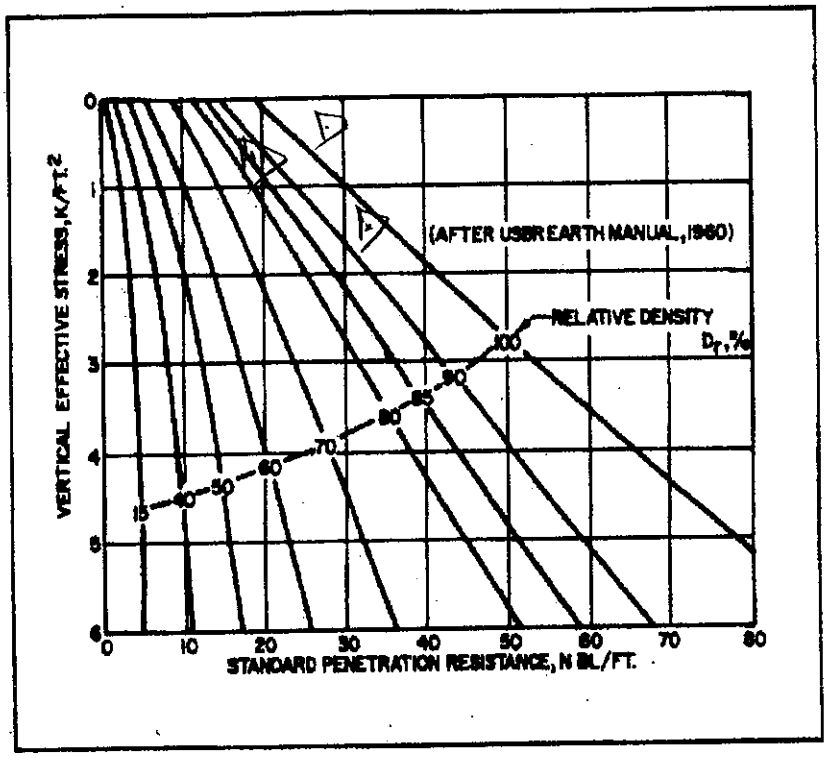


FIGURE 3
Correlations Between Relative Density and Standard Penetration Resistance in Accordance with Gibbs and Holtz

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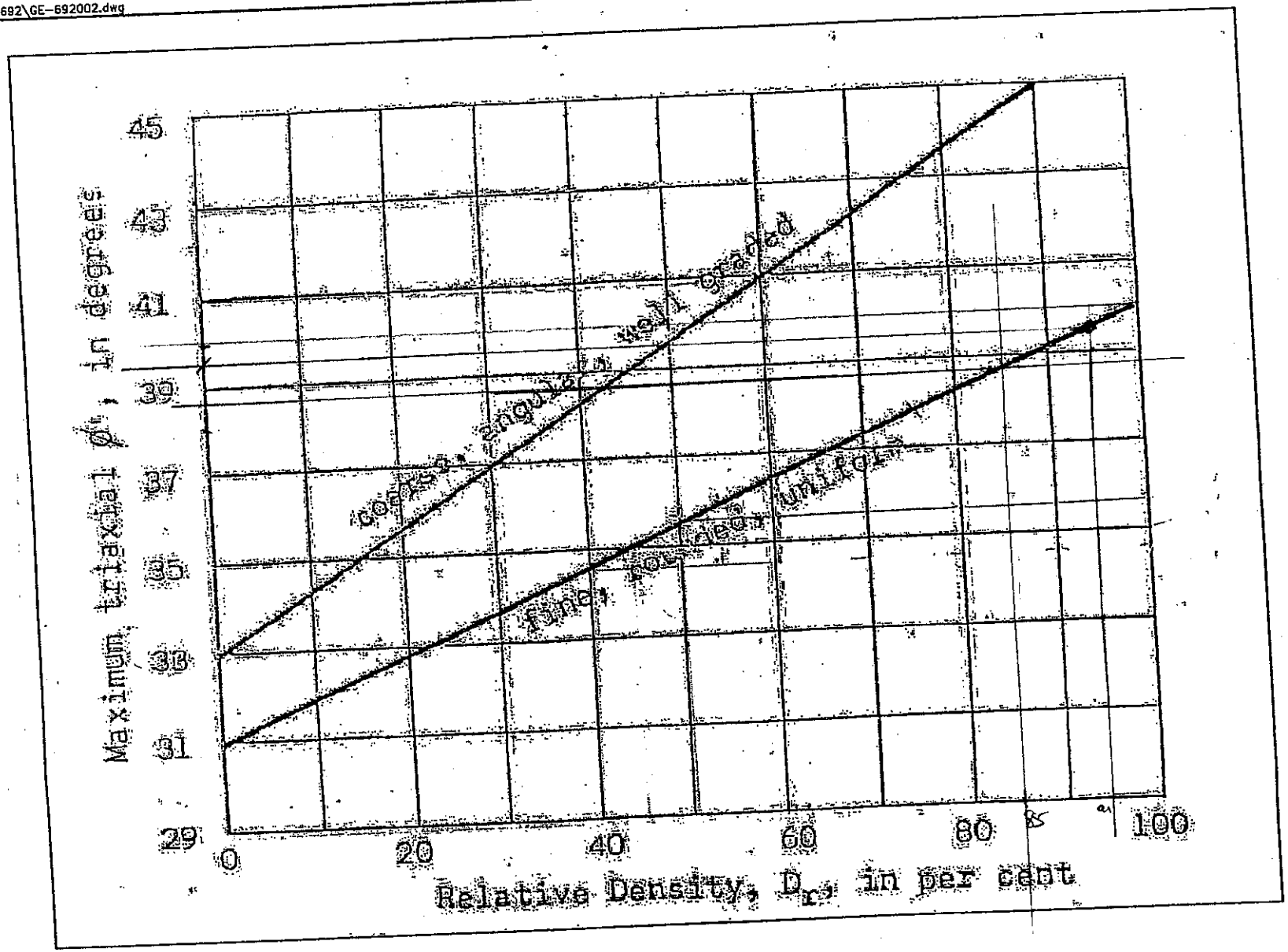
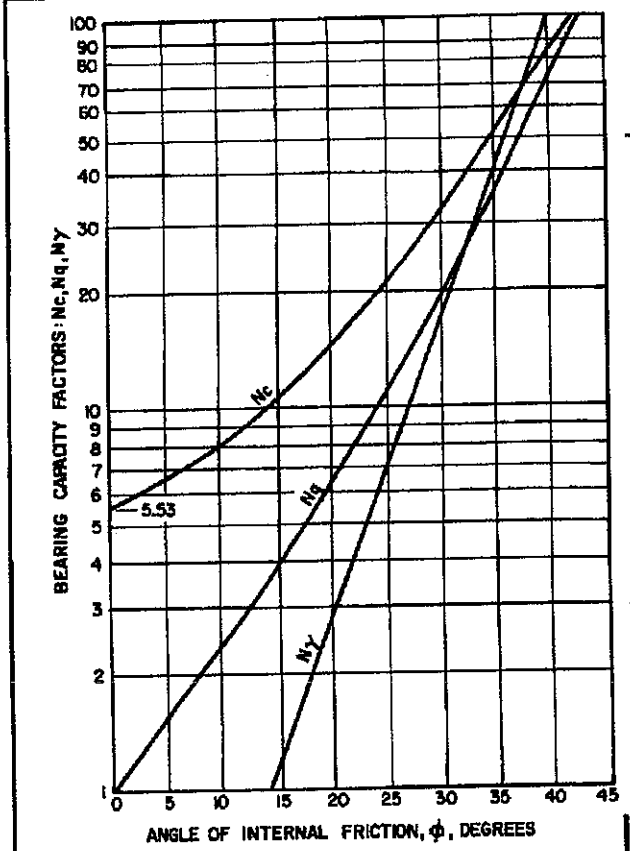


(AFTER SCHMERTMANN, 1975)

URS	Upper Llagas Creek Flood Protection Project Santa Clara County, CA	APPROXIMATE CORRELATION BETWEEN THE EFFECTIVE FRICTION ANGLE AND RELATIVE DENSITY FOR QUARTZ SANDS	NOT TO SCALE Figure 112 5/19/06



ULTIMATE BEARING CAPACITY = q_{ult}

CONTINUOUS FOOTING; GENERAL CASE

$q_{ult} = q' + q''$

q' = PORTION OF BEARING CAPACITY ASSUMING WEIGHTLESS FOUNDATION SOIL

q'' = PORTION OF BEARING CAPACITY FROM WEIGHT OF FOUNDATION SOILS

$q' = cN_c + \gamma DN_q$

$q'' = \gamma \frac{B}{2} N\gamma$

$q_{ult} = cN_c + \gamma DN_q + \frac{\gamma B}{2} N\gamma$

SQUARE OR RECTANGULAR FOOTING

$q_{ult} = cN_c\,(1 + .3\frac{B}{L}) + \gamma DN_q + 0.4\gamma BN_\gamma$

CIRCULAR FOOTING: R = B/2

$q_{ult} = 1.3\,cN_c + \gamma DN_q + 0.6\gamma RN_\gamma$

FOR COHESIONLESS FOUNDATION SOILS (c = 0)

CONTINUOUS FOOTING:

$q_{ult} = \gamma DN_q + \frac{\gamma B}{2} N\gamma$

SQUARE OR RECTANGULAR FOOTING:

$q_{ult} = \gamma DN_q + 0.4\gamma BN_\gamma$

CIRCULAR FOOTING:

$q_{ult} = \gamma DN_q + 0.6\gamma RN_\gamma$

FOR COHESIVE FOUNDATION SOILS (ϕ = 0)

CONTINUOUS FOOTING:

$q_{ult} = cN_c + \gamma D$

SQUARE OR RECTANGULAR FOOTING:

$q_{ult} = cN_c(1 + .3\frac{B}{L}) + \gamma D$

CIRCULAR FOOTING:

$q_{ult} = 1.3\,cN_c + \gamma D$

ASSUMED CONDITIONS:

1. $D \leq B$
2. SOIL IS UNIFORM TO DEPTH $d_o > B$.
3. WATER LEVEL LOWER THAN d_o BELOW BASE OF FOOTING.
4. VERTICAL LOAD CONCENTRIC.
5. FRACTION AND ADHESION ON VERTICAL SIDES OF FOOTING ARE NEGLECTED.
6. FOUNDATION SOIL WITH PROPERTIES c, ϕ, γ

FIGURE 1
Ultimate Bearing Capacity of Shallow Footings With Concentric Loads

URS

Job R84 Project No. 28649610 Page 1 of ____

Description RW109 Computed by Mano Sheet 1 of ____

Checked by MW Date 02/18/09

Reference

Date 2/06/09

Retaining Wall No. 109 – Type-1 Standard Wall.

Long = 395.7 ft.

Maximum height = 12.64 ft

Design height = 14 ft.

Closest borings = NB33, NB34 & NB35

Ground water Elevation

NB33 & NB34 ⇒ dry upto 474 ft during drilling

NB35 ⇒ 472.5 ft during drilling.

Assume GW Elevation = 472 ft.

Back fill material ⇒ Embankment fill Material.

Assume $\gamma = 130$ pcf

$\phi = 32°$

Back slope ≃ level.

Active earth pressure coefficient, K_a

$K_a = \tan^2(45 - \phi/2)$

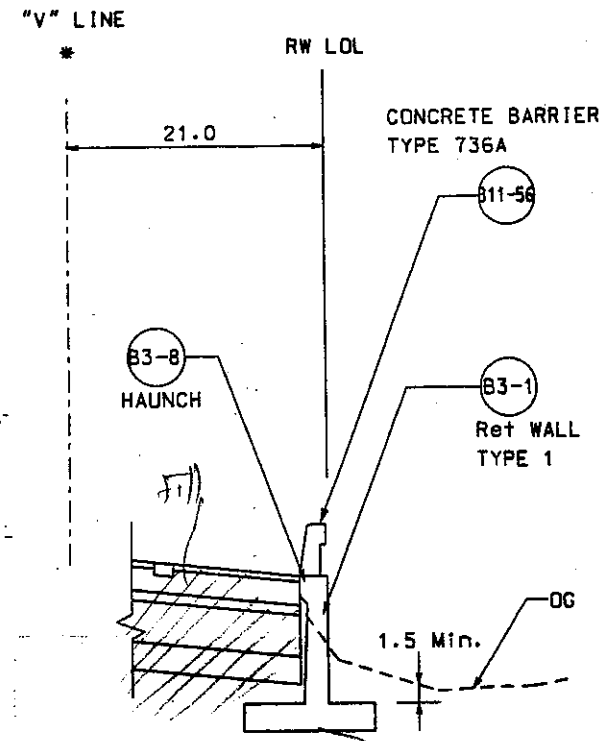
$= 0.295$

Equivalent Fluid Pressure (EFP)

$EFP = K_a \cdot \gamma$

$= 0.295 \times 130$

$= 38.4$ pcf



If we assume the fill material $\phi = 35$, $\gamma = 130$

EFP = 35.2 pcf ≃ 36 pcf OK

URS

Job SR 84 | Project No. 28649610 | Page 2 of ____
Description RW 109 | Computed by Mano | Sheet ____ of ____
Checked by MU | Date 2/10/09 | Date 02/18/09
Reference

Estimate q_{ult}.

Assume placed on Native Soil NB 33, NB 34 & NB 35

1) Sand and Gravel $c = 0$ $\phi = 33°$

BOFE ⇒ Vary from 492.8 to 480.5 ft.

Design height $H = 14$ ft, Toe pres = 3.3 ksf.

$B = 8'$, $D = 3$ ft.

$N_q = 28$, $N_\gamma = 28$

$$q_{ult} = 0 + 130 \times 3 \times 28 + \frac{130 \times 8 \times 28}{2}$$

$$= 25,480 \text{ psf}. \checkmark$$

. Toe Pressure (3.3) ksf

2) q_{ult} ⇒ Assume Placed on Clay

NB 34 @ 5' PP = > 4.5
25' UC = 7.4 tsf

NB 33 & NB 34 Clay Layer high blow Counts.

Assume $c = 2500$ psf, $\phi = 0$

$N_c = 5.53$ $N_q = 1$, $N_\gamma = 0$

$$q_{ult} = 2,500 \times 5.53 + 130 \times 3 \times 1 + 0$$

$$= 14,215 \text{ psf}$$

Summary

Say $q_{ult} = 13,500$ psf

$q_{all} = 4,500$ psf ✓

URS

Job SR84 Project No. 28649640 Page 3 of ____

Description RW109 Computed by Manon Date 2/10/09 Sheet ____ of ____

Checked by MW Date 02/18/09

Reference

Liquefaction Analysis

boring NB35

blow count = 34 (Modified Cal.)

Silty Sand (6 — 13.5 ft). [481 — 473.5 ft)

GW elev 473 ± 5 ft => 478 ft.

see page 4

URS

Job R-84 Project No. 28649640 Page 1 of ____

Description RW110 Computed by Mano Sheet ____ of ____

Checked by MM Date 02/19/09

Date 2/06/09

Reference

Retaining Wall No. #10. — Type-1 Standard Wall

Long = 546.1 ft

maximum height = 11.4 ft.

Design height = 12 ft.

Closest borings = NB 35 and NB 36.

Ground water Elev. = 473 ft (NB 35, NB 36 – Dry).

Deepest footing elev. = 482 ft.

Footing on ⟹ Silty Sand or/ Sandy lean clay.

Back fill ⇒ Embankment fill material.

for Fill material.

$\gamma_m = 130$ pcf

$\phi = 33°$

Back slope = level.

Active earth pressure coefficient.

$K_a = \tan^2(45 - \phi/2)$

$= 0.295$.

Equivalent Fluid Pressure (EFP)

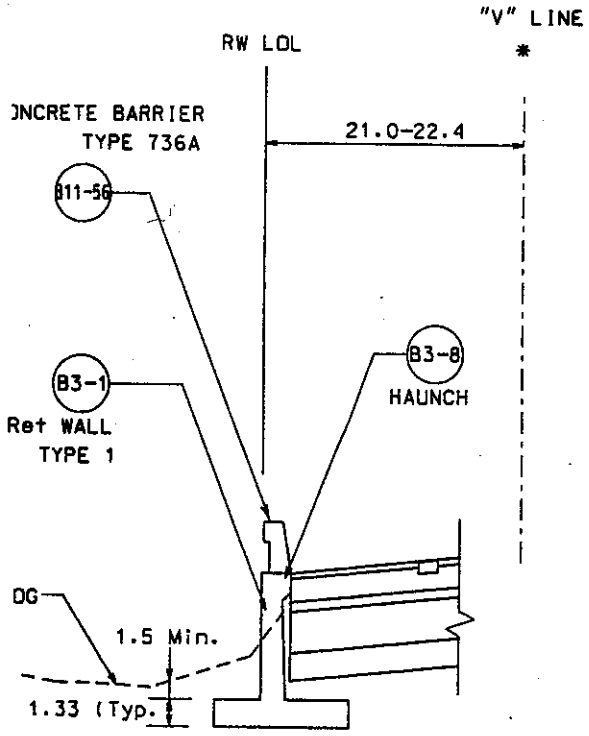
$= K_a \gamma$

$= 0.295 \times 130$

$= 38.4$ pcf.

If fill – $\phi = 35°$, $\gamma = 130$

EFP = 35.2 pcf < 36.



* Standard wall Design is for a 120 pcf unit weight soil.

Estimate $q_{ult} = CN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$

Assume placed on Native soil.

NB-35 & NB36

① Sand & Gravel $\phi = 33^\circ$ & $c = 0$ $D = 3$ ft

Design height; $h = 12$ ft, $B = 7$ ft } from Stad Plan.

Toe Pressure = 2.8 ksf

$N_q = N_\gamma = 28$

$q_{ult} = 0 + 130 \times 3 \times 28 + \frac{130 \times 7}{2} \times 28$

$= 23660$ psf

② Clay.

all clay layers ⇒ high blow counts /foot.

except the layer 13.5 to 17 ft in NB 35.

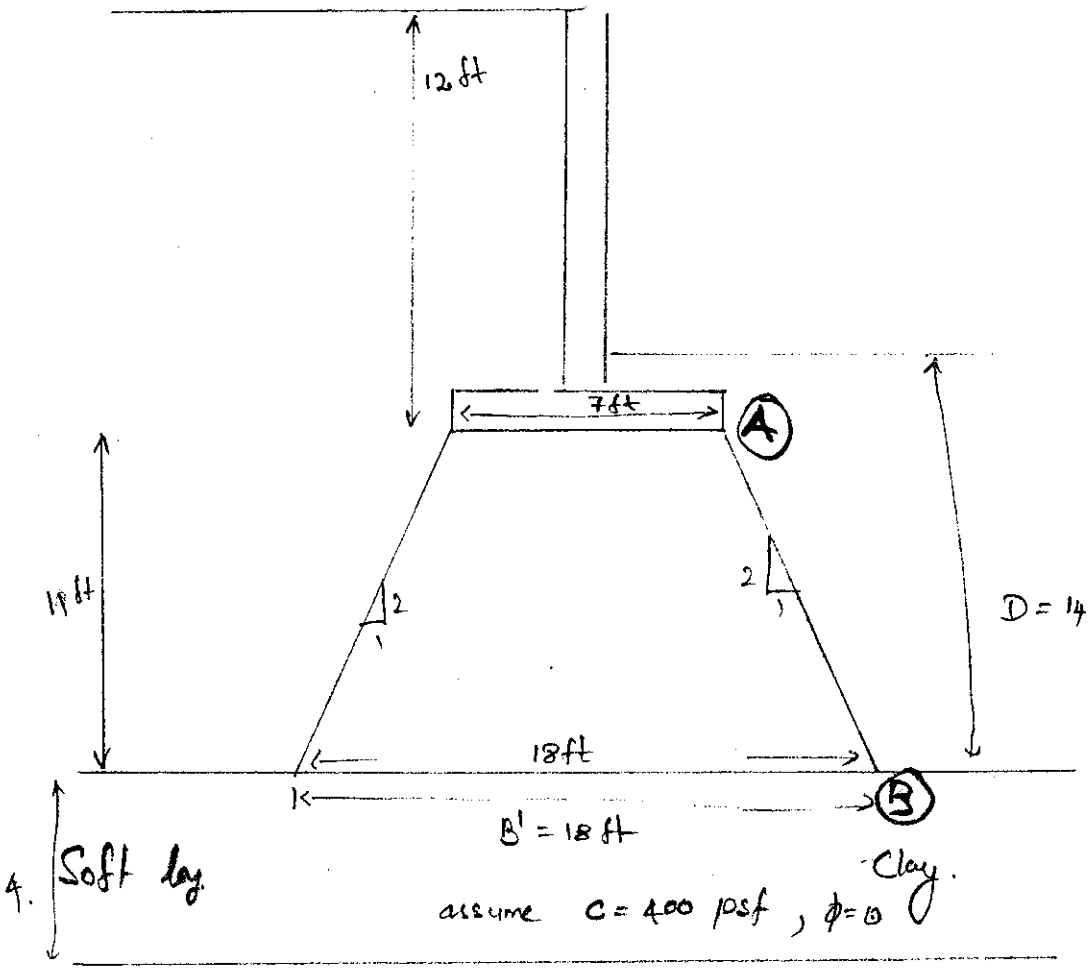
(A) Assume $c = 2000$ psf $\phi = 0$

$N_c = 5.53$, $N_q = 1$ $N_\gamma = 0$

$q_{uH} = 5.53 \times 2000 + 130 \times 3 \times 1 + 0$

$= 11450$ psf ← based on the soil directly under footing

(B) Consider Soft Clay layer in NB35.



$= cN_c + \gamma D N_q + \frac{1}{2} \gamma B' N_\gamma$ $\quad N_\gamma = 0$, $N_q = 1$, $N_c = 5.53$

$(q_{ult})_{Point\ B} = 400 \times 5.53 + 130 \times 14 \times 1 + 0$

$= 4032$ psf

$(q_{all})_B = q_{ult}/3 = 1344$ psf

$(q_{all}) \times 18 = (q_{all})_A \times 7.$

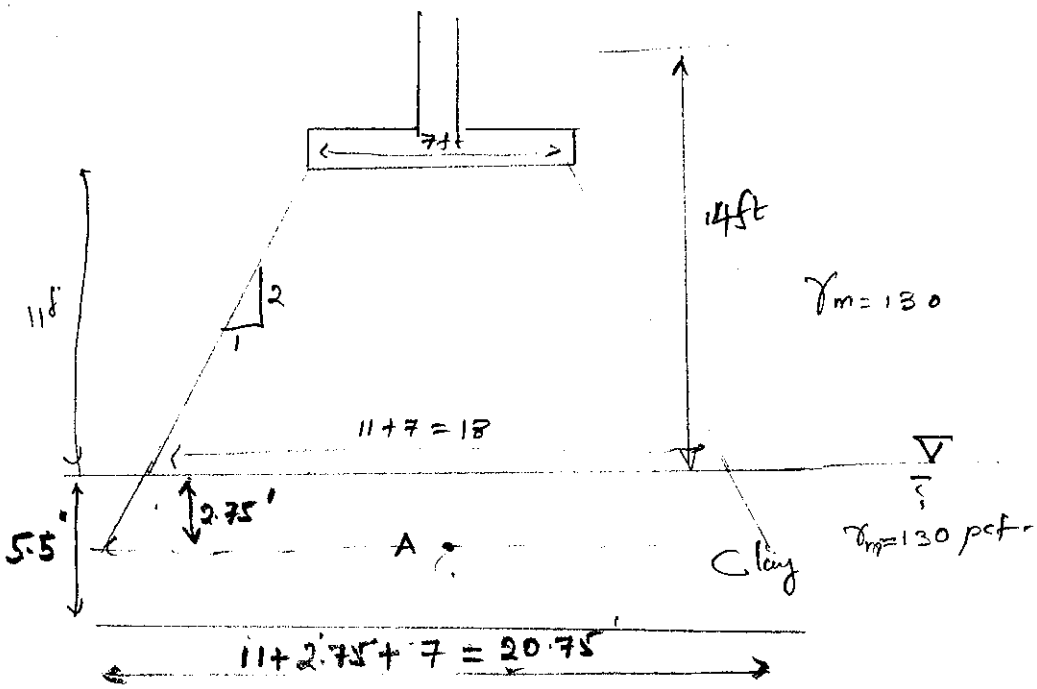
$(q_{all})_A = 3,458$

$(q_{ult})_A = 10,366$ psf.

Say $q_{ult\ min.} = 10,366$

Say $q_{ult} = 10,500$

$q_{all} = 3500$ psf



Initial Pressure @ A $P_o = 14 \times 130 + 2.75(130 - 62.4)$

$= 2005.9 = 2006$ psf

Assume Toe Pressure = 2.8 ksf

$\Delta p = \frac{7 \times 2800}{20.75} = 944.6$

$= 945$ psf

$P_f = P_o + \Delta p = 2006 + 945 = 2951$

Consolidation Settlement

$$\Delta H = \frac{C_c H}{1 + e_o} \log\left(\frac{P_o + \Delta P}{P_o}\right)$$

see page — DM 7.1-206

$C_c = 0.009 (LL - 10)$ ——— NAVFAC 7.1-224.

$LL = 85$

(1) $\frac{C_c}{1+e_o} = \frac{.135}{1.44} = 0.09$

$C_c = 0.009(25-10)$

$= 0.135$

(2) $\frac{C_c}{1+e_o} = 0.04$ (LL) ← see Page 12

$e_o = \frac{(SG)\gamma_w - \gamma_d}{\gamma_d}$

$= \frac{2.7 \times 62.4 - 117}{117}$

$= 0.44$

$\frac{C_r}{1+e_o} = .2 \times .09 = 0.018$

$\frac{C_r}{1+e_o} = .2 \times .04 = 0.008$ } say .018

for OC Clay

$C_r = \frac{1}{10} - \frac{1}{5}$ of C_c

Say $C_r = 0.2 C_c$

For OC clay.

$$\Delta H = \left(\frac{C_r}{1+e_o}\right)(H)\log\left(\frac{P_o + \Delta P}{P_o}\right)$$

$= (0.018)(5.5)\log\left(\frac{2951}{2006}\right)$

$= 0.0166$ ft

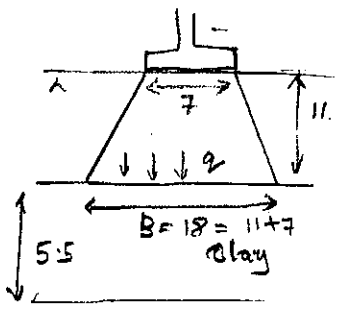
$= 0.2$ inch $\leq \frac{1}{4}$"

Immediate Settlement of Clay layer — see Page 9

$$\delta_v = \frac{qB}{E_u}(1-\nu^2) I$$ ——— DM 7.1-211

$H/B = \frac{5.5}{18} = 0.31$ $\nu = 0.5$, $L/B = \infty$ — see page 10

$I = 0.024$



$\frac{E_u}{C} = 600$ see Page 11

$E_u = 600 \times 400 = 240$ ksf

$$q = \frac{2800 \times 7}{18} = 1088.9 \quad \text{(Toe Press. 2.8 tsf)}$$

$$= 1089 \text{ psf}$$

$$\delta_v = \frac{(1089)(18)(1-0.5^2)0.024}{240{,}000}$$

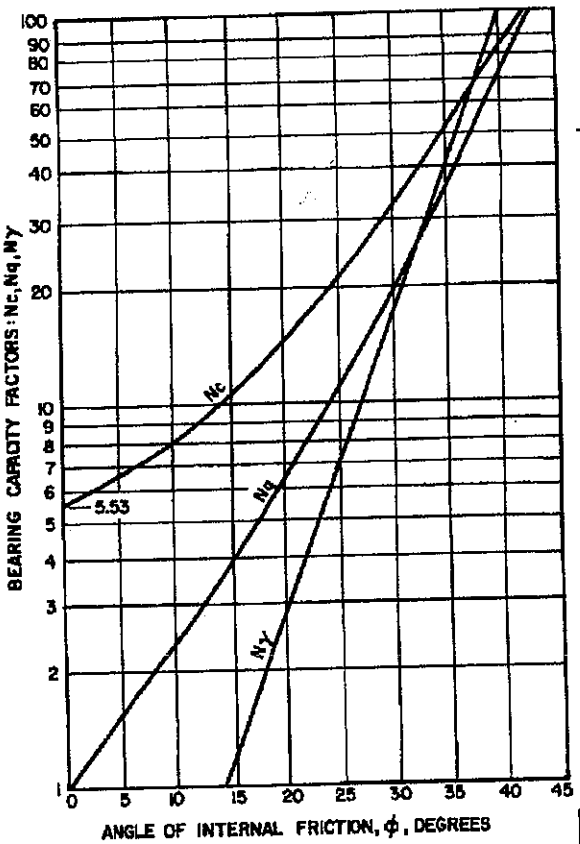
$$= 0.00147 \text{ ft.}$$

$$= 0.02 \text{ inch.}$$

Total Settlement = Consolidation + Immediate.

$$= 0.2 + 0.02$$

$$= 0.22 \text{ inch} \quad < \tfrac{1}{4} \text{ inch.}$$



ULTIMATE BEARING CAPACITY = q_{ult}

CONTINUOUS FOOTING; GENERAL CASE

$q_{ult} = q' + q''$

q' = PORTION OF BEARING CAPACITY ASSUMING WEIGHTLESS FOUNDATION SOIL

q'' = PORTION OF BEARING CAPACITY FROM WEIGHT OF FOUNDATION SOILS

$q' = cN_c + \gamma D N_q$

$q'' = \gamma \frac{B}{2} N\gamma$

$q_{ult} = cN_c + \gamma D N_q + \frac{\gamma B}{2} N\gamma$

SQUARE OR RECTANGULAR FOOTING

$q_{ult} = cN_c\,(1 + .3\frac{B}{L}) + \gamma D N_q + 0.4\gamma B N_\gamma$

CIRCULAR FOOTING: R = B/2

$q_{ult} = 1.3\,cN_c + \gamma D N_q + 0.6\gamma R N_\gamma$

FOR COHESIONLESS FOUNDATION SOILS (c = 0)

CONTINUOUS FOOTING:

$q_{ult} = \gamma D N_q + \frac{\gamma B}{2} N\gamma$

SQUARE OR RECTANGULAR FOOTING:

$q_{ult} = \gamma D N_q + 0.4\gamma B N_\gamma$

CIRCULAR FOOTING:

$q_{ult} = \gamma D N_q + 0.6\gamma R N_\gamma$

FOR COHESIVE FOUNDATION SOILS (ϕ = 0)

CONTINUOUS FOOTING:

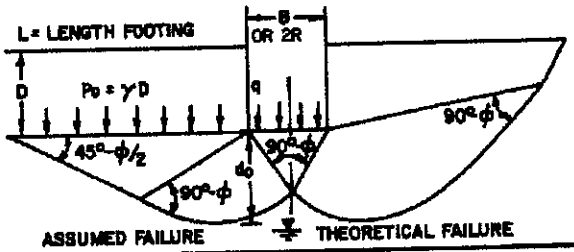
$q_{ult} = cN_c + \gamma D$

SQUARE OR RECTANGULAR FOOTING:

$q_{ult} = cN_c\,(1 + .3\frac{B}{L}) + \gamma D$

CIRCULAR FOOTING:

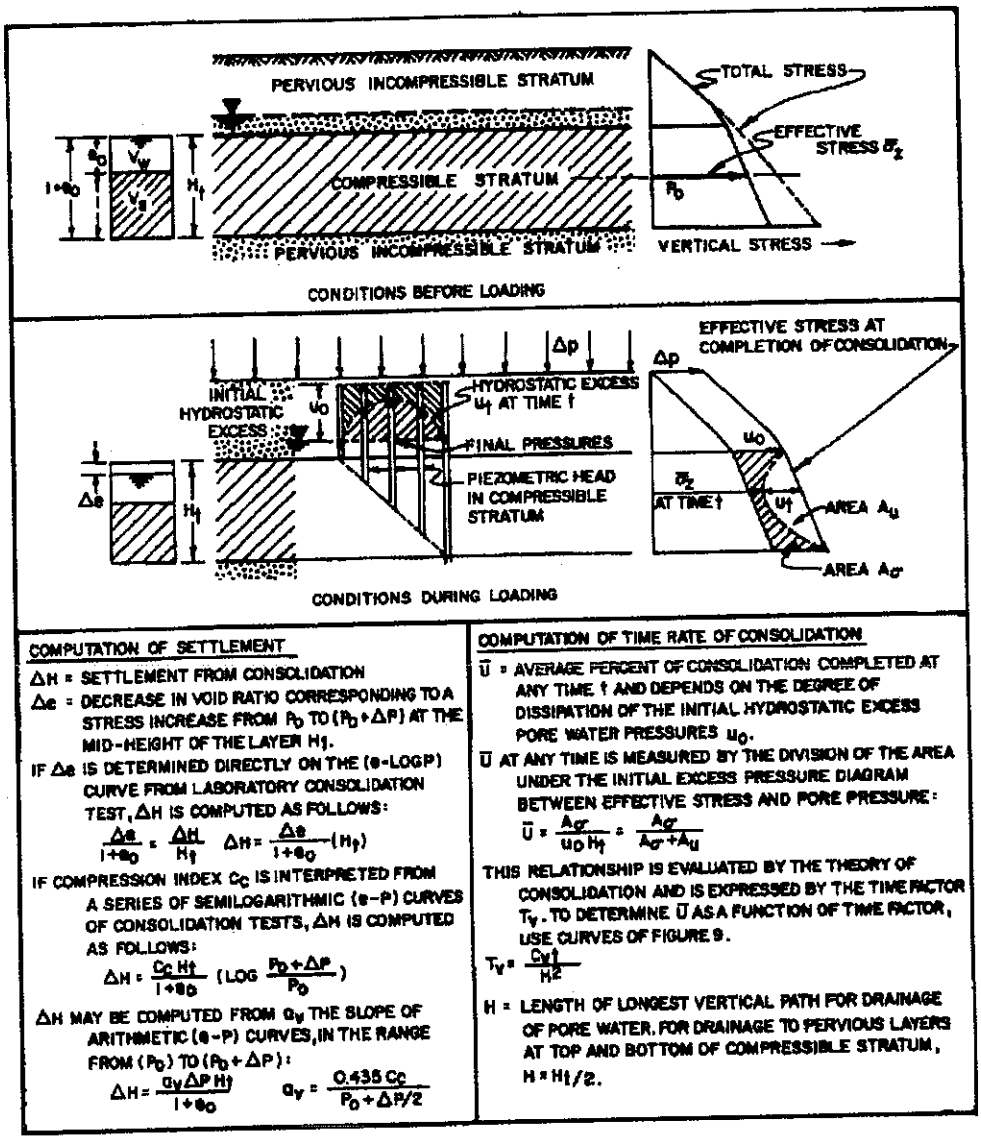
$q_{ult} = 1.3\,cN_c + \gamma D$



ASSUMED CONDITIONS:

1. $D \leq B$
2. SOIL IS UNIFORM TO DEPTH $d_o > B$.
3. WATER LEVEL LOWER THAN d_o BELOW BASE OF FOOTING.
4. VERTICAL LOAD CONCENTRIC.
5. FRACTION AND ADHESION ON VERTICAL SIDES OF FOOTING ARE NEGLECTED.
6. FOUNDATION SOIL WITH PROPERTIES c, ϕ, γ

FIGURE 1
Ultimate Bearing Capacity of Shallow Footings With Concentric Loads



COMPUTATION OF SETTLEMENT

ΔH = SETTLEMENT FROM CONSOLIDATION

Δe = DECREASE IN VOID RATIO CORRESPONDING TO A STRESS INCREASE FROM P_0 TO $(P_0+\Delta P)$ AT THE MID-HEIGHT OF THE LAYER H_t.

IF Δe IS DETERMINED DIRECTLY ON THE (e-LOGP) CURVE FROM LABORATORY CONSOLIDATION TEST, ΔH IS COMPUTED AS FOLLOWS:

$$\frac{\Delta e}{1+e_0} = \frac{\Delta H}{H_t} \qquad \Delta H = \frac{\Delta e}{1+e_0}(H_t)$$

IF COMPRESSION INDEX C_c IS INTERPRETED FROM A SERIES OF SEMILOGARITHMIC (e-P) CURVES OF CONSOLIDATION TESTS, ΔH IS COMPUTED AS FOLLOWS:

$$\Delta H = \frac{C_c H_t}{1+e_0}\left(\text{LOG}\ \frac{P_0+\Delta P}{P_0}\right)$$

ΔH MAY BE COMPUTED FROM a_v THE SLOPE OF ARITHMETIC (e-P) CURVES, IN THE RANGE FROM (P_0) TO $(P_0+\Delta P)$:

$$\Delta H = \frac{a_v \Delta P H_t}{1+e_0} \qquad a_v = \frac{0.435\, C_c}{P_0+\Delta P/2}$$

COMPUTATION OF TIME RATE OF CONSOLIDATION

$\bar{U}$ = AVERAGE PERCENT OF CONSOLIDATION COMPLETED AT ANY TIME t AND DEPENDS ON THE DEGREE OF DISSIPATION OF THE INITIAL HYDROSTATIC EXCESS PORE WATER PRESSURES u_0.

$\bar{U}$ AT ANY TIME IS MEASURED BY THE DIVISION OF THE AREA UNDER THE INITIAL EXCESS PRESSURE DIAGRAM BETWEEN EFFECTIVE STRESS AND PORE PRESSURE:

$$\bar{U} = \frac{A_{\bar{\sigma}}}{u_0 H_t} = \frac{A_{\bar{\sigma}}}{A_{\bar{\sigma}}+A_u}$$

THIS RELATIONSHIP IS EVALUATED BY THE THEORY OF CONSOLIDATION AND IS EXPRESSED BY THE TIME FACTOR T_v. TO DETERMINE $\bar{U}$ AS A FUNCTION OF TIME FACTOR, USE CURVES OF FIGURE 9.

$$T_v = \frac{C_v t}{H^2}$$

H = LENGTH OF LONGEST VERTICAL PATH FOR DRAINAGE OF PORE WATER. FOR DRAINAGE TO PERVIOUS LAYERS AT TOP AND BOTTOM OF COMPRESSIBLE STRATUM, $H = H_t/2$.

FIGURE 1
Consolidation Settlement Analysis

Immediate settlement δ_v is estimated as:

$$\delta_v = q\ B\ \left(\frac{1-\nu^2}{E_u}\right) I$$

q is applied uniform pressure; B is width of loaded area; I is combined shape and rigidity factor; ν is Poisson's ratio - ranges between 0.3 and 0.5, the higher value being for saturated soil with no volume change during loading; and E_u is undrained modulus obtained from laboratory or field (pressuremeter) tests. Table 1 (Reference 1, Stresses and Deflections in Foundations and Pavements, by Department of Civil Engineering, University of California, Berkeley) provides values of I. Empirical relationship derived from field measurement may be used to determine E_u when actual test values are not available; see Table 2 (adapted from Reference 2, An Engineering Manual For Settlement Studies, by Duncan and Buchignani). Empirical correlations for estimation of OCR (Over Consolidation Ratio) are presented in Chapter 3.

If the factor of safety against bearing failure (see DM-7.2, Chapter 4) is less than about 3, then the immediate settlement δ_v is modified as follows:

$$\delta_c = \delta_{v/SR}$$

δ_c = immediate settlement corrected to allow for partial yield condition

SR = Settlement Ratio

Determine SR from Figure 4 (Reference 3, Initial Settlement of Structures on Clay, by D'Appolonia, et al.). See Figure 5 for an example.

2. SETTLEMENT OF COARSE-GRAINED SOILS. This immediate settlement is a function of the width and depth of footing, elevation of the water table, and the modulus of vertical subgrade reaction (K_{v1}) within the depth affected by the footing. Figure 6 may be used to estimate K_{v1} from the soil boring log, and to compute anticipated settlement.

For large footings where soil deformation properties vary significantly with depth or where the thickness of granular soil is only a fraction of the width of the loaded area, the method in Figure 6 may underestimate settlement.

3. TOTAL SETTLEMENT IN GRANULAR SOILS. Total settlement is the combined effect of immediate and long-term settlements. A usually conservative estimate of settlement can be made utilizing the method in Figure 7 (Reference 4, Static Cone to Compute Static Settlement Over Sand, by Schmertmann). A review of methods dealing with settlement of sands utilizing the standard penetration test results can be found in Reference 5, Equivalent Linear Model for Predicting Settlements of Sand Bases, by Oweis.

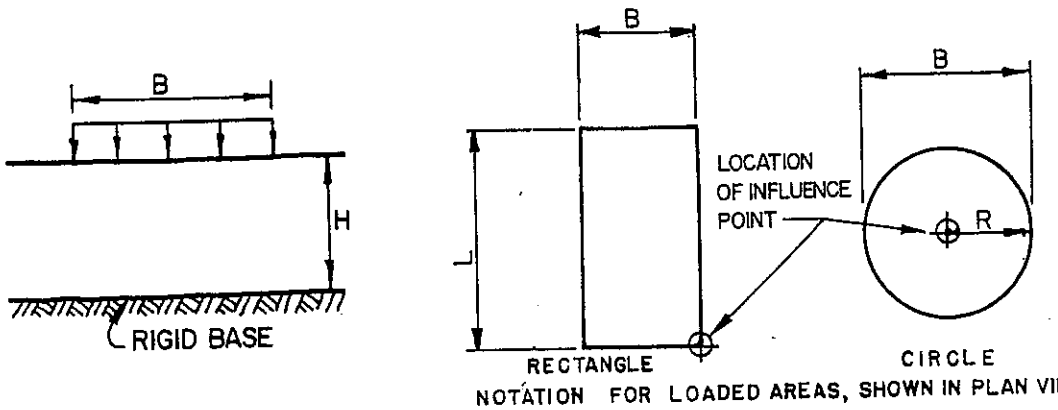
TABLE 1 (continued)
Shape and Rigidity Factors I for Calculating Settlements
of Points on Loaded Areas at the Surface of an Elastic Half-Space

Shape and Rigidity Factor I for Loaded Areas
on an Elastic Half-Space of Limited Depth Over a Rigid Base

H/B	Center of Rigid Circular Area Diameter = B	Corner of Flexible Rectangular Area				
		L/B = 1	L/B = 2	L/B = 5	L/B = 10	(strip) L/B = ∞
for ν = 0.50						
0	0.00	0.00	0.00	0.00	0.00	0.00
0.5	0.14	0.05	0.04	0.04	0.04	0.04
1.0	0.35	0.15	0.12	0.10	0.10	0.10
1.5	0.48	0.23	0.22	0.18	0.18	0.18
2.0	0.54	0.29	0.29	0.27	0.26	0.26
3.0	0.62	0.36	0.40	0.39	0.38	0.37
5.0	0.69	0.44	0.52	0.55	0.54	0.52
10.0	0.74	0.48	0.64	0.76	0.77	0.73
for ν = 0.33						
0	0.00	0.00	0.00	0.00	0.00	0.00
0.5	0.20	0.09	0.08	0.08	0.08	0.08
1.0	0.40	0.19	0.18	0.16	0.16	0.16
1.5	0.51	0.27	0.28	0.25	0.25	0.25
2.0	0.57	0.32	0.34	0.34	0.34	0.34
3.0	0.64	0.38	0.44	0.46	0.45	0.45
5.0	0.70	0.46	0.56	0.60	0.61	0.61
10.0	0.74	0.49	0.66	0.80	0.82	0.81

(AVG) = 0.445

I = (0.445)(4) = 1.78



NOTATION FOR LOADED AREAS, SHOWN IN PLAN VIEW

TABLE 2
Relationship Between Undrained Modulus and Overconsolidation Ratio

OCR*	Eu/c*		
	PI<30	30<PI<50	PI>50
<3	600	300	125
3 - 5	400	200	75
>5	150	75	50

* OCR = Overconsolidation ratio

c = Undrained shear strength

PI = Plastic index

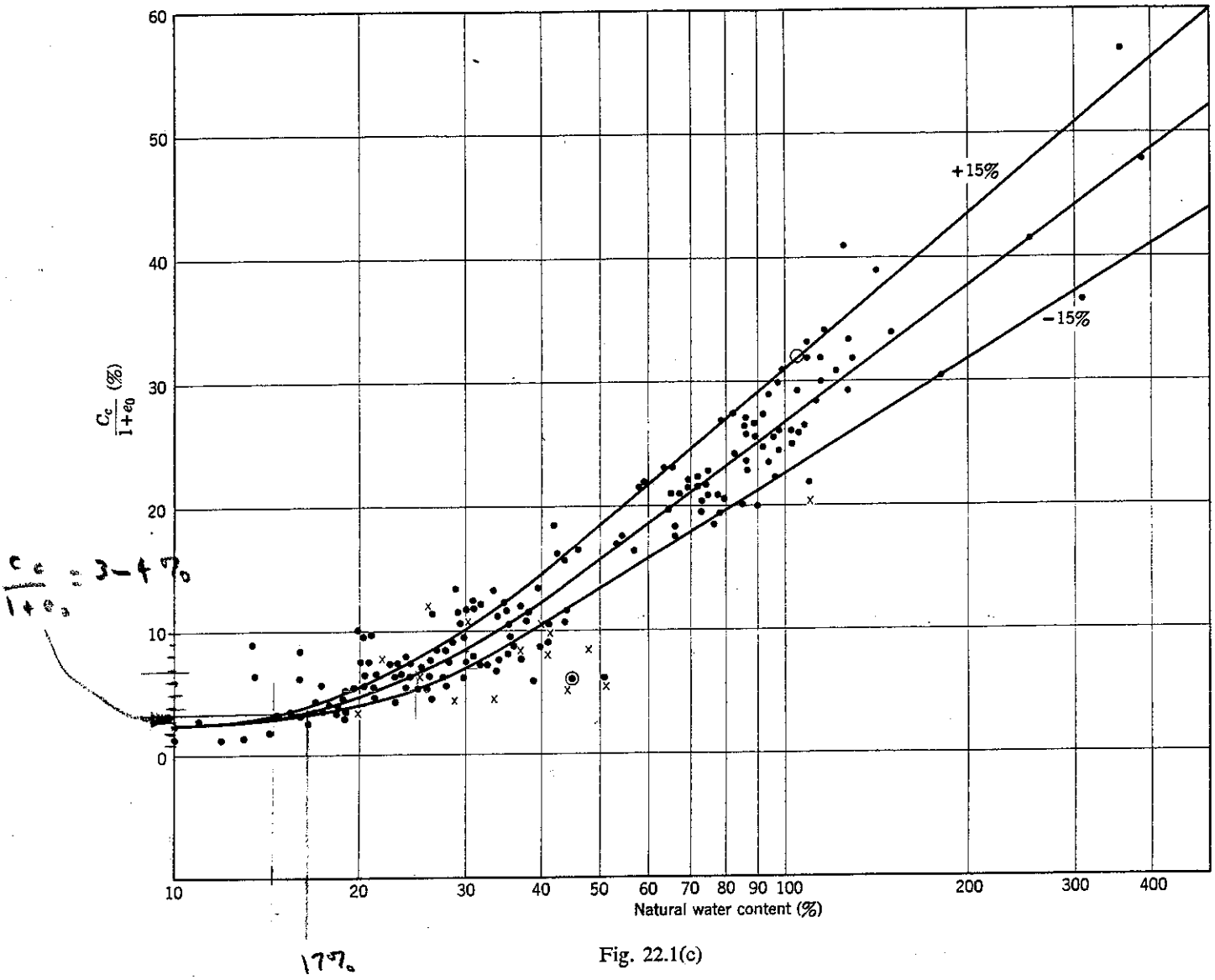


Fig. 22.1(c)

Unloading

Upon unloading a soil sample in confined compression the sample expands, as illustrated in Fig. 20.5. The parameter most commonly used to measure the expansion is

$$C_s = \text{swell index} = \frac{-\Delta e}{\Delta \log \bar{\sigma}_v} \qquad (22.1)$$

C_s is always much smaller than C_c for virgin compression. This is illustrated by the data in Table 22.1. By consolidating a series of specimens to different maximum vertical stresses $\bar{\sigma}_{vm}$ before unloading, a series of expansion curves are obtained. Such expansion curves tend to be parallel. Note, for example, in Fig. 20.5 that the unload portion from the first cycle and that from the second cycle are approximately parallel. Thus C_s is more or less the same for all $\bar{\sigma}_{vm}$.

In Fig. 22.2 values of swell index have been plotted against the corresponding liquid limit. C_s increases with increasing liquid limit, but any relation between C_s and w_l will be only approximate.

Reloading

If a clay is subjected to many cycles of load and unload, the compression and recompression curves tend toward each other, i.e., C_c for recompression approximately equals C_s.

The compressibility of a soil depends very much on the stress level in relation to the stress history. For example, we can see from Fig. 20.5 that the compressibility of the Cambridge clay is much greater in the virgin compression range than it is in the recompression range; this means the compression index above $\bar{\sigma}_{vm}$ is much greater than below $\bar{\sigma}_{vm}$. This important fact presents the engineer

URS

Job R84 Project No. 28649640 Page 1 of ____

Description RW 245 Computed by Mano Sheet ____ of ____

Checked by MU Date 2/09/09

Date 02/19/09

Reference

Retaining Wall No. 245 — Type -1 Standard Wall

Long = 1505.5 ft

Maximum height = 24.4

Design hagh = 24 ft.

Closest borings => RB03, NB04, NB30, NB31, NB32 & NB33

Ground water elevation

NB30 = 503 ft during drilling

NB31 = 490 ft

Say GW Elev. = 503 ft

Deepest footing Elevation => 509 ft., (silty sand, Lean clay, or Sandy

Back fill material => Embankement fill material

assume γ_m = 130 pcf.

ϕ = 34°

Back slope => Level.

Active earth pressure coefficient, K_a.

$$K_a = \tan^2(45 - \phi/2)$$

$$= 0.283$$

Equivalent Fluid Pressure (EFP)

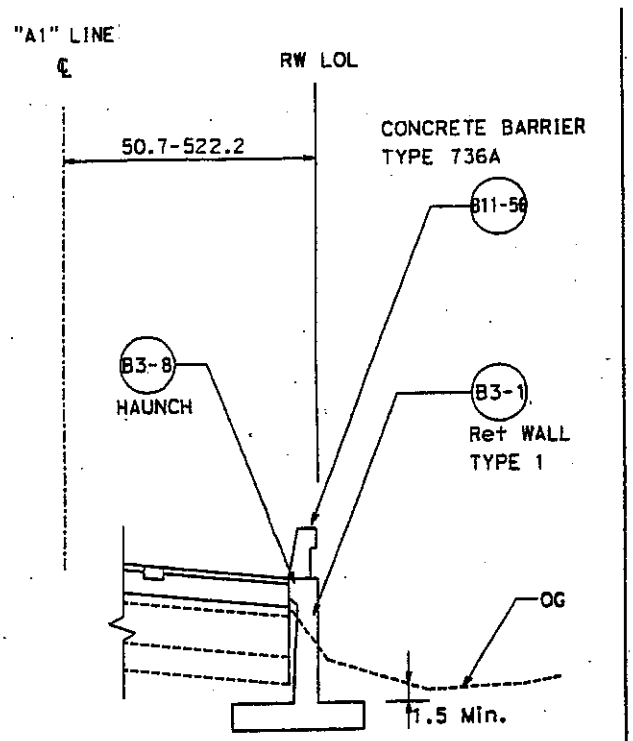
$$EFP = K_a \cdot \gamma$$

If $\phi = 35°$

EFP = 35.2

$$= 0.283 \times 130$$

$$= 36.8 \text{ pcf}$$



Estimate friction angle.

Clay.

			ϕ angle ← See page 6
NB30,	5 ft - depth	PI = 5	34
NB04	3.5 ft	PI = 17	31
NB32	18.5 ft.	PI = 11	33
NB33	5.0 ft	PI = 6	34

Clay = 31 — 34°

Sand. – γ_m = 130 pcf

	Depth ft	σ_v ksf	N_{corr}	D_r *	ϕ' **
NB04	5	0.68	130×0.8 = 104	100	40
NB31	9	1.17	99×0.8 = 79	100	40
NB32	9	1.17	100×0.8 = 80	100	40
NB33	9	1.17	36×0.8 = 29	95	39

Sand, ϕ = 39 — 40

Summary

Clay = 31 — 34°

Sand = 39 — 40

Say ϕ = 32 for Lower bound.

* See page 7 ** See page 8

URS

Page 3 of ____

Job R84 Project No. 28649640 Sheet ____ of ____

Description RW 245 Computed by Mano Date 2/09/09

Checked by MW Date 02/19/09

Reference

Estimate γ_m.

PointID	Depth, ft	Wet_Density, pcf	Dry_Density, pcf	Water_Content, %
NB04	3.5	132	120	9.9
NB04	8.5	131	113	16.3
NB04	13.5	137	119	15.5
NB30	8.5	136	116	17.2
NB30	23.5	140	127	10.7
NB30	28.5	136	121	12.9
NB30	43.5	139	122	13.6
NB30	48.5	136	117	16.8
NB31	3.5	123	115	6.4
NB31	5	134	123	8.2
NB31	8.5	132	125	5.1
NB31	13.5	131	111	18.7
NB31	18.5	118	110	7.4
NB31	48.5	133	110	20.5
NB32	23.5	131	106	23.8
NB32	28.5	137	119	15.1
NB32	33.5	129	109	18.0
NB32	38.5	131	109	20.1
NB32	43.5	130	108	20.3
NB32	49.5	118	90	31.1
RB03	1	128	116	10.9
RB03	3.5	128	120	6.8
	Average	131		

Estimate Ultimate Bearing Capacity, q_{ult} ← Page 10

Assume placed on Native soil

RB03, NB30, NB31, NB32, NB33 & NB04

$$q_{ult} = CN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma \qquad \gamma = 130 \text{ pcf}$$

BOFE Vary from 533 ft to 508.9 ft, D = 3 ft. (min.)

Lean clay

RB03	@ 2 ft	UC = 2.1 tsf	⇒ C =	2000 psf.
NB30	@ 9 ft	UC = 7.2 tsf	⇒ C =	7200 psf.
NB04	@ 4 ft	UC = 6.8 tsf	⇒ C =	6800 psf

Page 9

LOL Sta 5+00 to Sta 10+00

Lean clay RB03 ⇒ C = 2000

The wall height = 3.4 → 4.2, Design height = 4 ft

$N_c = 5.53$, $N_q = 1.0$ $N_\gamma = 0$

$$(q_{ult})_{clay} = CN_c + \gamma D N_q$$
$$= 2000 \times 5.53 + 130 \times 3 \times 1.$$
$$= 11,450 \text{ psf} \checkmark$$

for design height = 4
Toe pressure = 1.7 ok ✓

Sand and gravel

$C = 0$ $\phi = 33^\circ$ ⇒ $N_q = 28$, $N_\gamma = 28$

Say B = 8 ft.

$$q_{ult} = 130 \times 3 \times 28 + 0.5 \times 130 \times 8 \times 28$$
$$= 25,480 \text{ psf}$$

LOL Sta 10+00 to sta 20+00

maximum wall height = 24 ft.

Say NB 31 & N32

Granular material — high blow counts

NE 30

Lean clay ⇒ UC = 7.3 tsf.

C = 7000 psf

C is very high value, cohesion not vary along the alignment so we selected C = 4500 for design.

Say C = 4500 psf

$$q_{ult} = CN_c + \gamma D N_q$$

$$= 4500 \times 5.53 + 130 \times 3 \times 1$$

$$= 25,275 \text{ psf}, \quad \text{Say } 18,000 \text{ psf.}$$

Toe pressure = 4900 psf (h = 24 ft)

Summary

Sta 5+00 to 10+00

q_{ult} = 12,000 psf q_{all} = 4,000 psf

Sta 10+00 to 20+00

q_{ult} = 18,000 psf q_{all} = 6000 psf

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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INDEX TO PLANS

SHEET No.	TITLE
R-1	GENERAL PLAN
R-2	RETAINING WALL No. 236 - RETAINING WALL PLAN No. 1 OF 1
R-3	RETAINING WALL No. 314 - RETAINING WALL PLAN No. 1 OF 1
R-4	RETAINING WALL No. 317 - RETAINING WALL PLAN No. 1 OF 1
R-5	RETAINING WALL No. 320 - RETAINING WALL PLAN No. 1 OF 1
R-6	RETAINING WALL No. 437 - RETAINING WALL PLAN No. 1 OF 3
R-7	RETAINING WALL No. 437 - RETAINING WALL PLAN No. 2 OF 3
R-8	RETAINING WALL No. 437 - RETAINING WALL PLAN No. 3 OF 3
R-9	RETAINING WALL No. 109 - RETAINING WALL PLAN No. 1 OF 1
R-10	RETAINING WALL No. 110 - RETAINING WALL PLAN No. 1 OF 2
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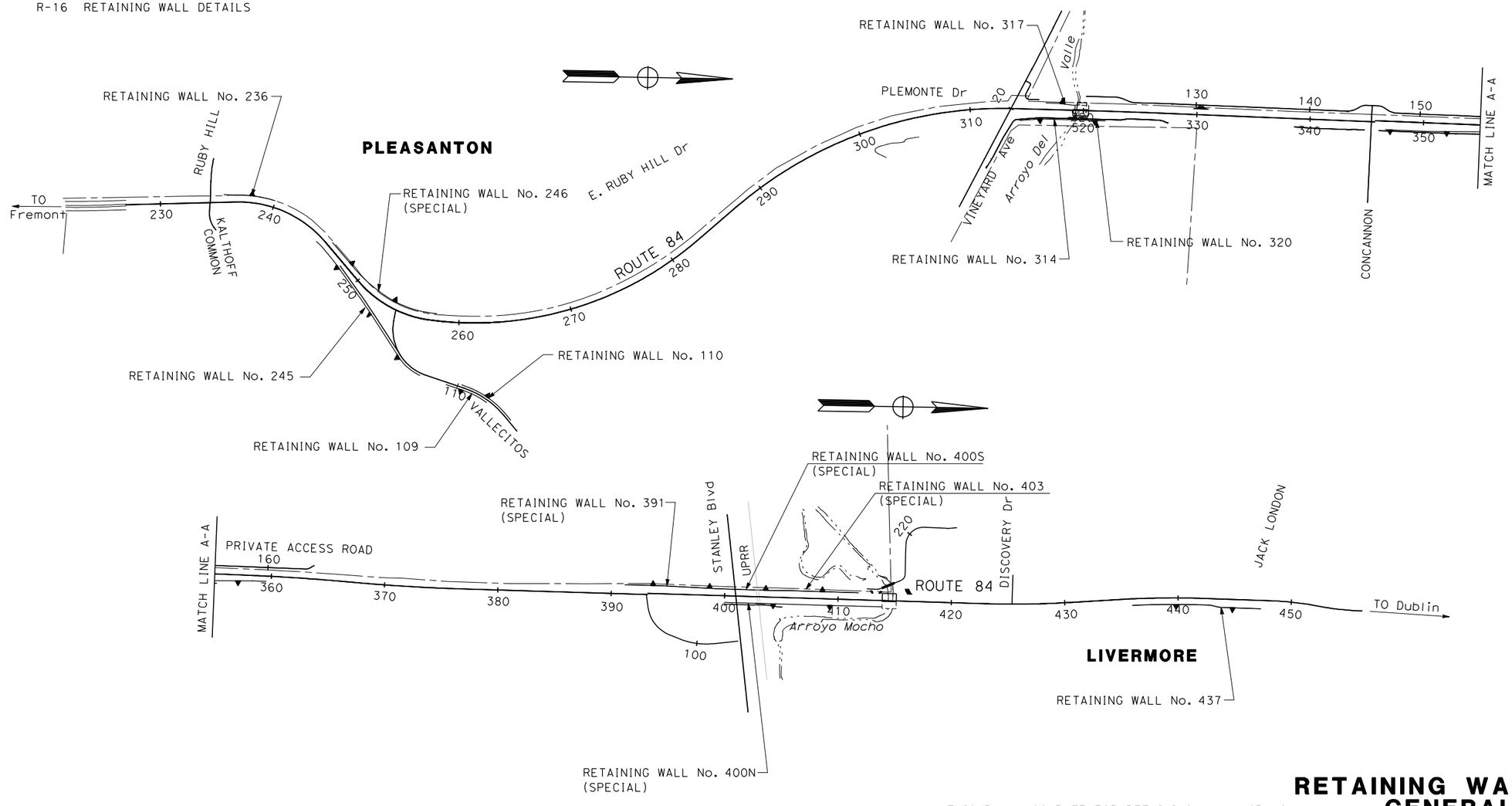
R-14	RETAINING WALL No. 245 - RETAINING WALL PLAN No. 3 OF 4
R-15	RETAINING WALL No. 245 - RETAINING WALL PLAN No. 4 OF 4
R-16	RETAINING WALL DETAILS



THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL KEY MAP
GENERAL PLAN

SCALE: 1" = 500'

R-1

REVISED BY | DATE REVISED

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 00-00-00 | DATE PLOTTED => 5/18/2009 | TIME PLOTTED => 6:32:37 PM

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => Madalina_Lapustea | DGN FILE => ...\429760qa001.dgn | CU 04256 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

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1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 95612

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

TOTAL LENGTH TYPE 1 RETAINING WALL 460.54′ (ALONG RWLOL)

Exp JOINT SPACING	96′	48′	48′	96′	96′	48′	28.54′
LENGTH ALONG WALL LOL	96′ (4 @ 24′)	48′ (2 @ 24′)	48′ (2 @ 24′)	96′ (4 @ 24′)	96′ (4 @ 24′)	48′ (2 @ 24′)	28.54′
DESIGN H	6′	8′	10′	10′	10′	10′	8′

Elev 575.07′
Beg RW No. 236
Sta 35+60.00

575.34′ 575.62′ 575.90′ 576.17′ 576.45′ 576.72′ 577.00′ 577.28′ 576.98′ 576.68′ 576.38′ 576.08′ 575.78′ 575.34′ OG 575.18′ 574.88′ 573.69′ 572.49′

Elev 569.38′
End RW No. 236
Sta 40+20.544

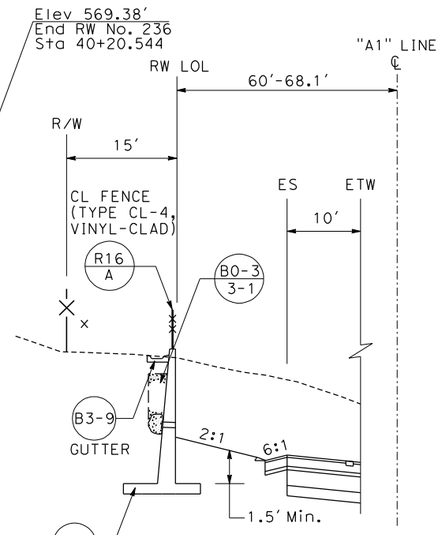
Approx. FG BEHIND WALL
TOP OF WALL (4′ CF NOT SHOWN)
FG
568.16′
567.43′
566.68′
1.33′ (Typ)
564.96′
564.06′
563.52′
B0-3 / 3-1 WEEP HOLE (Typ)
B0-3 / 3-2 WEAKENED PLANE (Typ)
B3-8 FOOTING STEP (Typ)
B0-3 / 3-4 EXPANSION JOINT (Typ)
PROJECTED EXISTING 24" HP GAS (RELOCATE BY OTHERS)

DATUM Elev 555.00′

36+00 37+00 38+00 39+00 40+00

ELEVATION (DEVELOPED)

SCALE Horiz 1"=20′
Vert 1"=4′



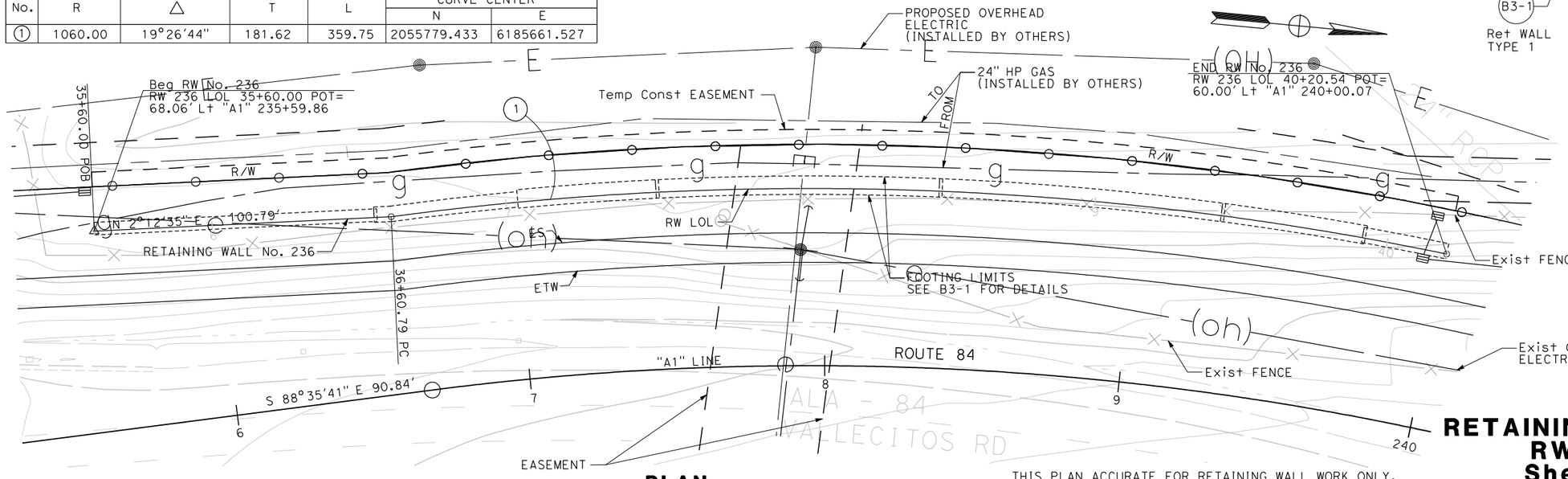
FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
①	1060.00	19°26′44"	181.62	359.75	2055779.433	6185661.527



PLAN

SCALE 1"=20′

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 236
Sheet 1 of 1

SCALE AS SHOWN

R-2

LAST REVISION | DATE PLOTTED => 5/18/2009
00-00-00 | TIME PLOTTED => 6:32:44 PM

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => Madalina_Lapustea | DGN FILE => ...\429760qa002.dgn | CU 04256 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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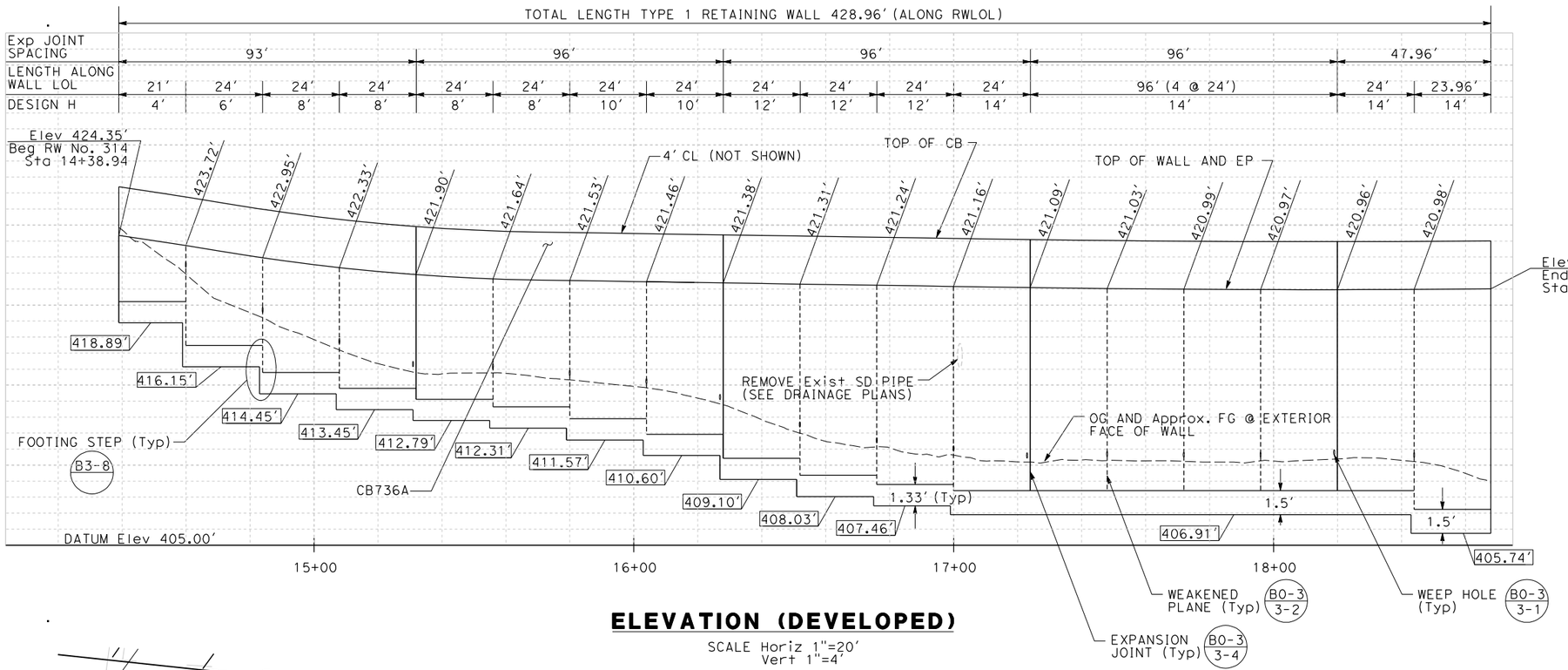
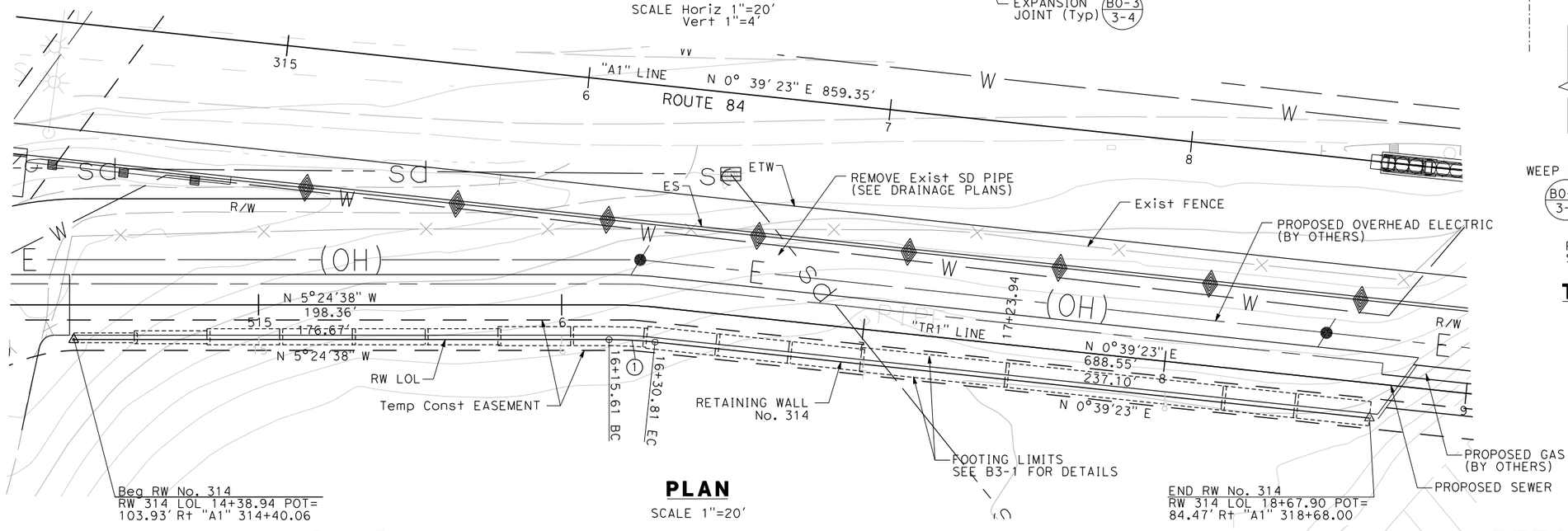
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans



ELEVATION (DEVELOPED)

SCALE Horiz 1"=20'
Vert 1"=4'

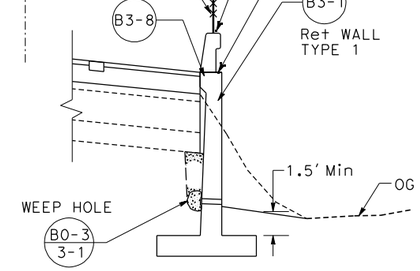


PLAN

SCALE 1"=20'

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
①	143.52	06°04'01"	7.61	15.20	2062822.1551	6183950.4622



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 314
Sheet 1 of 1

SCALE AS SHOWN

R-3

LAST REVISION 00-00-00 | DATE PLOTTED => 5/18/2009 | TIME PLOTTED => 6:32:52 PM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Madalina_Lapustea
DGN FILE => ...\429760qa003.dgn

CU 04256

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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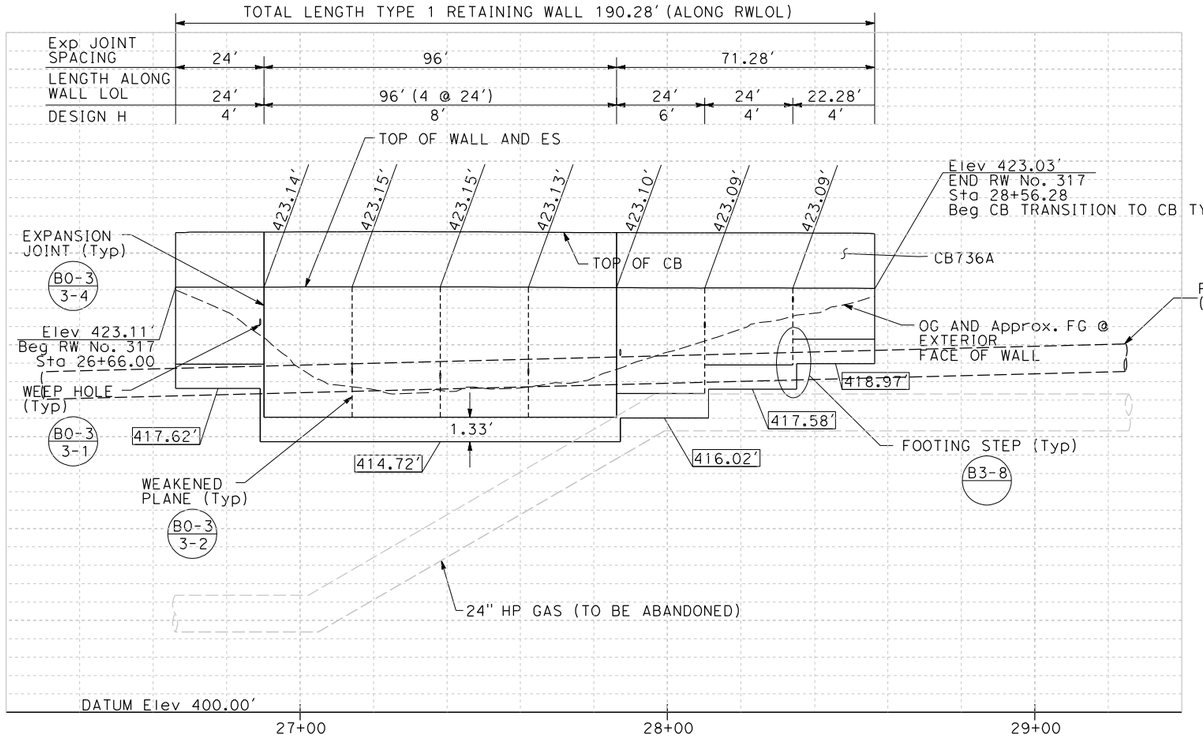
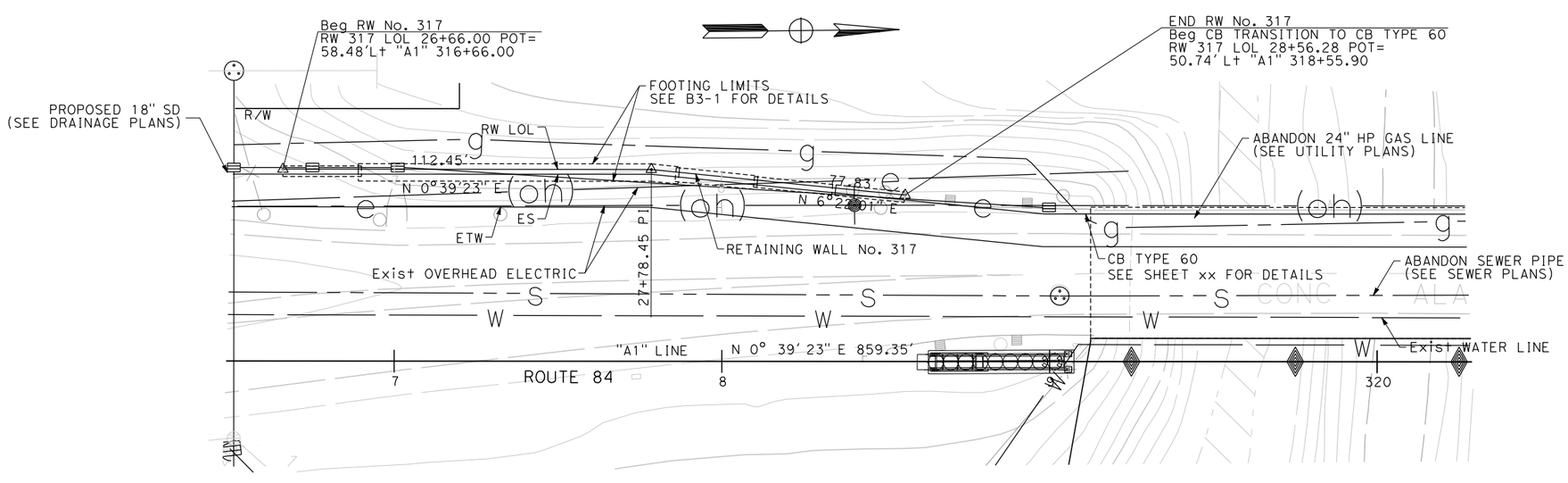
Suite 800
Oakland, CA 95612



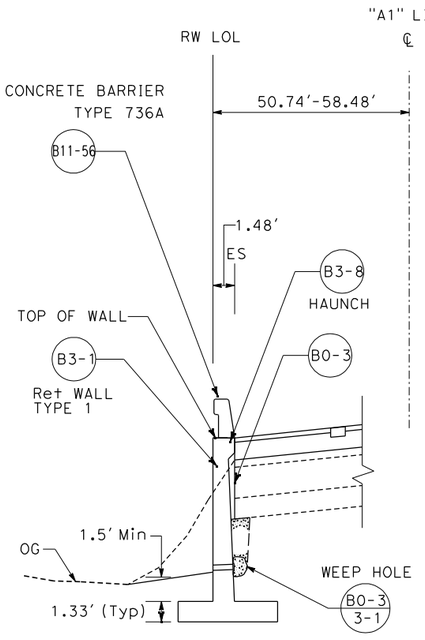
MIRRORED ELEVATION (DEVELOPED)

SCALE Horiz 1"=20'
Vert 1"=4'



PLAN

SCALE 1"=20'



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 317
Sheet 1 of 1

SCALE AS SHOWN

R-4

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Caltrans

LAST REVISION 00-00-00 | DATE PLOTTED => 5/18/2009 | TIME PLOTTED => 6:33:00 PM

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => Madalina_Lapustea | DGN FILE => ...\429760qa004.dgn | CU 04256 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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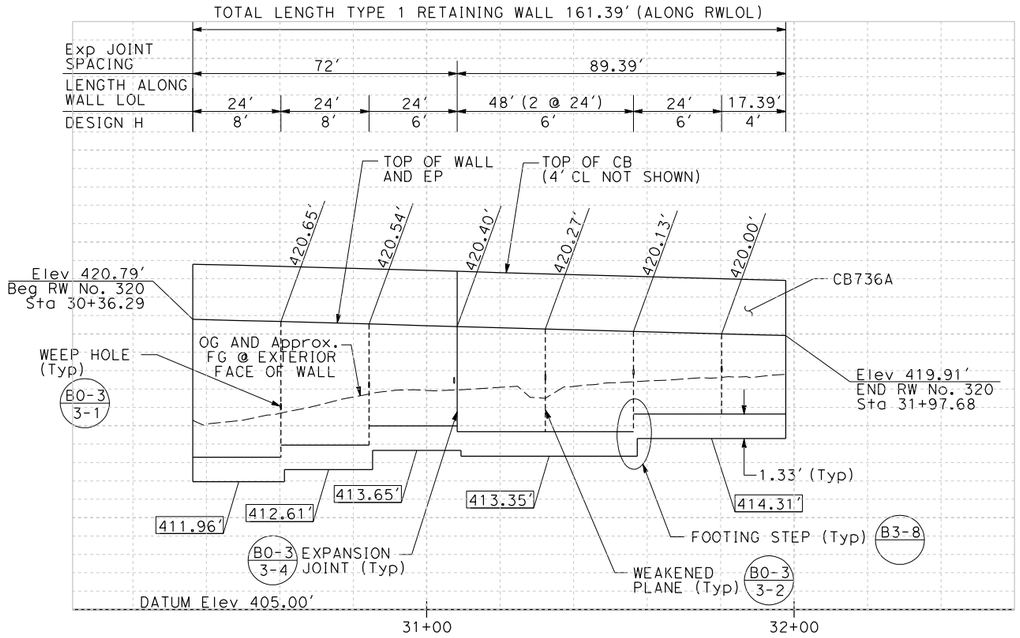
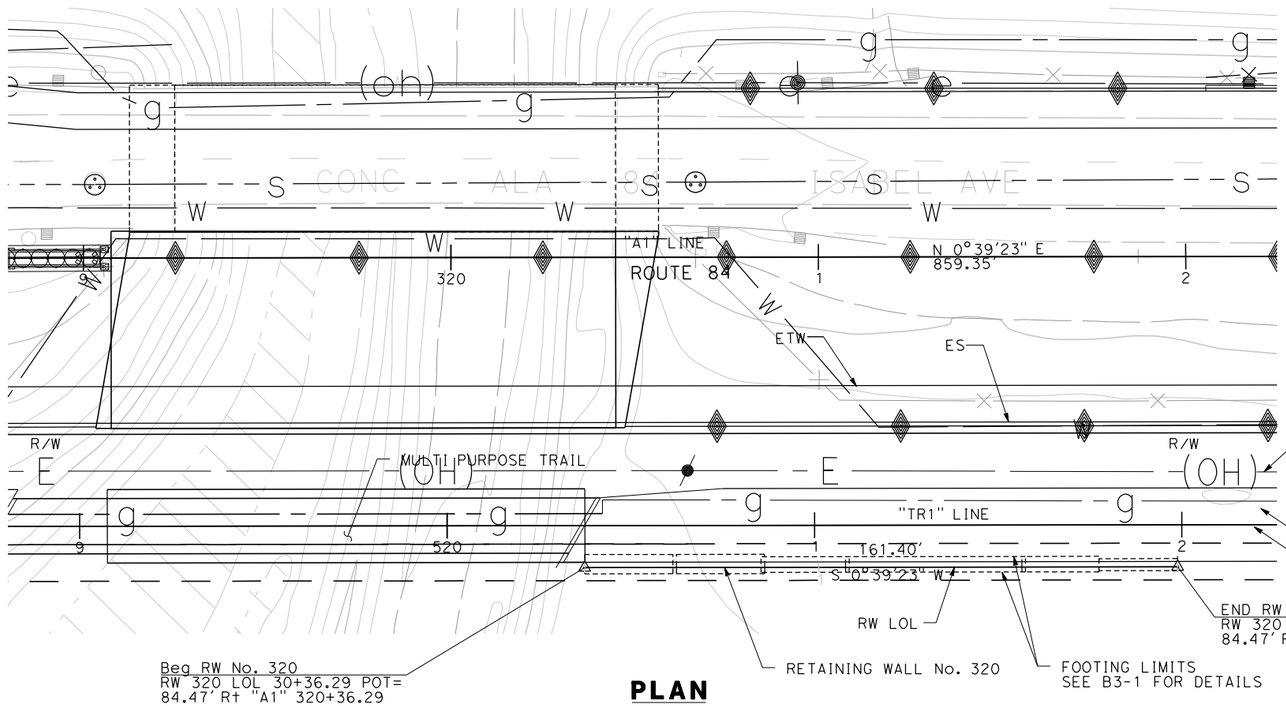


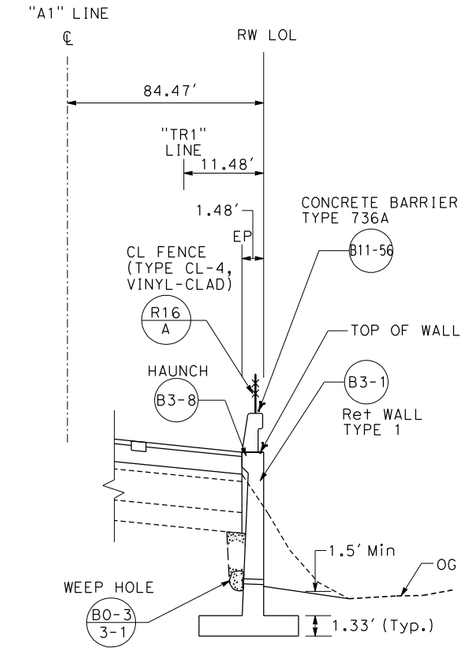
ELEVATION (DEVELOPED)

SCALE Horiz 1"=20'
Vert 1"=4'



PLAN

SCALE 1" = 20'



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 320
Sheet 1 of 1

SCALE AS SHOWN

R-5

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CONSULTANT FUNCTIONAL SUPERVISOR

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Caltrans

LAST REVISION 00-00-00 DATE PLOTTED => 5/18/2009 TIME PLOTTED => 6:33:08 PM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Madalina_Lapustea
DGN FILE => ...\429760qa005.dgn

CU 04256

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

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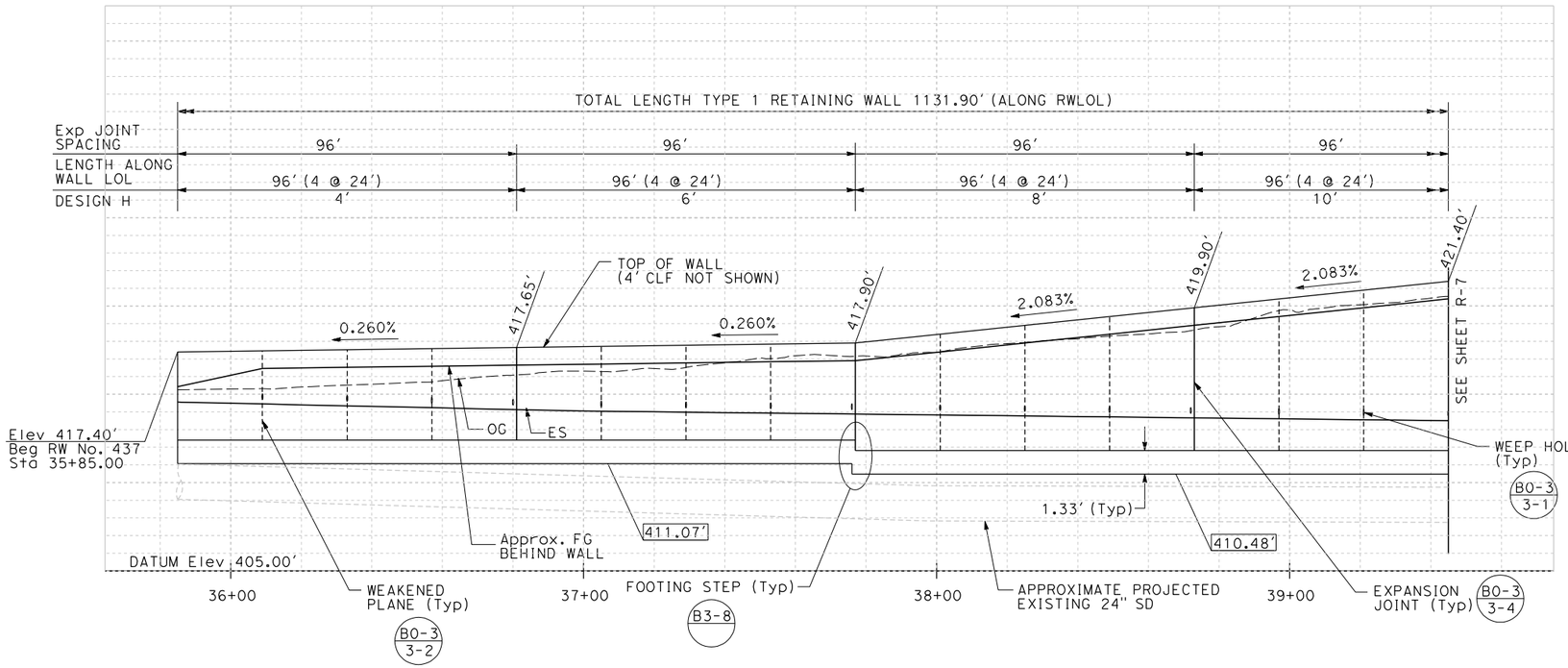
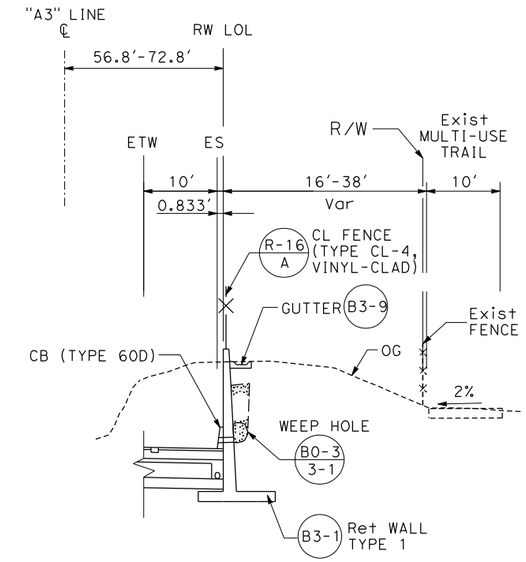
Suite 800
Oakland, CA 95612



MIRRORED ELEVATION (DEVELOPED)

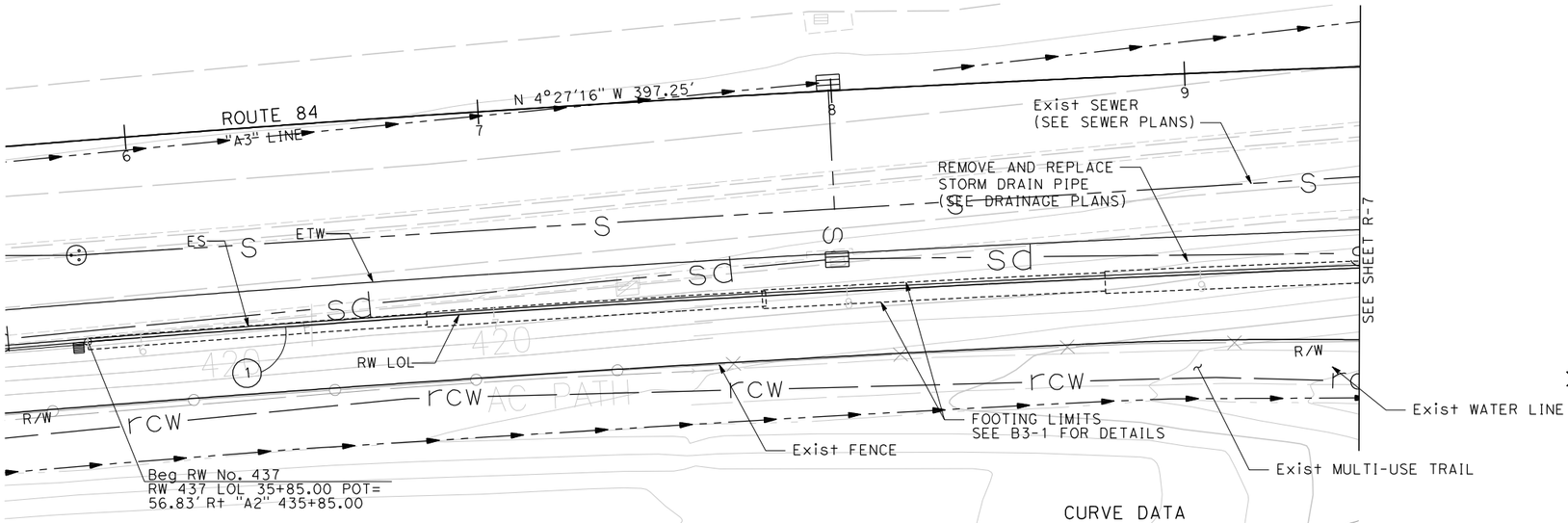
SCALE Horiz 1"=20'
Vert 1"=4'



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE



PLAN

SCALE 1"=20'

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
①	8588.20	04°32'23"	340.40	680.45	2075303.9301	6192500.7355

RETAINING WALL PLAN
RW No. 437
Sheet 1 of 3

SCALE AS SHOWN

R-6

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00 | DATE PLOTTED => 5/18/2009 | TIME PLOTTED => 6:33:15 PM

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => Madalina_Lapustea | DGN FILE => ...\429760qa006.dgn | CU 04256 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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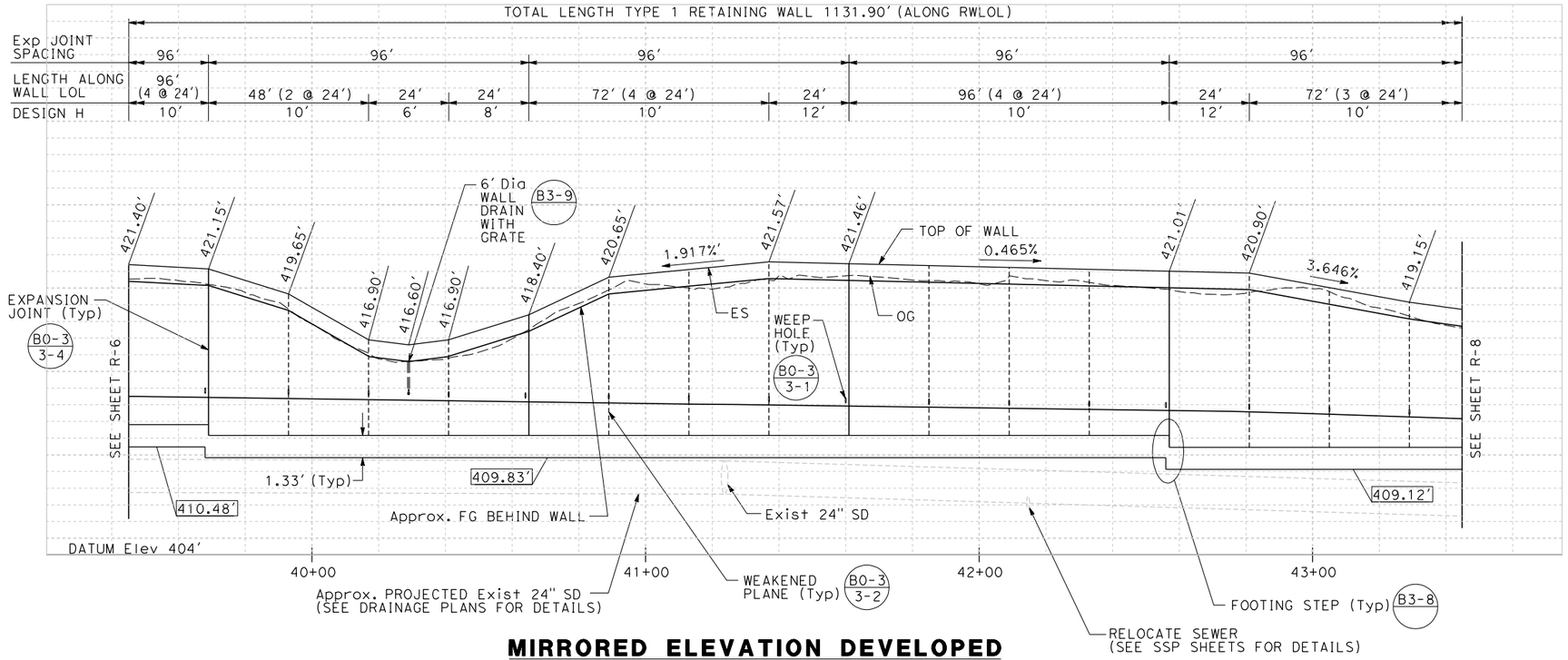
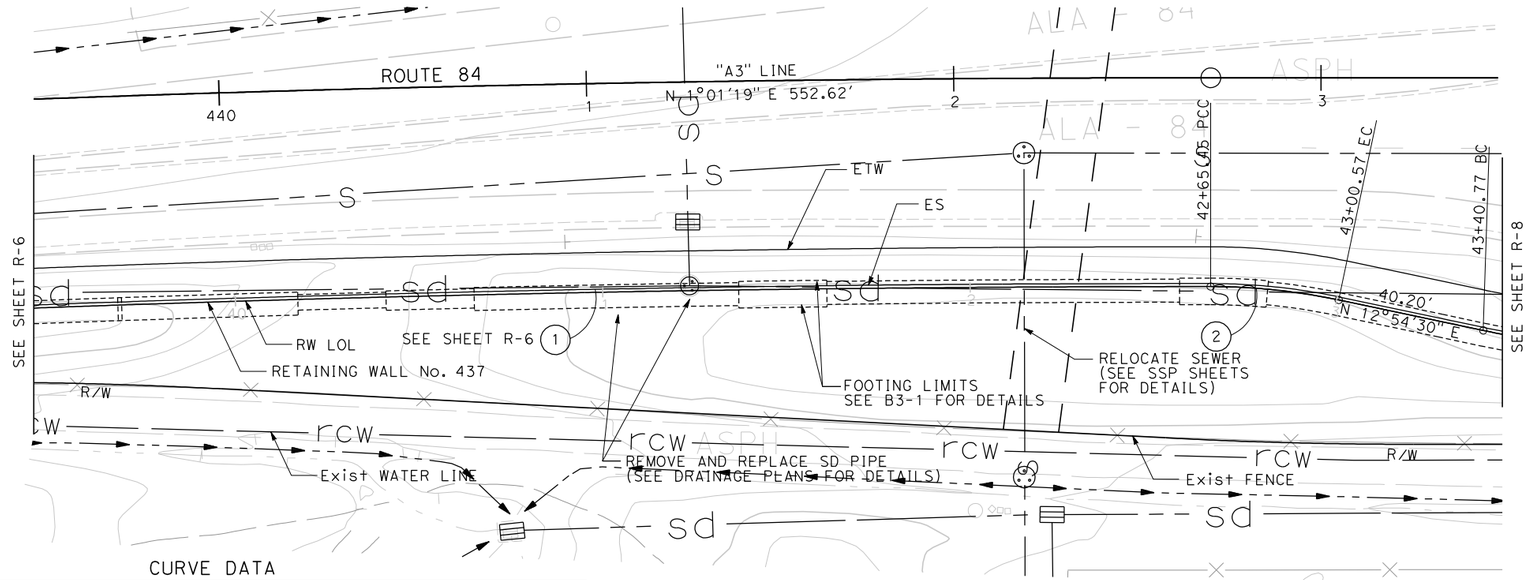
Oakland, CA 94612

URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 95612



MIRRORED ELEVATION DEVELOPED

SCALE Horiz 1"=20'
Vert 1"=4'



CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
②	169.17	11°53'34"	17.62	35.11	2075454.0995	6184083.0440

PLAN

SCALE 1"=20'

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 437
Sheet 2 of 3

SCALE AS SHOWN

R-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR | CALCULATED-DESIGNED BY | CHECKED BY | REVISED BY | DATE REVISED

LAST REVISION 00-00-00 | DATE PLOTTED => 5/18/2009 | TIME PLOTTED => 6:33:22 PM

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => Madalina_Lapustea | DGN FILE => ...\429760qa007.dgn | CU 04256 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

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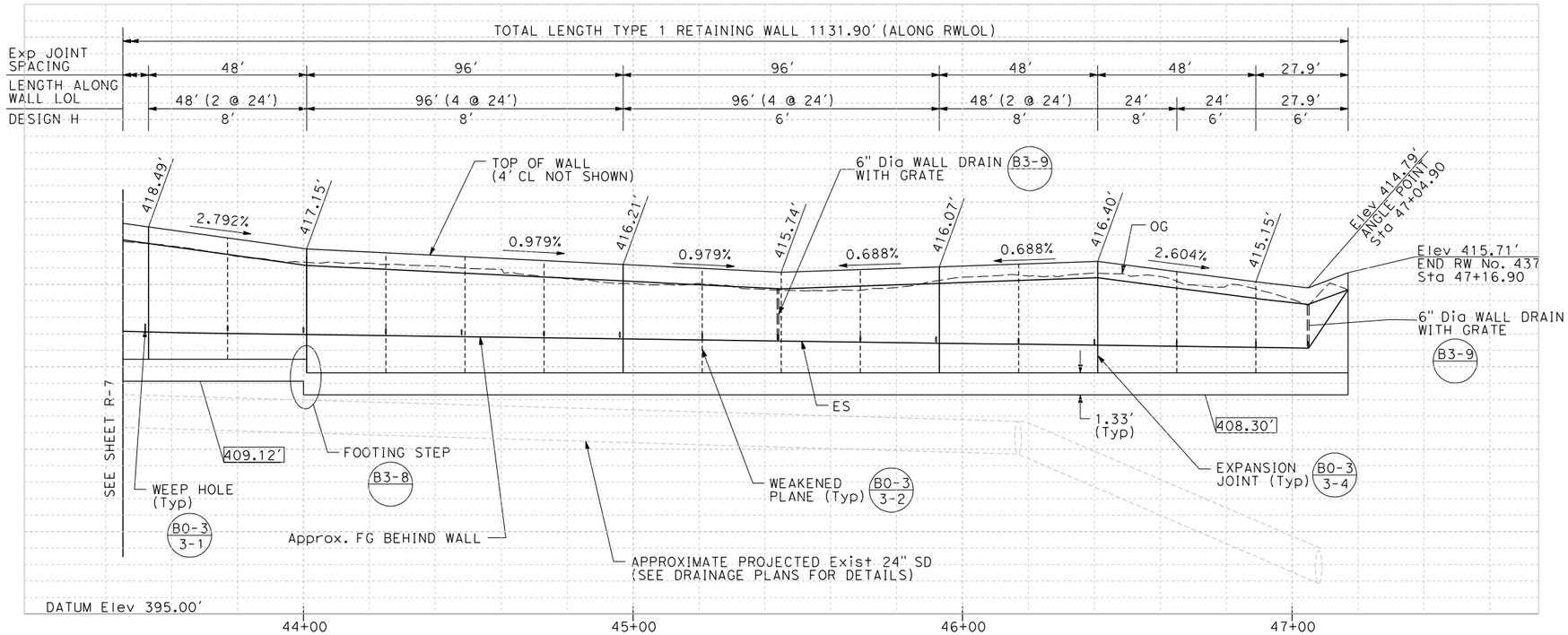
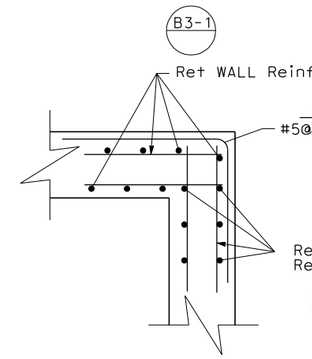


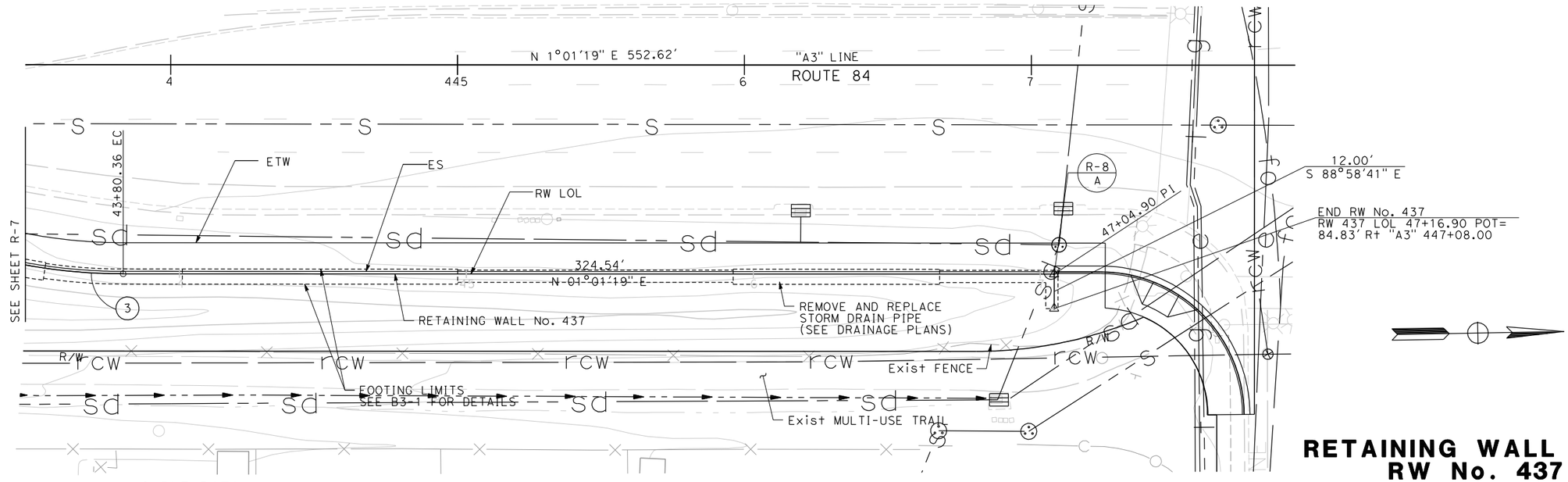
MIRRORED ELEVATION (DEVELOPED)

SCALE Horiz 1"=20'
Vert 1"=4'



DETAIL A

NO SCALE



PLAN

SCALE 1"=20'

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
③	190.83	11°53'11"	19.87	35.59	2075573.7093	6183741.1232

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 437
Sheet 3 of 3

SCALE AS SHOWN

R-8

REVISED BY | DATE REVISED

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION: DATE PLOTTED => 5/18/2009
00-00-00 TIME PLOTTED => 6:33:29 PM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Madalina_Lapustea
DGN FILE => ...\429760qa008.dgn

CU 04256

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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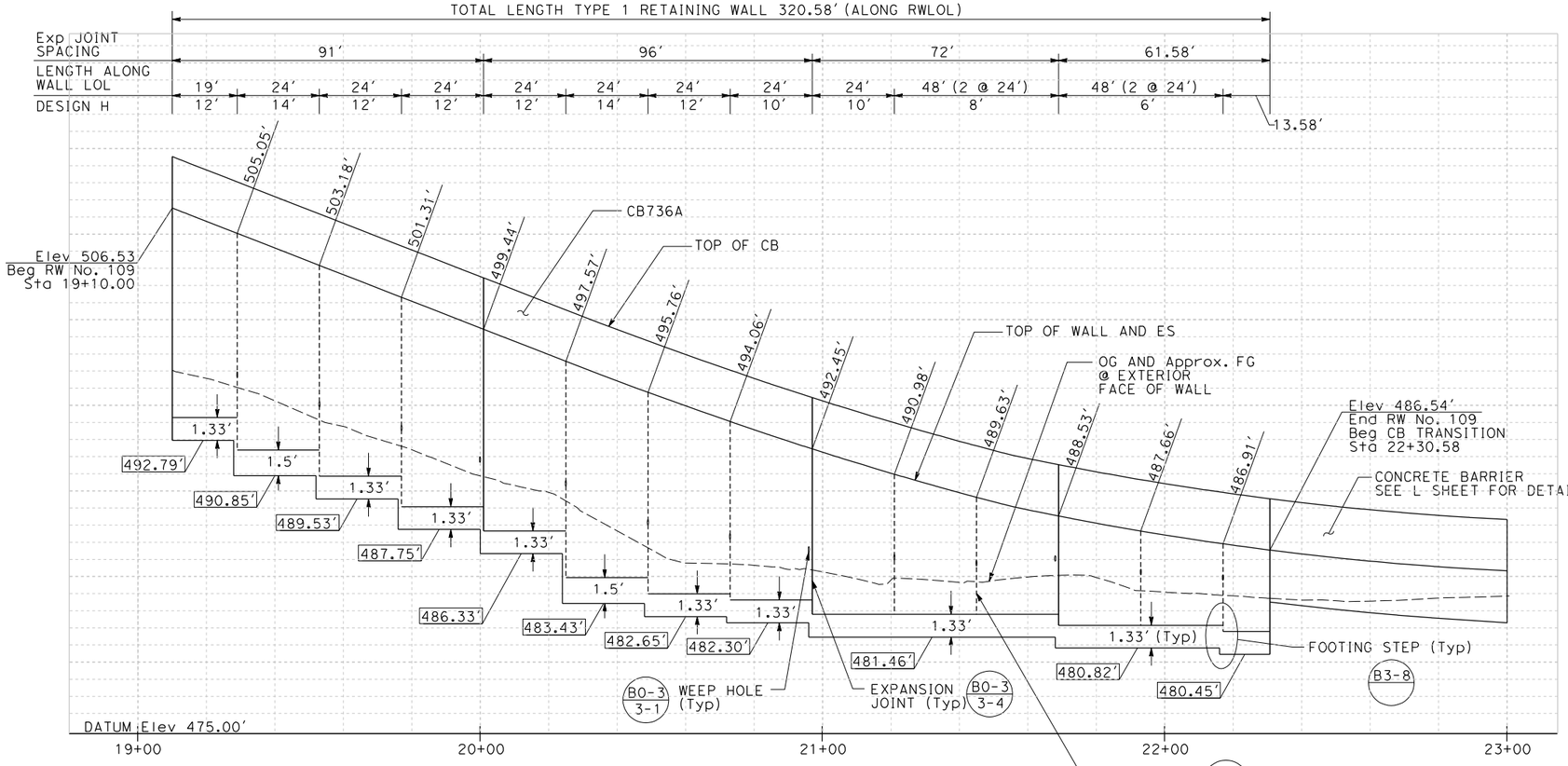
REVISED BY | DATE REVISED

CALCULATED-DESIGNED BY | CHECKED BY

SUPERVISOR | CONSULTANT FUNCTIONAL

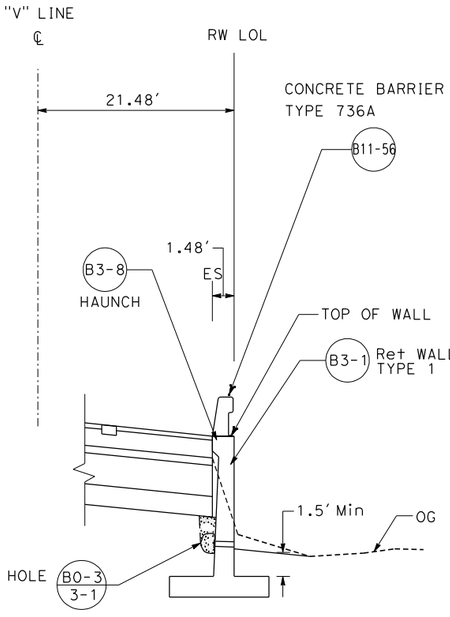
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans



ELEVATION DEVELOPED

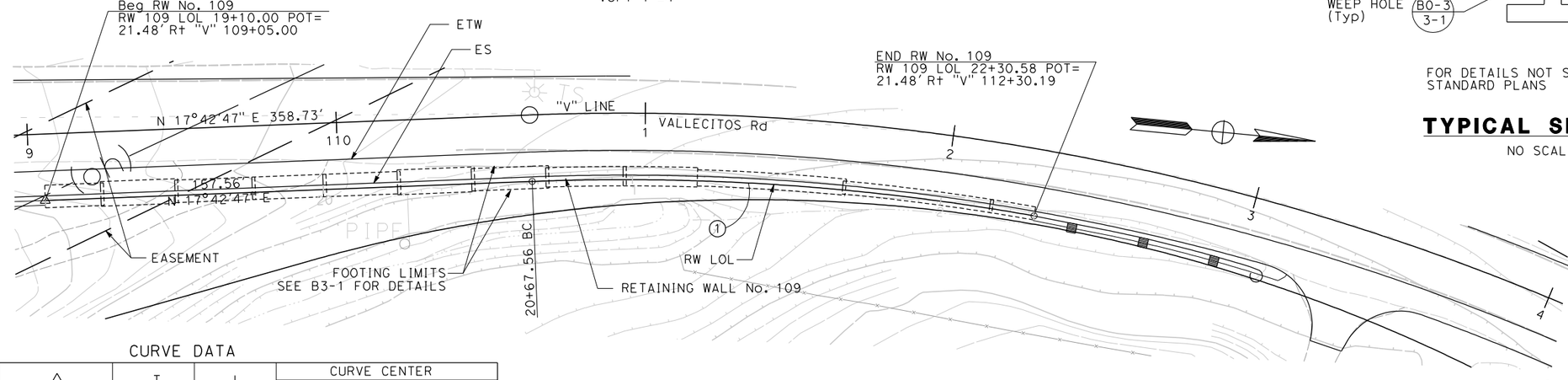
SCALE Horiz 1"=20'
Vert 1"=4'



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE



CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
①	758.52	12°18'50"	81.82	163.02	2057540.3762	6187011.3852

PLAN

SCALE 1"=20'

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 109
Sheet 1 of 1

SCALE AS SHOWN

R-9

LAST REVISION 00-00-00
DATE PLOTTED => 5/18/2009
TIME PLOTTED => 6:33:36 PM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Madalina_Lapustea
DGN FILE => ...\429760qa009.dgn

CU 04256

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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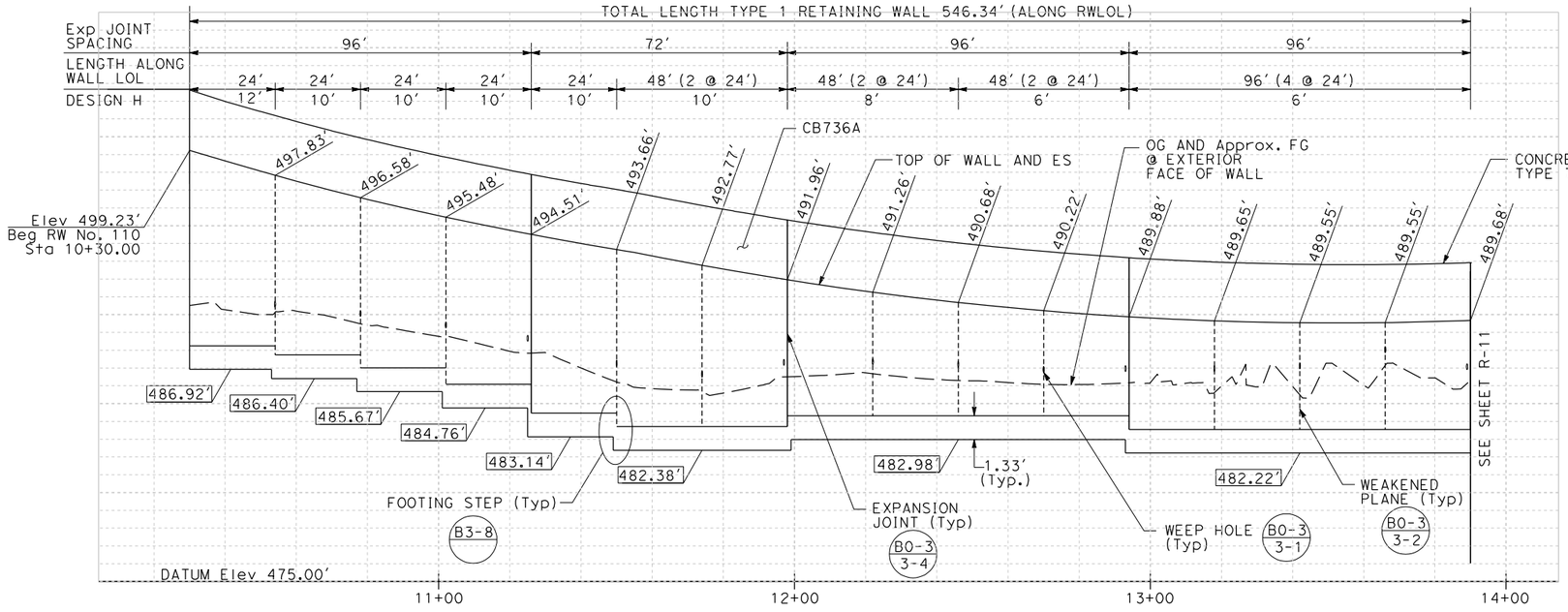
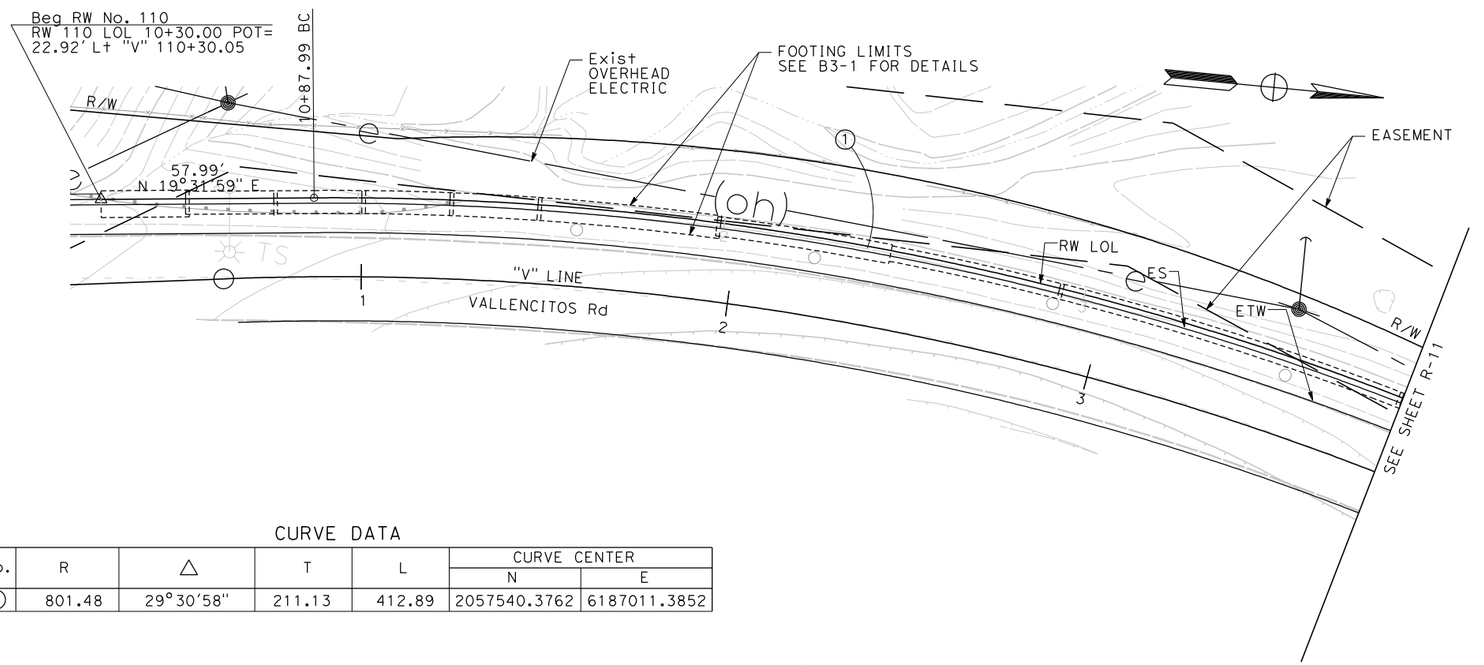


MIRRORED ELEVATION (DEVELOPED)

SCALE Horiz 1"=20'
Vert 1"=4'



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PLAN

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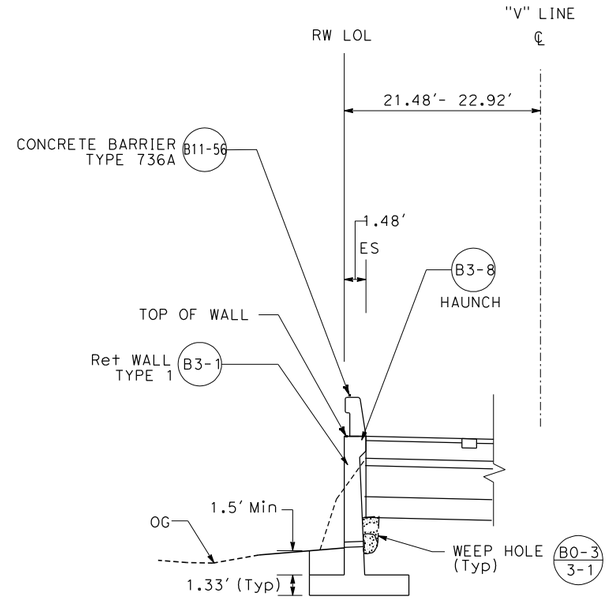

FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE

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RETAINING WALL PLAN
RW No. 110
Sheet 1 of 2

SCALE AS SHOWN

R-10

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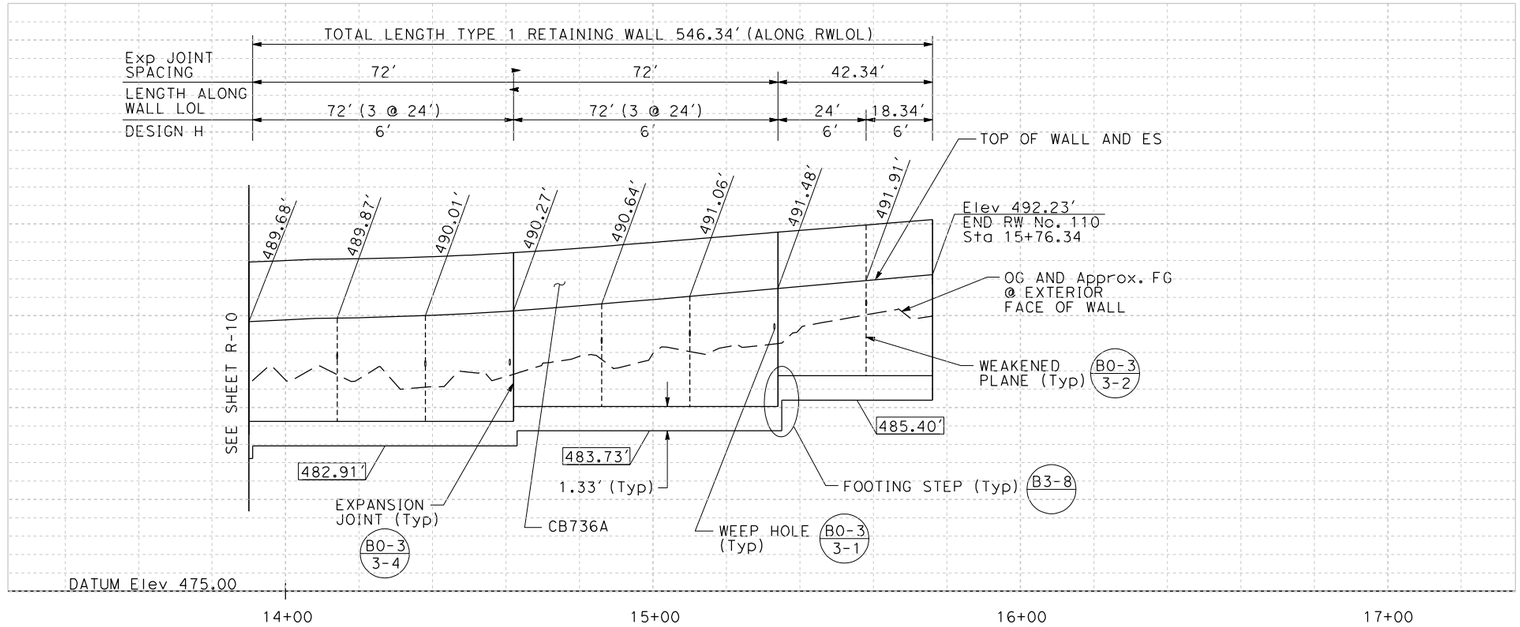

MIRRORED ELEVATION (DEVELOPED)

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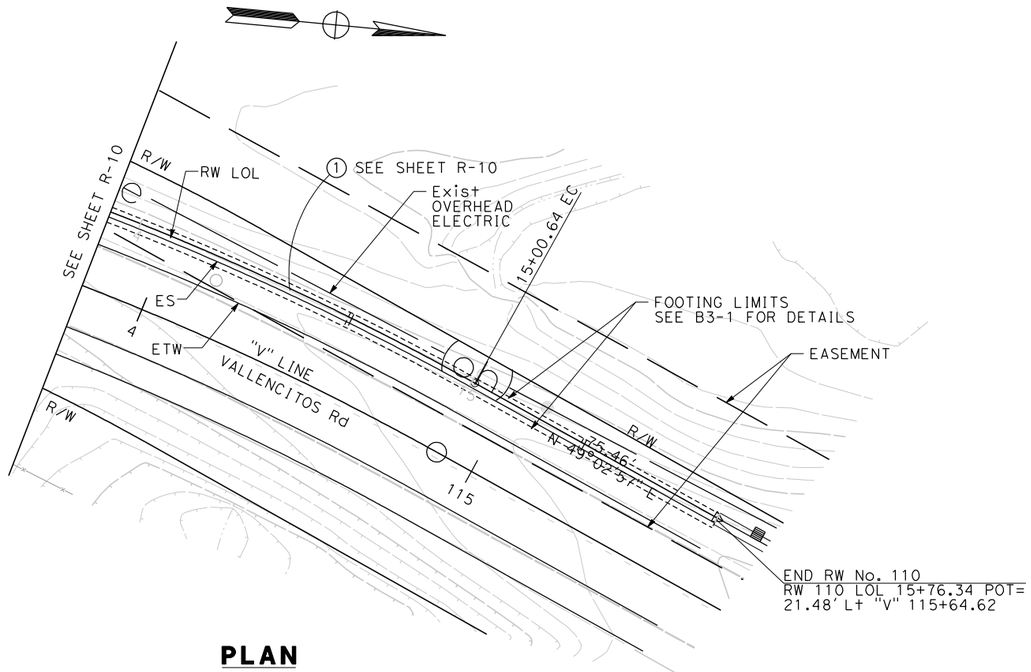

PLAN

SCALE 1"=20'

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RETAINING WALL PLAN
RW No. 110
Sheet 2 of 2

SCALE AS SHOWN

R-11

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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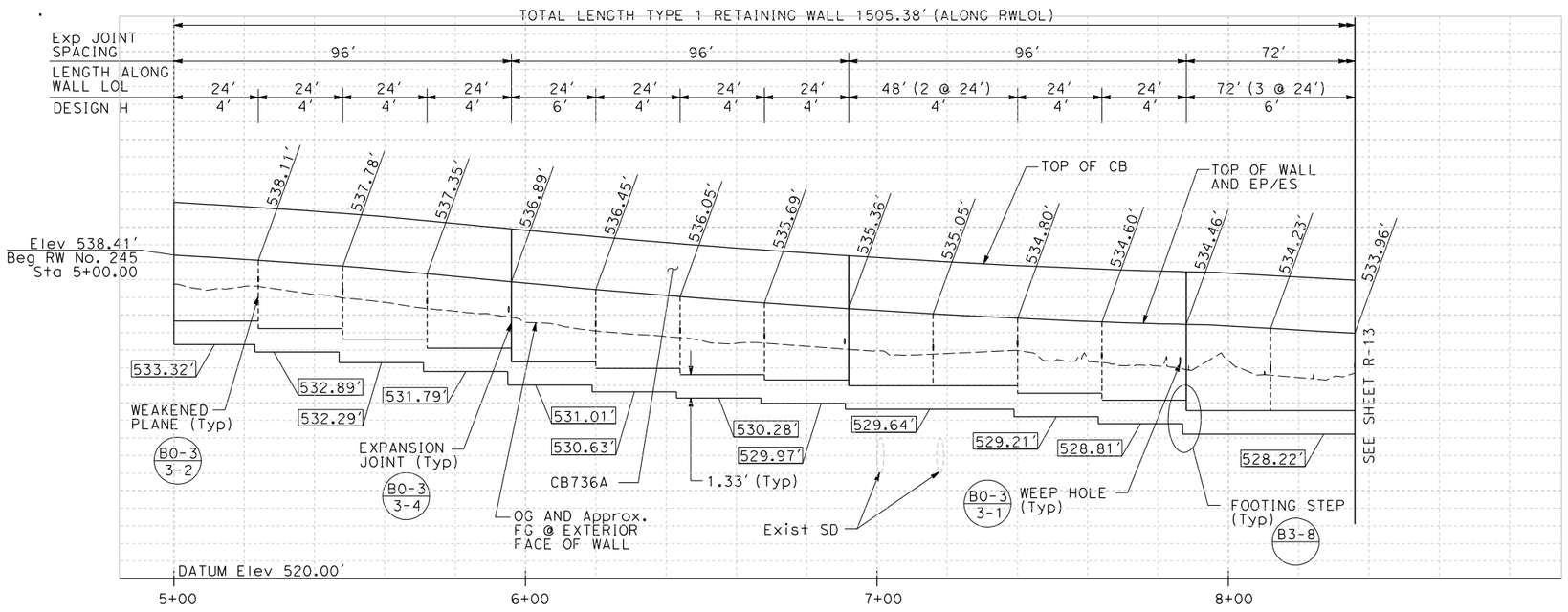

ELEVATION (DEVELOPED)

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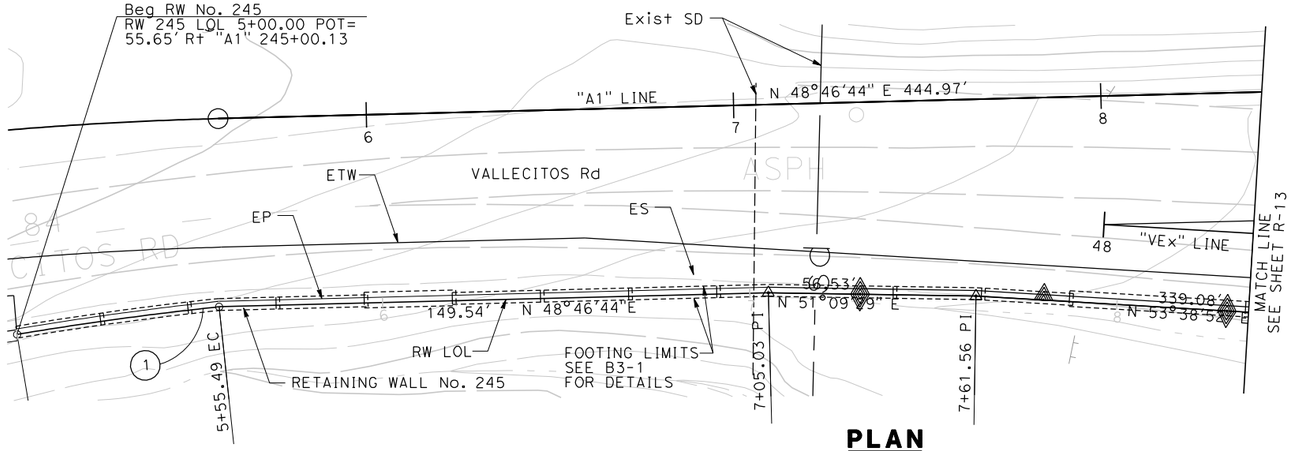

PLAN

SCALE 1"=20'

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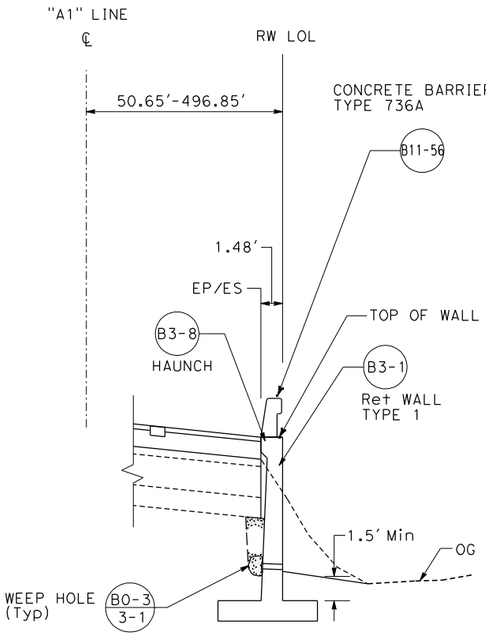

FOR DETAILS NOT SHOWN SEE STANDARD PLANS

TYPICAL SECTION

NO SCALE

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RETAINING WALL PLAN
RW No. 245
Sheet 1 of 4

SCALE AS SHOWN

R-12

LAST REVISION 00-00-00
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TIME PLOTTED => 6:33:58 PM

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Madalina_Lapustea
DGN FILE => ...\429760qa012.dgn

CU 04256

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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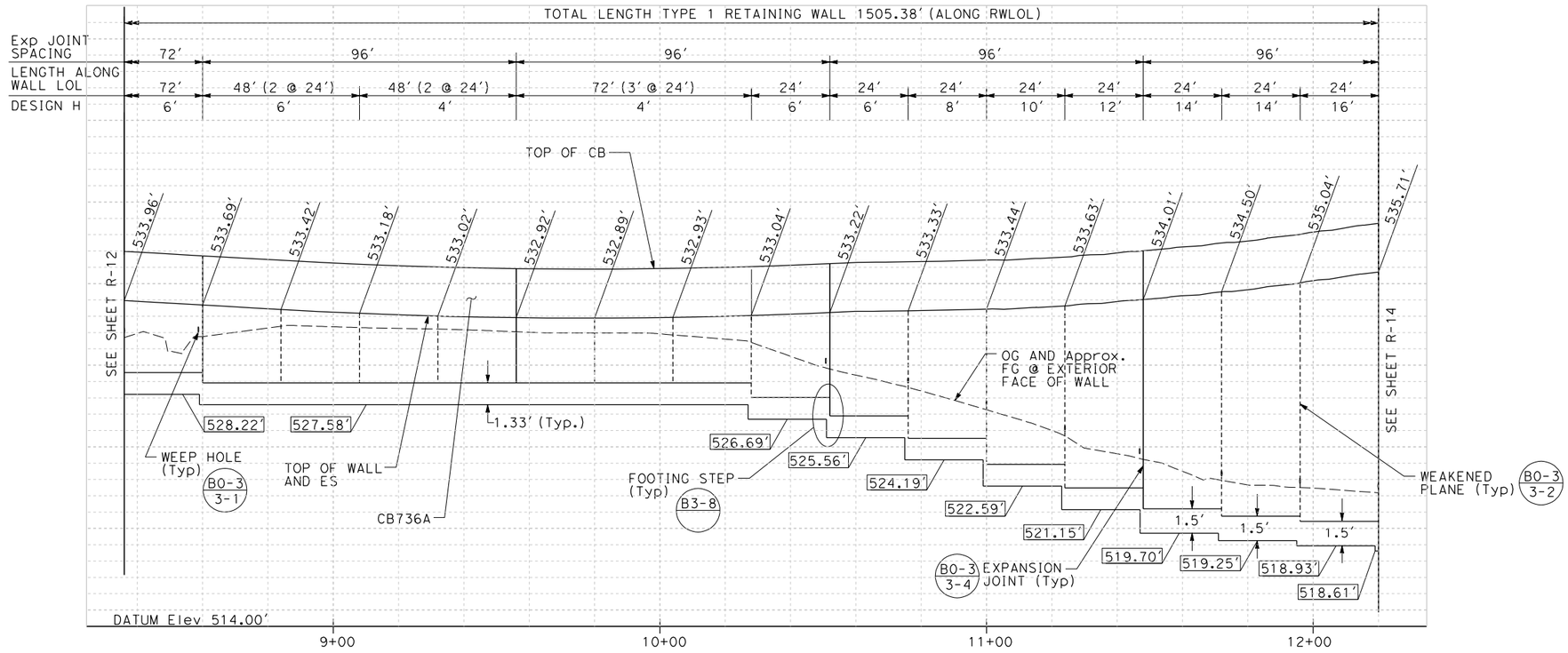

ELEVATION (DEVELOPED)

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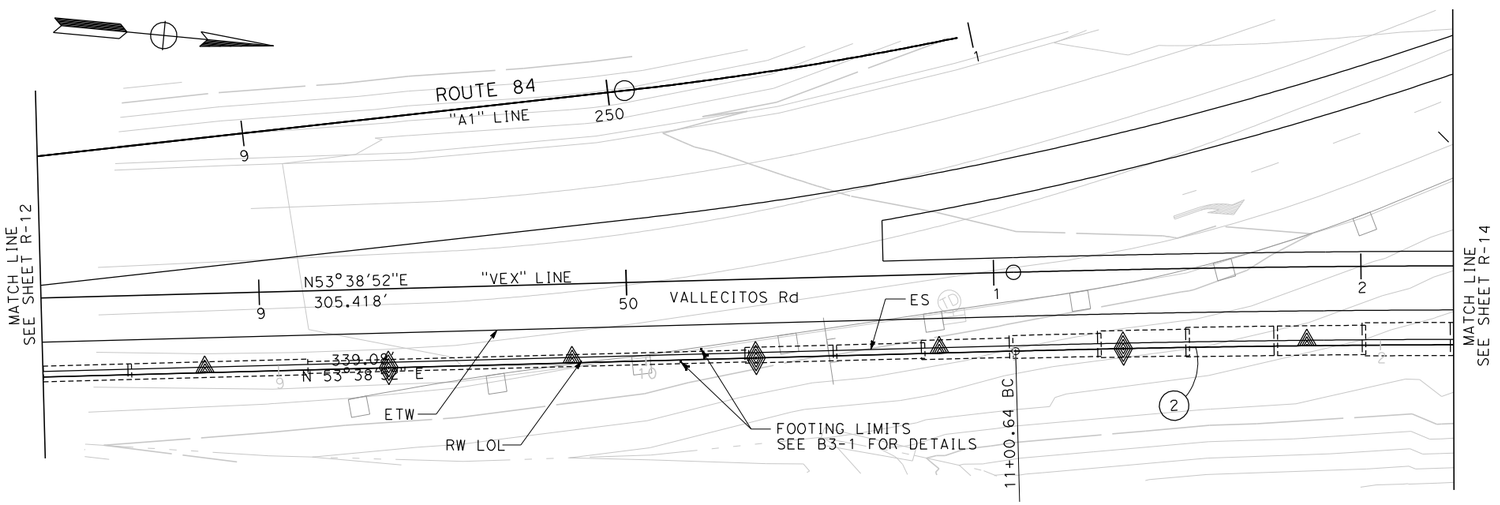
Vert 1"=4'



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PLAN

SCALE 1"=20'

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RETAINING WALL PLAN
RW No. 245
Sheet 2 of 4

SCALE AS SHOWN

R-13

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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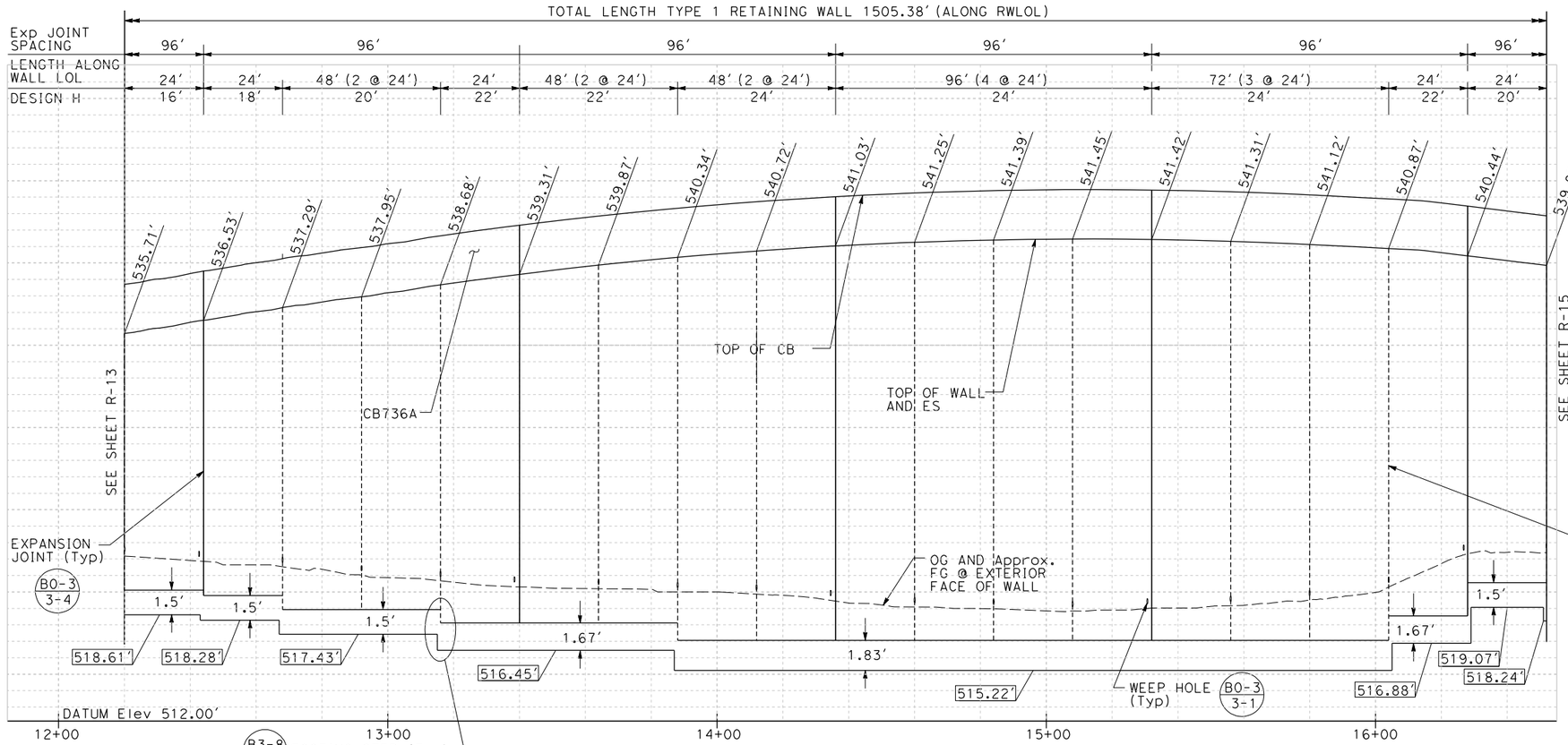
TOTAL LENGTH TYPE 1 RETAINING WALL 1505.38' (ALONG RWLOL)



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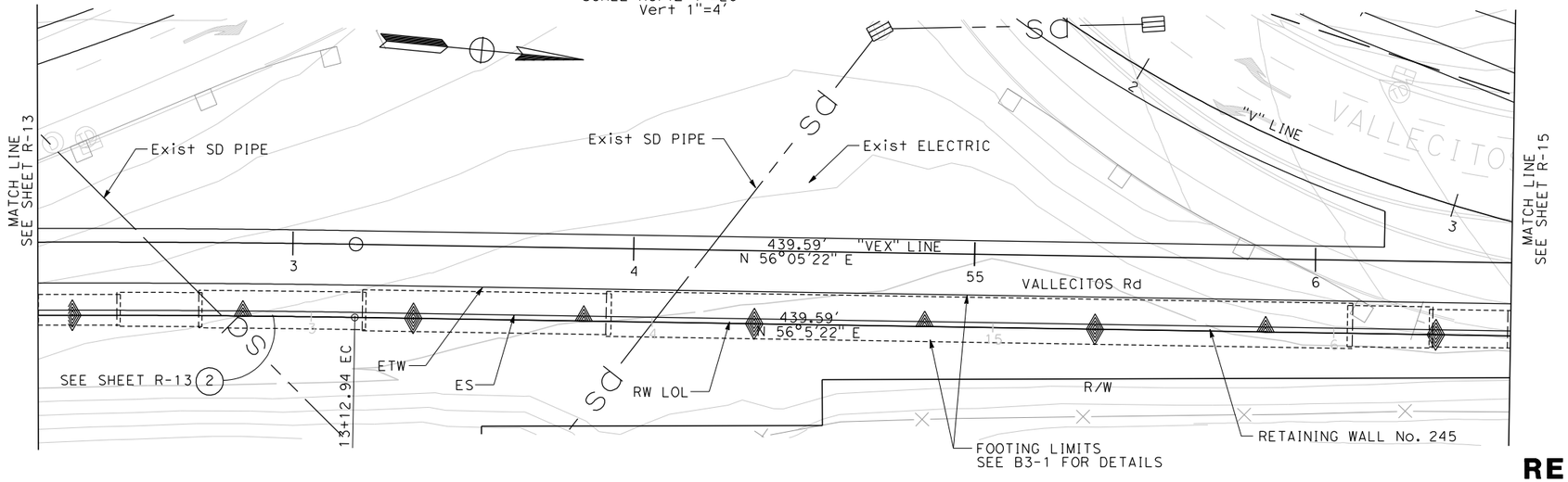

PLAN

SCALE 1"=20'

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RETAINING WALL PLAN
RW No. 245
Sheet 3 of 4

SCALE AS SHOWN

R-14

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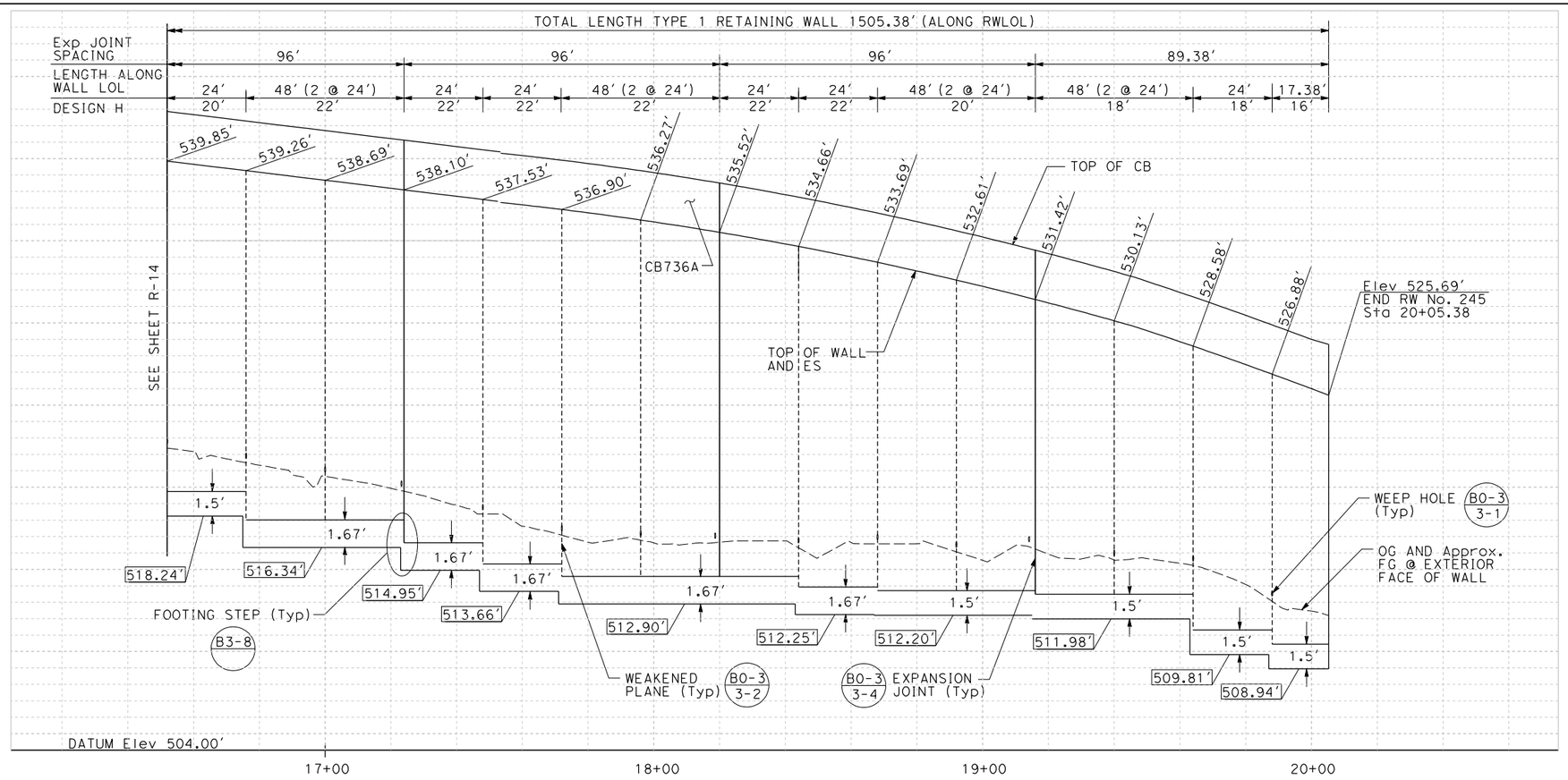

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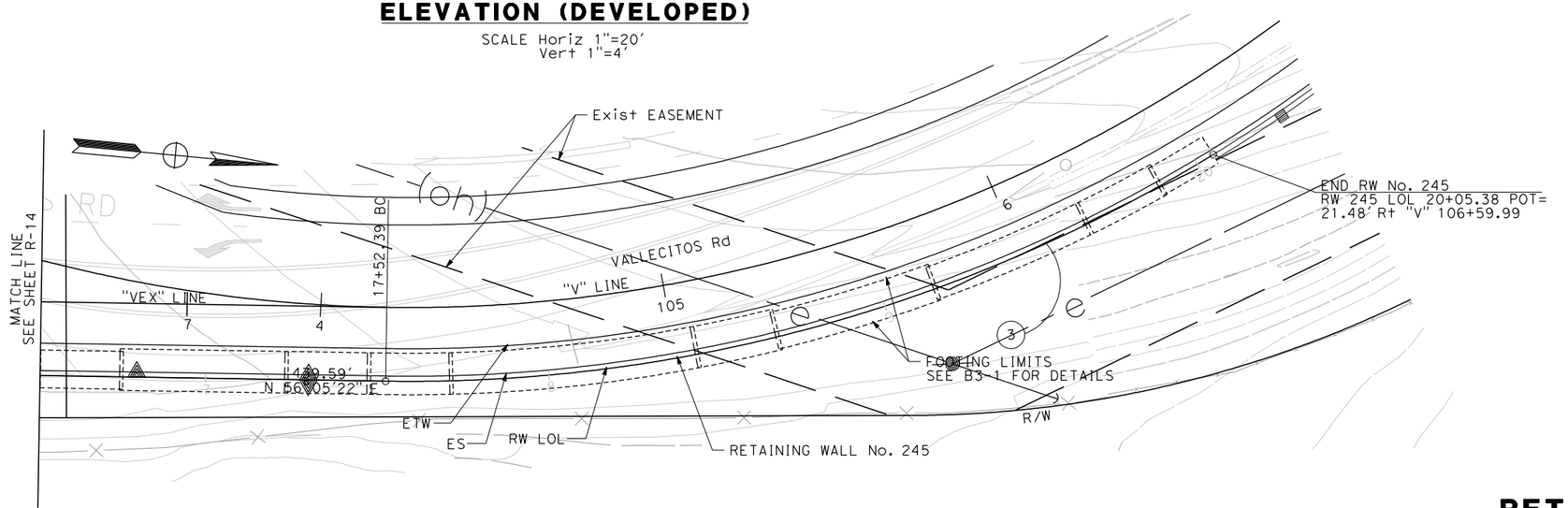

CURVE DATA

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PLAN

SCALE 1"=20'

THIS PLAN ACCURATE FOR RETAINING WALL WORK ONLY.

RETAINING WALL PLAN
RW No. 245
Sheet 4 of 4

SCALE AS SHOWN

R-15

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

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DATE PLOTTED => 5/18/2009
TIME PLOTTED => 6:34:18 PM

BORDER LAST REVISED 4/11/2008
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
USERNAME => Madaling_Lapustea
DGN FILE => ...\429760qa015.dgn
CU 04256
EA 297601

Review Discipline:	95% Caltrans Review Comments on Materials Route 84	**By:**	Caltrans
Comments Due By:		**Date:**	April 21, 2010
Date Reviewed By:		**Next JRT Meeting Date:**	TBD

TECHNICAL COMMENT REVIEW AND RESPONSE

EA# 297601 — **Comments from Caltrans Water Quality and Water Pollution Control**

CODE: A - Will Comply; B - URS to Evaluate; C - Will Not Incorporate; D – Agency (ACTIA) to Evaluate; E - No Action Required

AGCY	INIT	Item No.	Drawing or Page No.	Review Comments	Designer Responses	Initial Disp.	JRT Disp.	Final Disp.
MATERIALS – Materials Report								
CT	Cesar San Buenaventura	374		**Section 5.1 Structural Section Design Parameters** The total overlay thickness of 0.15' used in designing structural sections is inconsistent with the information presented in Section 5.5 of the Materials Report. Table 5-5 recommends 0.15'RHMA from Jack London Boulevard to Concannon Boulevard, 0.10'HMA under 0.15'RHMA from Concannon Road to south of Vallecitos road, and 0.15'HMA under 0.15'RHMA from south of Vallecitos road to Ruby Hill Road. Widening structural sections should be designed (to match the drainage layers) after taking into account the proposed overlays.	Based on further review of deflection study results, we have modified the recommendations for overlay. The thicknesses of asphalt concrete presented in CHEC's report were based on an early version of the as-built data (2007). However, the 2007 data had unverified information and conflicts with as-built plans that became available in 2008. With verified as-built data presented in Section 2, we have re-evaluated the overlay design recommendations for the reflective cracking criterion. Therefore, Table 5-5 will be modified. The revised recommendations can be summarized as a 0.15 foot RHMA in general.	A		
CT	CSB	375		**Section 5.4 New Pavement Structural sections** Is there a drainage ditch between sta. A1 240 and 246? If so, is there a need for overexcavation and recompaction in the ditch area?	Will comply. There is an existing drainage ditch on the west side of Route 84 beginning at A1 Station 230+00 and terminating at A1 Station 242+40. This drainage ditch is also shown on plan sheet X-3 cross section "A1" 240+00.07 to "A1" 246+00.00. Beginning at this latter location, a new culvert will be constructed under the highway terminating on the east side of Route 84. From the east side of Route 84, another drainage ditch continues northward. As shown on Sheet X-3, a new	A		

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EA# 297601

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AGCY	INIT	Item No.	Drawing or Page No.	Review Comments	Designer Responses	Initial Disp.	JRT Disp.	Final Disp.
					embankment is also planned on the west side of Route 84; the fill will be placed on the existing drainage ditch. We anticipate some overexcavation of unsuitable material (see Standard Specifications Section 19-2, Roadway Excavation) below the ditch bottom. A bid item should be included for unsuitable material.			
CT	CSB	376		What is the reason for proposing different HMA thicknesses in Section 5.4.4 and 5.5.5? Based on the information presented in Table 2-1, the existing ATPB layer within the limits, covered by both 5.4.4 and 5.5.5 Sections, is 0.55' below existing surface. Since the only variable design parameter is R-value of subgrade soils, we recommend that all layers be kept consistent except for 'AS'.	There is no Section 5.5.5 in the Materials Report; we presume you mean 5.4.5. Is our assumption correct? We will make thicknesses of RHMA, HMA, ATPB and Class 3 AB the same for SPCS 2 and SPCS 3. For SPCS 3, the thickness of Class 4 AS only will be reduced for a subgrade R-value of 25.			
CT	CSB	377		Also, for new widened sections, located up-gradient of existing structural sections with ATPB layer, provide an option of substituting ATPB layer with HMA for all scenarios, in addition to SPCS1. Use of structural SPCS1 as recommended here for all up-gradient scenarios (that is use of SPCS1 in conjunction with SPCS2, SPCS3, or SPCS4) constitutes unnecessary variability in grading plane. Every effort should be made to simplify from construction point of view as there are too many other variables (depth of existing drainage layers, R-values, proposed overlay thicknesses, proposed cross-slope corrections) to account for; minimize change of structural sections.	As presented in Table 5-4, there are twelve (12) locations where ATPB exists. If locations upgradient of existing ATPB are provided with an alternate pavement section to accommodate additional thickness of HMA in lieu of an ATPB layer, three (3) more pavement sections will be needed, for a total of fifteen (15) locations (equivalent SPCS 1 for SPCS 2, SPCS 3 and SPCS 4). This is in contrast to Caltrans review comment item no. 21, dated October 23, 2009, stating "There are too many structural sections proposed for the project. These			

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Date Reviewed By:		**Next JRT Meeting Date:**	TBD

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EA# 297601 — **Comments from Caltrans Water Quality and Water Pollution Control**

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AGCY	INIT	Item No.	Drawing or Page No.	Review Comments	Designer Responses	Initial Disp.	JRT Disp.	Final Disp.
					are cumbersome from both design and construction aspects. Simplify and minimize as much as possible." Furthermore, to keep construction costs down, we also minimized thickness of HMA layers.			
CT	CSB	378		**5.4.8 Summary of Recommended mainline Pavement Sections** Table 5-4 has been referenced but there is no Table 5-4 included in the Materials Report.	Table 5-4 was included in the Materials Report under the section for tables.			
CT	CSB	379		**6.3 Storm Drainage System** Do not include underdrain recommendations under the heading Storm Drainage System as they are designed to handle groundwater and not storm water. Include a separate heading.	Will revise and add new section entitled "6.4 Underdrain System"	A		
CT	CSB	380		**6.5.1 Along Mainline** 1st paragraph, last sentence is inconsistent with the recommendation made under Section 5.2, and referenced here.	Will delete this sentence.	A		
CT	CSB	381		**Section 9.2.5 Stabilization Fabric** Its use is no longer recommended; therefore remove it.	Will comply.	A		
MATERIALS – Project Plans								
CT	CSB	382	X-1	**Sheet X-1** Revise Note 4 to be consistent with the surface course of RHMA.	Will Comply. Is it feasible to have RHMA layer under dikes?. Please advise.	A		
CT	CSB	383	X-1	Will there be a conflict with the underdrain systems and storm drain systems? If necessary, construct underdrain trench at a sufficient offset to avoid conflict with the storm drain systems.	Will evaluate conflicts for next submittal.	A		
CT	CSB	384	X-1	For ease of construction, we recommend achieving surface		B		

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TECHNICAL COMMENT REVIEW AND RESPONSE

EA# 297601

Comments from Caltrans Water Quality and Water Pollution Control

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				cross slope of 5% on the shoulders by placing variable HMA on the shoulders. Other structural section elements below HMA including grading plane should be constructed without any break in cross slope between traveled way and shoulder. Revise the typical 'Underdrain and Edgedrain Detail', and all other typical cross-sections to reflect ATPB and structural section layers below ATPB having same cross slope for entire width (shoulders and traveled way).	Agree, the construction will be easier, but the shoulder section now will be lesser structural section and not same as the lane due to thinner HMA. We believe Caltrans now prefers to have lane and shoulders of same structural section.			
CT	CSB	385	X-1	Two overlay structural sections (structural section No.1 and No. 2) have been proposed but the Materials Report recommends three, and as commented on the Materials Report, the proposed new widening structural sections would need to be adjusted for the proposed overlay thicknesses in areas with drainage layers.	Materials report recommendations are being updated. The cross sections will be revised to match material report recommendations.	A		
CT	CSB	386	X-1	In areas where cross slope correction is proposed, include a detail to show placement of a min. 0.10' HMA by cold planning at conforms.	Already addressed in Construction detail C-23. Please provide comments on C-23.	C		
CT	CSB	387	X-1	Why is structural section no. 3 (new) drawn to show 5 elements? Remove one line (fourth from top) that will remove the visual appearance of the ATPB layer. Same applies to existing structural sections 1, 2, and 3 shown on Sheets X-2, and X-3.	Agree will remove additional line at all occurrences of structural section no. 3.	A		
CT	CSB	388	X-1	What is the deciding criterion in defining sawcut line? Sawcut is shown as variable from 0-9.5' from existing ET/W on Sheet X-2, 4 to 7' from ET/W on Sheet X-5. Other X-sheets show it at one foot inside the existing ET/W. Some other sheets show it at other distances from the ET/W. Some typical cross sections include a reference from ES.	The saw cut line is defined by a number of factors such as on location of underlying edge drains and underdrains, shifting of widening from one side of existing roadway to other side, and has been shown using a reference from where it will be easier to construct.	C		

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Date Reviewed By:		**Next JRT Meeting Date:**	TBD

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AGCY	INIT	Item No.	Drawing or Page No.	Review Comments	Designer Responses	Initial Disp.	JRT Disp.	Final Disp.
CT	CSB	389	X-2	**Sheet X-2** No.2 overlay of 0.15' RHMA-G over 0.10'HMA(A) is shown but Materials Report recommends 0.15' RHMA-G over 0.15'HMA(A).	Materials report recommendations are being updated. The cross sections will be revised to match material report recommendations.	A		
CT	CSB	390	X-3	**Sheet X-3** Is there a drainage ditch between sta. A1 240 and 246? If so, is there a need for overexcavtion and recompaction in the ditch area?	Same comment as comment no. 375. See response to comment no. 375.	A		
CT	CSB	391	X-3	No.2 overlay of 0.15' RHMA-G over 0.10'HMA(A) is shown but Materials Report recommends 0.15' RHMA-G over 0.15'HMA(A).	Materials report recommendations are being updated. The cross sections will be revised to match material report recommendations.	A		
CT	CSB	392	X-4	**Sheet X-4** Bottom typical (Sta. A1 251 to 256±) - - - Existing structural section No. 4 has ATPB layer but the proposed structural section No. 3 does not. We suggest reconstructing between Sta. 254+28 and 256 to a depth of 0.85' to remove ATPB layer. Otherwise, since widening is on the low side, the new structural section has to include ATPB layer.	The Typical section will be updated to remove section no 4 from the note. Section 4 actually starts at Sta 258+00 and would not be applicable to this typical section. Please see structural section limit notes at right of the section.	A		
CT	CSB	393	X-4	Top typical (Sta. A1 265+50 to 295±) - - - No.1 overlay of 0.15' RHMA-G has been shown but based on the Materials Report it should be No.2. Widening sections should be designed to account for 0.10' RHMA over 0.10' HMA(A). Also, re-evaluate whether non- ATPB section can be continued to sta. 290+00 as the widening on the southbound side is shown to be on the high side of super and on the northbound side it is all new pavement.	Materials report overlay recommendation is being updated and the typicals will match the recommendations for overlay and widening sections. Non ATPB section (Structural section 3) is continued till Sta 282+75. Please see note to the right of the section. At sta 282+75 the super elevation starts to drain the sub layer in widening direction and hence structural section 5 with ATPB starts at Sta 282+75.	A C		

Review Discipline:	95% Caltrans Review Comments on Materials Route 84	**By:**	Caltrans
Comments Due By:		**Date:**	April 21, 2010
Date Reviewed By:		**Next JRT Meeting Date:**	TBD

TECHNICAL COMMENT REVIEW AND RESPONSE

EA# 297601

Comments from Caltrans Water Quality and Water Pollution Control

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AGCY	INIT	Item No.	Drawing or Page No.	Review Comments	Designer Responses	Initial Disp.	JRT Disp.	Final Disp.
					Layout and super diagram combined with the typical will give a complete picture.			
CT	CSB	394	X-5	**Sheet X-5** Bottom Typical (Sta. A1 295 to 314±) - - - No.1 and No.2 overlay has been shown but based on the Materials Report it should be all No.2. Widening sections should be designed to account for 0.10' RHMA over 0.10 HMA(A). Sawcut is shown at 4 to 7 feet from the ETW on southbound side but one foot from the ETW on the northbound side.	Materials report overlay recommendation is being updated and the typicals will match the recommendations for overlay and widening sections. Sawcut line on NB is based on location of ED to be removed. SB has no ED and therefore more of existing shoulder can be utilized reducing cost of constructing new pavement.	A C		
CT	CSB	395	X-5	Top Typical (Sta. A1 314± to 319±) - - - If existing No.8 has ATPB layer as shown; then, why widen on the low side with non-ATPB (No.3)? Sawcut is shown one foot from the ETW on southbound side but 4 to 9' from ES on northbound side.	Please refer to L-9 and you will see the right saw cut shifting from NB to SB at Sta 317+61. at this point the existing NB pavement is overlaid as new SB, resulting in a crown reversal. So the edge drain removal stops at Sta 317+00 and edge drains are left in place from 317+00, and clean out vents are extended till proposed NB ES as they cannot be located in the median due to presence of a left turn pocket. When the edge drain is left in place the new widening happens with structural section 3. On NB 84, Sawcut line crosses existing ETW and would be difficult to reference from ETW.	C		
CT	CSB	396	X-6, X-7	**Sheet X-6, X-7** Typical (Sta. A1 320± to 322±), and Typical (Sta. A1 322± to	The existing edge drain is removed due to widening. The proposed SB median drains	E		

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				339±) - - - Confirm the location of edge drain and the corresponding sawcut line on these and other typicals. Why remove the existing edge drains and move them in, if they exist further out? Please note that other typicals on Sheet X-6 and X-7 show edge drain just outside the ET/W and not at ES as shown here.	in opposite direction compared to the existing NB. This creates a low point in ATPB layer at the sawcut line. Therefore the new Edge drain has to be moved to the saw cut location to collect the water. The edge drains will connect to inlets and cross culverts to drain the water from the median. As per the as builts, around Sta 333+25 the existing edge drains shift from ES to ETW. The typical sections reflect that change.			
CT	CSB	397	X-6, X-7	Typical (Sta. A1 322± to 339±) - - - If edge drains are to be removed, why do the removal of existing edge drain ends at 333+25? No.6 structural section is not to begin until sta. 337+51. Why do NB shoulder details for typical A1 327+47 to 332+50 show ATPB layer and new edge drain with structural section No. 3?	At Sta 333+25 the edge drains shift from ES to ETW and are not affected by sawcut line. So for cost efficiency, can be left in the median for drainage till Sta 339+00. Agree, NB shoulder details will be corrected not to show the proposed ED as the proposed NB ED will start at Sta 337+51.	E A		
CT	CSB	398	X-9	**Sheet X-9** Bottom Typical (Sta. A1 359+57 to 386+11) - - - Is it necessary to use an ATPB section (structural section no. 6) for SB widening? What is the minimum width for NB shoulder when widening with No.6, a multilayered section? Based on the Layout plans, it is unclear, what was the deciding criterion to propose No. 6 for some limits and No.11 for others?	It is necessary to match existing ATPB layer for SB widening as the superelevation on the curve drains the water towards southbound. The typical section needs to be observed with layout and super elevation sheet. The section is typical and does not show all the subgrade slope variations. For constructability purposes a minimum width 4' has been provided for structural	C		

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					section no. 6. Structural section 11 is for sliver widening areas of less than 4' width. The areas for structural section no. 11 can be seen on sheet L-14. Structural section No 11 also has been used on high side areas of super elevation.			
CT	CSB	399	X-9	Top Typical (Sta. A1 386+11 to 391+16) - - - Saw cut lines, again, are inconsistent between NB and SB on this and the following Sheets. For SB widening, shouldn't ATPB section start at 385± instead of 387+50. For NB widening, structural section No. 5 has been proposed for only 60 feet length. It is impractical during construction to keep changing the grading planes for short lengths. Propose a new structural section that has same grading plane as no. 3 or 7.	The width of proposed EP from existing EP does not allow saw cut to be placed at same offset for the NB as the SB. The presence of underground pump station structure also makes it advisable to saw cut 1' from etw for the NB. As builts show the edge drains to start from Sta 387+50, so the ATPB section was used from Sta 387+50. Will revise ATPB and new ED to start from 385+00 as it will be more conservative. As builts show different structural section used for a small stretch and the proposed sections match as builts for drainage layer. Will evaluate	C A B		
CT	CSB	400	X-11	**Sheet X-11** Is there a reason to choose use of structural section no. 8 below concrete barrier within these limits as the other typicals show only extension of top lift of HMA?	The idea is to build ED and UD systems flush with the retaining walls in this area. That implies full structural section till face of the wall and under the barrier.	C		
CT	CSB	401	X-11	Northbound Shoulder Details A3 399+55 to 403+37 - - - What is the clearance between the bottom of existing underdrain pipe to be removed and existing 96" pipe to remain? If	The existing edge drain does not conflict horizontally with the 96" pipe, and is at a minimum distance of 18ft. Will update the	C		

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				removal of underdrain poses any risk to existing 96" pipe, existing underdrain between A3 399+55 to 403+37 may be allowed to remain. Note that on plans, the underdrain pipe between A3 403+37 and 408+75 has been shown to remain. A new underdrain should still be constructed regardless.	typical section to better represent this horizontal separation. The edge drain is to be removed and has been called out on Sheets Subsurface Drains Edge Drain, SB-10 and SB-11. A new edge drain and under drain system will be constructed at proposed NB ES.			
CT	CSB	402	X-13	**Sheet X-13** What is the criterion for switching from overlay 2 to 1 and then back to 1.	The intent is to show differential overlay using structural section no. 2. No 1 is intended to be used where existing and proposed cross slopes and super elevation match and a uniform overlay can be achieved.	E		
CT	CSB	403	C-22	**Sheet C-22** Use 0.50' AB below HMA for maintenance vehicle pullouts.	Will Comply	A		
CT	CSB	404		**Drainage Plans** As commented before, there are numerous drainage pipes that are to be placed by trenching across the existing pavement. Propose details showing reconstruction of pavement.	Will provide trench paving detail showing reconstruction of pavement.	A		
CT	CSB	405		Selection of pipe materials in the APC table meeting 50-year design life based on the corrosion data and Altpipe output (computer program) provided in the Materials Report are to be reviewed by the Hydraulics Office.	Will coordinate with Caltrans Hydraulics Office.	A		
CT	CSB	406		**Special Provisions** Earthwork - - - Specifications regarding placement of selected material as recommended in Section 9.2.5 of the Materials Report needs to be incorporated in the Earthwork special provisions. Also incorporate the recommendations made in Section 6.1.2, Subgrade Preparation, regarding use of slurry	Will comply, the appropriate recommendations of the Materials Report will be incorporated into SSPs	A		

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AGC Y	INIT	Item No.	Drawing or Page No.	Review Comments	Designer Responses	Initial Disp.	JRT Disp.	Final Disp.
				cement backfill for filling voids resulting from removal of existing guardrail posts. Materials Report recommends backfilling these voids to present ground surface but backfilling to the grading plane instead of existing ground surface in cut areas would be sufficient. This item also needs to be included in the BEES.				
CT	CSB	407	SSP 29-010	Keep para 1 and 3, and delete para 2.	Will do	A		
CT	CSB	408	SSP 39-050	Para 16 - The aggregate for HMA Type A must comply with ¾- inch gradation when lift thickness is greater than 0.20', and ½- inch gradation when lift thickness is less than 0.20'.	Will do	A		

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TECHNICAL COMMENT REVIEW AND RESPONSE

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Item No.	Drawing or Page No.	Review Comments	Design Responses	Revision Action	JRT Disp.	Final Disp.
Office of Truck Services						
1	Section 2.2 Route 84	No information has been presented for sta. limits 236+32 and 246+ 81. If no record could be found then state so, but still include all station limits in the Table.	Table will be revised. Station of the northern limit of the first row of Table 2-1 was incorrectly converted from metric to English. The limits of the first row should have been from 227+00 to 246+81.	A		
2	Section 2.2 Route 84	Is there a PM layer between sta. 411 +85 and 419+ 72? Information shown here is inconsistent with the information shown in Section 5.4.1.	PM layer does not exist between Sta. 411+85 and 419+72; Section 5.4.1 will be revised.	A		
3	Section 2.2 Route 84	Delete last sentence. Refer to our comment under Section 5.4.	Will comply.	A		

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4	Section 2.4 Structural Pavement Section	How come none of the cores show ATPB layer? This layer is shown on submitted AsBuilts which represent relatively recent construction.	Table 2-2 presents thickness measurements of pavement components when boreholes were drilled. Nine pavement cores retrieved by subconsultant, CHEC, do not reveal ATPB layer. Other boring locations may consist of ATPB layer; however, they were not apparent from the drilled holes. ATPB also was not readily distinguishable from the drilled cuttings.	A		
5	Section 5.1 Structural Section Design Parameters	The total overlay thickness of 0.15' used in designing structural sections is inconsistent with the information presented in Section 5.5 of the Materials Report. Section 5.5 recommends 0.15'HMA from Jack London Boulevard to Concannon Boulevard but 0.15'RHMA over 0.13' HMA is recommended for the remainder of the project. Please note that Caltrans does not use lift thickness of 0.13'. It has to be in increments of 0.05, so it may be changed to either 0.10' or 0.15'	Will revise from recommended 0.13' HMA to 0.1' HMA from Concannon Blvd to pavement change south of Vallecitos Road.	A		

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6	Section 5.1 Structural Section Design Parameters	Discuss and specify sawcut line for widenings whether it is to be at edge of T/W or at a different location. Keep locations of edge drains and underdrains in consideration when determining saw cut lines.	Will include general requirement of saw cut line to be at least 1 foot from existing edge of travel way and be on the upslope side of existing edge drains.	A		
7	Section 5.2 and 5.4	Discuss here proposal of subgrade enhancement fabric and overexcavation to a depth of 4' as recommended in Section 6.1.2 and 9.21 of the Materials Report for sta. limits 227+00 to 234+00. We have concerns that the above recommendations may be difficult to construct unless a portion of shoulder pavement is removed to allow compaction with a standard roller.	Will comply.	A		

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8	Section 5.2 and 5.4	All borrow material generated from the project site regardless of the location within the project is considered 'local borrow' per Caltrans Standard Specifications and Special Provisions. Therefore, two statements included in the last paragraph regarding locally generated fill, one stating that the local material is not usable and the other stating that it is usable are contradictory unless more specific information is included. Also the statement, "In general, an R-value of 15 is required for imported fill material" is of no significance because the Project Plans do not show any imported borrow. To avoid paying for import material on an excess job as this one, where there is both good and poor quality material present, it is our recommendation that the special provision should be written such that it mandates higher R-value material generated from the project sta. limits 290 to 415 gets placed within 4 feet of the grading plane (instead of low R-value material generated from the remainder of the project). However, the Designer needs to verify whether the quantities generated from these cuts would be adequate for the purpose intended before implementing these recommendations.	Will coordinate with designer and include language in special provisions to limit imported borrow from Stations 290+00 to 415+00.	A		

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9	Section 5.2 and 5.4	Add a recommendation to include a note in the Project Plans that the elevation of ATPB layer may be adjusted, as to match the elevation of the existing ATPB layer. Some funds should be included in the PS&E to allow the Resident Engineer to make this adjustment.	Will comply.	A		
10	Section 5.2 and 5.4	Include recommendations for edge drain systems in conjunction with the use of ATPB layer.	Will comply.	A		
11	Section 5.2 and 5.4	Address the issue of existing shoulders. Propose where the sawcut line is to be, consider the location of edge drains and underdrains when determining the saw-cut line. Since it is recommended to remove the existing undedrains, saw cut line should be determined accordingly.	Will comply.	A		
12	Section 5.2 and 5.4	Include recommendations for ramps, city streets, access roads, maintenance roads, supergutter paving, trail/bike roads, etc.	Will comply.	A		
13	Section 5.2, 5.4 and 5.4.1	Verify the presence of permeable blanket and/or underdrain within sta. limits 411 +85 and 419+72 and design widenings accordingly.	Will comply.	A		
14	Section 5.2, 5.4 and 5.4.3	The submitted x-sections show cut from sta. 247 to 262. Is there a need for permeable material and/or toe drain?	There should be a toe drain included. Will include in discussion.	A		

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15	Section 5.2, 5.4 and 5.4.4	Verify and revise as necessary. A non-ATPB section has been recommended but AsBuilts information shown on Page 2-2 indicates ATPB for some of these limits.	Will comply.	A		
16	5.4.6 and 5.4.7	Groundwater is at 3' to 3.5' depth based on borings NB 37 and NB 38 (sta. 320±). Propose permeable blanket and underdrains in the vicinity to draw down the water and keep structural section dry.	NB37 and NB38 were drilled in the creek overflow channel of Arroyo Del Valle. At Sta. 320, the roadway will be supported on the Arroyo Del Valle bridge; therefore, no permeable blanket is considered necessary.	C		
17	5.4.8	The structural section is overdesigned, AB thickness may be reduced.	Concur that AB thickness could be reduced on the basis of structural pavement analysis; however, drainage requirements dictate both underdrain and pavement drainage layers be maintained at certain levels to make drainage layers continuous. It is our opinion that adding the AB thickness to maintain drainage flow in the ATPB and the permeable blanket would be a cost-effective way.	C		

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18	5.4.9	The submitted x-sections show cut from sta. 355 to 361. Is there a need for permeable material and/or toe drain?	Groundwater was not encountered to depth as much as 40 feet between Stations 337+00 and 363+00. Existing pavement section does not include any permeable blanket or toe drain. Therefore, it is our opinion that permeable material or toe drains are not required.	C		
19	5.4.10	Table 2-1 shows 0.75' existing AC above ATPB layer.	Will revise station limits for 5.4.10 and 5.4.11 to the following: 5.4.10 from 415+00 to 419+20 5.4.11 from 419+20 to 439+50	A		
20	5.4.13	Verify, if the project is going to require imported borrow. The Project Plans show excess material, and we don't see a need to import borrow.	Will confirm.	A		

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21	Section 5.2 and 5.4	There are too many structural sections proposed for the project. These are cumbersome from both design and construction aspects. Simplify and minimize as much as possible. There are also quite a few outstanding comments on the structural section design, as noted above. In our opinion, it may be more appropriate to have a meeting in evaluating how to minimize the number of proposed structural sections and agreeing on the final pavement design.	Recommended structural sections were based on three subgrade R-values in an attempt to minimize cost (see Table 5-2). The various generations of existing pavement section components, ATPB in particular, necessitate additional sections in order to maintain pavement drainage. We have further optimized the number of required sections.	A		
22	Section 5.5 Pavement Overlay / Rehabilitation	Refer to our comments on Section 5.1.	Will comply.	A		
23	6.1.3 Subgrade Preparation	Refer to our comments on Section 5.2 and 5.4.	Will comply (presumably comment refers to Section 6.1.2).	A		

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24	6.3 Storm Drainage System	It is recommended that all cuts for new pavement should include an underdrain system consisting of a layer of permeable material with toe drains but this has not been reflected in recommended pavement structural sections in Section 5.4.	Concur with this general approach for hill side excavation and low lying area. However, between Station 252+00 and 448+00, groundwater was not encountered as much as 40 feet in depth. Therefore, it should be reviewed on a segment by segment case whether permeable material or toe drains are warranted. These evaluations have been incorporated into the recommended sections presented in Section 5.	C		
25	6.3 Storm Drainage System	Recommend the depth of underdrain trench. Is the trench proposed to be outside the shoulder? It has been shown extending to the profile grade. Recommend size and type of underdrain pipe.	Will clarify discussion.	A		
26	6.3 Storm Drainage System	Are there any drainage systems that are to be placed by trenching through the existing pavement? If so, provide trench paving details.	Will comply.	A		
27	7 Corrosion Investigation	Title is missing.	Will modify.	A		

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28	7 Corrosion Investigation	Include a Table showing the line, stationing, offset, depth, and test data.	Will comply.	A		
29	7 Corrosion Investigation	Corrosion analysis should be performed on individual test data and recommendations should be summarized for the project. Also note that Culvert 4 has been superseded by AltPipe. It may be accessed from the following address: http://www.dot.ca.gov/hq/oppd/altpipe.htm	Will update.	A		
30	9.2.2 Specifications/ Structural Pavement Sections	Change asphalt concrete to Hot Mix Asphalt.	Will comply.	A		
31	9.2.5 Special Provisions	It is stated that the upper 4 feet of embankment fill below grading plane shall have a minimum R-value of 25. Does this apply to the entire project? If so, it is in contradiction with recommendations made under Section 9.2.1 where in R-value 15 material is recommended.	Will update Section 9.2.1 so that it is consistent with Section 9.2.5.	A		
32						

			By:	URS

Review of Draft Geotechnical Design Report (GDR) and Materials Report 35% PLANS REVIEW COMMENTS

TECHNICAL REVIEW COMMENTS AND RESPONSES
Independent Technical Review Comments,

Title: Route 84 Expressway Widening, Alameda County, CA | Submittal: **35% PS&E**

CODE: A-Will Comply; B-Consultant to Evaluate; C-Will Not Incorporate; D-Agency to Evaluate; E-No Action Required

		ROAD PLANS COMMENTS			
No.	**Section/Sheet No.**	**Review Comments**	**Design Responses**	**Proposed Action:**	**Final Action:**
CT – District Materials Engineer, Engineering Services I – Materials A; dated June 23, 2008					
1	GENERAL	Keep terminology and unit usage consistent throughout the Report e.g., feet instead of meters, HMA instead of asphalt concrete. AC or RAC-G may be used to discuss existing pavement structural sections, but for proposed asphalt products, use HMA	Will comply.	**A**	
2	Section 2.2 Route 84	1) State the As-Built Contract Numbers from where the information for existing structural Sections, shown in the table here, has been deciphered. Appendix should include copies of As-Built Plan Sheets (existing structural section information) relevant to all the information shown in the Table. There are no As-Builts provided in the Appendix for Route 84 between Concannon Boulevard and Ruby Hill Drive other than for the Vallecitos Road intersection realignment. Is this realignment project built already as the Title Sheet indicates the plans to be 95% and are stamped 'NOT FOR CONSTRUCTION'? Summarized structural section information from Vallecitos Road intersection realignment project in the text and table presented in the Report. This project does not show use of ATPB layer, and the existing structural section information currently presented in the table shows ATPB layer for the entire project limits. Since the corridor includes ATPB, PM, edge drains and underdrains, it is crucial to summarize existing structural section information very accurately. Discuss the location existing edge drains and underdrains (including their depth) from the edge of shoulder. This information is to be based on the As-Builts, and to facilitate our review, please either include the relevant sheets in the appendix or submit them separately.	Will verify information presented in this table and update/revise as necessary based on all available as-built information. Will include copies of all pertinent as-built plans in the 65% report submittal. Will verify completion status of Vallecitos Road intersection project and include as-built information for this section of the alignment, as available.	**A**	
3	Section 2.3 Isabel Avenue Connector	1) Is this information for the Isabel-Stanley connector ramp, if so, be more specific in ramp designation. Again, state the Contract No. from where this information is deciphered.	Will comply.	**A**	

4	Section 4.5 Corrosion	1) We are unable to review as this information is missing. It is stated that the engineering study is underway.	Corrosion study has been completed. Will include corrosion report in the 65% submittal.	**A**	
5	Section 5.1 Structural Section Design Parameters	1) It is stated that ATPB layer is proposed where new pavement section is located on the down gradient side of the existing pavement; however, all recommended structural section under Section 5.4 include ATPB layer.	1)The structural section design tables include 0.25 feet of ATPB to match existing pavement drainage presented on the as-built plans. The ATPB can be eliminated for the portions of new pavements where superelevation results in an upslope gradient.	**A**	
		2) Refer to our comments on Section 5.5 for proposed overlay thickness.	2) Will modify the table presented on page 5-8, "Summary of AC Overlay Recommendations", to include 0.15 foot thick RAC-G overlay only; the recommended section of DGAC will be omitted as requested.	**A**	
6	Section 5.2 Subgrade Conditions	1) In the Table, also show line designation, stationing, offset for all borings.	1) Will comply.	**A**	
		2) All R-value samples have been taken at depths of 1-5 feet. It is stated that profile grade sheets show minimal cut, generally 0-4 feet below present grade. However, under Section 6.5 Cuts and Excavations, it is stated that cuts ranging from 1 to 28 feet are anticipated. Substantiate that R-value samples taken so far represent all of the proposed subgrade soils. Take additional samples, if necessary. Also, provide us with cross-sections every 50 feet showing cuts greater than 4 feet including cuts into hillsides.	2) Will comply.	**A**	
		3) To be consistent with the recommendations made in Section 6.1.2 Subgrade Preparation of the Report, discuss here proposal of subgrade enhancement fabric in conjunction with overexcavation.	3) Will comply.	**A**	
		4) All imported fill to be placed within 5 feet of the subgrade should have a minimum R-value of 15 and not 10. Earthwork quantities for the project should be kept in mind when selecting R-value for designing pavement structural sections.	4) Will revise structural pavement sections for design R-value of 15 in all fill areas and include sections in 65% report submittal.	**A**	

		5) Since the project has a variable range of R-values, design conservatively. For fill areas where it is proposed to use design R-value of 25, this higher R-value can be used if specifications are written such that they ensure higher design R-value material (Rv = 25) will be used for subgrade preparation for those areas. If not specified, the Contractor has the option to use whatever suits his operations, and the project cannot be designed for higher R-value.	5) Will revise structural pavement sections for design R-value of 15 in all fill areas and include sections in 65% report submittal.	**A**	
7	5.4.2 OGAC and RAC Considerations	1) Whether or not to use OGAC is a judgment to be exercised by the preparer of the Report. If in the opinion of the designer, the project conditions indicate necessity of OGAC, then recommend its use. If OGAC is to be used then pertinent references made in the 1st paragraph of this section for use of OGAC may remain; otherwise, delete paragraph 1 including references made to Caltrans Pavement Selection Review Committee, and OGAC placement temperatures. As commented before, use current terminology.	Use of OGAC is not currently planned and was included in 35% submittal for discussion purposes only. This paragraph will be omitted from the 65% report submittal.	**A**	
8	5.4.3 and 5.4.4	1) Refer to our comments below on Section 5.5 pavement overlay/Rehabilitation. Proposed HMA thickness may be reduced.	1) The recommended structural sections for new pavements presented in Sections 5.4.3 and 5.4.4 include only 0.15 feet of RAC-G over either 0.75 or 0.9 feet of HMA. The RAC-G and HMA thicknesses presented in these tables represent the minimum total thickness necessary to meet the required Gravel Equivalent (including safety factor) for a TI of 11.0.	**E**	
		2) Why are the sections with permeable material so much thicker than non-permeable sections for the same design factors: There is no need to overdesign sections with permeable material as it can be substituted for AS.	2) We agree that the total GE for the recommended structural sections using Class 3 Permeable exceed the minimum required total GE for the given TI and subgrade R-value. However, these recommended structural sections of Class 3 Permeable base, ATPB and Class 2 AB layer were selected to match the drainage conditions of the existing, adjacent pavements based on available as-built plans.	**E**	

		3) Table 1 proposes permeable material for engineered fill areas where as Table 2 for cut areas does not. Table 3 shows cut section but no permeable material. Specify sta. limits where permeable material is proposed.	3) Will include station limits for each of the six tables presented in these sections in the 95% report submittal. Permeable material sections are included in Tables 1, 4, and 6 to match the permeable material sections of adjacent existing pavements based on available as-built plans.	**A**	
		4) Specify sta. limits where Rv=25 section is to be used, and this section is to be proposed only for areas where 1) the soils test data confirms existing subgrade soils to have R-value of 25 or higher or 2) the project specifications ensure that fill material used for subgrade preparation will have an R-value of 25. Also refer to our comments on Section 5.2 Subgrade Conditions.	4) Will comply.	**A**	
		5) Include recommendations for edge drain systems in conjunction with the use of ATPB layer.	5) Will comply.	**A**	
		6) Address the issue of existing shoulders. Propose where the sawcut line is to be, consider the location of edge drains and underdrains when determining the saw cutline. If the shoulders are to be saved then demonstrate their structural adequacy and make recommendations on how to revise cross slope.	6) Will comply.	**A**	
		7) Include recommendations for ramps, city streets, access roads, maintenance roads, supergutter paving, trail/bike roads, etc.	7) Will include recommended structural section for Stanley Blvd connector, bike trail and Zone 7 access road in 65% submittal. New pavement structural section at tie in locations to city streets will match those shown on existing as-built plans.	**A**	
9	Table 5-1	1) Two tables are presented side by side with conflicting information.	1) Recommended structural sections for the mainline pavements and for the shoulders are shown in the left and right side tables, respectively.	**E**	

		2) Identify sta. limits where permeable material is proposed.	2) Station limits are indicated in the table under the column heading "Segment Description". Column 7 in each table indicates where Class 3 permeable material is proposed for new pavements.	**E**	
10	Section 5.5 pavement overlay/Rehabilitation	1) It is stated that the recommendation were developed for a 10-year design Traffic index of 11; however, Section 5.1.1 states the 20-year TI to be 11. Which is correct?	1) The overlay recommendations presented by CHEC for existing pavements were developed for a 10-year design Traffic Index of 11.0 in accordance with guidelines presented in the Caltrans Flexible Pavement Rehabilitation Manual (June 1, 2001) which states on page 1-2 that "The design period of the overlays in this study are 10 years." The recommended structural pavement sections for new pavements were developed for a 20-year TI of 11.0.	**A**	
		2) As indicated in the e-mail from URS Crop. Dated June 05, 2008, a deflection study was performed to determine the remaining design life and future performance of the existing pavement, and because of lack of available information on the existing subgrade, and presence of poor subgrade soils along a portion of the project alignment. The deflection study report recommends an overlay thickness of 0.15 RAC-G over 0.15 DGAC. For portion of the pavement between Concannon Boulevard and Jack London Boulevard, this proposed overlay is a very conservative design since the pavement was constructed in 2000+/-. In our opinion, 0.15 RHMA-G (RAC-G) would be sufficient. For the segment between Ruby Hill Drive and Concannon Boulevard, we defer the decision until we receive further documentation on the age of the pavement and As-Built structural section information.	2) Will comply.	**A**	

		3) Verify if there any concerns with the proposed change in profile due to proposed overlay of the existing pavement. Are there any overhead structures with vertical clearance issues? Address conforms of the overlay at each end of the job and at existing bridges/approach slabs.	3) Widening of Isabel Avenue to highway standards will require shifting and raising the roadway crown as well as constructing an overlay section. Consideration will be given to vertical clearance in establishing new pavement and pavement overlay grades.	**A**	
		4) For reconstruction of failed pavement, the depth of digouts is to be to the top of the base but to a maximum depth of 0.5'. Depth of repair should not be one to two inches below the existing AC as stated as we do not want to disturb the base especially ATP, and replace it with HMA. The digout areas should be marked on the layout plans and itemized on the quantities sheets in the Project Plans.	4) Will modify report recommendations as noted.	**A**	
		5) Recommend Crack sealant to be low modulus asphalt crack sealant or asphalt rubber instead of emulsified crack sealant. Emulsion needs time to break and its placement becomes a concern because of limited lane closure hours in our District.	5) Will modify report recommendations as noted.	**A**	
11	6.1.2 Subgrade Preparation	1) Guardrail post embedment dimensions are 6" x 8" x 44". We do not believe that these voids can be compacted and backfilled with standard fill as a recommended here. Is there a need for special backfill? Review the proposed subgrade profile in relation to the existing post bottoms, and evaluate whether requiring regarding and recompacting , for a minimum width of a roller, to the anticipated depth of posts could be an appropriate strategy.	1) Will recommend in the 65% report submittal that guardrail post excavations be backfilled with cement slurry in accordance with Caltrans Standard Specifications.	**A**	
		2) Use of stabilization fabric should also be mentioned in other area s of the Report where overexcavation is discussed, e.g. Section 5.2. As stated before imported fill should have a minimum R-value of 15 within 5 feet of the finished grade.	2) Will modify report recommendations as noted.	**A**	
12	6.3 Storm Drainage System	1) Address trench paving details for drainage systems that are to be placed by trenching through the existing pavement.	1) Project will not include trenching through existing pavements. Where new drainage systems are required, the existing pavement section will be removed and replaced.	**E**	

		2) It is stated that pavement underdrain system is incorporated in the Drainage Plan Drawings D-1 through D-18. We have not been able to locate the proposed underdrain systems on these drawings but note that underdrain systems are usually shown on sheets separate from those showing storm drains. Edge drain systems also need to be shown.	2) Construction layout and detail sheets for the edge drainage system are currently being prepared as part of the civil plans and will be included in the 65% report submittal.	**A**	
		3) Recommend the location, and depth of underdrain trench. Underdrain trench is shown as extending to the profile grade. Is the trench to be outside the shoulder? Recommend size and type of underdrain pipe.	3) The typical underdrain and edge drain detail is presented on Sheet X-1 of the civil plans included.	**E**	
13	9.2 Specifications	1) Specifications and Special provisions used include old terminology and are in metric units. Use updated versions.	1) Will comply.	**A**	
		2) 9.2.1 Earthwork – Recommend specifications for handling poor subgrade soils that are to be removed with in Stations 227+00 and 234+00, and unsuitable soils in other areas of the project (CH soils with expansive nature listed under Section 6.5). If not specified contractor has the option to reuse them. Imported borrow to be used within 1.5 m of the profile grade should be specified to have an R-value of 15.	2) Will add detailed recommendations for handling overexcavated subgrade soils and other unsuitable soils to the "Special Provisions" section of the 65% report submittal.	**A**	
		3) Since Lean Concrete Base and Pavement Reinforcing Fabric are not recommended items for pavement structural section; why include these items in the recommended specifications?	3) Will remove from specifications.	**A**	
		4) Include specifications for Stabilization Fabric recommended in Section 6.1.2 Subgrade Preparation.	4) Will comply.	**A**	
14	Pavement Deflection and Analysis Report	Since the scope of this project does not include rehabilitation of the existing pavement, we have not commented in detail on this Report. If the scope changes, further comments will be made in the future.	No response required.	**E**	
CT – Office of Geotechnical Design – West; dated June 2, 2008					
15	General	The GDR did not contain any recommendations or details of the proposed retaining walls. Please provide this information when available.	Will include discussions for standard retaining walls in next submittal. Geotechnical design parameters and recommendations for non-standard retaining walls will be presented in separate Foundation Report.	**A**	

16	General	The GDR stated that recommendations for three non-standard walls are described in a separate Preliminary Foundation Investigation Report. Please provide this for our review.	Will comply.	**A**	

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. RONALD TSUNG
District Office Chief
Design, Alameda II

Attention: N. Perez / C. San Buenaventura

Date: October 23, 2009

File: 4-ALA-84 PM 22.9/27.1
4-297601
Expressway widening

From: MANINDER KAUR
Materials Design Engineer
Engineering Services I - Materials A

Concurred By: TINU MISHRA, P.E.
District Materials Engineer
District Branch Chief, Materials A

Subject: Review of Materials Report

We have reviewed the Materials portion of the Geotechnical Design Report and Materials Report prepared by URS Corporation, dated September 17, 2009 for Route 84 Expressway widening. This project will conform to the Pigeon Pass Project (EA 04-172404) to the South and the I-580/Isabel Avenue Interchange Project (EA 04-171304) to the North. Because of many still outstanding comments, and thus not finalized pavement structural sections, we are unable to perform a review of the PS&E at this time. Please note that we have spent a considerable amount of time in providing very detailed feedback through written comments and discussions, but spending time on the PS&E at this juncture is unproductive with so many impending revisions. Our comments on the Materials Report are as follows:

Section 2.2 Route 84

1. No information has been presented for sta. limits 236+32 and 246+ 81. If no record could be found then state so, but still include all station limits in the Table.

2. Is there a PM layer between sta. 411+85 and 419+72? Information shown here is inconsistent with the information shown in Section 5.4.1.

3. Delete last sentence. Refer to our comment under Section 5.4.

Section 2.4 Structural Pavement Section

1. How come none of the cores show ATPB layer? This layer is shown on submitted As-Builts which represent relatively recent construction.

Section 5.1 Structural Section Design Parameters

1. The total overlay thickness of 0.15' used in designing structural sections is inconsistent with the information presented in Section 5.5 of the Materials Report. Section 5.5 recommends 0.15'HMA from Jack London Boulevard to Concannon Boulevard but 0.15'RHMA over 0.13' HMA is recommended for the remainder of the project. Please note that Caltrans does not use lift thickness of 0.13'. It has to be in increments of 0.05, so it may be changed to either 0.10' or 0.15'

2. Discuss and specify sawcut line for widenings whether it is to be at edge of T/W or at a different location. Keep locations of edge drains and underdrains in consideration when determining saw cut lines.

Section 5.2 and 5.4

1. Discuss here proposal of subgrade enhancement fabric and overexcavation to a depth of 4' as recommended in Section 6.1.2 and 9.21 of the Materials Report for sta. limits 227+00 to 234+00. We have concerns that the above recommendations may be difficult to construct unless a portion of shoulder pavement is removed to allow compaction with a standard roller.

2. All borrow material generated from the project site regardless of the location within the project is considered 'local borrow' per Caltrans Standard Specifications and Special Provisions. Therefore, two statements included in the last paragraph regarding locally generated fill, one stating that the local material is not usable and the other stating that it is usable are contradictory unless more specific information is included. Also the statement, "In general, an R-value of 15 is required for imported fill material" is of no significance because the Project Plans do not show any imported borrow. To avoid paying for import material on an excess job as this one, where there is both good and poor quality material present, it is our recommendation that the special provision should be written such that it mandates higher R-value material generated from the project sta. limits 290 to 415 gets placed within 4 feet of the grading plane (instead of low R-value material generated from the remainder of the project). However, the Designer needs to verify whether the quantities generated from these cuts would be adequate for the purpose intended before implementing these recommendations.

3. Add a recommendation to include a note in the Project Plans that the elevation of ATPB layer may be adjusted, as to match the elevation of the existing ATPB layer. Some funds should be included in the PS&E to allow the Resident Engineer to make this adjustment.

4. Include recommendations for edge drain systems in conjunction with the use of ATPB layer.

5. Address the issue of existing shoulders. Propose where the sawcut line is to be, consider the location of edge drains and underdrains when determining the saw- cut line. Since it is recommended to remove the existing undedrains, saw cut line should be determined accordingly.

6. Include recommendations for ramps, city streets, access roads, maintenance roads, supergutter paving, trail / bike roads, etc.

5.4.1

1. Verify the presence of permeable blanket and/ or underdrain within sta. limits 411+85 and 419+72 and design widenings accordingly.

5.4.3

1. The submitted x-sections show cut from sta. 247 to 262. Is there a need for permeable material and/ or toe drain?

5.4.4

1. Verify and revise as necessary. A non-ATPB section has been recommended but As-Builts information shown on Page 2-2 indicates ATPB for some of these limits.

5.4.6 and 5.4.7

1. Groundwater is at 3' to 3.5' depth based on borings NB 37 and NB 38 (sta. 320±). Propose permeable blanket and underdrains in the vicinity to draw down the water and keep structural section dry.

5.4.8

1. The structural section is overdesigned, AB thickness may be reduced.

5.4.9

1. The submitted x-sections show cut from sta. 355 to 361. Is there a need for permeable material and/ or toe drain?

5.4.10

1. Table 2-1 shows 0.75' existing AC above ATPB layer.

5.4.13

1. Verify, if the project is going to require imported borrow. The Project Plans show excess material, and we don't see a need to import borrow.

* * *

There are too many structural sections proposed for the project. These are cumbersome from both design and construction aspects. Simplify and minimize as much as possible. There are also quite a few outstanding comments on the structural section design, as noted above. In our opinion, it may be more appropriate to have a meeting in evaluating how to minimize the number of proposed structural sections and agreeing on the final pavement design.

Section 5.5 Pavement Overlay / Rehabilitation

1. Refer to our comments on Section 5.1.

6.1.3 Subgrade Preparation

1. Refer to our comments on Section 5.2 and 5.4.

6.3 Storm Drainage System

1. It is recommended that all cuts for new pavement should include an underdrain system consisting of a layer of permeable material with toe drains but this has not been reflected in recommended pavement structural sections in Section 5.4.

2. Recommend the depth of underdrain trench. Is the trench proposed to be outside the shoulder? It has been shown extending to the profile grade. Recommend size and type of underdrain pipe.

3. Are there any drainage systems that are to be placed by trenching through the existing pavement? If so, provide trench paving details.

7 Corrosion Investigation

1. Title is missing.

2. Include a Table showing the line, stationing, offset, depth, and test data.

3. Corrosion analysis should be performed on individual test data and recommendations should be summarized for the project. Also note that Culvert 4 has been superseded by AltPipe. It may be accessed from the following address: http://www.dot.ca.gov/hq/oppd/altpipe.htm

9.2.2 Specifications/ Structural Pavement Sections

1. Change asphalt concrete to Hot Mix Asphalt.

9.2.5 Special Provisions

1. It is stated that the upper 4 feet of embankment fill below grading plane shall have a minimum R-value of 25. Does this apply to the entire project? If so, it is in contradiction with recommendations made under Section 9.2.1 where in R-value 15 material is recommended.

If you have any questions, please call Maninder Kaur at 286-4827.

c: Daily File, Project File, dg

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. RONALD TSUNG
District Office Chief
Design, Alameda II

Attention: N. Perez / C. San Buenaventura

Date: June 23, 2008

File: 4-ALA-84 PM 22.5/27.3
4-297600
Expressway widening

From: MANINDER KAUR
Materials Design Engineer
Engineering Services I - Materials A

Concurred By: TINU MISHRA, P.E.
District Materials Engineer
District Branch Chief, Materials A

Subject: Review of Materials Report

We have reviewed the Materials Report prepared by URS Corporation, dated April 28, 2008 prepared for Alameda County Transportation improvement Authority for Route 84 Expressway widening. This project will conform to the Pigeon Pass Project (EA 172403, currently in Construction) to the South and the I-580/Isabel Avenue Interchange Project (EA 171301, currently in Design) to the North. Our comments are as follows:

General

Keep terminology and unit usage consistent throughout the Report e.g., feet instead of meters, HMA instead of asphalt concrete. AC or RAC-G may be used to discuss existing pavement structural sections, but for proposed asphalt products, use HMA.

Section 2.2 Route 84

1) State the As-Built Contract Numbers from where the information for existing structural Sections, shown in the table here, has been deciphered. Appendix should include copies of As-Built Plan Sheets (existing structural section information) relevant to all the information shown in the Table. There are no As-Builts provided in the Appendix for Route 84 between Concannon Boulevard and Ruby Hill Drive other than for the Vallecitos road intersection realignment. Is this realignment project built already as the Title Sheet indicates the plans to be 95% and are stamped 'NOT FOR CONSTRUCTION'? Summarize structural section information from Vallecitos Road intersection realignment project in the text and

table presented in the Report. This project does not show use of ATPB layer, and the existing structural section information currently presented in the table shows ATPB layer for the entire project limits. Since the corridor includes ATPB, PM, edgedrains and underdrains, it is crucial to summarize existing structural section information very accurately. Discuss the location of existing edge drains and underdrains (including their depth) from the edge of shoulder. This information is to be based on the As-Builts, and to facilitate our review, please either include the relevant sheets in the Appendix or submit them separately.

Section 2.3 Isabel Avenue Connector

1) Is this information for the Isabel - Stanley connector ramp, if so, be more specific in ramp designation. Again, state the Contract No. from where this information is deciphered.

Section 4.5 Corrosion

1) We are unable to review as this information is missing. It is stated that the engineering study is underway.

Section 5.1 Structural Section Design Parameters

1) It is stated that ATPB layer is proposed where new pavement section is located on the down gradient side of the existing pavement; however, all recommended structural section under Section 5.4 include ATPB layer.

2) Refer to our comments on Section 5.5 for proposed overlay thickness.

Section 5.2 Subgrade Conditions

1) In the Table, also show line designation, stationing, offset for all borings.

2) All R-value samples have been taken at depths of 1-5 feet. It is stated that profile grade sheets show minimal cut, generally 0 to 4 feet below present grade. However, under 'Section 6.5 Cuts and Excavations' it is stated that cuts ranging from 1 to 28 feet are anticipated. Substantiate that R-value samples taken so far represent all of the proposed subgrade soils. Take additional samples, if necessary.

Also, provide us with cross-sections every 50 feet showing cuts greater than 4 feet including cuts into hillsides.

3) To be consistent with the recommendations made in 'Section 6.1.2 Subgrade Preparation' of the Report, discuss here proposal of subgrade enhancement fabric in conjunction with overexcavation.

4) All imported fill to be placed within 5 feet of the subgrade should have a minimum R-value of 15 and not 10. Earthwork quantities for the project should be kept in mind when selecting R-value for designing pavement structural sections.

5) Since the project has a variable range of R-values, design conservatively. For fill areas where it is proposed to use design R-value of 25, this higher R-value can be used if specifications are written such that they ensure higher design R-value material (Rv= 25) will be used for subgrade preparation for those areas. If not specified, the Contractor has the option to use whatever suits his operations, and the project cannot be designed for higher R-value.

5.4.2 OGAC and RAC Considerations

1) Whether or not to use OGAC is a judgment to be exercised by the preparer of the Report. If in the opinion of the designer, the project conditions indicate necessity of OGAC, then recommend its use. If OGAC is to used then pertinent references made in the 1st paragraph of this section for use of OGAC may remain; otherwise, delete paragraph 1 including references made to Caltrans Pavement Selection Review Committee, and OGAC placement temperatures. As commented before, use current terminology.

5.4.3 and 5.4.4

1) Refer to our comments below on Section 5.5 Pavement overlay / Rehabilitation. Proposed HMA thickness may be reduced.

2) Why are the sections with permeable material so much thicker than non-permeable sections for the same design factors? There is no need to overdesign sections with permeable material as it can be substituted for AS.

3) Table 1 proposes permeable material for engineered fill areas where as Table 2 for cut areas does not. Table 3 shows cut section but no permeable material. Specify sta. limits where permeable material is proposed.

4) Specify sta. limits where Rv = 25 section is to be used, and this section is to be proposed only for areas where: 1) the soils test data confirms existing subgrade soils to have R-value of 25 or higher or 2) the project specifications ensure that fill material used for subgrade preparation will have an R-value of 25. Also refer to our comments on Section 5.2 Subgrade Conditions.

5) Include recommendations for edge drain systems in conjunction with the use of ATPB layer.

6) Address the issue of existing shoulders. Propose where the sawcut line is to be, consider the location of edge drains and underdrains when determining the saw cutline. If the shoulders are to be saved then demonstrate their structural adequacy and make recommendations on how to revise cross slope.

7) Include recommendations for ramps, city streets, access roads, maintenance roads, supergutter paving, trail / bike roads, etc.

Table 5-1

1) Two tables are presented side by side with conflicting information.

2) Identify sta. limits where permeable material is proposed.

Section 5.5 Pavement overlay / Rehabilitation

1) It is stated that the recommendation were developed for a 10-year design Traffic Index of 11; however, Section 5.1.1 states the 20-year TI to be 11. Which is correct?

2) As indicated in the e-mail from URS Corp. dated June 05, 2008, a deflection study was performed to determine the remaining design life and future performance of the existing pavement, and because of lack of available information on the existing subgrade, and presence of poor subgrade soils along a portion of the project alignment. The deflection study report recommends an

overlay thickness of 0.15 RAC-G over 0.15 DGAC. For portion of the pavement between Concannon Boulevard and Jack London Boulevard, this proposed overlay is a very conservative design since the pavement was constructed in 2000±. In our opinion, 0.15 RHMA-G (RAC-G) would be sufficient. For the segment between Ruby Hill Drive and Concannon Boulevard, we defer the decision until we receive further documentation on the age of the pavement and As-Built structural section information.

3) Verify if there any concerns with the proposed change in profile due to proposed overlay of the existing pavement. Are there any overhead structures with vertical clearance issues? Address conforms of the overlay at each end of the job and at existing bridges / approach slabs.

4) For reconstruction of failed pavement, the depth of digouts is be to the top of the base but to a maximum depth of 0.5'. Depth of repair should not be one to two inches below the existing AC as stated as we do not want to disturb the base especially ATPB, and replace it with HMA.. The digout areas should be marked on the layout plans and itemized on the quantities sheets in the Project Plans.

5) Recommend Crack sealant to be low modulus asphalt crack sealant or asphalt rubber instead of emulsified crack sealant. Emulsion needs time to break and its placement becomes a concern because of limited lane closure hours in our District.

6.1.2 Subgrade Preparation

1) Guardrail post embedment dimensions are 6" x 8" x 44". We do not believe that these voids can be compacted and backfilled with standard fill as recommended here. Is there a need for special backfill? Review the proposed subgrade profile in relation to the existing post bottoms, and evaluate whether requiring regrading and recompacting, for a minimum width of a roller, to the anticipated depth of posts could be an appropriate strategy.

2) Use of stabilization fabric should also be mentioned in other areas of the Report where overexcavation is discussed e.g., Section 5.2. As stated before imported fill should have a minimum R-value of 15 within 5 feet of the finished grade.

6.3 Storm Drainage System

1) Address trench paving details for drainage systems that are to be placed by trenching through the existing pavement.
2) It is stated that pavement underdrain system is incorporated in the Drainage Plan Drawings D-1 through D-18. We have not been able to locate the proposed underdrain systems on these drawings but note that underdrain systems are usually shown on sheets separate from those showing storm drains. Edge drain systems also need to be shown.

3) Recommend the location, and depth of underdrain trench. Underdrain trench is shown as extending to the profile grade. Is the trench to be outside the shoulder? Recommend size and type of underdrain pipe.

9.2 Specifications

1) Specifications and Special provisions used include old terminology and are in metric units. Use updated versions.

2) 9.2.1 Earthwork - Recommend specifications for handling poor subgrade soils that are to be removed with in Stations 227+00 and 234+00, and unsuitable soils in other areas of the project (CH soils with expansive nature listed under Section 6.5). If not specified contractor has the option to reuse them. Imported borrow to be used within 1.5 m of the profile grade should be specified to have an R-value of 15.

3) Since Lean Concrete Base and Pavement Reinforcing Fabric are not recommended items for pavement structural section; why include these items in the recommended specifications?

4) Include specifications for Stabilization Fabric recommended in Section 6.1.2 Subgrade Preparation.

Pavement Deflection and Analysis Report

Since the scope of this project does not include rehabilitation of the existing pavement, we have not commented in detail on this Report. If the scope changes, further comments will be made in the future.

If you have any questions, please call Maninder Kaur at 286-4827.

c: Daily File, Project File, dg

ROUTE 84 EXPRESSWAY WIDENING PROJECT

LIVERMORE, CA.
RUBY HILL DRIVE TO JACK LONDON BOULEVARD

MATERIALS REPORT

Prepared for:

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December 2009

Hwy 84 Widening Materials Report.doc

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INTRODUCTION

V&A was retained by URS Corporation to perform a corrosion survey on State Highway 84, from Ruby Hill Drive to Jack London Boulevard, in Livermore, California. The objective of the investigation was to measure various soil parameters and evaluate the soil corrosivity to materials selected for retaining walls, bridge structures, and drainage along the highway. The soil was tested at depths ranging from 0 to 19 meters below existing grade. This report recommends corrosion control for construction materials being considered for a proposed retaining wall along the Ruby Hill Drive/Vallecitos Road segment of Highway 84, for retaining wall modifications at the Stanley Boulevard Underpass, for new and existing bridge structures at Arroyo del Valle and Arroyo Mocho stream crossings and for culverts and underdrain pipes along the roadway. The materials being considered as part of this investigation include buried reinforced concrete, prestressed concrete piles, steel pipe piles, metal culverts and metal or plastic drainage pipes.

This report gives recommendations for corrosion control of reinforced concrete foundations and soil nails for the Ruby Hill Drive/Vallecitos Road Retaining Wall from Station 245+50 to Station 258+00, and for reinforced concrete foundations and soil nails for two retaining walls at the Stanley Boulevard Underpass between Stations 391+00 and 412+00. Corrosion control recommendations are provided for reinforced concrete foundations, prestressed concrete piles, and steel pipe piles for existing highway bridge modifications and for new public access bridges at the Arroyo del Valle crossing, Station 320+00 and at the Arroyo Mocho crossing, Station 415+00. Metal culvert and underdrain pipe material recommendations for 50-year maintenance-free service based on ambient soil conditions are also included.

The investigation was conducted in accordance with California Department of Transportation's Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch "Corrosion Guidelines" (Guidelines) dated September 2003. These Guidelines consider representative soil or water samples to be corrosive to structural elements if one or more of the following conditions exist:

1) **The chloride concentration is 500 ppm or greater,**
2) **The sulfate concentration is 2,000 ppm or greater,**
3) **The pH is 5.5 or less.**

Evaluation of the soil environment was made in terms of potential corrosion damage to concrete and metal structures. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, 14 soil samples taken during a geotechnical investigation were provided to V&A for laboratory testing. The soil samples were analyzed for minimum (saturated) resistivity, as well as for pH, chloride and sulfate ion concentrations. All of these affect the corrosion rate of buried structures.

The minimum (saturated) resistivity of the 14 soil borings submitted for analysis ranged from 1,510 ohm-cm to 23,278 ohm-cm. The soil pH ranged from 7.1 to 9.1 and the water-soluble chloride concentrations ranged from below the detection limit of 2 mg/kg to 20 mg/kg. The water-soluble sulfate concentrations ranged from below the detection limit of 5 mg/kg to 7 mg/kg.

One water sample taken from the stream at the existing Arroyo del Valle Bridge site was also analyzed for resistivity, pH, soluble chloride and soluble sulfate. The water resistivity is 1,686 ohm-cm and its pH is 8.3. The soluble chloride is 63.7 mg/L and the soluble sulfate is 19.9 mg/L.

Culvert materials were selected using the Department of Transportation Alternative Pipe Culvert Selection Website (AltPipe Version 6.08) which calculates Maintenance-Free Service Design Estimates using California Department of Transportation (Caltrans) criteria. The latter are outlined in Caltrans California Test Method 643, in Caltrans Highway Design Manual, Section 850, Physical Standards, dated November 2, 2009 and in Design Information Bulletin 83-01 dated June 30, 2003. The results listed in Appendix 2 used conditions from the analyzed soil bore samples taken closest to each drainage system. Where no bore samples were taken near a drainage system, the more corrosive of two samples taken closest to the ends of the drainage system was used. Drainage Systems 56 and 59 used the analytical results of soil bore samples NB24-2-X and NB23-2-4, respectively, which were in better agreement with the field resistivity measurements at 10 feet below grade. An intermittent flow velocity of less than 1.5 meters/second (5 feet/second) under non-abrasive conditions, and a maximum burial depth of 10 feet were used for the AltPipe calculations.

CONCLUSIONS

- The soil bore chemical analyses and the stream water analysis all gave pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg and soluble sulfate concentrations less than 2,000 mg/kg. According to the Guidelines, the soils and water are considered *non-corrosive*.
- No corrosion mitigation for steel piles is required by the Guidelines for non-corrosive soil conditions.
- None of the proposed bridge structures are within 300 meters (1,000 feet) of salt or brackish water.

RECOMMENDATIONS

The test data and a review of the project requirements were used to make recommendations for each material alternative listed below:

Buried Reinforced Concrete Structures and Cast in Place Piles

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 5.1 centimeters should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should also have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

Prestressed Concrete Piles

Prestressed concrete piles should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 5.1 centimeters should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should also have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

Drainage Culverts and Underdrain Pipes

Specific material selections for each of the 35 proposed new or modified drainage systems have been determined using the Caltrans AltPipe (Alternative Pipe) Version 6.08. The results are presented in Appendix 2. Using soil bore sample data from sites in closest proximity to the new or modified drainage systems proposed along Highway 84, the following material recommendations are made for 50-year culvert service life:

- Coated steel pipe can be used in all of the proposed drainage systems. The coating material, minimum metal thickness, and recommended corrugated or ribbed structural designs are dictated by the soil resistivity, soil pH, and pipe diameter in each drainage system.
- Aluminum metal pipes are not recommended for sites where the soil pH is higher than 8.5.
- Ribbed and corrugated PVC and HDPE plastic pipe can be used at all drainage sites.
- Reinforced concrete pipes are acceptable for all of the proposed drainage systems. AltPipe recommends 0.75-inch concrete cover over steel reinforcement for 12 and 18-inch diameter pipe, and 1 inch of concrete cover for 24 to 42-inch diameter pipe.

Mechanically Stabilized Embankment and Metallic Soil Reinforcement Backfill

In accordance with the Guidelines, non-corrosive backfill for metallic soil reinforcement, such as tie-back anchors or soil nails and reinforced concrete structures shall meet the following requirements:

- Minimum resistivity greater than 1,500 ohm-cm.
- Water soluble chloride ion concentration less than 500 mg/kg.
- Water soluble sulfate ion concentration less than 2,000 mg/kg.
- A pH between 5.5 and 10.0.
- Slag aggregate should not be used in backfill due to high sulfate concentrations.

Soil Nails and Rock Anchors

Ruby Hill Drive/Vallecitos Road Retaining Wall and Stanley Boulevard Underpass Retaining Walls

All metallic soil reinforcement must be galvanized in accordance with requirements in California Department of Transportation Standard Specification 75-1.05

Soil Borings NB03 at Station 246+00 and NB05 at Station 293+00 were used to evaluate site corrosivity at the Ruby Hill Drive/Vallecitos Road Retaining Wall:

- NB03 has a pH of 7.5 and a minimum resistivity of 3,302 ohm-cm
- NB05 has a pH of 8.4 and a minimum resistivity of 7,312 ohm-cm

Soil Borings NB20 at Station 395+50 and NB22A at Station 408+00 were used to evaluate site corrosivity:

- NB20 has a pH of 8.2 and a minimum resistivity of 5,340 ohm-cm
- NB22A has a pH of 8.6 and a minimum resistivity of 5,386 ohm-cm

- Soil Nails
    - Soil nails shall be constructed in conformance with "Structure Reference Specification19-660," Section 10-1[1].
    - Corrosion mitigation measures are required at any level of soil corrosivity, due to the vital character of the soil nails. Individual corrosion mitigation measures shall depend on the specific construction of the soil nails.
    - Soil nail bar reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications.
        - Grade 60 soil nails bar reinforcement shall conform to ASTM Designation A 615 / A 615M or A 706 / A 706M requirements
        - Grade 75 soil nails bar reinforcement shall conform to ASTM Designation A 615 / A 615M
    - Soil nails shall be either a reinforcing bar encapsulated full length in a grouted corrugated plastic sheathing or an epoxy coated reinforcing bar partially encapsulated in a grouted corrugated plastic sheathing.
        - The bar shall be centered in the sheathing and the space between the sheathing and the bar shall be filled with grout.
        - The epoxy coating shall have a minimum thickness of 12 mils.
- Tieback Anchors
    - Tieback anchors shall be constructed in conformance with "Structure Reference Specification 50-560," Section 10-1.
    - Corrosion mitigation measures are required at any level of soil corrosivity due to the vital nature of the tieback anchors.
    - Grouting procedures shall follow guidelines discussed in Section 50, "Prestressing Concrete," of the Standard Specifications.
    - The tieback anchorage assembly and anchor steel shall be protected against rust, corrosion and physical damage prior to completion of all enclosure grouting or encasement in concrete per Section 50 of the Standard Specifications.
    - Strand type tendons shall be encapsulated in a corrosion inhibiting grease per Structure Reference Specification 50-560. The environment shall always be considered corrosive for the purposes of determining the proper test criterion.
- Tiedown Anchors
    - Tiedown anchors shall be constructed in conformance with "Structure Reference Specification 50-570," Section 10-1.
    - ***Corrosion mitigation measures are required at any level of soil corrosivity due to the vital nature of the tiedown anchors.***
    - Grouting procedures shall follow guidelines discussed in Section 50, "Prestressing Concrete," of the Standard Specifications.
    - Tiedown anchor steel shall be protected prior to completion of all grouting against rust, corrosion and physical damage per Section 50 of the Standard Specifications.

[1] "Structure Reference Specifications" can be found at (http://www.dot.ca.gov/hq/esc/structurespecs)

- Strand type tendons shall be encapsulated in a corrosion inhibiting grease per Structure Reference Specification 50-570. The environment shall always be considered corrosive for the purposes of determining the proper test criterion.

TEST METHODS

When predicting potential corrosion problems associated with a particular type of structure prior to installation, it is necessary to investigate the soil conditions the structure will encounter. Since corrosion is an electrochemical process accompanied by current flow, the electrochemical characteristics of a soil are of primary importance. Test methods utilized during this investigation reflect the most practical methods of evaluating corrosivity.

Resistivity is a measure of the ability of a soil to conduct an electric current. The higher the resistivity the more difficult it is for the soil to conduct current. Resistivity is primarily dependent on the soluble chemical and moisture content of the soil. Soils with high dissolved ion contents generally have low resistivity. As moisture is added to a soil, its resistivity will decrease as more ions are taken into solution. The soil resistivity decreases until the maximum solubility of the dissolved ions is reached. Increasing the moisture content beyond this point increases the soil resistivity by diluting the solution. Since corrosion rate depends on current flow through the soil, corrosivity normally increases as soil resistivity decreases.

Soils can contain a wide variety of soluble salts. Therefore, soils with similar resistivities can have significantly different corrosion characteristics, depending on the ions present. In most soils, the principal agents of corrosion are the chloride and sulfate ions, as well as pH. Chloride ions break down the protective surface films on metals and can corrode reinforcing steel in concrete structures. Sulfates attack the Portland cement in concretes. This is an expansive reaction that disrupts the concrete matrix and softens the surface. A high bicarbonate ion concentration lowers soil resistivity and facilitates other forms of corrosion; however, bicarbonate is not corrosive to metals. Soil pH is another measure of corrosivity. Acid (low pH) soils are corrosive to buried metallic and concrete structures. Neutral (pH 7) and alkaline (pH greater than 7) soils are passive to metal surfaces; therefore, corrosion rates become negligible.

Field Soil Resistivity

Field (in-situ) soil resistivity was measured at 17 locations along the Highway 84 project alignment. The same testing configuration was used at each location. At the Arroyo del Valle Bridge crossing, one resistivity station was set up at the northeast end of the existing bridge. Figure 1 is a vicinity and project location map. Figures 2 and 3 show the soil resistivity test site and the soil boring locations.

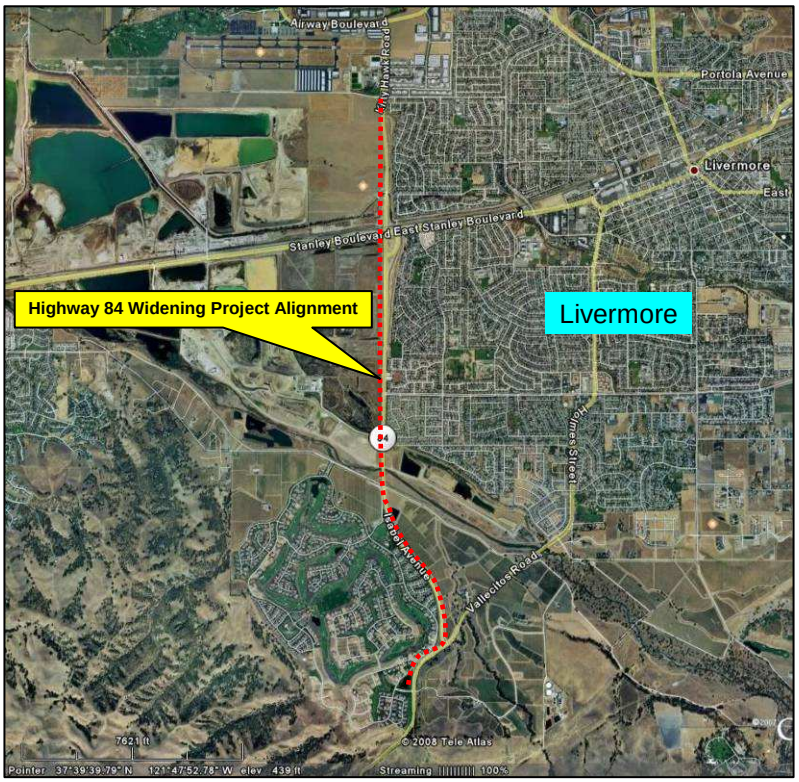

Figure 1. Vicinity and Project Site Map, Livermore, CA.

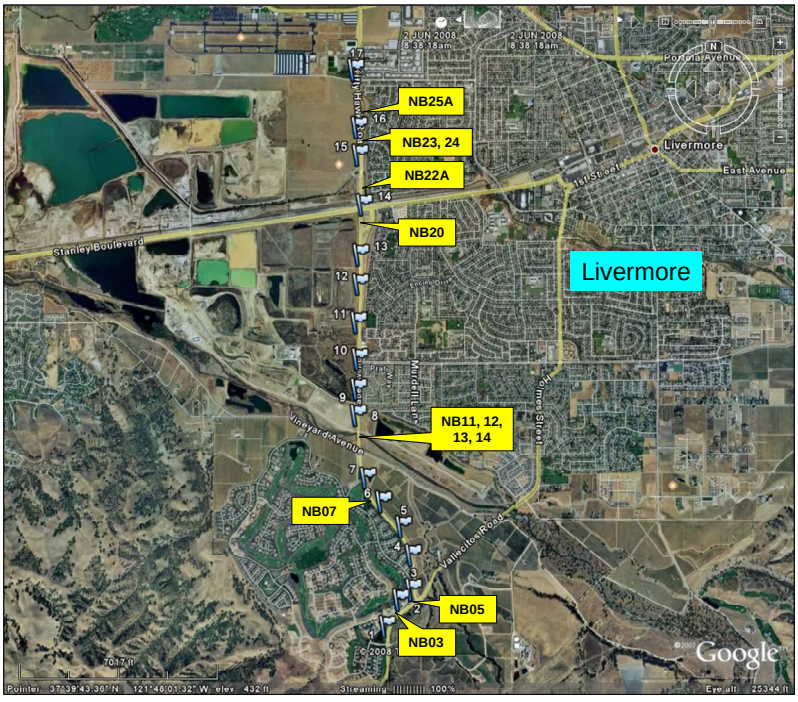

Figure 2. In-Situ Soil Resistivity Test Sites (flags) and Soil Bore Locations (NB-series)

In-situ soil resistivity measurements were conducted by the Wenner Electrode Method using an AEMC Soil Resistance Meter, Model 4500. The Wenner Electrode Method uses four equally spaced metal pins, driven into the ground in a straight line, as electrodes (see Figure 3).

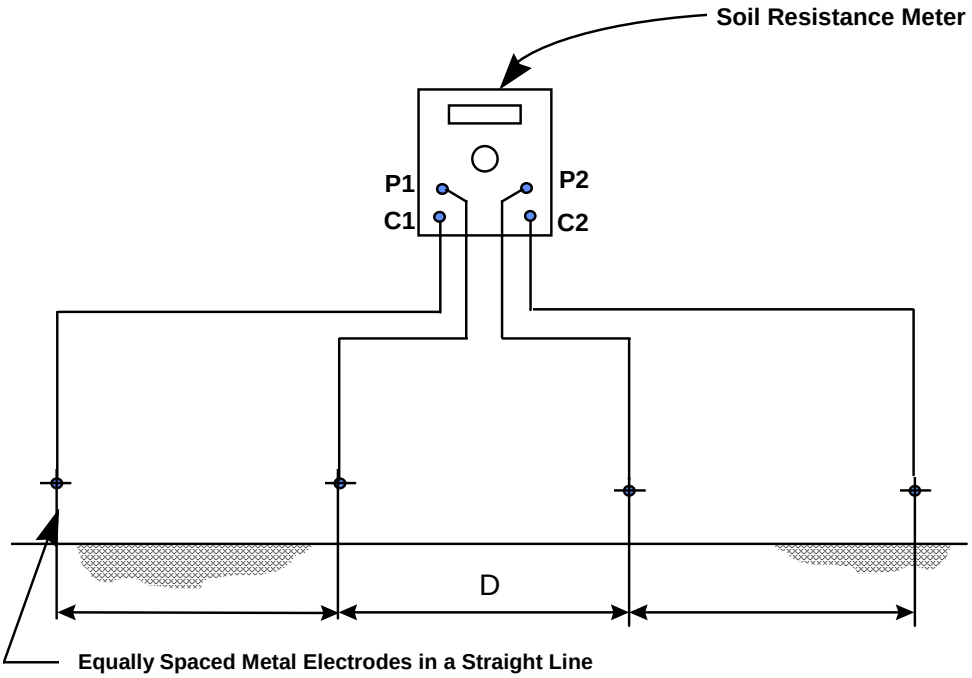

Figure 3. Wenner Electrode Method for Measurement of Soil Resistivity

An alternating current from the Soil Resistance Meter causes a current to flow through the soil between the outside electrodes, C1 and C2. The current flowing through the soil creates a voltage gradient, which is proportional to the average resistance of the soil mass to a depth equal to the distance between electrodes. The voltage drop is measured across electrodes P1 and P2. Resistivity of the soil is then computed from the instrument reading according to the following formula:

$$\rho = 2\pi AR$$

where: ρ = soil resistivity in ohm-cm
A = the distance between probes in cm
R = soil resistance in ohms (instrument reading)
$\pi = 3.1416$

Soil resistivity measurements were conducted at rod spacings of 1.5, 3.0, 4.5 and 6.0 meters. Another method of calculating the soil resistivity using the data from the Wenner Electrode Method is the Barnes-Layer Resistivity calculation. The Barnes-Layer calculation is used to determine the resistivity for each soil layer. The Wenner Electrode Method with 6.0-meter electrode spacings will consider the entire 6 meters

below the surface. The Barnes-Layer method will calculate the resistivity of layers 0 to 1.5 meters, 1.5 to 3.0 meters, 3.0 to 4.5 meters, and 4.5 to 6.0 meters below the surface. This method assumes the soil layers have a uniform thickness and are parallel to the surface. This may not always be true.

The Barnes-Layer method uses the following parameters to calculate layer resistivities:

$$\rho_{b-a} = KR_{b-a}$$

and

$$\frac{1}{R_{b-a}} = \frac{1}{R_b} - \frac{1}{R_a}$$

where:

ρ_{b-a}	=	Soil resistivity of layer depth b-a (ohm-cm)
a	=	Soil depth to top of layer (cm)
b	=	Soil depth to bottom of layer (cm)
R_a	=	Soil resistance read at depth a (ohms)
R_b	=	Soil resistance read at depth b (ohms)
R_{b-a}	=	Resistance of soil layer from a to b (ohms)
K	=	Layer constant (cm)
	=	$2\pi(b-a)$

Soil resistivities measured at the 17 test stations along the Highway 84 alignment, and Barnes-Layer resistivities calculated from this data, are listed in Table 1.

Laboratory Soil Analysis

To supplement the field resistivity test data, soil samples were obtained from 12 soil borings for laboratory soil resistivity analysis using a Soil Box in accordance with California Test Method 643. A water sample was also retrieved from Arroyo del Valle and analyzed by this method. The test apparatus is shown in Figure 4.

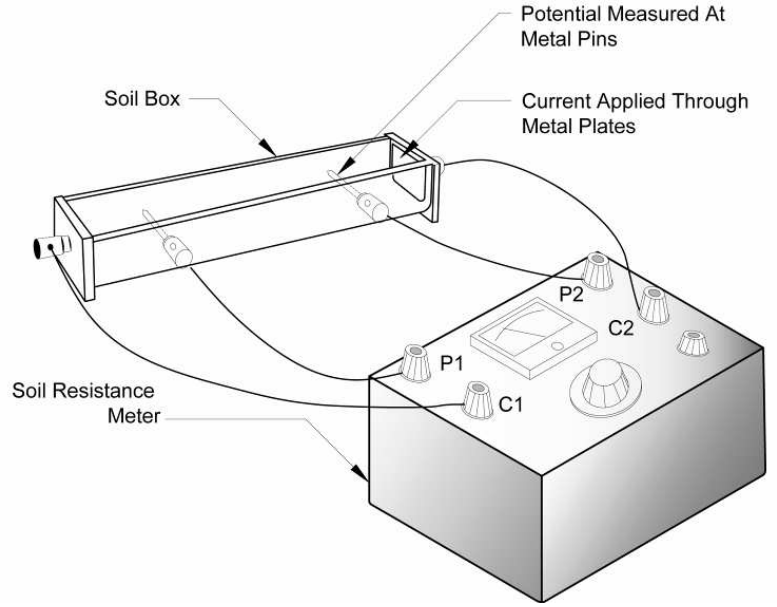

Figure 4. Soil Resistivity Measurement Using the Soil Box Method

The apparatus consists of a small plastic box with metal end plates for passing current through a tightly packed soil sample. Current is passed through the sample, causing a voltage drop across the sample. The soil resistivity is measured with a Soil Resistance Meter, similar to the AEMC Model 4500.

Soil resistivity is first measured in the "as-received" state. Distilled water is then added to the soil sample in 10-mL increments, and the resistivity is measured after each addition. As the soil sample becomes more saturated, the soil resistivity decreases until the minimum soil resistivity is reached.

Soil borings and a water sample from this study were forwarded to Cooper Testing Labs, Inc., in Palo Alto, CA, for minimum resistivity measurement, pH analysis and analysis of water soluble chloride and sulfate ion concentrations. The analytical procedures followed California Test Methods 417, 422 and 643.

TEST RESULTS

Data obtained during this investigation has been summarized in tabular form. Table 1 lists the results of the field soil resistivity measurements conducted at the Highway 84 site, along with Barnes-Layer resistivities calculated from this data. Table 2 summarizes these measurements. Table 3 lists the minimum resistivities and chemical analyses for the soil boring samples and the Arroyo del Valle water sample.

Table 1. Field Soil Resistivity Data

Site	Survey Station	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
1	236+00	1.5	2,394	0 - 1.5	2,394
		3.0	2,241	1.5 - 3.0	2,106
		4.5	2,183	3.0 - 4.5	2,077
		6.0	1,992	4.5 - 6.0	1,577
2	248+00	1.5	8,570	0 - 1.5	8,570
		3.0	6,435	1.5 - 3.0	5,151
		4.5	4,223	3.0 - 4.5	2,502
		6.0	1,494	4.5 - 6.0	508
3	253+00	1.5	6,885	0 - 1.5	6,885
		3.0	6,109	1.5 - 3.0	5,491
		4.5	4,654	3.0 - 4.5	3,152
		6.0	4,137	4.5 - 6.0	3,102
4	264+00	1.5	3,112	0 - 1.5	3,112
		3.0	3,351	1.5 - 3.0	3,631
		4.5	3,706	3.0 - 4.5	4,699
		6.0	3,562	4.5 - 6.0	3,191
5	274+00	1.5	3,198	0 - 1.5	3,198
		3.0	3,696	1.5 - 3.0	4,378
		4.5	4,280	3.0 - 4.5	6,258
		6.0	4,979	4.5 - 6.0	9,762
6	286+00	1.5	1,982	0 - 1.5	1,982
		3.0	1,858	1.5 - 3.0	1,748
		4.5	2,356	3.0 - 4.5	5,078
		6.0	2,796	4.5 - 6.0	6,369
7	298+00	1.5	4,654	0 - 1.5	4,654
		3.0	4,826	1.5 - 3.0	5,012
		4.5	5,745	3.0 - 4.5	9,281
		6.0	5,707	4.5 - 6.0	5,595
8	321+00	1.5	10,112	0 - 1.5	10,112
		3.0	4,615	1.5 - 3.0	2,990
		4.5	4,654	3.0 - 4.5	4,732
		6.0	1,762	4.5 - 6.0	615
9	331+00	1.5	16,566	0 - 1.5	16,566
		3.0	8,178	1.5 - 3.0	5,429
		4.5	4,826	3.0 - 4.5	2,652
		6.0	3,447	4.5 - 6.0	1,856

Site	Survey Station	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
10	342+00	1.5	10,773	0 - 1.5	10,773
		3.0	5,611	1.5 - 3.0	3,794
		4.5	4,826	3.0 - 4.5	3,771
		6.0	4,673	4.5 - 6.0	4,267
11	355+00	1.5	5,286	0 - 1.5	5,286
		3.0	3,600	1.5 - 3.0	2,730
		4.5	4,740	3.0 - 4.5	12,915
		6.0	4,903	4.5 - 6.0	5,466
12	365+00	1.5	3,055	0 - 1.5	3,055
		3.0	2,662	1.5 - 3.0	2,359
		4.5	2,442	3.0 - 4.5	2,095
		6.0	2,298	4.5 - 6.0	1,953
13	376+00	1.5	3,993	0 - 1.5	3,993
		3.0	4,501	1.5 - 3.0	5,156
		4.5	4,539	3.0 - 4.5	4,617
		6.0	4,558	4.5 - 6.0	4,616
14	398+00	1.5	4,012	0 - 1.5	4,012
		3.0	3,581	1.5 - 3.0	3,234
		4.5	3,993	3.0 - 4.5	5,185
		6.0	4,596	4.5 - 6.0	8,406
15	416+00	1.5	11,481	0 - 1.5	11,481
		3.0	11,223	1.5 - 3.0	10,975
		4.5	15,541	3.0 - 4.5	67,460
		6.0	16,968	4.5 - 6.0	23,417
16	426+00	1.5	9,154	0 - 1.5	9,154
		3.0	9,556	1.5 - 3.0	9,996
		4.5	8,302	3.0 - 4.5	6,576
		6.0	8,197	4.5 - 6.0	7,896
17	447+00	1.5	3,083	0 - 1.5	3,083
		3.0	2,719	1.5 - 3.0	2,432
		4.5	3,131	3.0 - 4.5	4,491
		6.0	3,294	4.5 - 6.0	3,903

Table 2. Summary of Field Resistivity Results

Resistivity at Depth (ohm-cm)			
Depth	**Minimum**	**Maximum**	**Average**
1.5 meters	1,982	16,566	6,371
3.0 meters	1,858	11,223	4,986
4.5 meters	2,183	15,541	4,949
6.0 meters	1,494	16,968	4,668
Layer Resistivity (ohm-cm)			
Layer	**Minimum**	**Maximum**	**Average**
0 - 1.5 meters	1,982	16,566	6,371
1.5 - 3.0 meters	1,748	10,975	4,507
3.0 - 4.5 meters	2,077	67,460	8,679
4.5 - 6.0 meters	508	23,417	5,441

Table 3. Soil Resistivity and Chemical Data

Item No.	Boring No.	Sample No.	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
					pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	NB03	2-3	1.5 - 2.0	3,302	7.5	<5	6
2	NB05	2-3	1.5 - 2.0	7,312	8.4	<5	<2
3	NB07	3-3	1.5 - 2.0	1,510	7.1	<5	20
4	NB11	5-3	6.1 - 6.6	7,255	7.4	<5	<2
5	NB12	2-X	1.5 - 2.0	10,028	8.6	<5	<2
6	NB13	6-3	7.6 - 8.1	7,992	8.3	<5	<2
7	NB14	2-3	1.5 - 2.0	10,586	8.5	<5	<2
8	NB20	2-3	1.1 - 1.5	5,340	8.2	7	<2
9	NB22A	1-4	1.1 - 1.5	5,386	8.6	<5	9
10	NB23	2-4	1.5 - 2.0	5,347	8.4	<5	2
11	NB23	13-3	18.3 - 18.7	6,052	7.9	<5	3
12	NB24	2-X	1.5 - 2.0	14,478	9.1	<5	<2
13	NB24	13-4	18.3 - 18.7	1,978	7.8	<5	7
14	NB25A	2-4	2.6 - 3.0	23,278	8.3	<5	<2
Arroyo del Valle	water	N/A	N/A	1,686**	8.3	19.9*	63.7*

* The chloride and sulfate results for the water sample are in mg/L units.

** Water resistivity in ohm-cm.

Based on the Guidelines, the analyzed soil samples and the water sample are considered *non-corrosive* to buried metallic objects and reinforced concrete structures in regard to chloride and sulfate contents, pH and minimum soil resistivity.

Appendix 1. Soil Sample Minimum Resistivities and Chemical Analyses

Corrosivity Test Summary

CTL # 632-005 & 006 **Date:** 6/13/2008 **Tested By:** PJ **Checked:** PJ

Client: V&A **Project:** URS-Caltrans Hwy 84 Widening **Proj. No:** 08-0216

Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Sample Description
Boring	Sample, No.	Depth, ft.	As Rec.	Minimum	Saturated	mg/kg	mg/kg	%		(Redox)	As Received	
						Dry Wt.	Dry Wt.	Dry Wt.		mv	%	
			ASTM G57	Cal 643	ASTM G57	Cal 422-mod.	Cal 417-mod.	Cal 417-mod.	Cal 643	SM 2580B	ASTM D2216	
NB03-2-3	-	5 - 6.5	-	3,302	-	6	<5	<0.0005	7.5	-	2.7	Brown Clayey SAND, trace Gravel
NB05-2-3	-	5-6.5	-	7,312	-	<2	<5	<0.0005	8.4	-	1.6	Reddish Brown SAND w/ Gravel, trace Clay
NB07-3-3	-	5 - 6.5	-	1,510	-	20	<5	<0.0005	7.1	-	3.0	Brown Sandy CLAY
NB11-5-3	-	20 - 21.5	-	7,255	-	<2	<5	<0.0005	7.4	-	1.6	Brown GRAVEL w/ Clay & Sand
NB12-2-X	-	5 - 6.5	-	10,028	-	<2	<5	<0.0005	8.6	-	0.9	Brown SAND w/ Clay & Gravel
NB13-6-3	-	25-26.5	-	7,992	-	<2	<5	<0.0005	8.3	-	1.2	Brown GRAVEL w/ Sand, trace Silt
NB14-2-3	-	5 - 6.5	-	10,586	-	<2	<5	<0.0005	8.5	-	0.7	Brown GRAVEL w/ Sand
NB20-2-3	-	3.5 - 5	-	5,340	-	<2	7	0.0007	8.2	-	2.0	Brown Clayey SAND
NB22A-1-4	-	3.5 - 5	-	5,386	-	9	<5	<0.0005	8.6	-	1.3	Brown SAND w/ Clay & Gravel
NB23-2-4	-	5 - 6.5	-	5,347	-	2	<5	<0.0005	8.4	-	1.1	Brown SAND w/ Clay & Gravel
NB23-13-3	-	60 - 61.5	-	6,052	-	3	<5	<0.0005	7.9	-	1.9	Reddish Brown Silty SAND w/ Gravel (slightly plastic)
NB24-2-X	-	5 - 6.5	-	14,478	-	<2	<5	<0.0005	9.1	-	0.6	Grayish Brown SAND w/ Clay & Gravel
NB24-13-4	-	60 - 61.5	-	1,978	-	7	<5	<0.0005	7.8	-	2.1	Reddish Brown Sandy SILT
NB25A-2-4	-	8.5 - 10	-	23,278	-	<2	<5	<0.0005	8.3	-	0.5	Brown GRAVEL w/ Silt & Sand
Arroyo del Valle		water	-	1,686	-	63.7*	19.9*	-	8.3	-	-	Water sampled at existing Arroyo del Valle bridge

Note: The Chloride and Sulfate results for the water sample are in units of mg/L.

Appendix 2. Culvert and Underdrain Pipe Service Design Estimates

50-Year Maintenance-Free Service Design Estimates For Drainage Facilities Using Caltrans Highway Design Manual Criteria and AltPipe Version 6.08

Caltrans AltPipe

Project EA: 297601
Project Engineer: Stephen Huang, URS
Location: Livermore
Description: Hwy 84 Widening

Steel Pipes

	Drainage System	1	1	1	3	3	3	5	7	7
	Pipe Diameter (in)	18	24	30	12 (CSP)	18	36	18	18	30
Pipe Type	Coating	Minimum Thickness (in)								
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.052	0.052
	AL2 (Aluminum Type 2)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BC (Bituminous Coating)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BCI (BC+paved invert)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PA (Polymerized Asphalt)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS (Polymeric Sheet)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064
	AL2 (Aluminum Type 2)	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064
	BC (Bituminous Coating)	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064
	BCI (BC+paved invert)	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064
	PA (Polymerized Asphalt)	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)		0.064	0.064			0.064			0.064
	AL2 (Aluminum Type 2)		0.064	0.064			0.064			0.064
	BC (Bituminous Coating)		0.064	0.064			0.064			0.064
	BCI (BC+paved invert)		0.064	0.064			0.064			0.064
	PA (Polymerized Asphalt)		0.064	0.064			0.064			0.064
	PS (Polymeric Sheet)		0.064	0.064			0.064			0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL (Galvanized)		0.064	0.064			0.064			0.064
	AL2 (Aluminum Type 2)		0.064	0.064			0.064			0.064
	BC (Bituminous Coating)		0.064	0.064			0.064			0.064
	BCI (BC+paved invert)		0.064	0.064			0.064			0.064
	PA (Polymerized Asphalt)		0.064	0.064			0.064			0.064
	PS (Polymeric Sheet)		0.064	0.064			0.064			0.064
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)		0.064	0.064			0.064			0.064
	AL2 (Aluminum Type 2)		0.064	0.064			0.064			0.064
	BC (Bituminous Coating)		0.064	0.064			0.064			0.064
	BCI (BC+paved invert)		0.064	0.064			0.064			0.064
	PA (Polymerized Asphalt)		0.064	0.064			0.064			0.064
	PS (Polymeric Sheet)		0.064	0.064			0.064			0.064
	CSS (Composite Steel Spiral)			0.064			0.064			0.064

Aluminum Pipes

	Drainage System	1	1	1	3	3	3	5	7	7
	Pipe Diameter (in)	18	24	30	12 (CSP)	18	36	18	18	30
Pipe Type		Minimum Thickness (in)								
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations		0.060	0.060	0.075	0.060	0.060	0.075	0.060	0.060	0.075
Corrugated Aluminum Pipe - Annular Corrugations - 3" X 1" Corrugations				0.060			0.060			0.060
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations		0.060	0.060	0.075	0.060	0.060	0.075	0.060	0.060	0.075
Corrugated Aluminum Pipe - Helical Corrugations - 3" X 1" Corrugations				0.060			0.060			0.060
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch			0.060	0.060			0.060			0.060
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch			0.060	0.060			0.060			0.060

Plastic Pipes

	Drainage System	1	1	1	3	3	3	5	7	7
	Pipe Diameter (in)	18	24	30	12 (CSP)	18	36	18	18	30
Pipe Type		Availability								
PVC Corrugated		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed		Allowable	Allowable	Allowable		Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S		Allowable	Allowable	Allowable		Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed		Allowable	Allowable			Allowable		Allowable	Allowable	
HDPE Corrugated - Type C		Allowable	Allowable			Allowable		Allowable	Allowable	

Reinforced Concrete Pipes

	Drainage System	1	1	1	3	3	3	5	7	7
	Pipe Diameter (in)	18	24	30	12	18	36	18	18	30
Steel Cover (in)		0.75	1	1	0.75	0.75	1	0.75	0.75	1
Sacks of Cement		5	5	5	5	5	5	5	5	5
Percentage Water		10	10	10	10	10	10	10	10	10

Other Information

	Drainage System	1	1	1	3	3	3	5	7	7
	Soil Bore Sample	NB03-2-3							NB05-2-3	
Soil pH		7.5	7.5	7.5	7.5	7.5	7.5	7.5	8.4	8.4
Minimum Soil Resistivity (ohm-cm)		3,302	3,302	3,302	3,302	3,302	3,302	3,302	7,312	7,312
Sulfate Concentration (ppm)		5	5	5	5	5	5	5	5	5
Chloride Concentration (ppm)		6	6	6	6	6	6	6	2	2
Abrasion Level		1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50	50
Height of Cover (ft)		10	10	10	10	10	10	10	10	10

Caltrans AltPipe

Project EA: 297601
Project Engineer: Stephen Huang, URS
Location: Livermore
Description: Hwy 84 Widening

Steel Pipes

	Drainage System	11	13	14	15	16	18	19	20
	Pipe Diameter (in)	18	18	18	18	18	18	18	18
Pipe Type	Coating	Minimum Thickness (in)							
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)								
	AL2 (Aluminum Type 2)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BC (Bituminous Coating)								
	BCI (BC+paved invert)								
	PA (Polymerized Asphalt)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS (Polymeric Sheet)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)								
	AL2 (Aluminum Type 2)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	BC (Bituminous Coating)								
	BCI (BC+paved invert)								
	PA (Polymerized Asphalt)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)								
	AL2 (Aluminum Type 2)								
	BC (Bituminous Coating)								
	BCI (BC+paved invert)								
	PA (Polymerized Asphalt)								
	PS (Polymeric Sheet)								
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL (Galvanized)								
	AL2 (Aluminum Type 2)								
	BC (Bituminous Coating)								
	BCI (BC+paved invert)								
	PA (Polymerized Asphalt)								
	PS (Polymeric Sheet)								
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)								
	AL2 (Aluminum Type 2)								
	BC (Bituminous Coating)								
	BCI (BC+paved invert)								
	PA (Polymerized Asphalt)								
	PS (Polymeric Sheet)								
	CSS (Composite Steel Spiral)								

Aluminum Pipes

	Drainage System	11	13	14	15	16	18	19	20
	Pipe Diameter (in)	18	18	18	18	18	18	18	18
Pipe Type		Minimum Thickness (in)							
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations		0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
Corrugated Aluminum Pipe - Annular Corrugations - 3" X 1" Corrugations									
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations		0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
Corrugated Aluminum Pipe - Helical Corrugations - 3" X 1" Corrugations									
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch									
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch									

Plastic Pipes

	Drainage System	11	13	14	15	16	18	19	20
	Pipe Diameter (in)	18	18	18	18	18	18	18	18
Pipe Type		Availability							
PVC Corrugated		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

	Drainage System	11	13	14	15	16	18	19	20
	Pipe Diameter (in)	18	18	18	18	18	18	18	18
Steel Cover (in)		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Sacks of Cement		5	5	5	5	5	5	5	5
Percentage Water		10	10	10	10	10	10	10	10

Other Information

	Drainage System	11	13	14	15	16	18	19	20
	Soil Bore Sample	NB07-3-3							
Soil pH		7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Minimum Soil Resistivity (ohm-cm)		1,510	1,510	1,510	1,510	1,510	1,510	1,510	1,510
Sulfate Concentration (ppm)		5	5	5	5	5	5	5	5
Chloride Concentration (ppm)		20	20	20	20	20	20	20	20
Abrasion Level		1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50
Height of Cover (ft)		10	10	10	10	10	10	10	10

Caltrans AltPipe

Project EA: 297601
Project Engineer: Stephen Huang, URS
Location: Livermore
Description: Hwy 84 Widening

Steel Pipes

	Drainage System	21	21	23	25	25	25	26	26	26
	Pipe Diameter (in)	30	36	18	18	36	42	18	30	42
Pipe Type	Coating	Minimum Thickness (in)								
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)		0.138	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	AL2 (Aluminum Type 2)	0.052	0.052							
	BC (Bituminous Coating)	0.109	0.109	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BCI (BC+paved invert)	0.109	0.109	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PA (Polymerized Asphalt)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS (Polymeric Sheet)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)			0.064	0.064	0.064	0.064	0.064	0.064	0.064
	AL2 (Aluminum Type 2)	0.064	0.064							
	BC (Bituminous Coating)		0.109	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	BCI (BC+paved invert)		0.109	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PA (Polymerized Asphalt)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)					0.064	0.064		0.064	0.064
	AL2 (Aluminum Type 2)	0.064	0.064							
	BC (Bituminous Coating)	0.109	0.109			0.064	0.064		0.064	0.064
	BCI (BC+paved invert)	0.109	0.109			0.064	0.064		0.064	0.064
	PA (Polymerized Asphalt)	0.064	0.064			0.064	0.064		0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064			0.064	0.064		0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL (Galvanized)					0.064	0.064		0.064	0.064
	AL2 (Aluminum Type 2)	0.064	0.064							
	BC (Bituminous Coating)	0.109	0.109			0.064	0.064		0.064	0.064
	BCI (BC+paved invert)	0.109	0.109			0.064	0.064		0.064	0.064
	PA (Polymerized Asphalt)	0.064	0.064			0.064	0.064		0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064			0.064	0.064		0.064	0.064
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)					0.064	0.064		0.064	0.064
	AL2 (Aluminum Type 2)	0.064	0.064							
	BC (Bituminous Coating)	0.109	0.109			0.064	0.064		0.064	0.064
	BCI (BC+paved invert)	0.109	0.109			0.064	0.064		0.064	0.064
	PA (Polymerized Asphalt)	0.064	0.064			0.064	0.064		0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064			0.064	0.064		0.064	0.064
	CSS (Composite Steel Spiral)	0.064	0.064			0.064	0.064		0.064	0.064

Aluminum Pipes

	Drainage System	21	21	23	25	25	25	26	26	26
	Pipe Diameter (in)	30	36	18	18	36	42	18	30	42
Pipe Type		Minimum Thickness (in)								
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations		0.075	0.075							
Corrugated Aluminum Pipe - Annular Corrugations - 3" X 1" Corrugations		0.060	0.060							
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations		0.075	0.075							
Corrugated Aluminum Pipe - Helical Corrugations - 3" X 1" Corrugations		0.060	0.060							
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch		0.060	0.060							
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch		0.060	0.060							

Plastic Pipes

	Drainage System	21	21	23	25	25	25	26	26	26
	Pipe Diameter (in)	30	36	18	18	36	42	18	30	42
Pipe Type		Availability								
PVC Corrugated		Allowable	Allowable	Allowable	Allowable	Allowable		Allowable	Allowable	
PVC Ribbed		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed				Allowable	Allowable			Allowable		
HDPE Corrugated - Type C				Allowable	Allowable			Allowable		

Reinforced Concrete Pipes

	Drainage System	21	21	23	25	25	25	26	26	26
	Pipe Diameter (in)	30	36	18	18	36	42	18	30	42
Steel Cover (in)		1	1	0.75	0.75	1	1	0.75	1	1
Sacks of Cement		5	5	5	5	5	5	5	5	5
Percentage Water		10	10	10	10	10	10	10	10	10

Other Information

	Drainage System	21	21	23	25	25	25	26	26	26
	Soil Bore Sample	NB07-3-3		NB12-2-X						
Soil pH		7.1	7.1	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Minimum Soil Resistivity (ohm-cm)		1,510	1,510	10,028	10,028	10,028	10,028	10,028	10,028	10,028
Sulfate Concentration (ppm)		5	5	5	5	5	5	5	5	5
Chloride Concentration (ppm)		20	20	2	2	2	2	2	2	2
Abrasion Level		1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50	50
Height of Cover (ft)		10	10	10	10	10	10	10	10	10

Caltrans AltPipe

Project EA: 297601
Project Engineer: Stephen Huang, URS
Location: Livermore
Description: Hwy 84 Widening

Steel Pipes

	Drainage System	30	30	30	30	31	31	31	32	36
	Pipe Diameter (in)	18	24	30	36	18	24	30	18	18
Pipe Type	Coating	Minimum Thickness (in)								
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	AL2 (Aluminum Type 2)									0.052
	BC (Bituminous Coating)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BCI (BC+paved invert)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PA (Polymerized Asphalt)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS (Polymeric Sheet)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	AL2 (Aluminum Type 2)									0.064
	BC (Bituminous Coating)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	BCI (BC+paved invert)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PA (Polymerized Asphalt)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)		0.064	0.064	0.064		0.064	0.064		
	AL2 (Aluminum Type 2)									
	BC (Bituminous Coating)		0.064	0.064	0.064		0.064	0.064		
	BCI (BC+paved invert)		0.064	0.064	0.064		0.064	0.064		
	PA (Polymerized Asphalt)		0.064	0.064	0.064		0.064	0.064		
	PS (Polymeric Sheet)		0.064	0.064	0.064		0.064	0.064		
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL (Galvanized)		0.064	0.064	0.064		0.064	0.064		
	AL2 (Aluminum Type 2)									
	BC (Bituminous Coating)		0.064	0.064	0.064		0.064	0.064		
	BCI (BC+paved invert)		0.064	0.064	0.064		0.064	0.064		
	PA (Polymerized Asphalt)		0.064	0.064	0.064		0.064	0.064		
	PS (Polymeric Sheet)		0.064	0.064	0.064		0.064	0.064		
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)		0.064	0.064	0.064		0.064	0.064		
	AL2 (Aluminum Type 2)									
	BC (Bituminous Coating)		0.064	0.064	0.064		0.064	0.064		
	BCI (BC+paved invert)		0.064	0.064	0.064		0.064	0.064		
	PA (Polymerized Asphalt)		0.064	0.064	0.064		0.064	0.064		
	PS (Polymeric Sheet)		0.064	0.064	0.064		0.064	0.064		
	CSS (Composite Steel Spiral)			0.064	0.064			0.064		

Aluminum Pipes

	Drainage System	30	30	30	30	31	31	31	32	36
	Pipe Diameter (in)	18	24	30	36	18	24	30	18	18
Pipe Type		Minimum Thickness (in)								
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations										0.060
Corrugated Aluminum Pipe - Annular Corrugations - 3" X 1" Corrugations										
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations										0.060
Corrugated Aluminum Pipe - Helical Corrugations - 3" X 1" Corrugations										
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch										
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch										

Plastic Pipes

	Drainage System	30	30	30	30	31	31	31	32	36
	Pipe Diameter (in)	18	24	30	36	18	24	30	18	18
Pipe Type		Availability								
PVC Corrugated		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed		Allowable	Allowable			Allowable	Allowable		Allowable	Allowable
HDPE Corrugated - Type C		Allowable	Allowable			Allowable	Allowable		Allowable	Allowable

Reinforced Concrete Pipes

	Drainage System	30	30	30	30	31	31	31	32	36
	Pipe Diameter (in)	18	24	30	36	18	24	30	18	18
Steel Cover (in)		0.75	1	1	1	0.75	1	1	0.75	0.75
Sacks of Cement		5	5	5	5	5	5	5	5	5
Percentage Water		10	10	10	10	10	10	10	10	10

Other Information

	Drainage System	30	30	30	30	31	31	31	32	36
	Soil Bore Sample	NB12-2-X								NB20-2-3
Soil pH		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.2
Minimum Soil Resistivity (ohm-cm)		10,028	10,028	10,028	10,028	10,028	10,028	10,028	10,028	5,340
Sulfate Concentration (ppm)		5	5	5	5	5	5	5	5	7
Chloride Concentration (ppm)		2	2	2	2	2	2	2	2	2
Abrasion Level		1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50	50
Height of Cover (ft)		10	10	10	10	10	10	10	10	10

Caltrans AltPipe

Project EA: 297601
Project Engineer: Stephen Huang, URS
Location: Livermore
Description: Hwy 84 Widening

Steel Pipes

	Drainage System	38	38	41	42	43	44	44	44	47
	Pipe Diameter (in)	12 (CSP)	18	12 (CSP)	18	18	18	24	36	24
Pipe Type	Coating	Minimum Thickness (in)								
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	AL2 (Aluminum Type 2)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BC (Bituminous Coating)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BCI (BC+paved invert)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PA (Polymerized Asphalt)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS (Polymeric Sheet)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)		0.064		0.064	0.064	0.064	0.064	0.064	0.064
	AL2 (Aluminum Type 2)		0.064		0.064	0.064	0.064	0.064	0.064	0.064
	BC (Bituminous Coating)		0.064		0.064	0.064	0.064	0.064	0.064	0.064
	BCI (BC+paved invert)		0.064		0.064	0.064	0.064	0.064	0.064	0.064
	PA (Polymerized Asphalt)		0.064		0.064	0.064	0.064	0.064	0.064	0.064
	PS (Polymeric Sheet)		0.064		0.064	0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)							0.064	0.064	0.064
	AL2 (Aluminum Type 2)							0.064	0.064	0.064
	BC (Bituminous Coating)							0.064	0.064	0.064
	BCI (BC+paved invert)							0.064	0.064	0.064
	PA (Polymerized Asphalt)							0.064	0.064	0.064
	PS (Polymeric Sheet)							0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL (Galvanized)							0.064	0.064	0.064
	AL2 (Aluminum Type 2)							0.064	0.064	0.064
	BC (Bituminous Coating)							0.064	0.064	0.064
	BCI (BC+paved invert)							0.064	0.064	0.064
	PA (Polymerized Asphalt)							0.064	0.064	0.064
	PS (Polymeric Sheet)							0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)							0.064	0.064	0.064
	AL2 (Aluminum Type 2)							0.064	0.064	0.064
	BC (Bituminous Coating)							0.064	0.064	0.064
	BCI (BC+paved invert)							0.064	0.064	0.064
	PA (Polymerized Asphalt)							0.064	0.064	0.064
	PS (Polymeric Sheet)							0.064	0.064	0.064
	CSS (Composite Steel Spiral)								0.064	

Aluminum Pipes

	Drainage System	38	38	41	42	43	44	44	44	47
	Pipe Diameter (in)	12 (CSP)	18	12 (CSP)	18	18	18	24	36	24
Pipe Type		Minimum Thickness (in)								
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations		0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.075	0.060
Corrugated Aluminum Pipe - Annular Corrugations - 3" X 1" Corrugations									0.060	
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations		0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.075	0.060
Corrugated Aluminum Pipe - Helical Corrugations - 3" X 1" Corrugations									0.060	
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch								0.060	0.060	0.060
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch								0.060	0.060	0.060

Plastic Pipes

	Drainage System	38	38	41	42	43	44	44	44	47
	Pipe Diameter (in)	12 (CSP)	18	12 (CSP)	18	18	18	24	36	24
Pipe Type		Availability								
PVC Corrugated		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed			Allowable		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S			Allowable		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed			Allowable		Allowable	Allowable	Allowable	Allowable		Allowable
HDPE Corrugated - Type C			Allowable		Allowable	Allowable	Allowable	Allowable		Allowable

Reinforced Concrete Pipes

	Drainage System	38	38	41	42	43	44	44	44	47
	Pipe Diameter (in)	12 (CSP)	18	12 (CSP)	18	18	18	24	36	24
Steel Cover (in)		0.75	0.75	0.75	0.75	0.75	0.75	1	1	1
Sacks of Cement		5	5	5	5	5	5	5	5	5
Percentage Water		10	10	10	10	10	10	10	10	10

Other Information

	Drainage System	38	38	41	42	43	44	44	44	47
	Soil Bore Sample	NB20-2-3								
Soil pH		8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
Minimum Soil Resistivity (ohm-cm)		5,340	5,340	5,340	5,340	5,340	5,340	5,340	5,340	5,340
Sulfate Concentration (ppm)		7	7	7	7	7	7	7	7	7
Chloride Concentration (ppm)		2	2	2	2	2	2	2	2	2
Abrasion Level		1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50	50
Height of Cover (ft)		10	10	10	10	10	10	10	10	10

Caltrans AltPipe

Project EA: 297601
Project Engineer: Stephen Huang, URS
Location: Livermore
Description: Hwy 84 Widening

Steel Pipes

	Drainage System	48	49	49	50	50	53	53	54
	Pipe Diameter (in)	24	12 (WSP)	18	12 (WSP)	18	18	24	18
Pipe Type	Coating	Minimum Thickness (in)							
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	AL2 (Aluminum Type 2)	0.052							0.052
	BC (Bituminous Coating)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BCI (BC+paved invert)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PA (Polymerized Asphalt)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS (Polymeric Sheet)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.064		0.064		0.064	0.064	0.064	0.064
	AL2 (Aluminum Type 2)	0.064							0.064
	BC (Bituminous Coating)	0.064		0.064		0.064	0.064	0.064	0.064
	BCI (BC+paved invert)	0.064		0.064		0.064	0.064	0.064	0.064
	PA (Polymerized Asphalt)	0.064		0.064		0.064	0.064	0.064	0.064
	PS (Polymeric Sheet)	0.064		0.064		0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)	0.064						0.064	
	AL2 (Aluminum Type 2)	0.064							
	BC (Bituminous Coating)	0.064						0.064	
	BCI (BC+paved invert)	0.064						0.064	
	PA (Polymerized Asphalt)	0.064						0.064	
	PS (Polymeric Sheet)	0.064						0.064	
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL (Galvanized)	0.064						0.064	
	AL2 (Aluminum Type 2)	0.064							
	BC (Bituminous Coating)	0.064						0.064	
	BCI (BC+paved invert)	0.064						0.064	
	PA (Polymerized Asphalt)	0.064						0.064	
	PS (Polymeric Sheet)	0.064						0.064	
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)	0.064						0.064	
	AL2 (Aluminum Type 2)	0.064							
	BC (Bituminous Coating)	0.064						0.064	
	BCI (BC+paved invert)	0.064						0.064	
	PA (Polymerized Asphalt)	0.064						0.064	
	PS (Polymeric Sheet)	0.064						0.064	
	CSS (Composite Steel Spiral)								

Aluminum Pipes

	Drainage System	48	49	49	50	50	53	53	54
	Pipe Diameter (in)	24	12 (WSP)	18	12 (WSP)	18	18	24	18
Pipe Type		Minimum Thickness (in)							
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations		0.060							0.060
Corrugated Aluminum Pipe - Annular Corrugations - 3" X 1" Corrugations									
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations		0.060							0.060
Corrugated Aluminum Pipe - Helical Corrugations - 3" X 1" Corrugations									
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch		0.060							
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch		0.060							

Plastic Pipes

	Drainage System	48	49	49	50	50	53	53	54
	Pipe Diameter (in)	24	12 (WSP)	18	12 (WSP)	18	18	24	18
Pipe Type		Availability							
PVC Corrugated		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed		Allowable		Allowable		Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S		Allowable		Allowable		Allowable	Allowable	Allowable	Allowable
HDPE Ribbed		Allowable		Allowable		Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C		Allowable		Allowable		Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

	Drainage System	48	49	49	50	50	53	53	54
	Pipe Diameter (in)	24	12 (WSP)	18	12 (WSP)	18	18	24	18
Steel Cover (in)		1	0.75	0.75	0.75	0.75	0.75	1	0.75
Sacks of Cement		5	5	5	5	5	5	5	5
Percentage Water		10	10	10	10	10	10	10	10

Other Information

	Drainage System	48	49	49	50	50	53	53	54
	Soil Bore Sample	NB20-2-3	NB22A-1-4						NB23-2-4
Soil pH		8.2	8.6	8.6	8.6	8.6	8.6	8.6	8.4
Minimum Soil Resistivity (ohm-cm)		5,340	5,386	5,386	5,386	5,386	5,386	5,386	5,347
Sulfate Concentration (ppm)		7	5	5	5	5	5	5	5
Chloride Concentration (ppm)		2	9	9	9	9	9	9	2
Abrasion Level		1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50
Height of Cover (ft)		10	10	10	10	10	10	10	10

Caltrans AltPipe

Project EA: 297601
Project Engineer: Stephen Huang, URS
Location: Livermore
Description: Hwy 84 Widening

Steel Pipes

	Drainage System	55	56	57	57	59	59	59	59
	Pipe Diameter (in)	18	18	18	24	12	18	30	36
Pipe Type	Coating	Minimum Thickness (in)							
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	AL2 (Aluminum Type 2)	0.052				0.052	0.052	0.052	0.052
	BC (Bituminous Coating)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	BCI (BC+paved invert)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PA (Polymerized Asphalt)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS (Polymeric Sheet)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)	0.064	0.064	0.064	0.064		0.064	0.064	0.064
	AL2 (Aluminum Type 2)	0.064					0.064	0.064	0.064
	BC (Bituminous Coating)	0.064	0.064	0.064	0.064		0.064	0.064	0.064
	BCI (BC+paved invert)	0.064	0.064	0.064	0.064		0.064	0.064	0.064
	PA (Polymerized Asphalt)	0.064	0.064	0.064	0.064		0.064	0.064	0.064
	PS (Polymeric Sheet)	0.064	0.064	0.064	0.064		0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)				0.064			0.064	0.064
	AL2 (Aluminum Type 2)							0.064	0.064
	BC (Bituminous Coating)				0.064			0.064	0.064
	BCI (BC+paved invert)				0.064			0.064	0.064
	PA (Polymerized Asphalt)				0.064			0.064	0.064
	PS (Polymeric Sheet)				0.064			0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL (Galvanized)				0.064			0.064	0.064
	AL2 (Aluminum Type 2)							0.064	0.064
	BC (Bituminous Coating)				0.064			0.064	0.064
	BCI (BC+paved invert)				0.064			0.064	0.064
	PA (Polymerized Asphalt)				0.064			0.064	0.064
	PS (Polymeric Sheet)				0.064			0.064	0.064
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)				0.064			0.064	0.064
	AL2 (Aluminum Type 2)							0.064	0.064
	BC (Bituminous Coating)				0.064			0.064	0.064
	BCI (BC+paved invert)				0.064			0.064	0.064
	PA (Polymerized Asphalt)				0.064			0.064	0.064
	PS (Polymeric Sheet)				0.064			0.064	0.064
	CSS (Composite Steel Spiral)							0.064	0.064

Aluminum Pipes

	Drainage System	55	56	57	57	59	59	59	59
	Pipe Diameter (in)	18	18	18	24	12	18	30	36
Pipe Type		Minimum Thickness (in)							
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations		0.060				0.060	0.060	0.075	0.075
Corrugated Aluminum Pipe - Annular Corrugations - 3" X 1" Corrugations								0.060	0.060
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations		0.060				0.060	0.060	0.075	0.075
Corrugated Aluminum Pipe - Helical Corrugations - 3" X 1" Corrugations								0.060	0.060
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch								0.060	0.060
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch								0.060	0.060

Plastic Pipes

	Drainage System	55	56	57	57	59	59	59	59
	Pipe Diameter (in)	18	18	18	24	12	18	30	36
Pipe Type		Availability							
PVC Corrugated		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed		Allowable	Allowable	Allowable	Allowable		Allowable	Allowable	Allowable
HDPE Corrugated - Type S		Allowable	Allowable	Allowable	Allowable		Allowable	Allowable	Allowable
HDPE Ribbed		Allowable	Allowable	Allowable	Allowable		Allowable		
HDPE Corrugated - Type C		Allowable	Allowable	Allowable	Allowable		Allowable		

Reinforced Concrete Pipes

	Drainage System	55	56	57	57	59	59	59	59
	Pipe Diameter (in)	18	18	18	24	12	18	30	36
Steel Cover (in)		0.75	0.75	0.75	1	0.75	0.75	1	1
Sacks of Cement		5	5	5	5	5	5	5	5
Percentage Water		10	10	10	10	10	10	10	10

Other Information

	Drainage System	55	56	57	57	59	59	59	59
	Soil Bore Sample	NB23-2-4	NB24-2-X			NB23-2-4			
Soil pH		8.4	9.1	9.1	9.1	8.4	8.4	8.4	8.4
Minimum Soil Resistivity (ohm-cm)		5,347	14,478	14,478	14,478	5,347	5,347	5,347	5,347
Sulfate Concentration (ppm)		5	5	5	5	5	5	5	5
Chloride Concentration (ppm)		2	2	2	2	2	2	2	2
Abrasion Level		1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50
Height of Cover (ft)		10	10	10	10	10	10	10	10

FOR CONTRACT NO. 297614

MATERIALS INFORMATION

ARROYO MOCHO ACCESS BRIDGE FOUNDATION REPORT

DATED 10/19/2010

04-ALA-84, PM 22.9/27.1

OCTOBER 19, 2010

FOUNDATION REPORT

ARROYO MOCHO ACCESS BRIDGE LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Improvement Authority (ACTIA)
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URS

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Project 28649640

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Subject: **Foundation Report**
Zone 7 Access Bridge at Arroyo Mocho
Route 84 Expressway Widening
Pleasanton and Livermore, California

Dear Ms. Garcia:

URS has completed the accompanying Foundation Report for the Zone 7 Access Bridge at Arroyo Mocho in Livermore, California. The report was prepared in accordance with Caltrans Guidelines for Foundation Investigation Reports, Version 2.0, dated March 2006. We also prepared a Geotechnical Design and Materials Report for Route 84 Expressway Widening project from Ruby Hill Drive in Pleasanton to Jack London Boulevard in Livermore; a Foundation Report for special retaining walls to support cuts and fills along both sides of the Route 84 alignment has also been prepared.

The Foundation Report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed access bridge. The opinions and recommendations have been based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Ms. Anne-Marie Moore, G.E., and Madhu Thummaluru, P.E., performed the engineering analysis and assisted with the preparation of this report. Mr. Mark Schmoll, C.E.G, prepared the site geology and geologic hazards portion of this report. Mr. Michael Larson, G.E., provided review, consultation and guidelines for the project.

Our responses to comments received from Caltrans are incorporated into this report.

If any questions should arise, or if we can be of further service, please contact the undersigned at (408) 297-9585.

Sincerely,

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1.1 GENERAL

The project proposes to widen and upgrade State Route (SR) 84 to expressway standards (55 mph) from Ruby Hill Drive in Pleasanton to Jack London Boulevard in Livermore for the purpose of 1) reducing congestion along SR 84 and improving local traffic circulation, 2) reducing impacts of regional traffic diverting to local streets, and 3) improving safety and operations on SR 84. In addition, the project also proposes to improve pedestrian and bicycle access along this section of SR 84 by connecting multi-use trails.

SR 84 will be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment, with some alternative potential changes in roadway curvature at the southern limit in the section between Ruby Hill Drive and Vallecitos Road. As an expressway, access on to SR 84 would be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Discovery Drive (proposed) and Jack London Boulevard would be widened and upgraded to accommodate future traffic movements. At the intersection of SR 84/Stanley Boulevard the northbound ramp will be widened. A multi-use trail located on the east side of SR 84 between Jack London Boulevard and Concannon Boulevard would remain.

Improvements to SR 84 would include widening two existing bridge structures, two new bridge structures, and constructing retaining walls. The bridge structures include:

- Arroyo Del Valle Bridge, 33-0710
- Arroyo Del Valle Trail Bridge (new structure)
- Arroyo Mocho Bridge, 33-0713
- Arroyo Mocho Access Bridge (new structure)

Retaining Walls are planned at the following locations:

Table 1-1: Summary of Planned Retaining Walls

Wall No.	Approximate Beginning Station	Length (ft)*
RW236	'A1' Line Sta. 235+60	440
RW245	'A1" Line Sta. 245+00	1,505
RW246	'A1' Line Sta. 246+00	1,154
RW314	'A1' Line Sta. 314+40	429
RW317	'A1' Line Sta. 316+66	192
RW320	'A1' Line Sta. 320+36	161
RW391	'A1' Line Sta. 391+05	920
RW400N	'A3' Line Sta. 400+00	1,180
RW400S	'A3' Line Sta. 400+10	247

Wall No.	Approximate Beginning Station	Length (ft)*
RW403	'A3' Line Sta. 402+98	882
RW437	'A2' Line Sta. 435+85	1,120
RW109	'V' Line Sta. 109+05	396
RW110	'V' Line Sta. 110+30	546

* Length measured along retaining wall layout line

The subject of this Foundation Report (FR) is construction of new access bridge to the west of existing Arroyo Mocho Bridge (Bridge No. 33-0713) located at PM 26.6 in Livermore, California. Figure 1-1 shows the location of this structure.

1.2 SCOPE OF INVESTIGATION

The geotechnical services performed for the Arroyo Mocho Zone 7 Access Bridge were as follows:

- Reviewed existing subsurface information and as-built plans
- Geotechnical field investigation including two exploratory borings, R-08-023 and R-07-024
- Laboratory testing to estimate pertinent engineering properties
- Design recommendations and opinions were developed for the following topics:
  - Drilled pier and spread footing design recommendations
  - Resistance to lateral loads
  - Approach fill settlement, if any
  - Abutment grading and approach fill construction
  - Earthquake information consistent with Caltrans Response Spectra Design Techniques
  - Assessment of the potential for earthquake induced liquefaction, settlement, and lateral spreading
  - Corrosion testing and analysis
  - Address construction issues, including:
    - ▪Earthwork for abutments and new bridge approaches
    - ▪Construction dewatering

Review related to environmental and hazardous waste issues was performed by Baseline Environmental and the results are presented in a separate report.

1.3 CALTRANS REVIEW COMMENTS

We reviewed comments prepared by Caltrans (dated June 2, 2008) for the Arroyo Mocho Zone 7 Access Bridge for the Foundation Report (35% submittal) dated April 11, 2008, and Foundation Report (65% submittal), dated March 23, 2009. Our response to these comments are incorporated into this report. We also reviewed comments prepared by Caltrans (dated April 27, 2010) for the 95% PS&E submittal dated March 16, 2010. The Log of Test Boring sheet (Figures 3-4c) is revised to show the new boring identification numbers consistent with Caltrans

Logging, Classification, and Presentation Manual, dated June 2007. The following table shows the new boring identification numbers that correspond to the boring numbers referenced in this report.

Boring Number (Old)	Boring Number (New)*
NB23	R-08-023
NB24	R-07-024

* As described in Caltrans Logging, Classification, and Presentation Manual, dated June 2007

Copies of the review comments and our responses are presented in Appendix A.

2.1 PROJECT DESCRIPTION

SR 84 is to be widened to the east between Vineyard Avenue and Concannon Boulevard, and to the west for the remainder of the alignment, which will require widening of two existing bridges at Arroyo Del Valle and Arroyo Mocho. The location of Arroyo Mocho Access Bridge is shown on Figure 1-1. The existing three-span bridge at Arroyo Mocho is to be widened approximately 71 feet to the west, and a new, separate Zone 7 access bridge across Arroyo Mocho is to be constructed just west of the roadway widening. The Zone 7 access bridge, the subject of this foundation report, is to be a cast-in-place reinforced concrete box girder bridge, supported on two abutments. We understand that 16-inch Cast-In-Drilled-Hole (CIDH) piles are currently planned to support Abutment 1 and spread footing is the planned foundation type for Abutment 2. As shown on Figure 2-2 and on the utility plans (sheet U-18), an existing 24 inch gas pipe line crosses the southern abutment layout with the top of pipe at Elevation 408.67 feet. The bottom of Abutment 1 pile cap and Abutment 2 spread footing are planned at Elevation 409.42 feet. The access bridge is to have a deck at about Elevation 422.5 feet and soffit at about Elevation 417 feet. The bridge will have an overall length of 120 feet with a clear width of 15 feet between concrete barriers. Based on the project hydraulic report (Wreco, 2009), the 100-year water surface is estimated at about Elevation 414.7 feet. The piles at Abutment 1 will have a design service load of 130 kips (LRFD Service-I Limit State) and nominal resistance in compression of 260 kips. Total load at the Abutment 2 is approximately 565 kips and is supported on a 5.5 feet wide and 20 feet long spread footing.

We understand that rock slope protection having side slope inclinations of 2:1 (horizontal:vertical) is currently planned beneath the proposed access bridge to mitigate scour. The portion of the channel located beneath the existing Arroyo Mocho bridge is concrete lined, with side slopes between the abutments and center piers inclined at about 2.5:1 (horizontal:vertical).

The plan and elevation sections for the proposed access bridge are shown on the General Plan, Figure 2-1. The Foundation Plan for the proposed bridge is included as Figure 2-2.

3.1 GEOLOGIC SETTING

3.1.1 Regional Geology

The SR 84 alignment lies within the Livermore Valley within the central portion of the Coast Ranges geomorphic province of California. Northwest-southeast-trending valleys and ridges characterize the regional morphology of the Coast Ranges province. These topographic features are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent predominantly strike-slip faulting along the San Andreas fault system between the Pacific and North American plates. Regional geologic mapping shows the project alignment to be underlain by Holocene alluvium and channel sand and gravel deposits along the active channel of Arroyo Del Valle (Dibblee, 1980; Gramer et al., 1996). More recent mapping by Witter and others (2006) subdivide the alluvium into latest Holocene alluvial fan deposits extending from about Jack London Boulevard south to Stanley Boulevard, Holocene alluvial fan deposits extending from about Stanley Boulevard to just north of Concannon Boulevard, and historic stream channel deposits within the active channels of Arroyo Mocho and Arroyo Del Valle. The geologic map (Figure 3-1) shows the aerial extent of these various geologic units. Witter (2006) also maps a small area of stream terrace deposits and Pleistocene alluvial fan deposits, mostly east of SR 84 and north of Arroyo Del Valle in the vicinity of Concannon Boulevard South of Arroyo Del Valle the road alignment crosses through Holocene alluvium deposits and alluvial fan deposits as it enters the mouth of a canyon at the south end of the alignment. The surrounding low hills south of the intersection of Vallecitos Road are mapped as older alluvium deposits and the Pleistocene Livermore Gravels Formation. The project alignment does not cross into these older formations.

In this portion of southeastern Alameda County, the underlying "bedrock" is the non-marine sedimentary Livermore Gravels Formation (Graymer, et al.1996; Dibblee, 1980). The Livermore Gravels Formation is up to about 4,000 feet thick and lies as much as 400 feet below the alluvium in the central Livermore Valley (Hall, 1958). It contains poorly to moderately consolidated cobble conglomerate, conglomeratic sandstone, and coarse-grained sandstone with some siltstone and claystone (Graymer et al., 1996). The Livermore Gravels may have been encountered at depth in some of the deeper borings completed near the southern portion of the project alignment, however it is difficult to distinguish between the gravelly alluvium soils and the older Livermore Gravels in the borings.

3.1.2 Regional Tectonic Setting and Seismicity

The project alignment lies between known active and potentially active geologic faults. In general, earthquakes occur as a result of movement along active faults. For the purpose of activity classification, faults are generally grouped into the following categories by the California Division of Mines and Geology (renamed the California Geological Survey, CGS) (Jennings, 1994):

- Holocene: displacement has occurred within the last 10,000 to 11,000 years.
- Late Quaternary: displacement has occurred within the last 700,000 years, but evidence of Holocene activity is lacking.

- Quaternary: evidence of displacement within the last 1.6 million years, but evidence of Holocene activity is lacking.
- Pre-quaternary: no recognized evidence of displacement in the last 1.6 million years.

Generally, faults with Holocene movement are considered to be "active" while faults with late Quaternary to Quaternary movement are considered to be "potentially active".

The closest active faults to the project alignment are the Greenville, Calaveras, and Verona Williams faults (Mualchin, 1996). The California Geological Survey (2000) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. All three of these faults are included as Alquist-Priolo (A-P) zoned faults. The Greenville fault is located about 5.2 miles (8.3 km) east of the project alignment. The Calaveras fault is located about 4.5 miles (7.3 km) west of the alignment and the Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. More distant active faults include the Hayward fault located 10.5 miles (16.9 km) southwest of the southern end of the project alignment, and the San Andreas fault located 29 miles (46.7 km) southwest of the southern end of the project alignment. Figure 3-2 shows active faults within the site region relative to the project. The project alignment does not cross any mapped A-P zoned faults.

Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1 mile (1.6 km) southeast of the southern end of the project alignment, and the Livermore fault, located about 1,000 feet northeast of the intersection of SR 84 and Jack London Boulevard (Dibblee, 1980). The geologic map (Figure 3-1) shows the location of the Livermore fault as mapped by Dibblee (1980) and on the Seismic Safety Element of the Alameda County General Plan (1982). The California Geological Survey (2000) includes a portion of the Las Positas fault as an A-P zoned fault south of the Lawrence Livermore complex, but does not extend the A-P zone as far west as Dibblee (1980) and Wagner et al. (1990) map the fault. Both Dibblee and Wagner also map the Livermore fault as a concealed fault trending northwesterly. The Seismic Safety Element of the Alameda County General Plan (1982) also shows this fault on hazard maps, indicating its location is based on a groundwater barrier. They classify the fault as "potentially uncertain", meaning the activity of the fault is insufficient to give it an activity classification. Wagner et al. (1990) map the Livermore fault as an early Quaternary fault (2,000,000 to 700,000 years old). The project alignment does not cross either the Los Positas fault or the Livermore fault.

The following is a brief description of the nearby active faults.

3.1.2.1 Calaveras Fault

The Calaveras fault is a dextral strike-slip fault that is part of the larger San Andreas fault system and is located along the eastern side of the East Bay Hills. The fault is located about 4.5 miles (7.3 km) west of the project alignment and is predominantly a vertical fault with a slip rate of 12 to 18 mm/year (WGCEP, 2003). Active seismicity, including a moderate magnitude earthquake in 1856, has been recorded along the Calaveras fault resulting in surface ruptures and large earthquakes (Kelson and others, 1996; Simpson and others, 1999). In addition to seismic events, fault creep continues to be present along the Calaveras fault as indicated by a seismic surficial fault rupture in numerous localities.

3.1.2.2 Greenville Fault

The Greenville fault lies 5.2 miles (8.3 km) east of the project alignment. Recent investigations of the Greenville fault and Mount Diablo thrust indicate that these two structures are geometrically linked, with the Mount Diablo thrust acting to transfer strain from the Greenville fault to the Concord-Green Valley fault (Unruh and Sawyer, 1997). This suggests that the Greenville fault does not continue to the north as previously mapped, but dies out near Morgan Territory Road. Two earthquakes during January 1980 on this fault measured Richter magnitudes of 5.9 and 5.8.

Available data on the late Quaternary slip rate of the Greenville fault are sparse and have significant uncertainties. The Working Group on California Earthquake Probabilities estimates the slip rate on the Greenville fault to be about 2 mm/yr (WGCEP, 2003). Based on correlation of terraces south of Livermore Valley offset by the Greenville fault, Wright et al. (1982) documented approximately 90 m of Pleistocene displacement. The deformed terraces were estimated to be 125,000 to 180,000 years old, based on soil profile development, thus implying a slip rate of 0.5 to 0.7 mm/yr (Wright et al., 1982). Paleoseismic trench investigations across one of the strands of the northern Greenville fault documented evidence for Holocene surface-rupturing events. Wright et al. (1982) estimated a horizontal slip rate of approximately 0.1 to 0.3 mm/yr with a recurrence interval estimated to be on the order of 550 years. Recent investigations by Unruh and Sawyer (1998) and Sawyer and Unruh (2002) indicate a 70-km length for the active Greenville fault. Preliminary Holocene slip rate estimates from a site at the northern end of the Livermore Valley are 4.1 ± 1.8 mm/yr (Sawyer and Unruh, 2002). However, Unruh cites strong geomorphic and structural evidence to support a more limited rupture length for a MCE on the Greenville fault. Detailed geomorphic and preliminary paleoseismic investigations support a maximum rupture length of 43 km along the northern part of the Greenville fault, equivalent to rupture of the Livermore and Arroyo Mocho sections investigated by Unruh and Sawyer (1998). A rupture of this length would generate a MCE of M 7.

3.1.2.3 Verona Williams Fault

The Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. This fault is shown as an uncertain trace over a curving length of about 4 miles (6½ km) along the base of the hills on the north side of the Vallecitos Valley (CGS, 2000). Because the CGS believes that there is insufficient evidence to indicate that this fault is inactive and that there is sufficient evidence to indicate that this fault is potentially active, it is included within an Alquist-Priolo Earthquake Fault Zone (Hart, 1975; CDMG, 1982a).

3.1.2.4 Las Positas Fault

The Las Positas fault was originally mapped in 1975 and 1977 by Herd as a northeast-trending, 15-km long zone of left-lateral strike slip faults. Herd showed the southwest end of the fault (the end closest to the project alignment) covered by alluvium and landslides. Herd cites geomorphic features including scarps and several drainages that have been deflected as evidence for recent movement along the fault. Radiometric dating of buried charcoal from a faulted stream terrace indicated that faulting had occurred 17,400 ± 250 years ago (Carpenter et al., 1980). Bonilla et al. (1980) described several en echelon fractures that they attributed to tectonic movement along

the Las Positas fault following the two 1980 Livermore earthquakes on the Greenville fault. An analysis of seismicity in the Livermore Valley area following these two earthquakes showed that the movement along the Las Positas fault was left-lateral and that this fault is "probably seismically active", although the analysis of the limited data set compiled for this study could not prove seismic activity (Ellsworth and Marks, 1980).

California Division of Mines and Geology Fault Evaluation Report 112 by Smith (1981) summarizes the exploratory work and mapping that were performed by numerous authors to evaluate the activity of the Las Positas fault and this document was used to justify the delineation of the Earthquake Fault Zone along a portion of this fault. The Alquist-Priolo Earthquake Fault Zone delineated along the Las Positas fault is located about 3.5 miles (5.6 km) northeast end of the project alignment (CGS, 2000).

3.1.3 Local Geology

Based on a review of the borings completed along the project alignment, the soil profile typically consists of road base/fill overlying alluvium. The road base, where encountered, ranged from about 6 inches thick to as much as 18 inches thick. Alluvium was encountered in all of the borings underlying the road base. The alluvium consists of complexly interbedded sand, silt and clay with gravel and extensive channel deposits of sandy gravel, clayey gravel and poorly graded sand/gravel mixtures. More recent mapping by Witter and others (2006) shows the subject site to be predominantly underlain by historic stream channel deposits and latest holocene alluvian fan deposits. In general the alluvium encountered below 50 feet consists primarily of silty clay to lean clay interbedded with thin sand/gravel deposits. The uncorrected N-values from borings were nearly all above 40 blows per foot and most were well above 50 blows per foot in cohesionless soils, even in the silts and clays located below Elevation 350 feet. Silts and clays encountered at shallow depths typically have N-values in the range of 10 to 28 blows per foot.

3.2 SITE AND SUBSURFACE CONDITIONS

3.2.1 Site Topography

The SR 84 alignment between Jack London Boulevard and Ruby Hill Drive crosses the relatively flat Livermore Valley. The topography along the existing roadway ranges in elevation from approximately 410 to 420 feet between Jack London Boulevard at Station 448+00 to the drainage crossing of Arroyo Del Valle at Station 320+00. The incised Arroyo Del Valle and Arroyo Mocho drainage crossings are at about Elevation 400 feet in the channel bottom. South of Arroyo Del Valle crossing the road alignment gradually climbs a gentle alluvial fan, rising to about Elevation 590 feet south of Ruby Hill Drive at Station 227+00. South of the intersection with Vallecitos Road the road alignment is surrounded by low rolling hills as it enters the mouth of a canyon.

Development along the project is mixed, including agricultural, scattered commercial and industrial (mainly at the north end), residential communities and gravel quarries. The gravel quarries are extensive and extend between about Station 314+00 north of Vineyard Avenue to Station 415+00 at the Arroyo Mocho bridge crossing. The majority of the gravel quarries are located along the west side of SR 84.

3.2.2 Field Exploration

Subsurface exploration for the existing Arroyo Mocho Bridge was performed in November 1996 by others and included three rotary wash borings, B-18, B-19 and B-20, which extended to a maximum depth of 100 feet. These borings reportedly encountered alluvial deposits consisting of dense to very dense sands and gravels and stiff to hard clays and silts to the maximum depth of each boring. Free groundwater was reportedly observed at a depth of about 88 feet (Elevation 332 feet) in Boring B-20. Groundwater levels were not recorded in either of the other borings due to the rotary wash drilling method used.

To supplement available data, a subsurface investigation for design of the bridge widen and adjacent new Zone 7 access bridge was performed between December 26, 2007 and January 2, 2008, and included two borings, NB23 and NB24, which extended to terminal depths of 101.5 feet. The borings were initially drilled with a 4-inch solid flight auger so that the depth to groundwater could be measured. Thereafter, the drilling method was switched to 4⅞ inch rotary wash. Please refer to Figure 3-3 for relative locations of recent borings performed for this study, as well as those completed by others in 1996.

A representative of URS supervised the drilling operations and soil sampling. Visual classifications of the soils encountered were made from cuttings and soil samples. The soil samples collected from the borings were sealed immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. All borings were backfilled with a mixture of cement and bentonite in accordance with the requirements of the Alameda County Flood Control and Water Conservation District, also known as Zone 7 Water Agency. For details of field exploration refer to Appendix B.

The Unified Soil Classification System and the guidelines summarizing soil consistency and relative density are presented on the Log of Test Borings (LOTBs) legend, Figures 3-4a and 3-4b. Descriptions of the soils encountered in the current borings by URS and previous borings by others are presented on Figures 3-4c and 3-4d, respectively. The logging method used in preparing the LOTBs is consistent with Caltrans Soil and Rock Logging, Classification and Presentation Manual, dated June 2007. These logs also illustrate the notation used for the size of samplers and the methods of advancing them.

3.2.3 Laboratory Testing

The water content, dry density, plasticity index (PI) and grain size distribution (PA), and unconfined compressive strength (UC) were determined for selected samples to estimate the strength and compressibility of the underlying soils. The locations of these tests, together with the resistance to penetration of the samplers are shown at the corresponding locations on the LOTBs. One consolidation test was performed on a sample as part of the study performed by others in 1996. The laboratory test results are provided in tabular form and/or graphically in Appendix B.

3.2.4 Soil Conditions

3.2.4.1 Fill

Embankment fills at the site consists of about 6 inches of aggregate base at Borings NB23 and NB24.

3.2.4.2 Native

Native soils were encountered below the aggregate base fill in Borings NB23 and NB24 and beginning at ground surface in the borings performed in 1996. Borings B-18 through B-20 encountered mostly silty sand to sandy silt in the upper 3 to 6 feet of the borings; NB23 encountered primarily clayey sand. Underlying the surficial loose to medium dense sand and silt layer were dense to very dense clayey gravel, silty gravel, clayey sand, silty sand and poorly graded sand deposits; these sand and gravel deposits extended to the terminal depths of the borings. Scattered cobbles were encountered in Borings NB23 (at depth of 3 feet), NB24 (between depths of 3 and 8 feet), B-18 (depths between 25 and 30 feet, at depth of 97 feet) and B-20 (between depths of 20 and 33 feet). Numerous interbedded layers of very stiff to hard, sandy clay and clayey silt ranged in thickness from 3 to 24 feet in the 1996 and current borings.

3.2.5 Groundwater

Free groundwater was reportedly encountered at a depth of approximately 88 feet (Elevation 332 feet) in Boring B-20 drilled in 1996. Free groundwater levels were not recorded in either of the other two borings drilled during that investigation (B-18 and B-19) due to the rotary wash drilling method used. Groundwater was reportedly measured by others at a depth of about 91 feet (Elevation 334 feet), and 66 feet (Elevation 358 feet) in November 1996 and February 1997, respectively in a monitoring well (Alameda County Flood Control and Water Conservation District, Zone 7, well No. 32/SE 7N1) located near the site of existing Arroyo Mocho bridge Abutment 4. Groundwater was reportedly measured at a depth of about 42 feet (Elevation 376 feet) in February 1997 in a nearby piezometer that was installed as part of 1996 study and located just south of Stanley Boulevard. Groundwater levels measured in February 1997 were taken following two months of heavy rains. These water levels indicate that groundwater recharge responds rapidly to rainfall infiltration.

Free groundwater was not encountered in either of the two borings (NB23, NB24) drilled at Arroyo Mocho for this investigation above a depth of 8 feet where the drilling method was switched to rotary wash, thereby precluding a reliable groundwater measurement. However, drilling fluid was measured at a depth of 42.5 feet (Elevation 374.5 feet), five days after temporarily stopped drilling in NB23, prior to resuming drilling on January 2, 2008. Wet soils were noted at a depth of about 24½ feet in a nearby hollow stem auger boring, NB22A, drilled near Station 408+00 for proposed retaining wall structures; however, at the completion of drilling to a depth of 30 feet, the boring was noted to be dry.

None of the shallow "RB" borings completed for pavement design and completed using hollow stem auger methods encountered groundwater. These borings were generally 10 to 15 feet in depth. No groundwater springs or seeps were observed on or near the project alignment, and the

stream channels crossed by the alignment flow only during the rainy season and shortly afterwards.

In our opinion, a design groundwater level at 376 feet would be appropriate for the site.

3.3 GEOLOGIC HAZARDS

3.3.1 Surface Fault Displacement and Ground Shaking

The project alignment does not cross any Alquist-Priolo Earthquake Fault Zones; surface rupture due to faulting along the alignment, therefore, is not expected to occur. However, the short distance to the Earthquake Fault Zones along the Calaveras, Verona Williams, Greenville and Hayward faults does create a high risk for ground shaking from fault movement. The intensity of the ground shaking is dependent upon the size of the earthquake, the distance of the epicenter from the site, the direction that the earthquake propagates along the fault, and the site geologic conditions.

3.3.2 Landslide and Slope Failure

No landslides were noted in the vicinity of the Arroyo Del Valle creek crossing and a review of the U.S. Geological Survey landslide map for the Livermore quadrangle (Nilsen, 1975) does not show any other landslides.

3.3.3 Scour

The channel bottom and side slopes beneath the existing and proposed SR 84 bridges over Arroyo Mocho are reportedly lined with concrete based on the as-built plans for construction of the existing bridge. The portion of the channel at the proposed access bridge crossing, however, is unlined. Based on the project hydraulic analysis (Wreco 2009), we understand that total scour to a depth of 1.1 feet bgs is anticipated at the access bridge abutments. We understand that recommendations for scour mitigation are provided in the project hydraulic report. The executive summary section of Bridge Design Hydraulic Study report by Wreco, dated January 9, 2009 is attached to this report as Appendix C.

3.3.4 Flooding

With the exception of the active channels of Arroyo Del Valle and Arroyo Mocho, the project alignment is located outside of the 100-year flood zone as shown on the FEMA flood hazard zone maps (ABAG, 2007).

3.3.5 Subsidence and Seismic Compaction

Subsidence typically occurs as a result of subsurface fluid extraction (e.g. groundwater, petroleum) or compression of soft, geologically young sediments. Groundwater extraction for high volume municipal and agricultural use has the potential to cause future ground subsidence in the region. However, we are not aware of subsidence in the area and no active petroleum

wells are present within many miles of the site (California Division of Oil, Gas, and Geothermal Resources, 2001).

Compaction settlement, or seismic densification, occurs when loose granular soils above the groundwater table increase in density as a result of earthquake shaking. This soil densification can result in differential settlement because of variations in soil composition, thickness, and initial density. With the exception of some loose to medium dense cohesionless soils encountered in the upper 20 feet in B-19, B-20, and NB24, the cohesionless materials are dense to very dense at the Arroyo Mocho crossing. For Design, we estimated the potential post-earthquake settlement at borings NB23 and NB24, using the computer program LIQUEFY PRO. In out analyses we used a peak ground acceleration (PGA) of 0.5g and design earthquake moment magnitude (Mw) of 7.5. The results of these studies indicated that the magnitude of seismic compaction settlement at abutments will be less than ¼ inch.

3.3.6 Liquefaction Potential

Liquefaction is a phenomenon whereby sediments temporarily lose shear strength and collapse. This condition is caused by cyclic loading during earthquake shaking that generates high pore water pressures within the sediments. The soil type most susceptible to liquefaction is loose, cohesionless, granular soil below the water table and within about 50 feet of the ground surface. Liquefaction can result in loss of foundation support and settlement of overlying structures, ground subsidence and translation due to lateral spreading, lurch cracking, and differential settlement of affected deposits. Lateral spreading occurs when a layer liquefies at depth and causes horizontal movement or displacement of the overburden mass toward a free face such as a stream bank or excavation, or toward an open body of water.

In a regional study of the nine-county San Francisco Bay region for the U.S. Geological Survey, Witter et al. (2006) mapped the liquefaction susceptibility of the soils along the project alignment. The alluvium between Jack London Boulevard and Stanley Boulevard (Station 401+00) is mapped as having “high” liquefaction susceptibility. Between Stanley Boulevard and Arroyo Del Valle (Station 321+00) the alluvium is mapped as having “moderate” liquefaction susceptibility. From Arroyo Del Valle extending south about 1,500 feet to Station 304+00, the alluvium is mapped as having “high” liquefaction susceptibility and south of this point to the southern end of the project alignment the soils are mapped as having “moderate” liquefaction susceptibility. The historic channel deposits at both Arroyo Del Valle and Arroyo Mocho are mapped as having “very high” liquefaction susceptibility.

Based on a review of the borings completed at Arroyo Mocho, several relatively thin discontinuous strata of loose to medium dense clayey and silty sand and sandy silt were encountered in the upper 20 feet in current Boring NB24 and in previous borings B-19 and B-20. These upper granular soils could be subject to liquefaction if saturated, however the depth to groundwater is likely at least 25 feet or greater based on the borings drilled in this area. The granular soils encountered below a depth of 25 feet are mostly dense to very dense, and therefore the potential for liquefaction and lateral spreading of these materials to occur is considered to be low.

3.4 GEOLOGICAL PROFILES AND ENGINEERING PARAMETERS

A generalized soil profile is presented as Figure 3-5 illustrating the layering of the various soil strata and summarizing the corresponding geotechnical parameters. It should be noted that this profile was developed based on extrapolation of available data from the borings drilled for this investigation and, therefore, may differ from actual conditions. Engineering soil parameters presented on the profile were selected from laboratory test results as well as engineering judgment and local experience.

The undrained shear strength, relative density, dry unit weight and moisture content are the engineering soil parameters used in our foundation design and analysis. Atterberg limits tests and particle analyses were performed for classification of soils. In general, unconfined compression tests were performed on cohesive soil samples to estimate the undrained shear strength. Some disturbance may occur while sampling cohesive soils; therefore unconfined compressive strengths in localized areas can be lower than the insitu field conditions. Consequently, engineering judgment and local experience were applied in our interpretation of the laboratory test results. The relative density of cohesionless soils was estimated from vertical effective stress and Standard Penetration Resistance, N blows per 1 foot based on correlations developed by Gibbs and Holtz (DM7.1 – 87, 1986). Where non-standard sampler sizes were used, such as the modified California sampler (2½ inch outside diameter), a correction factor was applied to the observed blows per 1 foot to estimate the Standard Penetration Resistance, N values.

4.1 CORROSION EVALUATION

An assessment of the potential for corrosion of various buried foundation and pipe structures was performed by V& A Consulting Engineers (V&A). The results of their investigation are presented in Appendix D. The following paragraphs include their summary, conclusions, and recommendations.

4.2 SUMMARY

The objective of this investigation is to measure various soil parameters and evaluate the results with respect to possible levels of corrosion at proposed Arroyo Mocho Access Bridge site. Corrosivity was determined for materials of the proposed project structure to depths ranging from 0 to 6 m below grade.

The California Department of Transportation, Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch has published "Corrosion Guidelines" (Guidelines) to define corrosive soil. The Guidelines consider soil to be corrosive to structural elements (steel reinforced concrete) if one or more of the following conditions exist for water or soil samples:

1) The chloride concentration is 500 ppm (mg/kg) or greater,
2) The sulfate concentration is 2,000 mg/kg or greater, or
3) The pH is 5.5 or less.

A wide variety of soluble salts is typically found in soils. Two soils having the same resistivity may have significantly different corrosion characteristics, depending on the specific ions available. The major constituents that accelerate corrosion are chlorides, sulfates and the acidity (pH) of the soil. Chloride ions tend to break down otherwise protective surface deposits, and can result in corrosion of reinforcing steel in concrete structures. Sulfates in soil can be highly aggressive to portland cement concrete by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. High concentrations of bicarbonates tend to decrease soil resistivities. Although bicarbonates are not aggressive to concrete, lower resistivity environments can promote corrosion activity.

Acidity, as indicated by the pH value, is another important factor of soil. The lower the pH (the more acidic the environment), the higher will be the corrosivity with respect to buried metallic and concrete structures. As pH increases above 7 (the neutral value), conditions become increasingly more alkaline and passive to buried structures.

Evaluation of the in-situ soil environment was made in terms of potential damage to structures due to corrosion. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, soil samples collected by URS during the geotechnical investigation were forwarded to Cooper Testing Laboratory in Palo Alto, California for chemical analysis. The soil samples were analyzed for minimum resistivity, pH, water soluble chloride ion concentration, and water soluble sulfate ion concentration in accordance with the Guidelines.

The results are summarized in the following table.

Table 4-1: Soil Corrosion Test Results Summary

Sample ID	Minimum Resistivity (ohm-cm)	pH	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
NB23, 2-4	5,347	8.4	2	<5
NB23, 13-3	6,052	7.9	3	<5
NB24, 2-X	14,478	9.1	<2	<5
NB24, 13-4	1,978	7.8	7	<5

As shown above, the pH of the soil samples analyzed ranged from 7.8 to 9.1. The water soluble chloride ion concentration of the soil samples analyzed ranges from less than 2 milligrams per kilogram (mg/kg) to 7 mg/kg. The water soluble sulfate ion concentration of the soil samples was below the minimum detection level of 5 mg/kg. In addition, the minimum (saturated) resistivity of the four samples selected from the borings ranged from 1,978 ohm-cm to 14,478 ohm-cm.

No water was sampled at the Arroyo Mocho Access Bridge site since the streambed was dry at the time field resistivity readings were taken (May 2008). The bridge structure is not located within 1,000 feet (300 meters) of salt or brackish water.

4.3 CONCLUSIONS

Soil samples were obtained for corrosion analysis at Boring Locations NB23 and NB24. As shown in the preceding Table 4-1, the soil boring chemical analyses resulted in pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg and soluble sulfate concentrations less than 2,000 mg/kg. Therefore, according to the Guidelines, the soil at the site is considered non-corrosive. According to the Guidelines, no corrosion mitigation for steel piles is required for non-corrosive soil conditions.

4.4 RECOMMENDATIONS

4.4.1 Buried Reinforced Concrete Structures

Buried concrete structures (including CIDH piles) should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A concrete cover of a minimum of 2 inches should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.
- The concrete should be allowed to cure according to the manufacturer's recommendations.

4.4.2 Steel Piles

At this time, steel driven pile foundations are not proposed for this site.

5.1 SEISMIC DESIGN METHODOLOGY AND RESOURCES

The seismic design methodology adopted for this project is based on the following current Caltrans standards:

- Seismic Design Criteria (SDC), v 1.4, June 2006
- Guidelines for Foundation Investigations and Reports, v 2.0, dated March 2006
- California Seismic Hazard Map (Mualchin, 1996)

5.2 PEAK BEDROCK ACCELERATION

The active faults close to the SR 84 alignment between Ruby Hill Drive and Jack London Boulevard are the Greenville, Calaveras, and Verona Williams faults. The Greenville fault, Calaveras fault, and Verona Williams fault are designated with Maximum Credible Earthquake (MCE) magnitudes of 7.25, 7.5 and 6.0, respectively, by the California Seismic Hazard Map (Mualchin, 1996). The locations of these faults and associated peak bedrock acceleration (PBA) contours were obtained from the California Seismic Hazard Map and transferred to a topographical map showing the SR 84 structure. Three faults contribute the same level of ground shaking at the site (0.5g) even though the Verona Williams fault is closest to the site. The MCE, nevertheless, is the earthquake on the Calaveras fault since it potentially releases the highest energy (M=7.5). The SR 84 alignment is roughly parallel to the Calaveras fault, and the distance from the site to the Calaveras fault is approximately 4.5 miles.

Table 5-1: Seismic Source Parameters

Fault	Type	MCE	Distance (miles)	Near Field Effects?	Design PBA (g)
Calaveras	strike-slip	7.5	4.5	Y	0.5
Greenville	strike-slip	7.25	5.2	Y	0.5
Verona Williams	Unknown	6	1.7	Y	0.5

5.3 FAULT TYPE, NEAR-FIELD, AND SPECTRAL ACCELERATION INCREASES

The technical report that accompanies the California Seismic Hazard Map (Mualchin, 1996) indicates that the controlling fault (Calaveras) has strike-slip displacement. Therefore, in accordance with Caltrans design procedures referenced above, an increase in design spectral accelerations is not required for fault type. However, since the project alignment is less than 9.5 miles from the nearest active fault, design spectral accelerations should be modified to account for near-fault effects as follows:

Table 5-2: Spectral Acceleration Increase for Near Field Effects

Period (sec)	Increase in Spectral Acceleration (%)
< 0.5	0
0.5 – 1.0	0 – 20 (determined by linear interpolation)
≥1	20

At the time of this study, no bridge structures with fundamental period of vibration greater than 1.5 seconds are anticipated, and therefore no adjustments are required for long period effects.

5.4 SOIL PROFILE TYPE AND DEPTH TO ROCK-LIKE MATERIALS

Borings performed during this study for SR 84 between Ruby Hill Drive and Jack London Boulevard indicate a soil profile consisting of dense to very dense and stiff to hard alluvial deposits that extend to a depth of at least 100 feet. Recorded SPT blow counts over the depth of exploration in the vicinity of the Arroyo Mocho creek crossing generally range from about 30 to over 100 blows per foot or more (uncorrected). Although the maximum depth of our recent exploration did not extend much beyond 100 feet, the regional geology suggests the soils become stiffer and denser with increasing depth.

The standard penetration resistance was used to classify the soil profile based on the guidelines given in SDC Table B.1. No potentially liquefiable soils were identified based on the current information. Accordingly, the project site is classified as Soil Profile Type D.

5.5 DESIGN ACCELERATION RESPONSE SPECTRA

Based on Caltrans SDC (Version 1.4), the design seismic response spectrum for the site can be estimated with spectral acceleration values generated by:

- Soil Profile Type D
- Maximum Credible Earthquake (MCE) Magnitude 7.25 ± 0.25
- Peak bedrock acceleration 0.5 g
- No ARS increase for fault-type or long period structure
- ARS increase for near-field effect

The Design Acceleration Response Spectrum (ARS) corresponding to Soil Profile Type D, magnitude of controlling event 7.25 ± 0.25, and a PBA of 0.5 g were obtained from SDC Figure B.8 and modified to account for near field effects as described above. Spectral values are provided in Table 5-3.

Table 5-3: Spectral Acceleration Values
(PBA = 0.5 g, M = 7.5, Soil Type D)

Period	Soil Type D	
	Sa (g)	Sa* (g)
0.010	0.50	0.50
0.020	0.50	0.50
0.030	0.50	0.50
0.050	0.50	0.50
0.075	0.72	0.72
0.100	0.92	0.92
0.120	1.04	1.04
0.150	1.16	1.16
0.170	1.21	1.21
0.200	1.26	1.26
0.240	1.27	1.27
0.300	1.25	1.25
0.400	1.19	1.19
0.500	1.12	1.12
0.750	0.94	1.04
1.000	0.77	0.93
1.500	0.48	0.58
2.000	0.32	0.39
3.000	0.17	0.20
4.000	0.11	0.13

*Modified for near-field effects

Based on as-built plans from Caltrans dated May 1999 and approved in October 2002, the nearby Isabel Avenue Bridge over Arroyo Mocho is a three-span reinforced concrete slab bridge supported at abutments on the north and south ends (Abut 1 and Abut 4) and two middle piers (Pier 2 and Pier 3). The abutments and piers are supported on driven steel H-piles. The table below presents a summary of the design capacities and bottom of pile cap elevations:

Table 6-1: As-Built Pile Data Table, Arroyo Mocho Bridge

Location	Pile Type	Bottom of Pile Cap (ft)*	Design Loading (Service) (tons)	Nominal Resistance Compression (tons)	Nominal Resistance Tension (tons)	Design Tip Elevation (ft)*	Specified Tip Elevation (ft)*
Abut 1	HP 10x57	411.4	40	80	0	380.0 (1) 401.0 (2)	380.0
Pier 2	HP 10x57	385.8	70	140	0	327.5 (1) 375.0 (2)	327.5
Pier 3	HP 10x57	385.8	70	140	0	327.5 (1) 375.0 (2)	327.5
Abut 4	HP 10x57	411.4	40	80	0	380.0 (1) 401.0 (2)	380.0

Design tip elevation is controlled by the following demands:
(1) Compression, (2) Tension
* Elevation converted from NGVD29 datum shown on as-built plans to NGVD88 datum

Based on the as-built plans, piles were driven to an average tip elevation, converted to NGVD88 datum, of 378.2 feet at Abutment 1 and 378.4 feet at Abutment 4; average tip elevations were not provided on the as-built plans for piles at Piers 2 and 3.

The as-built plans also indicate that the channel beneath the bridge is lined with reinforced concrete having side slopes between each abutment and outside of adjacent pier of 2.5:1 (horizontal:vertical) and finish grade at Elevation 404.5 feet (converted to NGVD88 datum). All available as-built plans for the bridge are provided in Appendix E.

The geotechnical design report prepared by others for the existing bridge indicates a design scour depth to Elevation 386.0 feet, assuming that the channel bottom was unlined. The bottom of pile cap elevations presented in the table above appear to be based on the presumption that the channel bottom would not be protected from scour.

7.1 DISCUSSION

The proposed bridge is underlain predominantly by very dense sands and gravels embedded with occasional lenses of silty and clayey deposits.

The principal geotechnical issues at the site are:

- Selection of the type and depth of foundation that will be compatible with the underlying soils; and
- Selection of the type of foundation at Abutment 1 that minimizes potential additional loads onto the existing 24 inch gas pipe line.

Although the subgrade soils at both abutments are capable of supporting the anticipated footing pressures, a pile foundation at Abutment 1 will be more applicable to transmit the loads along the pile shafts and to a bearing layer deeper than the existing 24 inch gas line; this should minimize additional foundation stress on the gas line. Based on the available subsurface data, a CIDH pile system is feasible at Abutment 1. Since there is no potential buried utility conflict at Abutment 2 (Figure 2-2), a spread footing is considered feasible.

The following sections present the geotechnical design parameters for CIDH piles and spread footings.

7.2 DESIGN CAPACITY

7.2.1 Axial Pile Capacity Analysis

We understand that the Structural Engineer has elected to use 16-inch CIDH piles for support of Abutment 1 of the proposed access bridge. Current Caltrans practice is to design abutments in accordance with Working Stress Design (WSD) methodology. Table 7-1 presents a summary of the foundation design data provided by the Structural Engineer.

Table 7-1: Foundation Design Data Table for Arroyo Mocho Access Bridge

Location	Design Method	Pile Type	Finished Grade Elevation (ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	No. of Piles per Support
					B	L		
Abut 1	WSD	16” CIDH	415.00	409.67	9.0	21.5	1	9

The design loading conditions and nominal resistance are developed in accordance with the LRFD approach. Loads from LRFD service-I Limit State are used as design loads for WSD of the abutment. Table 7-2 presents the foundation design loads.

Table 7-2: Foundation Design Loads for Arroyo Mocho Access Bridge

Location	Service Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Limit State (Controlling Group, kips)			
	Total Load			Compression		Tension		Compression		Tension	
	Per Support	Max per Pile	Per Support	Per Support	Max per Pile	Per Support	Max per Pile	Per Support	Max per Pile	Per Support	Max per Pile
Abut 1	910	130	700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The specified tip elevations presented in the following "Pile Data Table" (Table 7-3) are based on frictional resistance and end bearing developed in the subgrade soils that underlie the site.

Table 7-3: Pile Data Table for Arroyo Mocho Access Bridge

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)
		Compression	Tension		
Abut 1	16" CIDH	260	0	376.0 (a) 394.0 (b)	376.0

Design tip elevation is controlled by the following demands:
(a) Compression, (b) Lateral

The results of our axial pile capacity analysis, which form the basis for the design tip elevations provided above, are presented in Appendix F. The CIDH piles are approximately 33½ feet in length. These dimensions are consistent with Caltrans' construction guidelines for CIDH piles since the length to pile size ratio (L/D) are less than 30. Since drilling of the CIDH pile is expected to be above the design groundwater level (El. 376 ft), the minimum 24 inch diameter pile guideline can be waived.

No group reduction factor needs to be applied to single pile compression load capacities presented above, provided a center-to-center spacing of at least three pile diameters is used.

7.2.2 Bearing Capacity

As discussed in Section 7.1 spread footings are recommended at Abutment 2. Current Caltrans practice is to design the abutments in accordance with Working Stress Design (WSD) methodology. Table 7-4 presents a summary of the spread footing design load data provided by the Structural Engineer.

Table 7-4: LRFD Service Limit State I Loads for Spread Footing

Support Location	Total Load				Permanent Load		
	Vertical Load (kips)	Effective Dimensions (ft)		Horizontal Load in Long. Direction (kips)	Vertical Load (kips)	Effective Dimensions (ft)	
		Width	Length			Width	Length
Abut 2	565	10.0	21.5	0	460	10.0	21.5

Based on the subgrade soils encountered, footings should be designed for the soil bearing capacity or nominal bearing resistance shown in the following table:

Table 7-5: Spread Footing Data Table

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)	
	B	L			Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (ksf)
Abut 2	**10.0**	**21.5**	**409.42**	**5.0**	**7.00**	**6.00**

Using the soil bearing pressures described above, we estimate a total settlement of less than 1-inch at the abutments.

7.2.3 Resistance to Lateral Loads

The CIDH pile foundations are capable of resisting lateral loads. Resistance to lateral loads can be developed by bending of the pile and by pile-soil interaction. The magnitude of the lateral load resistance that can develop depends upon several factors such as the pile size, the physical properties of the surrounding soils, the structural design of the pile, and the direction of loading. Lateral load capacity of CIDH piles was calculated assuming that all soils in the potential scour zone are scoured. We used LPILE 4.0 (Reese et al., October 2000) to assist in estimating the lateral load resistance of 16-inch CIDH piles.

Output files for laterally loaded piles at the abutments and bents are presented in Appendix G and include deflection versus depth, bending moment versus depth, shear versus depth, and total stress versus depth. Charts showing load versus deflection for free and fixed head condition at top of pile are included in Appendix G as Figure G-1.

We recommend that a group efficiency factor of 0.6 be applied to the lateral capacity of individual piles in trailing rows for a minimum center-to-center spacing of at least three times the pile diameter in the loaded direction.

Resistance to transient lateral loads from wind or earthquakes can be developed by friction between the bottom of the spread footings and the soil and the passive resistance on the front face of the footings. An ultimate friction coefficient of 0.4 should be used between the bottom of the footings and underlying soil, provided the footings are cast neat against undisturbed native soil. Ultimate passive resistance of the soil may be estimated using an equivalent fluid weight of 400 pcf against the footings for a level backfill ground surface. The recommended values presented above are ultimate values, and should be used with an appropriate factor of safety.

7.3 PILE INSTALLATION

All piles should be installed under the direct observation of the Geotechnical Engineer and in accordance with Section 49 of the Caltrans Standard Specifications, Piling. Specific additions and modifications to these requirements are discussed below.

Based on Boring NB23, we anticipate that proposed CIDH piles will be drilled through predominantly granular soils consisting of dense to very dense clayey sand and clayey gravel. The clayey sand deposits contain numerous gravel pieces. Groundwater is estimated to be at approximate Elevation 376 feet. Although the groundwater is not anticipated during the CIDH pile installation, some sloughing and caving of the gravels is anticipated. Therefore, we recommend the Contractor have casing with a minimum diameter of 24 inches onsite, should it be needed to minimize the risk of caving. If casing is used, the casing should be withdrawn from the hole slowly as the concrete is being placed; a minimum head of concrete of 3 feet should be maintained in the casing at all times to prevent reduction of the diameter of drilled shaft due to earth and/or hydrostatic pressures on the fresh concrete. Alternatively, drilling fluid meeting the project special provisions could be used. Contractor should anticipate some difficulty during augering and casing installation due to the gravels encountered at the site. All CIDH piles should be constructed under the direct observation of the Geotechnical Engineer.

Concrete should be placed by the tremie method. Concrete placement operations should be controlled to confirm that the tremie is not broken during the continuous concrete pour from bottom to top. Care should be taken to prevent extraneous material from mixing with fresh concrete.

7.4 APPROACH EMBANKMENT SETTLEMENT

Based on the plans provided it appears that new fill at the access bridge approach will be less than 5 feet; we estimate the corresponding settlement to be less than 1/8 inch. The settlement will predominantly be immediate and should occur during fill placement; long-term consolidation settlement should be negligible.

7.5 SLOPE STABILITY

Based on topographic data, it appears that the existing slopes along Arroyo Mocho at the proposed access bridge are inclined at about 2:1 (horizontal:vertical) with channel bottom at about Elevation 406 feet. The General Plan (Figure 2-1) for the structure indicates that rock slope protection is to be placed along the slope, inclined at 1.5:1. The embankment soils consist primarily of medium dense to very dense silty and clayey sands and gravels with interbeds of stiff lean clay, which in our opinion, are sufficiently strong to support the proposed 1.5:1 slopes.

Based on our analyses, the computed minimum (critical) factor of safety at Abutments 1 and 2 are **2.0** and **1.6**, respectively. The computed factor of safety values exceed the minimum required value of 1.5 mentioned in Section 5.2.2.3 of Bridge Design Specifications (August 2004). Slope stability analyses were performed with the assumption that the rock slope protection along the slopes at abutments will protect it from scour. The results of slope stability analyses are presented in Appendix H as Figures H-1 and H-2. In addition, because liquefaction potential at this location is considered to be low, we believe that potential for lateral spreading at this site is also low.

7.6 APPROACH FILL EARTHWORK

All earthwork should be completed in accordance with the applicable sections of the Caltrans Standard Specifications and as described in URS' companion Geotechnical Design and Materials Report for the SR 84 Expressway Widening project.

7.7 APPROACH FILLS AND ABUTMENT EXCAVATION

Expansive soil materials should not be placed as part of the embankment within the limits of the abutments for the full width of the embankment. Expansive soil materials for this requirement are defined as having either an Expansion Index (EI) greater than 50 (EI to be determined in accordance with ASTM D 4829), or a Sand Equivalent (SE) less than 20 (SE to be determined in accordance with California Test 217). This requirement is exclusive of the structure backfill and pervious backfill requirements as shown on the plans and set forth under Sections 19-3.06 and 19-3.065, respectively, in the Standard Specifications (Caltrans, 2006). Refer to Figure 7-1 for the minimum limits for non-expansive soils within an embankment near a bridge.

Footing areas should be excavated as required to bring those areas to their finish subgrade elevations. All loose soil should be removed prior to footing construction. We do not anticipate that groundwater will be encountered in abutment footing excavation; therefore, we recommend abutment excavations be classified as Structure Excavations (Bridge) in accordance with Section 11 of Bridge Design Aids, March 2005.

8.1 TEMPORARY CONSTRUCTION EXCAVATION

We anticipate that excavation into the native soils for construction of the abutments will result in temporary near vertical unsupported soil faces as high as about 13 feet. Safety standards set by OSHA limit the height of unshored vertical excavations to 5 feet if construction personnel will be working in the excavations. The set of guidelines published by OSHA (Department of Labor, Occupational Safety and Health Administration, 1989), classifies soils in detail as Type A, B, or C. In general, Type A soils are stronger and more cohesive, Type B soils are intermediate, and Type C soils are weaker or more granular. Based on the soil type, depth, duration the excavation is open, and sequence of soils exposed in the excavation, OSHA recommends maximum allowable slopes. For example, for excavations 20 feet or less in depth through homogeneous soils, they state that maximum allowable slopes (horizontal to vertical) should be ¾:1, 1:1, and 1½:1 for Type A, B, and C soils, respectively. Based on the granular nature of the soils encountered in our recent borings, the soils at the abutments are considered to be OSHA Type C.

The guidelines provided by OSHA are for trench excavations; they state that there is uncertainty as to when and to what degree an employer must slope, shore, or otherwise protect employees in a "non-trench" excavation. In consideration of these factors, we recommend that temporary cut slopes in the existing embankment fills not exceed 1½:1 during construction.

For locations where excavation with sloping sides is not viable because of space limitations or in areas where temporary slopes steeper than 1½:1 are planned, shoring will be required. The Contractor should retain an experienced Registered Civil Engineer to design the shoring system.

8.2 CONSTRUCTION DEWATERING

Bottom of spread footing at Abutment 2 is planned at Elevation 409.42 feet, with bottom of Abutment 1 CIDH pile tip at Elevation 376 feet. Free groundwater was not encountered in boring NB24 performed during this investigation at the Arroyo Mocho crossing. Drilling fluid was measured at a depth of 42.5 feet (Elevation 374.5 ft), five days after temporarily stopped drilling NB23, prior to resuming drilling on January 2, 2008. Based on historical data, free groundwater has been encountered in the area as shallow as about Elevation 376 feet. Based on this information, it appears unlikely that free groundwater will be encountered in excavations for Abutment 2 spread footings. It is also unlikely that groundwater seepage will be encountered in the CIDH pile excavations, if they are drilled in summer months followed by concrete placement on the same day. We anticipate that any water that accumulates in the excavations could be removed using standard sumping methods.

8.3 EFFECTS OF CONSTRUCTION WORK ON ADJACENT STRUCTURES

Efforts should be made to minimize effects of construction work on adjacent structures. If new foundation excavations and overexcavations are located in close proximity to existing foundations, either underpinning or shoring beneath existing foundations could be required.

The recommendations presented in this Foundation Report are based on information obtained from new and previous explorations made at widely separated locations, site reconnaissance, review of available historic data, and upon local experience and engineering judgment.

The recommendations presented in this report are based on the assumption that the soil and geologic conditions do not deviate substantially from those encountered in the exploratory borings. If any variations are encountered during construction, URS should be contacted so that supplementary recommendations can be made.

If the planned construction is changed from that presently conceived, URS should be retained to review the changes and make modifications to the original recommendations represented in this report in order to meet the project needs.

The Geotechnical Engineer should review the final specifications and drawings to verify that these documents are consistent with the intent of the geotechnical recommendations. Geotechnical issues may arise which are not apparent at this time. URS should be retained during construction to review the soil conditions encountered and the construction procedures. All earthwork and testing should be completed under the direct observation of a representative of our firm.

Specific review and investigation for environmental issues and subsurface environmental contamination were beyond the scope of our services.

The elevations shown on the new LOTBs are based on interpolation from spot and contour elevations shown on available topographic maps.

The opinions and recommendations presented in this Foundation Report were developed with the standard of care commonly used as state of the practice in the profession. No other warranties are included, either express or implied, as to the professional advice provided in this report.

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INDEX OF PLANS

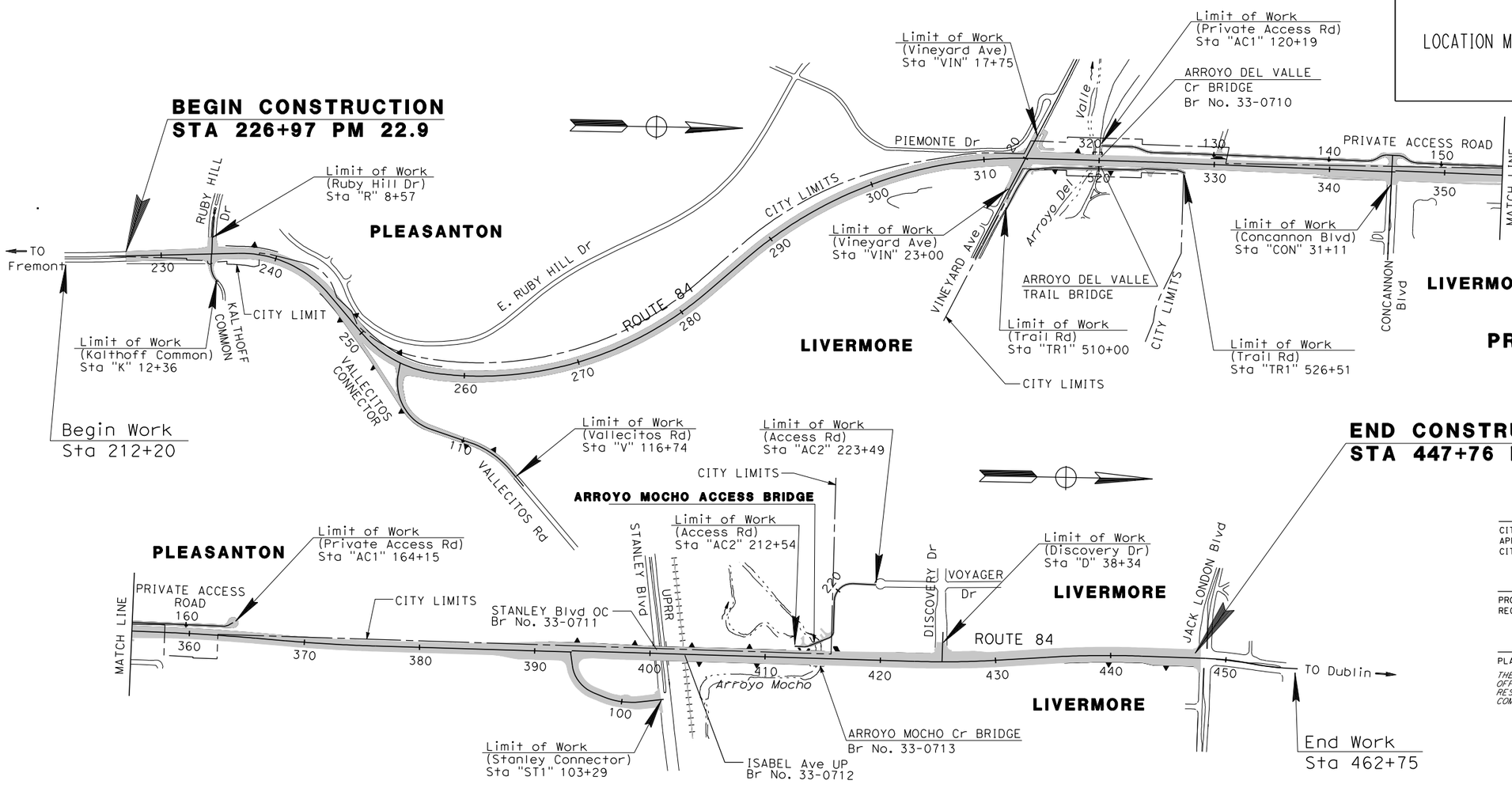
Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY
IN ALAMEDA COUNTY
IN AND NEAR LIVERMORE AND PLEASANTON
FROM 0.1 MILE SOUTH OF RUBY HILL DRIVE TO JACK LONDON BOULEVARD

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

LOCATION MAP



PROJECT VICINITY MAP
FIGURE 1-1

NO SCALE

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

CITY ENGINEER
APPROVE AS TO FEATURES AFFECTING CITY OF LIVERMORE — DATE

PROJECT ENGINEER — DATE
REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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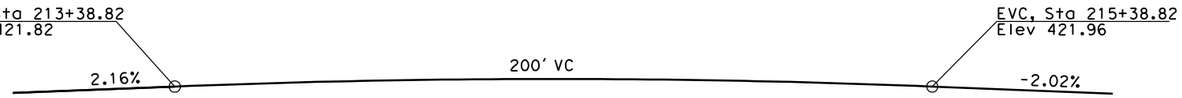
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

CONTRACT No. **04-297604**

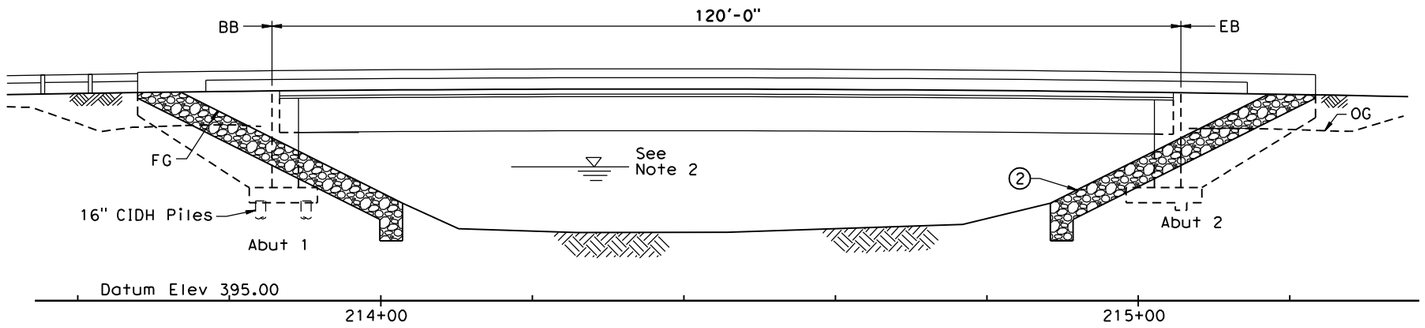
APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER	CALTRANS DESIGN OVERSIGHT APPROVAL	REGISTRATION No.	LICENSE Exp DATE	DATE SIGNED
BEN RAZEGHI	NESTOR P. PEREZ			

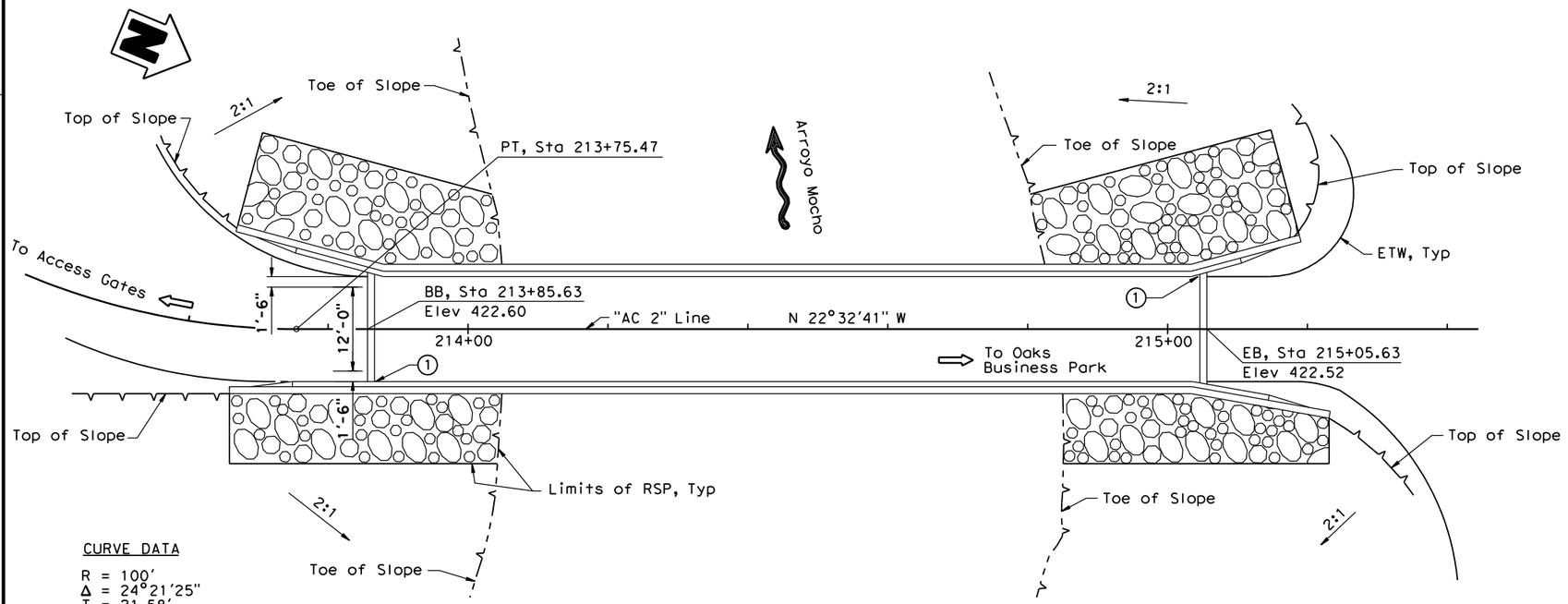
DATE PLOTTED => 12/14/2009
TIME PLOTTED => 9:56:10 AM
LAST REVISION 00-00-00



PROFILE GRADE
No Scale



ELEVATION
1" = 10'-0"



CURVE DATA

R = 100'
Δ = 24°21'25"
T = 21.58'
L = 42.51'

PLAN
1" = 10'-0"

NOTES:

1. For General Notes, see "FOUNDATION PLAN" sheet.
2. For Hydrologic Summary, see "FOUNDATION PLAN" sheet.

NOTES:

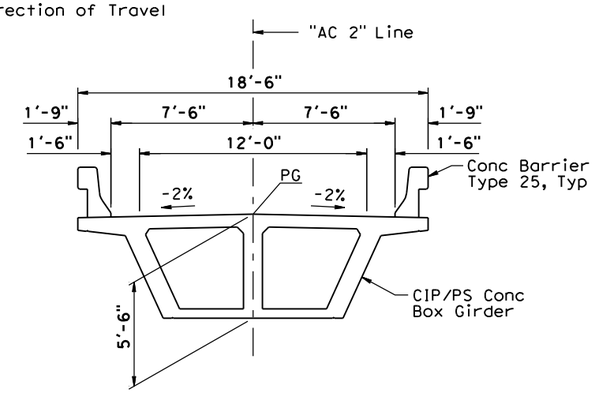
① Paint Bridge Name, "Arroyo Mocho Access Bridge"

② Rock Slope Protection (1/4Ton, Method B)

LEGEND

Indicates Direction of Flow

Indicates Direction of Travel



TYPICAL SECTION
1/4" = 1'-0"

INDEX TO PLANS

Sheet No.	Title
1	GENERAL PLAN
2	DECK CONTOURS
3	FOUNDATION PLAN
4	ABUTMENT 1 LAYOUT
5	ABUTMENT 2 LAYOUT
6	ABUTMENT DETAILS NO. 1
7	ABUTMENT DETAILS NO. 2
8	ABUTMENT DETAILS NO. 3
9	TYPICAL SECTION
10	GIRDER LAYOUT
11	ROCK SLOPE PROTECTION
12	LOG OF TEST BORINGS 1 of 4
13	LOG OF TEST BORINGS 2 of 4
14	LOG OF TEST BORINGS 3 of 4
15	LOG OF TEST BORINGS 4 of 4

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT	DESIGN	BY P. Zhao	CHECKED R. Sennett	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 WITH "LOW-BOY"; PERMIT DESIGN VEHICLE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu, PROJECT ENGINEER
	DETAILS	BY P. Zhao	CHECKED R. Sennett	LAYOUT BY P. Zhao	CHECKED R. Sennett		
SIGN OFF DATE	QUANTITIES	BY R. Huang	CHECKED W. Sennett	SPECIFICATIONS BY K. Chen	PLANS AND SPECS COMPARED G. Xu		

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

BRIDGE NO.	ARROYO MOCHO ACCESS BRIDGE
N/A	
POST MILES	GENERAL PLAN
N/A	

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/09/08 | 04/07/08 | 09/15/08 | 12/19/08 | 04/30/09 | 01/27/10 | 08/16/10

SHEET 1 OF 15

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USERNAME => Peter DATE PLOTTED => 8/13/2010 TIME PLOTTED => 9:46:38 AM

FIGURE 2-1

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84			

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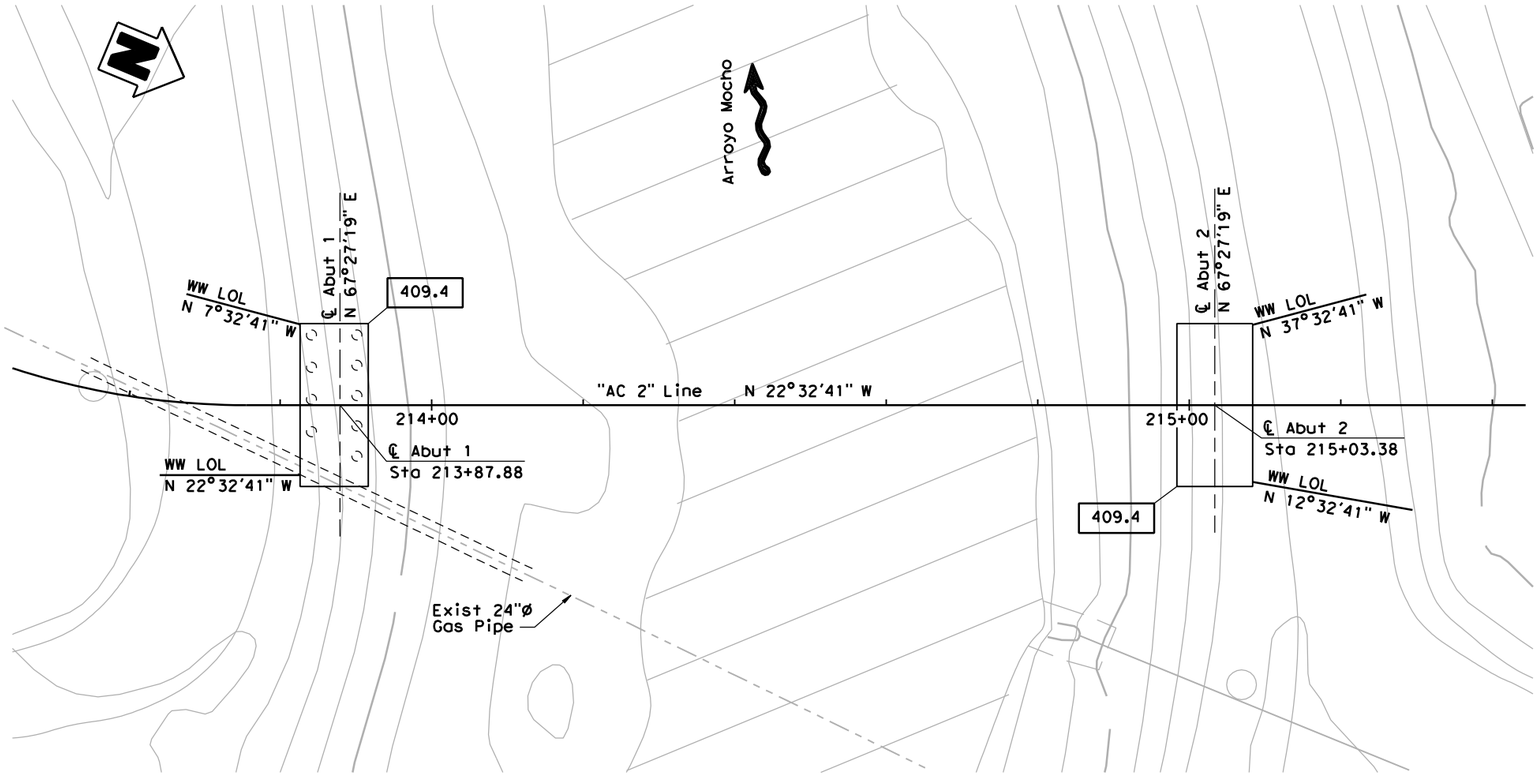
SACRAMENTO, CALIFORNIA 95831

LEGEND

Indicates Direction of Flow

XXX.xx Indicates Bottom of Footing Elevation



BENCHMARK DATA

B-31 - MONUMENT GTS205 MONUMENT IS A SET 5/8" REBAR WITH PLASTIC CAP LABELED "GTS CTRL PT." MONUMENT IS LOCATED ON THE WEST SIDE OF ISABEL JUST SOUTH OF THE CREEK THAT IS +/- 1000 FT SOUTH OF DISCOVERY DR. IT IS 21 FT SOUTH OF 6FT CHAIN LINK FENCE AND 25.5 FT WEST OF ABUTMENT WALL.
ELEVATION: 419.84' NORTHING: 2072557.560
EASTING: 6183906.224

B-33 - MONUMENT GTS303 MONUMENT IS A SET 5/8" REBAR WITH PLASTIC CAP LABELED "GTS CTRL PT." MONUMENT IS LOCATED ON THE SOUTH SIDE OF THE CHANNEL THAT IS SOUTH OF DISCOVERY DR, +/- 200 FT WEST OF ISABEL, 8FT SOUTH OF ANGLE POINT OF CONCRETE WALL.
ELEVATION: 414.26' NORTHING: 2072505.810
EASTING: 6183714.251

HYDROLOGIC SUMMARY

Drainage Area: 50 square miles

	Design Flood	Base Flood
Frequency (Years)	50	100
Discharge (Cubic feet per second)	3,900	4,800
Water Surface (Elevation at bridge)	413.62	414.66

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.

FOUNDATION PLAN

1" = 10'-0"

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

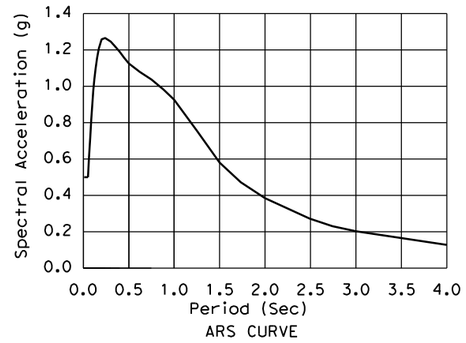
DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition and the Caltrans Amendments, Preface dated December 2008; except that Abutments and Concrete Barrier Type 25 are designed using Bridge Design Specifications ('96 AASHTO w/ Revisions by Caltrans).

SEISMIC DESIGN: Caltrans Seismic Design Criteria (SDC) Version 1.4 dated June 2006

DEAD LOAD: Includes 35 psf for future wearing surface

LIVE LOADING: HL93 and Permit Design Vehicle

SEISMIC LOADING: Modified Caltrans SDC ARS Curve
Soil Profile Type D
Magnitude Group (7.25?.25)
Peak Rock Acceleration = 0.5g



ARS CURVE

CONCRETE: fy = 60 ksi
f'c = 3.6 ksi
n = 8
See "Prestressing Notes" on 'GIRDER LAYOUT' sheet

PILE FOOTING DATA TABLE

Support Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)
		Compression	Tension		
Abut 1	16" CIDH	260	0	376.0(a) 394.0(b)	376.0

Design tip elevations controlled by the following demends:
(a) Compression; (b) Lateral

SPREAD FOOTING DATA TABLE

Support Location	Working Stress Design (WSD)		Load and Resistance Factor Design (LRFD)		
	Permissible Gross Contact Stress (Settlement) (ksf)	Allowable Gross Bearing Capacity (ksf)	Service Permissible Net Contact Stress (Settlement) (ksf)	Strength Factored Gross Nominal Bearing Resistance ϕ_b= 0.50 (ksf)	Extreme Event Factored Gross Nominal Bearing Resistance ϕ_b= 1.00 (ksf)
Abut 2	7.00	6.00	N/A	N/A	N/A

FIGURE 2-2

Stephen Huang 08/18/2010
GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT	SCALE: 1"=10'-0"	VERT.DATUM NAVD88	HORZ.DATUM NAD83	DESIGN	BY P. Zhao	CHECKED R. Sennett	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	PHOTOGRAMMETRY AS OF: 11/10/2005	ALIGNMENT TIES		DETAILS	BY P. Zhao	CHECKED R. Sennett	
SIGN OFF DATE	SURVEYED BY Dan Scott	DRAFTED BY Abhijeet Bhoi		QUANTITIES	BY R. Huang	CHECKED W. Sennett	
	FIELD CHECKED BY Dan Scott	CHECKED BY					

Guoping Xu
PROJECT ENGINEER

BRIDGE NO. N/A
POST MILE N/A

ARROYO MOCHO ACCESS BRIDGE
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/09/08 04/07/08 09/15/08 12/19/08 04/30/09 01/22/10 08/16/10

SHEET 3 OF 15

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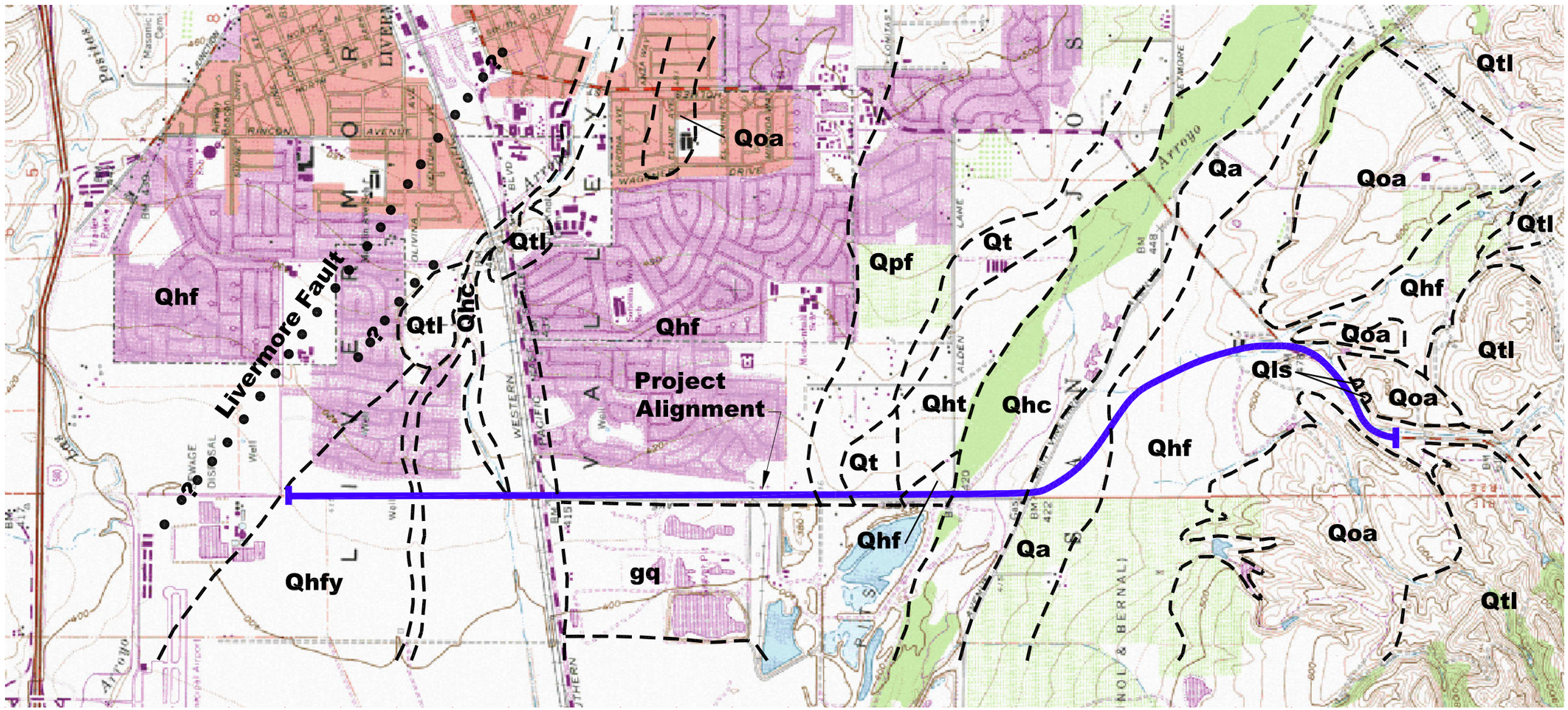


LEGEND:

-----	Approximate geologic contact
?• • • • •	Concealed fault
gq	Gravel quarries
Qhc	Historical stream channel deposits
Qls	Holocene landslide deposits
Qhfy	Latest Holocene alluvial fan deposits
Qhf	Holocene alluvial fan deposits
Qa	Holocene alluvium deposits, undifferentiated
Qht	Holocene stream terrace deposits
Qt	Holocene to latest Pleistocene stream terrace deposits
Qpf	Latest Pleistocene alluvial fan deposits
Qoa	Early to late Pleistocene older alluvium deposits
Qtl	Pleistocene Livermore Gravels Formation

0 0.2 0.4 0.6 0.8 1.0 mile

Approximate Scale in Mile

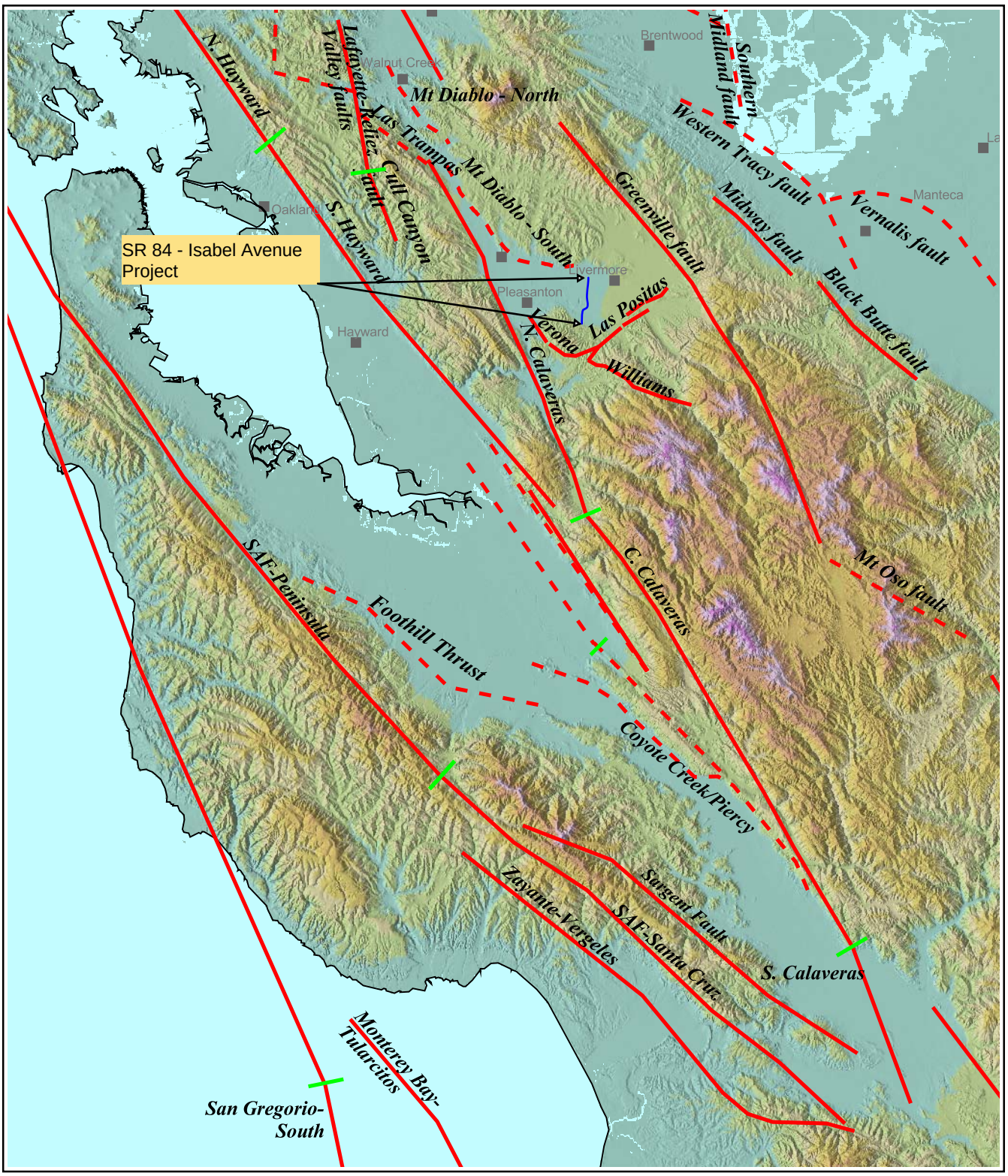
Geologic map modified from Dibblee, T.W., 1980 and Witter, R.C., et al, 2006

URS

SR 84 Isabel Ave
Livermore, California
Alameda County

SITE AND GEOLOGIC MAP

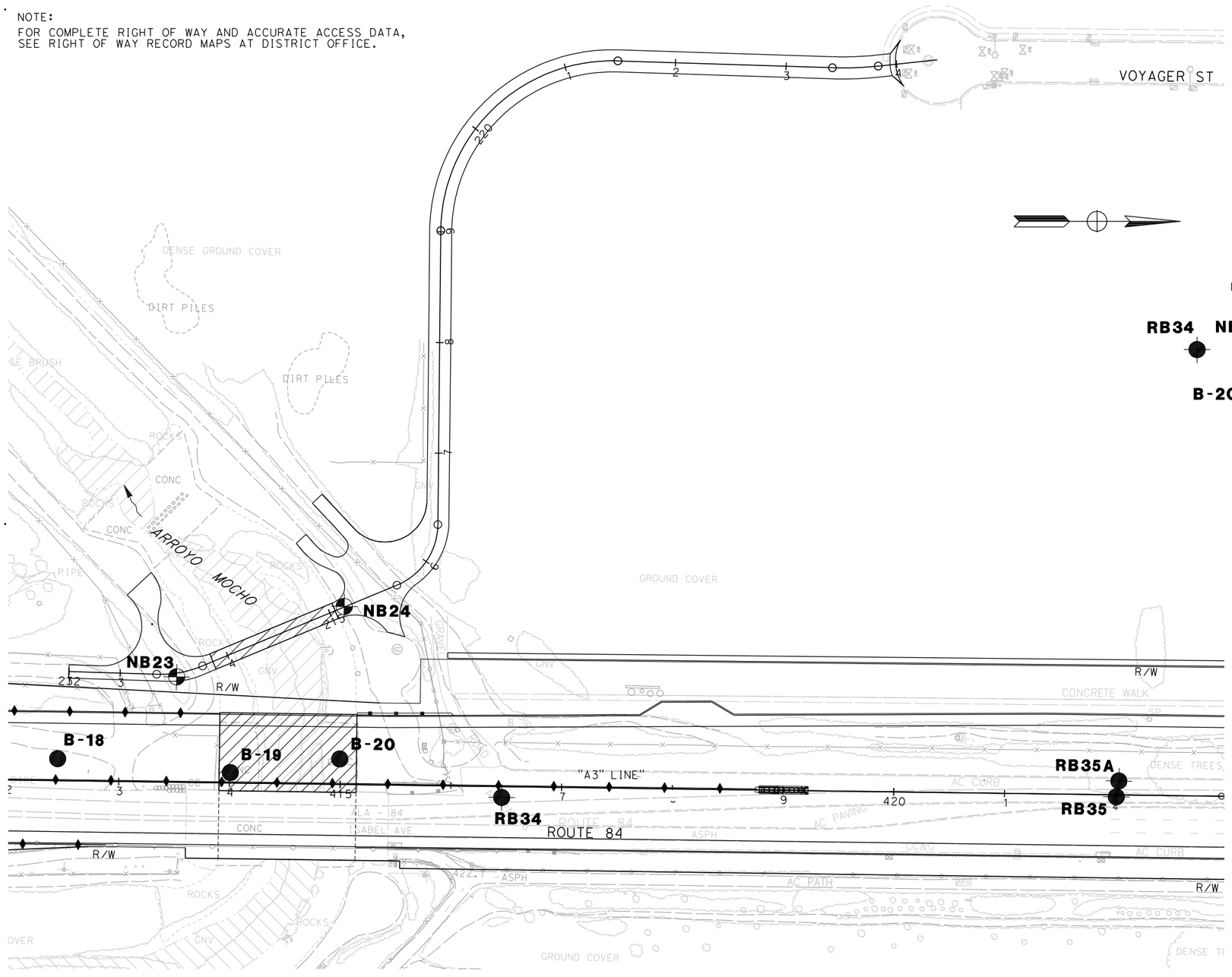
SCALE
Figure
3-1
April /2008



Fault Sources: URS Seismic Hazard Model

URS	28649640 SR 84 - Isabel Ave Livermore, CA	REGIONAL FAULT MAP	Figure **3-2**

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



LEGEND:

RB34 **NB24** EXPLORATORY BORING FROM CURRENT STUDY

B-20 EXPLORATORY BORING BY OTHERS (1996)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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1333 Broadway, Suite 300
Oakland, CA 94612

ARROYO MOCHO ACCESS BRIDGE
SITE AND BORING LOCATION PLAN

SCALE 1"=100'

FIGURE 3-3

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

REVISED BY | DATE REVISED
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00 | DATE PLOTTED => 12/14/2009 | TIME PLOTTED => 10:00:37 AM

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => madhu_thummaluru | DGN FILE => ...\Access\Bor-Location-Access.dgn | CU 04256 | EA 297601

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

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1333 Broadway,
Suite 800
Oakland, CA 94612

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size (square)	A	Auger Boring
Size (square)	R P	Rotary drilled boring Rotary percussion boring (air)
Size (diamond)	R	Rotary drilled diamond core
Size (square)	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

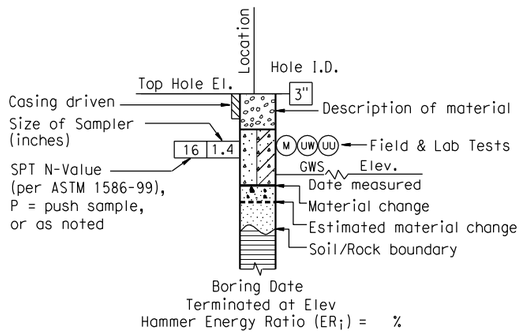
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

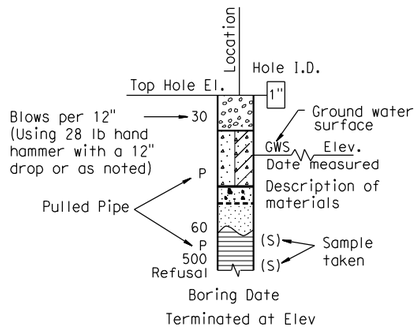
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

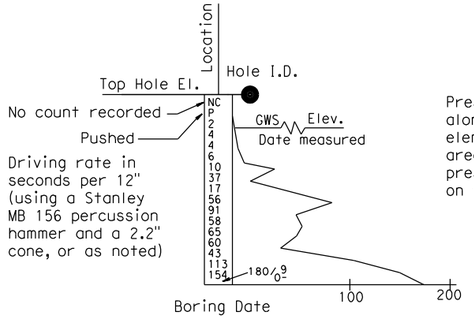
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



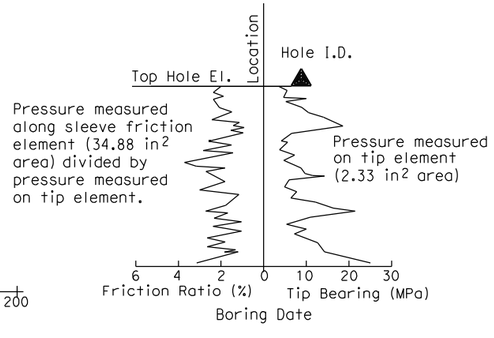
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ARROYO MOCHO ACCESS BRIDGE
FIGURE 3-4a

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO.	SOIL LEGEND
FUNCTIONAL SUPERVISOR NAME: S. HUANG	DRAWN BY: A. CHEUNG CHECKED BY: M. THUMMALURU FIELD INVESTIGATION BY: C. RAMBO		DESIGN BRANCH	N/A POST MILES N/A	LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 12 OF 15

FILE => ...\legend-soil Access-Br.dgn

USERNAME => mdahu_thummalu DATE PLOTTED => 9/27/2010 TIME PLOTTED => 10:04:43 AM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang No. C 42289 Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ARROYO MOCHO ACCESS BRIDGE

FIGURE 3-4b

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. N/A	SOIL LEGEND
FUNCTIONAL SUPERVISOR NAME: S. HUANG	DRAWN BY: A. CHEUNG CHECKED BY: M. THUMMALURU	FIELD INVESTIGATION BY: C. RAMBO	DESIGN BRANCH	POST MILES N/A	LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

FILE => ...\legend-soil2 Access-Br.dgn

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 13 OF 15

USERNAME => mdahu_thummaluru DATE PLOTTED => 9/2/2010 TIME PLOTTED => 10:04:54 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Stephen Huang
No. C 42289
Exp. 03/31/10
CIVIL
STATE OF CALIFORNIA

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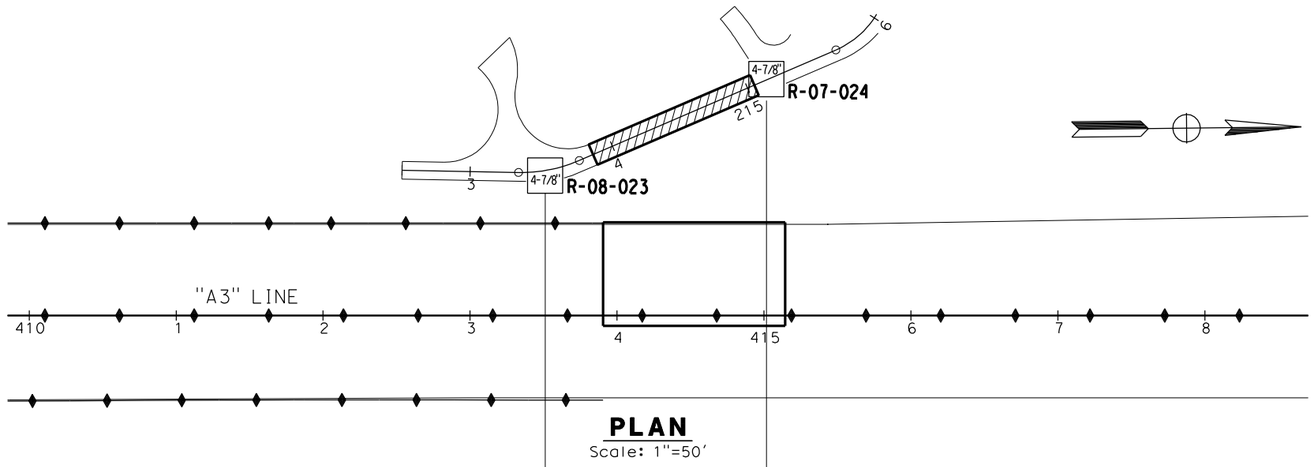
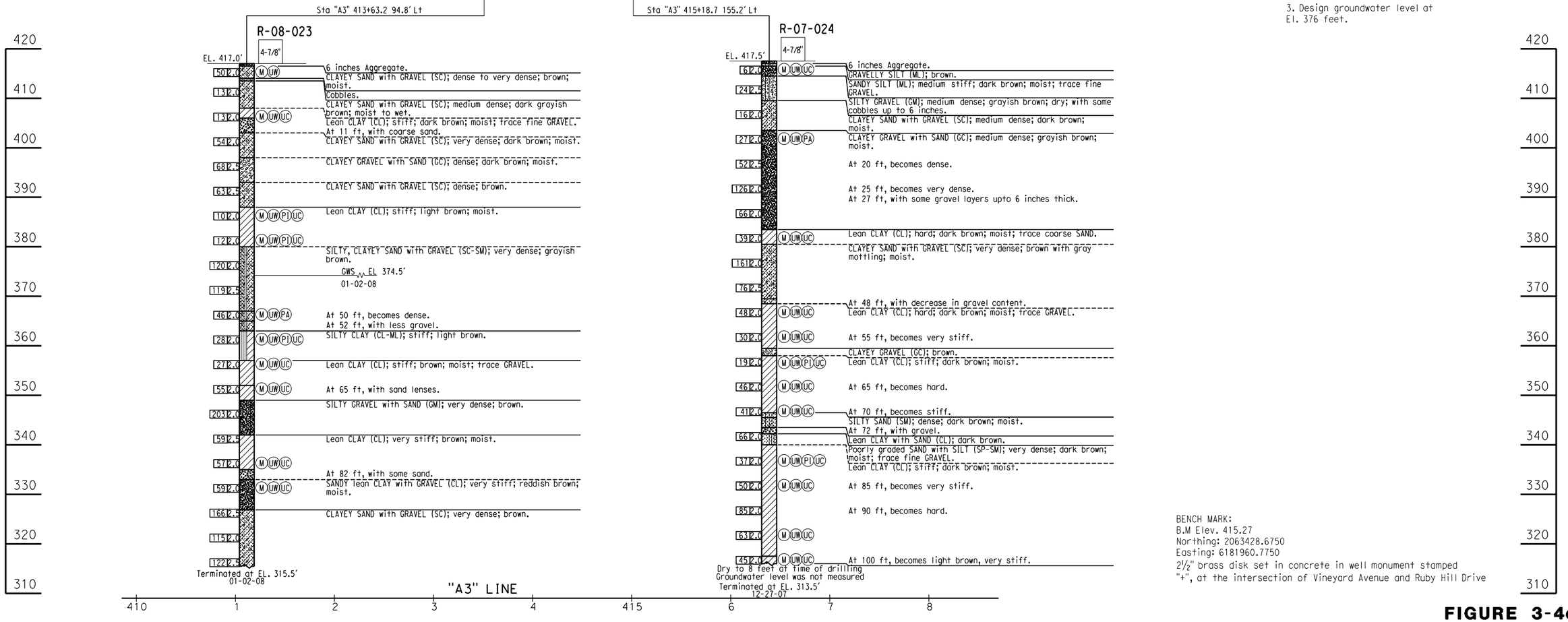
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612



PLAN
Scale: 1"=50'

NOTE:
1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (JUNE 2007)
2. Drilling fluid was measured at EL. 374.5 feet in NB23, 5 days after temporyily stopped drilling.
3. Design groundwater level at El. 376 feet.



BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
2½" brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive

FIGURE 3-4c

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO.	ARROYO MOCHO - ACCESS BRIDGE
FUNCTIONAL SUPERVISOR NAME: S. HUANG	DRAWN BY: A. CHEUNG	FIELD INVESTIGATION BY: C. RAMBO		DESIGN BRANCH	N/A	LOG OF TEST BORINGS
	CHECKED BY: M. THUMMALURU				POST MILES N/A	

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 14 OF 15

FILE => ...\access\LOTB-Access-Br.dgn

USERNAME => mdahl_thummaluru DATE PLOTTED => 9/2/2010 TIME PLOTTED => 10:05:05 AM

NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

2. Soil classification and description conform to ASTM D2487.

BENCHMARK:

All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).

TBM No. 2: Mon. No. 220

A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.004 meters right of Center Line Station "I5" 122+19.529. The elevation is 126.311 meters (414.41 feet).

Contract Number: 04-233054

City Project Numbers: 89-50

Date Accepted: 10/1/02

AS-BUILT DRAWING

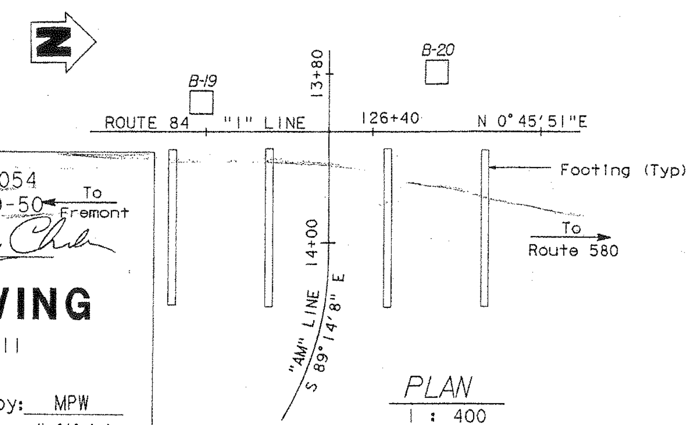
Resident Engineer: Hank Doll

Vali Cooper & Associates

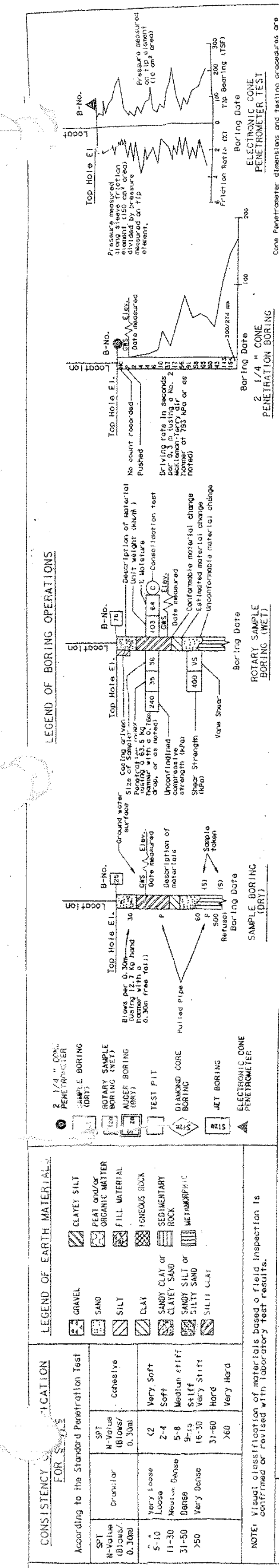
[X] No Changes

[ ] Changes As Noted

Revisions by: MPW (Initials)



PLAN 1 : 400



B-18 (5.8m Lt., Sta. 125+73.1, Elev. 127.1m)

SILTY SAND (SM) medium brown, very fine grained, poorly graded, medium dense, dry.
SANDY SILT (ML) with gravel, light to medium brown, gap graded, medium dense, moist.
SANDY GRAVEL/GRAVELLY SAND (GP/SP) medium brown to light gray @ 1.65m, gap graded, medium dense, dry, gravel is fine to coarse grained, sand is primarily fine grained.

SANDY SILT (ML) with minor gravel, medium brown, loose, non plastic, moist, grading to CLAY (CL) with minor sand and gravel.

GRAVELLY LEAN CLAY (CL) brown, stiff, low to moderate plasticity, fine to coarse gravel, subrounded to rounded.

CLAYEY GRAVEL (GC) lens.

Local sandy layers.

GRAVEL AND COBBLES (GC) with silty clay matrix, fine to coarse gravel and small cobbles, gap graded, very dense.

SILTY GRAVEL (GM) brown, medium to coarse grained sand, primarily fine gravel, moderately graded, very dense.

CLAYEY GRAVEL (GC) medium brown, coarse grained, poorly graded, dense, subrounded to rounded gravel, clay is low to medium plasticity.
SILTY GRAVEL (GM) with sand, brown to gray, fine to coarse grained, moderately graded, very dense, primarily fine gravel.

Local lenses of fine to coarse grained, very dense, SANDY GRAVEL (GP).

Fine to coarse gravel, moderately gap graded.

CLAYEY GRAVEL (GC) brown, low to moderate plasticity clay matrix, gravel is coarse grained, subrounded to rounded, very dense.

GRAVELLY SAND (SP) fine to coarse sand, fine gravel, moderately graded, very dense.

SANDY GRAVEL (GW) light brown, moist, very dense, sand, silt and minor clay matrix, coarse gravel is subangular.

5-7.5cm layers of Gravelly Sand (SP).

CLAY (CL) brown, hard.

No recovery.

SANDY GRAVEL (GM) with clay, brown, moist to wet, very dense.

CLAYEY GRAVEL (GC) brown, moist, very dense.

Scattered cobbles.
SANDY CLAYEY GRAVEL (GM/GC) brown, damp, very dense, medium to coarse gravel, subangular to angular.

11/8/96
Bottom @ 30.3m

B-19 (3.5m Lt., Sta. 126+19.3, Elev. 127.3m)

SANDY SILT (ML) gray-brown, damp, loose.

SILTY SAND (SM) with gravel, gray-brown, damp, medium dense, medium to coarse sand, fine gravel.

WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, damp, dense, fine to coarse gravel.

LEAN CLAY (CL) brown, moist, stiff.

WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, moist, loose, rounded fine to coarse gravel in cuttings at 5.7m.
6m: No recovery, clayey sand to clayey gravel cuttings.

Very dense.

CLAYEY GRAVEL (GC) with sand, brown, moist, very dense, fine to coarse gravel.

LEAN CLAY (CL) yellow-brown, moist, very stiff.

WELL GRADED GRAVEL (GW) with sand, brown, moist to wet, very dense, fine to coarse gravel, medium to coarse sand.

WELL GRADED GRAVEL WITH CLAY AND SAND (GW-GC) brown to yellow-brown, moist, very dense, fine to coarse gravel, medium to coarse grained sand.

Lens of LEAN CLAY (CL) from 15.3 to 15.45m.

No recovery.

GRAVELLY SAND TO SANDY GRAVEL (SW/GW) gray-brown, wet, very dense.

SILT (ML) brown, moist to wet, very stiff, slightly plastic.

POORLY GRADED SAND (SP) with gravel, gray-brown, wet, very dense, coarse sand and gravel.

LEAN CLAY (CL) dark yellow-brown, moist, hard.

SILT (ML) dark yellow-brown, moist, hard.

11/6/96
Bottom @ 24.45m

B-20 (7.1m Lt., Sta. 126+47.5, Elev. 127.2m)

SILT (ML) with gravel, dark brown, damp, stiff, minor string, plastic.
SILT (ML) with sand, dark brown, damp, stiff, open-pore structure, gravel at 1m.

SANDY GRAVEL (GM/GP) brown, damp, medium dense, fine to coarse gravel, moderate amount of sand and silt matrix.

LEAN CLAY (CL) with gravel, brown, damp to moist, stiff.

SANDY GRAVEL (GP) gray-brown, moist, dense, minor silt, fine to coarse gravel.

Coarse gravel and cobbles.

Cobble layer, minor caving.

Cobble in sampler.

Coarse gravel and cobbles.

GRAVELLY SAND (SP-SM) moderate sand and silt matrix, dense, scattered cobbles.

Very dense, coarse gravel and cobbles, local clay lens.

SANDY SILTY GRAVEL (GM) brown, damp, very dense.

Very dense.

CLAYEY SILT (ML) brown, damp, very stiff.

CLAYEY SILT (ML) with sand, brown, moist, very stiff, fractured, sand is very fine to fine grained.

SILTY SAND (SM) brown, moist, dense, sand is very fine to medium grained.
SANDY CLAY (CL) with gravel, brown, moist, hard, minor fine to coarse gravel throughout. Layers of Clayey Silt (ML) with fine grained sand.

Increasing sand and gravel.
SANDY GRAVEL (GP/GM) green-brown, moist, very dense.

SILTY CLAY (CL) brown, moist, very stiff.

POORLY GRADED SAND (SP) gray-brown, moist, very dense, sand is coarse to very coarse grained, minor silt.
SANDY GRAVEL (GM/GP) brown, moist to wet, very dense, coarse gravel.
GWS 100.5 11/12/96

SILTY CLAY (CL) brown, moist, very stiff, slightly plastic.

11/12/96
Bottom @ 30.45m

124+00 125+00 126+00 127+00 128+00

Notes:

1. See the plans dated May 11, 1999 for stationing. For example I Line Sta 136+62 (Metric) = A3 Line Sta 448+23 (English).

2. Structure Design produced the data presented in the table below. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

Revisions made to this Log of Test Borings from the original ____ Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from A3 Line (84)
B-18	412+45	19.0 ft. Lt
B-19	414+00	11.5 ft. Lt
B-20	415+00	23.0 ft. Lt

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		407	407

REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

REGISTERED PROFESSIONAL ENGINEER G. NEELAKANTAN No. 2391 Exp. 9/30/01 GEOTECHNICAL STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/10 GEOTECHNICAL STATE OF CALIFORNIA

Caltrans Metric

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	MILE POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84	22.9/27.1		

REGISTERED GEOTECHNICAL ENGINEER — DATE 3/9/09

ARROYO MOCHO BRIDGE (ACCESS)

LOG OF TEST BORINGS 4 OF 4

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE ANDINVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04 276
EA: 297600

BRIDGE No. 33-0713

Sheet 15 of 15

DATE PLOTTED => 8/18/2010

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY J. HULSE

CHECKED BY T. HUBER

N. MACE, V. THILAKARATNE, J. THURBER

FIELD INVESTIGATION BY:

DATE:

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

O. RODRIGUEZ

PROJECT ENGINEER

BRIDGE NO. 33C-0407

KILOMETER POST

ARROYO MOCHO BRIDGE

LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

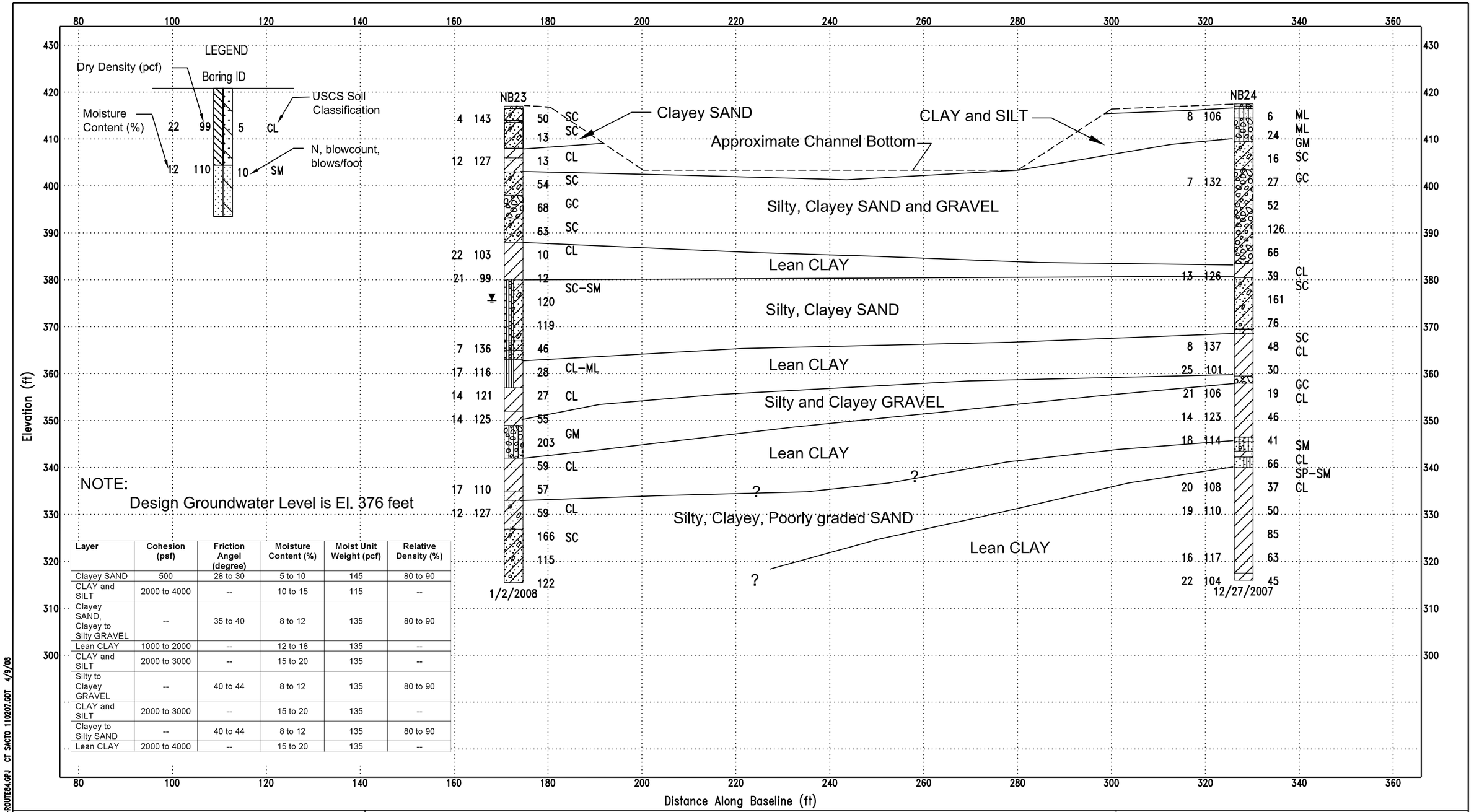
DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 12 OF 12

TIME PLOTTED => $$$$$$SYTIME$$$$$$

FIGURE 3-4d



Layer	Cohesion (psf)	Friction Angel (degree)	Moisture Content (%)	Moist Unit Weight (pcf)	Relative Density (%)
Clayey SAND	500	28 to 30	5 to 10	145	80 to 90
CLAY and SILT	2000 to 4000	--	10 to 15	115	--
Clayey SAND, Clayey to Silty GRAVEL	--	35 to 40	8 to 12	135	80 to 90
Lean CLAY	1000 to 2000	--	12 to 18	135	--
CLAY and SILT	2000 to 3000	--	15 to 20	135	--
Silty to Clayey GRAVEL	--	40 to 44	8 to 12	135	80 to 90
CLAY and SILT	2000 to 3000	--	15 to 20	135	--
Clayey to Silty SAND	--	40 to 44	8 to 12	135	80 to 90
Lean CLAY	2000 to 4000	--	15 to 20	135	--

URS Corporation
55 S. Market Street, Suite 1500
San Jose, CA 95113
Telephone:
Fax:

Project Number: 28649640

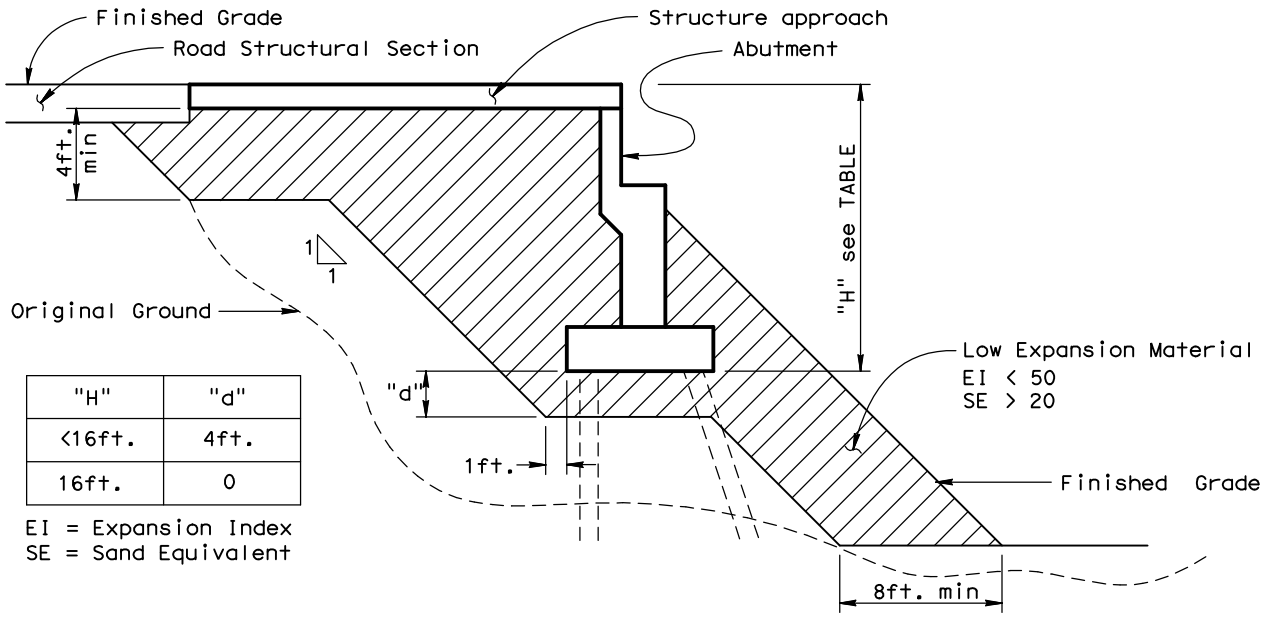
LITHOLOGY GRAPHICS

USCS Poorly Graded Gravel with sand
USCS Clayey Sand with gravel
Boulders and cobbles
USCS Lean Clay
USCS Lean Clay with sand
USCS Clayey Gravel
USCS Silty, Clayey Sand with gravel
USCS Silty Clay
USCS Silty Gravel with sand
USCS Sandy Lean Clay with gravel
USCS Gravelly Silt
USCS Sandy Silt
USCS Silty Gravel (poorly graded)
USCS Clayey Gravel with sand
USCS Silty Sand

GENERALIZED SOIL PROFILE
ARROYO MOCHO CREEK CROSSING
Route 84 Expressway Widening
Alameda County, California

Figure 3-5

SIMPLE FENCE 2 - B SIZE 28649640-ROUTE84.GPJ CT SACTO 110207.GDT 4/9/08



"H"	"d"
<16ft.	4ft.
16ft.	0

EI = Expansion Index
SE = Sand Equivalent

EXPANSIVE SOIL EXCLUSION ZONE DETAIL

NO SCALE

08/19/09	Route 84 Expressway Improvements Livermore, California	EXPANSIVE SOIL EXCLUSION ZONE IN BRIDGE EMBANKMENT	Figure 7-1
	URS		

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. OVERCOMER Y. HOR
Liaison Engineer
Office of Special Funded Projects
Structures Design Services & Earthquake Engineering

Date: June 2, 2008

File: 04-ALA-84 PM 22.5/27.3
04-297601
Rte 84 Expressway
Widening Project
Various Structures

From: EDUARDO ORTEGA
Associate Materials and Research Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Type Selection Reports Review

Per your request, we have completed the review of Type Selection Reports prepared by URS and MGE Consultants for the above referenced project. The project site is located in the City of Livermore, Alameda County, California. The Route 84 Expressway Widening Project will require the following structures work:

Existing Bridge Widenings
Arroyo Del Valle Bridge (Widen)
Arroyo Mocho Bridge (Widen)

New Bridges
Arroyo Mocho Access Bridge
Arroyo Del Valle Trail Bridge

Retaining Walls
Retaining Wall 246 at East Ruby Hill Drive
Retaining Walls 400N and 400S at Isabel Avenue Undercrossing

Based in our review, we have the following comments on the project:

1. All shallow and deep pile support foundations for bridge should be designed based on LRFD. Refer to Memo to Designers 3-1 for deep foundations and 4-1 for spread footings.

2. Settlement calculations should be included for the shallow footing support abutments located within clay.

3. Lateral condition bearing capacity of shallow footing should be addressed.

4. Do the shallow footing of bents who are within clay layer should be deepened?

5. In the tieback walls, looks like the soldier beam embedment depth is too shallow, could you please clarify.

6. Typical section for tie back walls does not show walers, could you please clarify.

7. Is there any horizontal boring drilling program for Soil Nail Walls?

8. Note that soil nail wall standard special provisions (SSP) have been revised by Caltrans. Use new SSP in your recommendations for the proposed soil nail walls.

* * * * *

Should you have any questions, please call me at (510) 286-4821.

c: TPokrywka, MMomenzadeh, E☺rtega, Daily File, Route File, Translab File

Eduardo ☺rtega/mm/297601 Type Selection. doc

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES • OFFICE OF SPECIAL FUNDED PROJECTS

Comments

(DRAFT REVISION 01/2008)

Structure:	**Rte 84 Express Way Widening**	Route:	**84**		
Bridge No:	**33-0710, 33-0711, Arroyo Del Valle Trail Bridge, Arroyo Mocho Access Bridge and Retaining wall No. 400N, 400S AND 246.**	EA:	**297601**	Liaison:	**Overcomer Hor**
District	**04**	Reviewer:	**Mahmood Momenzadeh**	Reviewed Date:	**June 2,2008**
Review Level:	**Type Selection Pack.**	Consultant	**URS**	Response Date:	**January 12, 2009**

ABBREVIATIONS: BDA Bridge Design Aids; BDD Bridge Design Details; GP General Plan; IPG OSFP Information and Procedures Guide; MTD Memo to Designers; SDC Seismic Design Criteria; SDS Suctural Detailing Standards

Item	Comment	Response	Notes
	Structure Type Selection Report		
1	All shallow and deep pile support foundations for bridge should be designed based on LRFD. Refer to Memo to Designers 3-1 for deep foundations and 4-1 for spread footings.	Will comply.	
2	Settlement calculations should be included for the shallow footing support abutments located within clay.	Will comply.	
3	Lateral condition bearing capacity of shallow footing should be addressed.	Will include estimate of passive resistance and discuss applicability in the shallow footing design.	
4	Do the shallow footing of bents who are within clay layer should be deepened?	Bent support has been revised to deep pile foundation to address erosion issues and support of shallow footing in fine grained soils such as clays.	
5	In the tieback walls, looks like the soldier beam embedment depth is too shallow, could you please clarify.	The planned tieback wall system uses continuous horizontal support elements (soldier pileless wall) based on Bridge Design Specifications, Section 5, Figure 5.8.1-2b. The embedment depth for the continuous horizontal elements presented on the general plans was a minimum value; the required embedment depth will be based on structural analysis with geotechnical parameters provided in the draft Foundation Report. Will include the relevant parameters in the updated Foundation Report for the walls.	
6	Typcial section for tie back walls does not show walers, could you please clarify.	The planned tieback wall system uses continuous horizontal support elements (soldier pileless wall) based on Bridge Design Specifications, Section 5, Figure 5.8.1-2b. Thus, no	

Item	Comment	Response	Notes
		walers are planned.	
7	Is ther any horizontal boring drilling program for Soil Nail Walls?	Because of site access restrictions from Ruby Hill Property management, it is currently unfeasible to include horizontal borehole in the field exploration program. Will develop an SSP to require Contractor to pre-drill, submit and review results, modify design if necessary, and seek Caltrans approval prior to actual soil nail installation.	
8	Note that soil nail wall standard special provisions (SSP) have been revised by Caltrans. Use new SSp in your recommendations for the proposed soil nail walls.	Will comply.	

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. OVERCOMER Y. HOR
Liaison Engineer
Office of Special Funded Projects
Structures Design Services
& Earthquake Engineering

Date: July 22, 2009

File: 04-ALA-84, PM 22.5/27.3
04-297601
Rte 84 Expressway
Widening Project
Various Structures

From: EDUARDO ORTEGA
Associate Materials and Research Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

CHRIS RISDEN
Engineering Geologist
Office of Geotechnical Design - West
Geotechnical Services
Division of Engineering Services

GRANT WILCOX
Branch Chief, Branch B
Office of Geotechnical Design - West
Geotechnical Services
Division of Engineering Services

Subject: 65% PS&E and Foundation Report Review

Per your request, we have completed the review of 65% PS&E and Foundation Report prepared by URS and MGE Consultants for the above referenced project. The project site is located in the City of Livermore, Alameda County, California. The Route 84 Expressway Widening Project will require the following structures work:

Existing Bridge Widenings
Arroyo Del Valle Bridge (Widen)
Arroyo Mocho Bridge (Widen)

New Bridges
Arroyo Mocho Access Bridge
Arroyo Del Valle Trail Bridge

Retaining Walls
Retaining Wall 246 at East Ruby Hill Drive
Retaining Walls 400N and 400S at Isabel Avenue Undercrossing

Based in our review, we have the following comments on the project:

GENERAL

- Please provide a legend on the General Soil Profiles that identify the values found on either side of the vertical soil profiles.

FIGURES ON FOUNDATION REPORT
(Retaining Walls 246, 391, 400N, 400S, and 403)

1. Figure 2-1: Change index to include Retaining Wall No.'s found in this report

2. Figure 5-2: Horizontal reference line in Profile on LOTBs should be "A2" and "A3", not "A1".

3. Figure 5-2: The north arrow is not correctly aligned.

4. Retaining Wall 400N LOTBs: 400N is referenced on the wrong side of the "A3" line on the plan figure at top of sheet.

5. Retaining Wall 400N LOTBs: Horizontal reference line in Profile should read "A3" instead of "A1".

6. Figure 8-1: Horizontal reference line in Profile should read "A3" and not "A1".

7. Figure 8-1: The north arrow is misaligned.

8. Figure 8-1: Please reference all walls along the "A3" line on the Plan drawing at top of sheet.

RETAINING WALLS

1. Retaining walls No: 109, 110. 236, 245, 314, 317, 320, 400S, and 437 (mentioned on Table 1-1 "Summary of Planned Retaining Walls" on the Foundation Report for Arroyo Mocho Access Bridge dated March 23, 2009) are not part of this submittal. Please clarify.

2. An horizontal drilling program is needed for tie back retaining wall 400N Type A and for soil nail retaining walls No: 246, 391, 403, and 400N Type D. SSP has to be developed for this program to prepare the LOTBs and revise the wall design details, if it is planned to include this work as part of the construction program. Contractor has to submit results of the horizontal drilling and provide calculations and drawings to be reviewed by this Office prior to start of construction.

3. No vertical drilling program reported for pile foundations of retaining wall No 400N Type B. Please clarify.

ARROYO MOCHO BRIDGE (WIDEN)

1. Sheet 2/13 shows Pier 2 & 3 at specified tip elevation of 340.0 ft. Foundation Report Table 7-2 and sheet 2/12 shows the same tip elevation at 336.0 ft. Correct the discrepancy. If it was a round up it should be at a lower elevation (335.0 ft).

2. Provide details and calculations for the retaining wall shown on "Typical Plan" Sheet 11/13.

ARROYO DEL VALLE BRIDGE (WIDEN)

1. Provide details and calculations for the retaining wall shown on "Typical Plan" sheet 13/14.

UTILITY CROSSINGS

Contractor should request a permit for a trenchless construction method based on soil and groundwater conditions to buried proposed utilities, as bore & jack, micro tunneling or other method.

GRAVEL MINING OPERATIONS

There is an ongoing mining operation anticipated for the next 25 years adjacent to the west side of SR 84 Isabel Avenue, between approximately Stanley Boulevard and Arroyo Del Valle by Vulcan Materials Quarry and at both side of SR 84 between Vineyard Avenue and Alden Lane by Cemex Quarry, both up to 50 feet of existing right-of-way line. Is there any program to install slope inclinometers to monitor the stability of the slopes adjacent to SR 84 that could be impacted due to the mining operations? This Office has to review the details of the program.

* * * * *

Should you have any questions, please call me at (510) 286-4821.

c: TPokrywka, MMomenzadeh, GWilcox, CRisden, E©rtega, Daily File, Route File, Translab File

Eduardo ©rtega/mm/297601 65% FR. doc

Office of Special Funded Projects
Comment & Response Form

General Project Information	Review Phase	Reviewer Information
Dist: 04 EA: 297601 **Project Name: Rte 84 Expressway Widening Project** **OSFP Liaison: Overcomer Y. Hor** **Phone: (916) 227-8419** **e-mail: overcomer_hor@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection ☒ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☐ Other:_____ **Structure Information** (Use when necessary to document comments by individual structure) **Structure Name: Arroyo Mocho Access Br** **Br No: N/A**	**Reviewer Name: Eduardo Ortega** **Functional Unit: Geotechnical** **Cost Center: 59-327** **Phone Number: (510) 286-4821** **e-mail: eduardo_ortega@dot.ca.gov** **Date of Review: 7-22-09**

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1		General	Please provide a legend on the General Soil Profiles that identify the values found on either side of the vertical soil profiles.	Will include a legend on the General Soil Profile.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

Office of Special Funded Projects
Comment & Response Form

General Project Information	Review Phase	Reviewer Information
Dist: 04 EA: 297601 **Project Name: 4-ALA-84 PM 26.6** **OSFP Liaison: Overcommer Hor** **Phone: 916-227-8419** **e-mail:** **Overcomer_Hor@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection ☐ 65% PS&E Unchecked Details ☒ PS&E (Review No. _) ☐ Construction Support ☐ Other:_____ **Structure Information** (Use when necessary to document comments by individual structure) **Structure Name: Arroyo Mocho Access Br** **Br No: _____**	**Reviewer Name: Eduardo Ortega** **Functional Unit: Geotechnical** **Cost Center: 327** **Phone Number: 510-286-4821** **e-mail: Eduardo_Ortega@dot.ca.gov** **Date of Review: 03/22/10**

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	Found. Report	LOTB	Log of Test Boring (LOTB) shall follow the requirements of Caltrans Logging, Classification, and Presentation Manual dated June 2007 or obtain an exception. Holes shall be identified using the following convention: HHH-YY-NNN HHH: Hole type according Figure 2-2 of the Manual YY: 2-digit year NNN: 3-digit number (001-199)	Will comply to modify LOTBs..	
2	Found. Report	Response to June 2, 2008 comments	Due to site access restrictions from Ruby Hill Property, please submit the SSP requiring the Contractor to pre-drill, submit and review results, modify design if necessary, and seek Caltrans approval prior to actual soil nail installation.	We understand that this comment is for Retaining Wall 246. Response to this comment is provided in Foundation Report for Retaining Walls 246. 391, 400N, 400S, and 403, dated September 15, 2010.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

3	Found. Report	Seismic	The bridge was type selected about a year before the new Caltrans Seismic Design Criteria (SDC) was implemented. Therefore, the seismic procedure and information used is based on the 1996 Seismic Hazard Map (SHM) and the 2001 SDC. The seismic related findings in the report are proper and consistent with the 2001 SDC and 1996 SHM and I have no further comments/questions.	Comment noted.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

FIELD EXPLORATION PROGRAM

The geotechnical field investigation consisted of two geotechnical borings extending to terminal depths of 101.5 feet below the existing ground surface. The explorations were performed between December 26, 2007 and January 2, 2008, by Pitcher Drilling of Redwood City, California (rotary wash boring).

Boring locations were carefully selected to obtain subsurface information for geotechnical design recommendations for the proposed structure while avoiding underground utilities and subsurface obstructions. Layout of the explorations was performed by representatives of URS, and exploration locations were checked for conflict with underground utilities by contacting Underground Service Alert (USA) Network. USA, in turn, alerted the various municipalities and utility companies that a subsurface investigation was to be conducted near their utilities.

After underground utility clearance, URS obtained drilling permits from the Alameda County Flood Control and Water Conservation District, and coordinated with appropriate personnel to accommodate the required inspection during and following exploration at each location.

Rotary Wash Boring (NB23 and NB24)

The rotary wash borings were drilled to provide the necessary information to evaluate the subsurface stratigraphy and to allow acquisition of high-quality soil samples for laboratory testing. The borings were drilled and sampled at the locations indicated on the Site and Boring Location Plan, Figure 3-3. Both borings were advanced to a depth of 101.5 feet below existing ground surface using a truck-mounted drill rig under the supervision of a URS representative who maintained a record of all field activities, classified the soils encountered using the Unified Soil Classification System (USCS), and prepared logs of the borings.

The drilling operation proceeded carefully, with particular attention to potential interference with utilities or other buried structures. During drilling, both disturbed and undisturbed samples were obtained for identification and laboratory testing. Soil samples were generally obtained at 5-foot intervals and at changes in strata. Samples were obtained using an unlined split spoon sampler (SPT), having an outside diameter of 2 inches, lined/unlined Modified California (MC) sampler, having an outside diameter of 2½ inches, and lined/unlined Standard California Sampler, having an outside diameter of 3 inches. A 140-pound hammer falling through a distance of 30 inches was used to drive the samplers. The blow count recorded on the boring logs adjacent to the sample depth is the number of blows required to drive the sampler for the final 1 foot of a maximum 18 inch drive.

One of the objectives of the field investigation was to obtain high-quality undisturbed samples for laboratory testing. Effort was made to minimize sample disturbance during sample handling and transportation. After careful withdrawal from the ground, the sample was placed upright and the ends of the sample were cleaned of disturbed soil. If possible, pocket penetrometer tests were performed on the bottom end of cohesive soil samples. Both ends of the samples were covered with plastic caps, and carefully transported to the URS laboratory.

LABORATORY TESTING PROGRAM

A laboratory testing program was carried out to determine the index and engineering properties of the major subsurface strata encountered at the site. The laboratory testing program included conventional tests to confirm the existing information on the engineering characteristics of the major strata and to refine some of the engineering parameters, where it was deemed appropriate. These tests were performed at the URS laboratory in San Jose.

This appendix briefly describes the testing program and procedures for the different types of tests, and then presents detailed test results.

Index Tests

Index tests were performed on both cohesive and cohesionless soil samples to aid in soil classification and in correlation with other engineering parameters. Index tests included Atterberg Limits, gradation analyses, moisture content and dry density determinations. Atterberg Limits tests were performed in accordance with ASTM D 4318. Particle analyses were performed in accordance with ASTM D 422. The moisture content tests were performed in accordance with ASTM D 2216. Dry density was determined in accordance with ASTM D 2937. The locations of these tests are indicated on the Logs of Test Borings adjacent to the appropriate sample depths. The results are summarized in Table B-1.

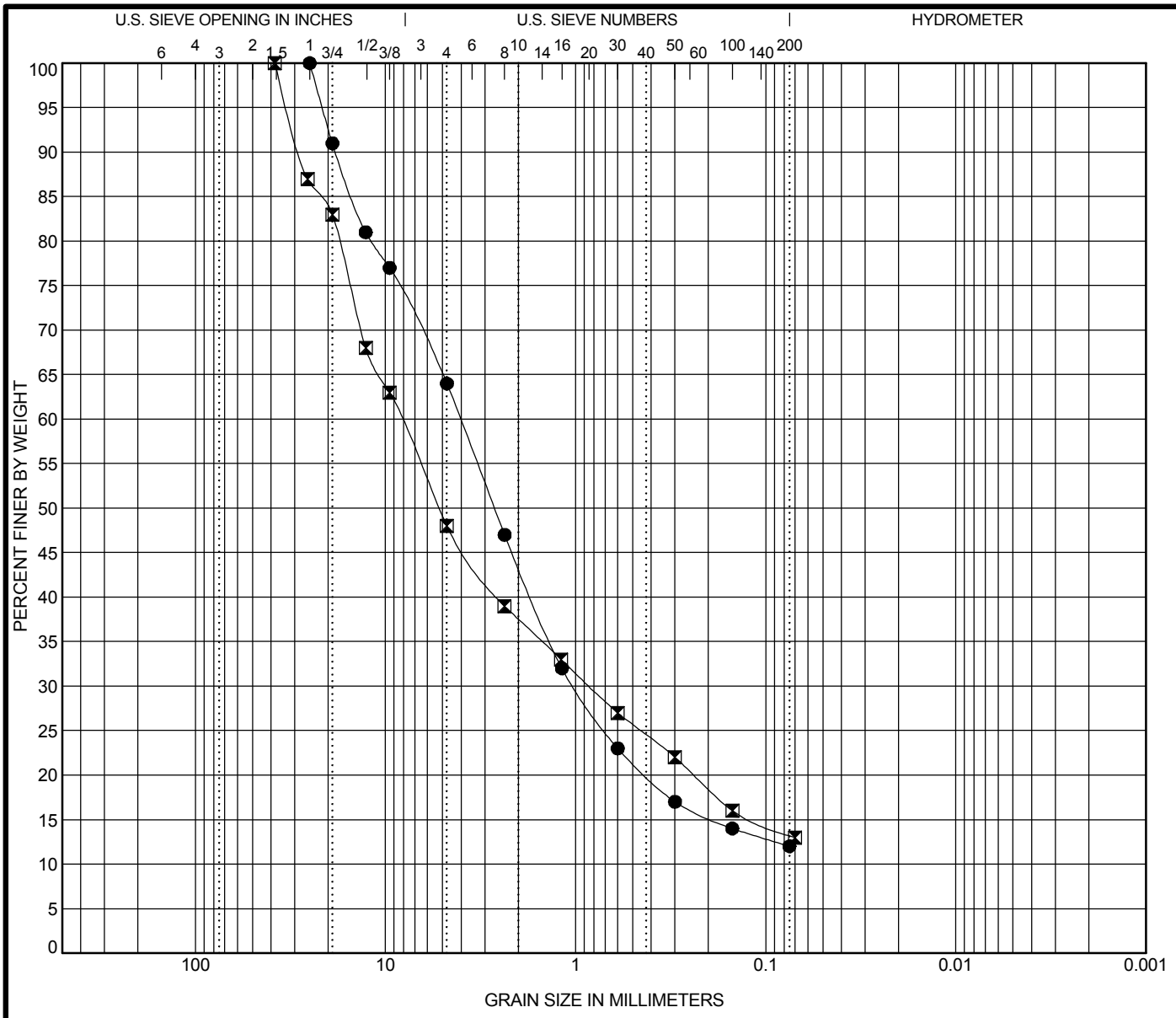
A plasticity chart graphically presenting the results of the Atterberg Limits tests is included on Figure B-1. Grain size distribution curves are presented graphically on Figure B-2.

Unconfined Compression Tests

Unconfined compression tests were performed on select cohesive soil samples to assist in determining shear strength parameters. These tests were performed in accordance with ASTM D 2166. The locations of these tests are indicated on the Logs of Test Borings adjacent to the appropriate sample depths. The results are summarized in Table B-1.

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Depth (feet)	Sieve Analysis Results (Percent Passing)												Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
			%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200	Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
NB23	27-Dec-07	1																	4.5	143
NB23		10																6680	12	127
NB23		30													31	18	13	1960	22.4	103
NB23		35													27	18	9	2020	21	99
NB23		50			91	81	77	64	47	32	23	17	14	12					7.5	136
NB23		55													23	18	5	2860	17.5	116
NB23		60																3430	13.7	121
NB23		65																2390	13.5	125
NB23		80																5630	17.5	110
NB23		85																5590	12.1	127
NB24	26-Dec-07	1																1230	8	106
NB24		15	100	87	83	68	63	48	39	33	27	22	16	13					7.2	132
NB24		35																9640	13.2	126
NB24		50																3140	8.2	137
NB24		55																5350	25	101
NB24		60													28	18	10	3130	21.5	106
NB24		65																12830	13.8	123
NB24		70																3150	17.8	114
NB24		80													27	19	8	3740	20	108
NB24		85																6450	18.9	110
NB24		95																9890	16.3	117
NB24		100																7210	22.3	104



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**NB23**	**50.0**	**Poorly graded SAND (SP-SC) with clay and gravel**				**6.82**	**107.44**
⊠	**NB24**	**15.0**	**Clayey GRAVEL (GC) with sand**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**NB23**	**50.0**	**25**	**4.029**	**1.015**		**36.0**	**52.0**	**12.0**	
⊠	**NB24**	**15.0**	**38.1**	**8.277**	**0.845**		**52.0**	**34.7**	**13.3**	

URS GRAIN SIZE 28649640-ROUTE84.GPJ CT SACTO 061407.GDT 2/12/09

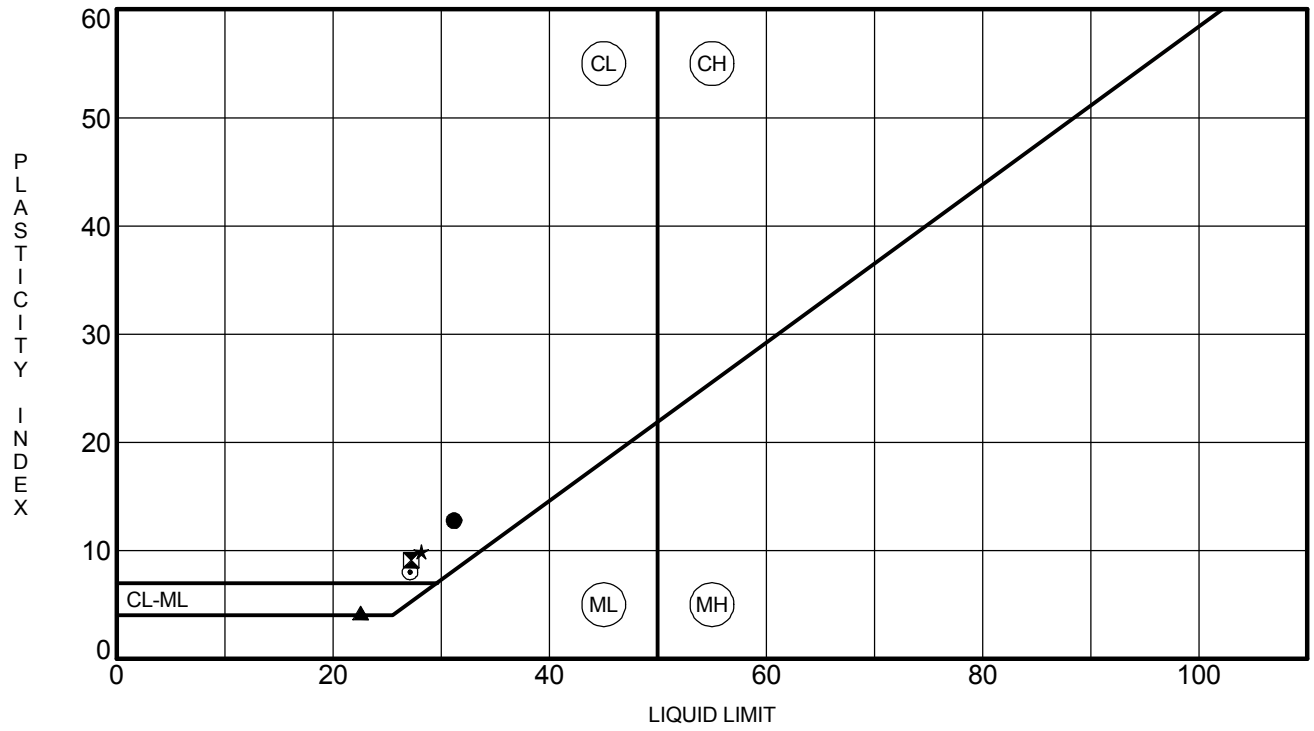
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: Route 84 Expressway Widening
Location: 04 Alameda 84
Number: 28649640

FIGURE B-1



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**NB23**	**30.0**	**31**	**18**	**13**		**Lean CLAY (CL)**
⊠	**NB23**	**35.0**	**27**	**18**	**9**		**Lean CLAY (CL)**
▲	**NB23**	**55.0**	**23**	**18**	**5**		**Sandy, silty CLAY (CL-ML)**
★	**NB24**	**60.0**	**28**	**18**	**10**		**Lean CLAY (CL)**
⊙	**NB24**	**80.0**	**27**	**19**	**8**		**Lean CLAY (CL)**

URS

55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: Route 84 Expressway Widening
Location: 04 Alameda 84
Number: 28649640

FIGURE B-2

URS ATTERBERG LIMITS 28649640-ROUTE84.GPJ CT SACTO 061407.GDT 2/12/09

04-ALA-84
EA 297601
33C-0710/33C-0713

State Route 84 Expressway Widening Project
Cities of Livermore and Pleasanton, Alameda County, California

Bridge Design Hydraulic Study Report

Prepared for:

Caltrans

and

ACTIA
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY

Prepared by:

WRECO

May 2009

Executive Summary

This study represents the hydrologic and hydraulic assessment for the proposed State Route 84 (SR 84) Expressway Bridge widening at Arroyo del Valle, the new Trail Bridge over Arroyo del Valle, the proposed SR 84 Expressway Bridge widening at Arroyo Mocho, and the new Access Bridge over Arroyo Mocho in the City of Livermore, Alameda County, California. The bridges are located on the SR 84 Expressway Widening Project.

Hydraulic analyses were performed for the existing and proposed conditions using the design flows from the Zone 7 Water Agency (Zone 7). For Arroyo del Valle and Arroyo Mocho, the design flood simulation in the model was controlled by the normal depth calculated from the average channel slope at the downstream straight channel reach. The Zone 7 design criterion is 100-year plus 2 ft of freeboard. The results from the hydraulic analyses for the proposed conditions are summarized in Table 1 through Table 4, below.

Table 1: SR 84 Expressway at Arroyo del Valle Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	7,000	417.48	411.18	6.30	11.68
50-year	5,400	417.48	410.06	7.42	10.34

Table 2: Trail Bridge at Arroyo del Valle Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	7,000	415.58	411.71	3.87	8.31
50-year	5,400	415.58	410.55	5.03	7.62

Table 3: SR 84 Expressway at Arroyo Mocho Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	4,800	416.87	415.01	1.86	6.02
50-year	3,900	416.87	413.97	2.90	5.70

Table 4: Access Bridge at Arroyo Mocho Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	4,800	417.02	414.66	2.36	6.31
50-year	3,900	417.02	413.62	3.40	6.00

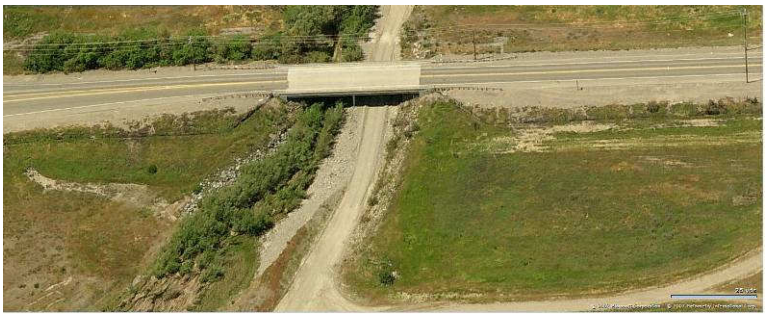


Photo 1. Aerial of SR 84 Expressway at Arroyo del Valle (maps.live.com)

The existing Arroyo del Valle Bridge was declared scour critical by Caltrans HQ. The scour analysis was conducted using the methodology recommended by the FHWA. The calculated potential scour depths at the bridge structures are summarized in Table 5 through Table 7.

Table 5: SR 84 Expressway at Arroyo del Valle Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	1.15	12.74	**13.89**
Pier #2	Negligible	1.15	13.37	**14.52**
Abutment #3	Negligible	1.15	6.31	**7.46**

Table 6: Trail Bridge at Arroyo del Valle Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	2.90	21.58	**24.48**
Pier #2	Negligible	2.90	22.43	**25.33**
Abutment #3	Negligible	2.90	22.09	**24.99**

Table 7: Access Bridge at Arroyo Mocho Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	1.1	-	**1.1**
Abutment #2	Negligible	1.1	-	**1.1**

Photo 2. Aerial of SR 84 Expressway at Arroyo Mocho (maps.live.com)

Extensive coordination has been made between Caltrans and the Design Team over the recommended countermeasures in scour prevention for the bridges within this Project. According to Caltrans, rock slope protection (RSP) alone is insufficient for scour protection. Supporting the piers of the SR 84 Bridge at Arroyo del Valle and the Trail Bridge at Arroyo del Valle on piles, as well as piles for the abutments of the new Trail Bridge, are the primary scour countermeasures proposed. The piers for the widened SR 84 Expressway bridge at Arroyo del Valle and the Trail Bridge at Arroyo del Valle should have piles as deep as the estimated total scour. The Access Bridge at Arroyo Mocho should have spread footings located as deep as the estimated total scour. RSP shall also be placed along the proposed embankments for the existing SR 84 Expressway bridge at Arroyo del Valle. RSP generally consists of rock on channel and structure boundaries to limit the effects of erosion. It is the most common type of countermeasure due to its general availability, ease of installation, and relatively low cost.

Per Caltrans recommendation, the existing RSP at the Arroyo del Valle bridge appears to be substandard and will be removed and replaced with new RSP meeting the current standards in HEC-23. The rock size at the toe of embankment was determined using the Isbash Formula per HEC-23. For the Trail Bridge, just upstream of the Trail Bridge, in between the bridges, and on the upstream face of the SR 84 Bridge, at least ¼-Ton rock with a thickness of 3.3 feet and Backing Class Number 1 or 2 with a minimum thickness of 1.8 feet and 1.25 feet, respectively, would be required. For the downstream face of the SR 84 Bridge and just downstream of the SR 84 Bridge, at least 1-Ton rock with a thickness of 5.4 feet and Light rock (inner layer) with a minimum thickness of 2.5 ft would be required. ¼-Ton rock would also be required for the Access Bridge.

The proposed embankment will only fill up to the edge of the low flow channel. There will be no fill in the low flow channel. Permitting agencies may require mitigation for any impacted areas in the channel and/or habitats, which would prohibit certain countermeasures.

ROUTE 84 EXPRESSWAY WIDENING PROJECT

LIVERMORE, CA.

RUBY HILL DRIVE TO JACK LONDON BOULEVARD

Proposed Arroyo Mocho Access Bridge

FOUNDATION INVESTIGATION REPORT

Prepared for:

URS Corporation
55 South Market Street, Suite 1500
San Jose, CA 95113

Prepared By:

V&A
Lake Merritt Plaza
1999 Harrison Street, Suite 975
Oakland, CA 94612

July 2008

Hwy 84 Found Report_Arroy Mocho Access Brdg.doc

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INTRODUCTION

V&A was retained by URS Corporation to perform a corrosion survey on State Highway 84, from Ruby Hill Drive to Jack London Boulevard, in Livermore, California. The objective of the investigation was to measure various soil parameters and evaluate the results with respect to possible levels of corrosion at the site. The soil was tested at depths ranging from 0 to 19 meters below existing grade. This report provides recommendations for corrosion control of structural foundation materials under consideration for the existing Arroyo Mocho Access Bridge construction on Highway 84 (Isabel Avenue). The materials being considered as part of this investigation include buried reinforced concrete, prestressed concrete piles and steel piles.

The investigation was conducted in accordance with California Department of Transportation's Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch "Corrosion Guidelines" (Guidelines) dated September 2003. These Guidelines consider representative soil or water samples to be corrosive to structural elements if one or more of the following conditions exist:

1) **The chloride concentration is 500 ppm or greater,**
2) **The sulfate concentration is 2000 ppm or greater,**
3) **The pH is 5.5 or less.**

Evaluation of the soil environment was made in terms of potential corrosion damage to concrete and metal structures. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, soil samples taken during a geotechnical investigation were provided to V & A for laboratory testing. The soil samples were analyzed for minimum (saturated) resistivity, as well as for pH, chloride, and sulfate ion concentrations. All of these affect the corrosion rate of buried structures.

The minimum (saturated) resistivity of four soil samples selected from two borings at the Arroyo Mocho Bridge ranged from 1,978 ohm-cm to 14,478 ohm-cm. The soil pH analyses ranged from 7.8 to 9.1 and the water-soluble chloride concentrations ranged from below the detection limit of 2 mg/kg to 7 mg/kg. The water-soluble sulfate concentrations were below the detection limit of 5 mg/kg. The pH, chloride and sulfate ion concentrations all indicate the sampled soils are *non-corrosive*, as defined by the Guidelines.

No water was sampled was at the Arroyo Mocho Bridge site because the streambed was dry at the time field resistivity readings were taken (May 14, 2008).

CONCLUSIONS

- The soil boring chemical analyses and the stream water analysis all gave pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg and soluble sulfate concentrations less than 2,000 mg/kg. According to the Guidelines, the soils and water are considered *non-corrosive*.
- No corrosion mitigation for steel piles is required by the Guidelines for non-corrosive soil conditions.
- This structure is not within 300 meters (1,000 feet) of salt or brackish water.

RECOMMENDATIONS

The test data and a review of the project requirements were used to make recommendations for each structural foundation material alternative listed below.

Buried Reinforced Concrete Structures and Cast in Place Piles

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following for installations in *non-corrosive* soil:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 5.1 centimeters should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

Prestressed Concrete Piles

Prestressed concrete piles should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 5.1 centimeters should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

Steel Piles

No corrosion mitigation is required for non-corrosive soils

TEST METHODS

When predicting potential corrosion problems associated with a particular type of structure prior to installation, it is necessary to investigate the soil conditions the structure will encounter. Since corrosion is an electrochemical process accompanied by current flow, the electrochemical characteristics of a soil are of primary importance. Test methods utilized during this investigation reflect the most practical methods of evaluating corrosivity.

Resistivity is a measure of the ability of a soil to conduct an electric current. The higher the resistivity, the more difficult it is for the soil to conduct current. Resistivity is primarily dependent on the soluble chemical and moisture content of the soil. Soils with high dissolved ion contents generally have low resistivity. As moisture is added to a soil, its resistivity will decrease as more ions are taken into solution. The soil resistivity decreases until the maximum solubility of the dissolved ions is reached. Increasing the moisture content beyond this point increases the soil resistivity by diluting the solution. Since corrosion rate

depends on current flow through the soil, corrosivity normally increases as soil resistivity decreases.

Soils can contain a wide variety of soluble salts. Therefore, soils with similar resistivities can have significantly different corrosion characteristics, depending on the ions present. In most soils, the principle agents of corrosion are the chloride and sulfate ions, as well as pH. Chloride ions break down the protective surface films on metals and can corrode reinforcing steel in concrete structures. Sulfates attack the Portland cement in concretes. This is an expansive reaction that disrupts the concrete matrix and softens the surface. A high bicarbonate ion concentration lowers soil resistivity and facilitates other forms of corrosion; however, bicarbonate is not corrosive to metals. Soil pH is another measure of corrosivity. Acid (low pH) soils are corrosive to buried metallic and concrete structures. Neutral (pH 7) and alkaline (pH greater than 7) soils are passive to metal surfaces; therefore, corrosion rates become negligible.

Field Soil Resistivity

Field (in-situ) soil resistivity was measured at 17 locations along the Highway 84 project alignment. The same testing configuration was used at each location. At the Arroyo Mocho Bridge crossing, one resistivity station was set up at the northwest end of the existing bridge. Figure 1 is a vicinity and project location map. Figure 2 shows the soil resistivity test site and the soil boring locations.

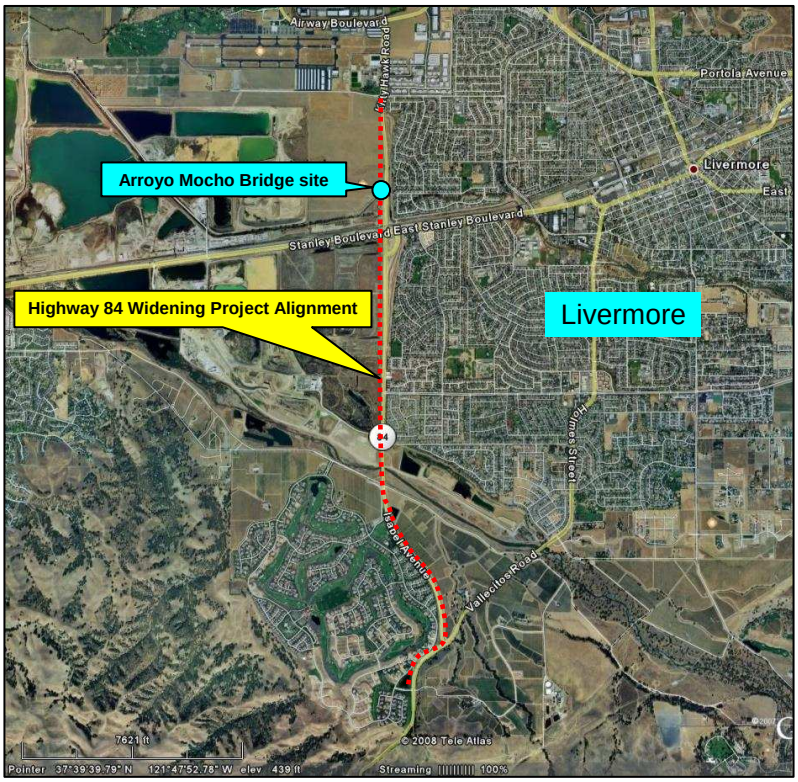


Figure 1. Vicinity Map for Arroyo Mocho Bridge Foundation Investigation, Livermore, CA.

Figure 2. In-Situ Soil Resistivity Testing and Soil Bore Locations

In-situ soil resistivity measurements were conducted by the Wenner Electrode Method using an AEMC Soil Resistance Meter, Model 4500. The Wenner Electrode Method uses four equally spaced metal pins, driven into the ground in a straight line, as electrodes (see Figure 3).

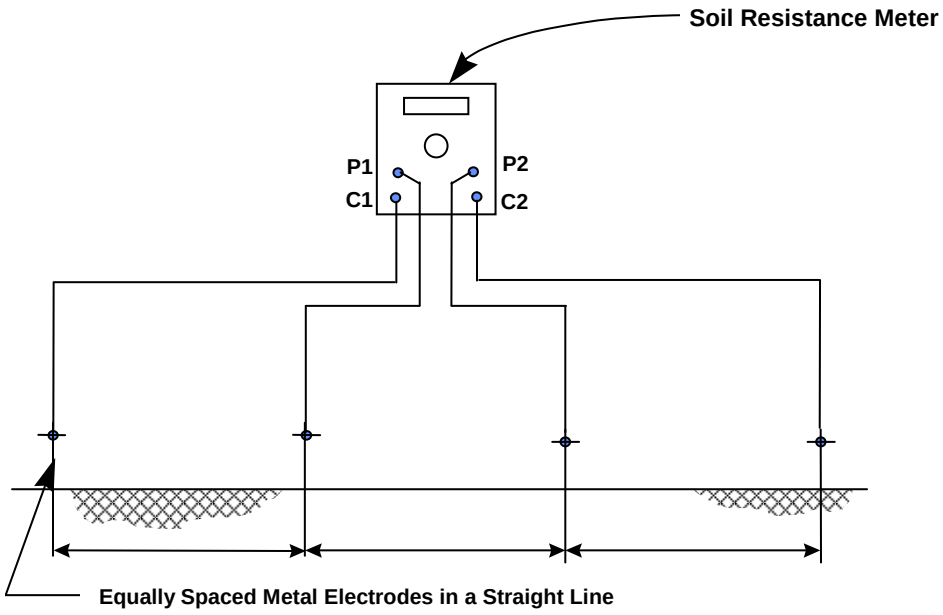


Figure 3. Wenner Electrode Method for Soil Resistivity Measurement

An alternating current from the Soil Resistance Meter causes a current to flow through the soil between the outside electrodes, C1 and C2. The current flowing through the soil creates a voltage gradient, which is proportional to the average resistance of the soil mass to a depth equal to the distance between electrodes. The voltage drop is measured across electrodes P1 and P2. Resistivity of the soil is then computed from the instrument reading according to the following formula:

$$\rho = 2\pi AR$$

where: ρ = soil resistivity in ohm-cm
A = the distance between probes in cm
R = soil resistance in ohms (instrument reading)
π = 3.1416

Soil resistivity measurements were conducted at rod spacings of 1.5, 3.0, 4.5 and 6.0 meters. Another method of calculating the soil resistivity using the data from the Wenner Electrode Method is the Barnes-Layer Resistivity calculation. The Barnes-Layer calculation is used to determine the resistivity for each soil layer. While the Wenner Electrode Method with 6.0 meter electrode spacings will consider the entire six meters below the surface, the Barnes-Layer method will calculate the resistivity of layers 0 to 1.5 meters, 1.5 to 3.0 meters, 3.0 to 4.5 meters and 4.5 to 6.0 meters below the surface. This method assumes the soil layers have a uniform thickness and are parallel to the surface. This may not always be true.

The Barnes-Layer method uses the following parameters to calculate layer resistivities:

$$\rho_{b-a} = KR_{b-a}$$

and

$$\frac{1}{R_{b-a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

Where:

ρ_{b-a}	=	Soil resistivity of layer depth b-a (ohm-cm)
a	=	Soil depth to top of layer (cm)
b	=	Soil depth to bottom of layer (cm)
R_a	=	Soil resistance read at depth a (ohms)
R_b	=	Soil resistance read at depth b (ohms)
R_{b-a}	=	Resistance of soil layer from a to b (ohms)
K	=	Layer constant (cm)
	=	$2\pi(b-a)$

Soil resistivities measured at the Arroyo Mocho Bridge and Barnes-Layer resistivities calculated from this data are listed in Table 1.

Laboratory Soil Analysis

To supplement the field resistivity test data, soil samples were obtained from soil borings NB23 and NB24 for laboratory soil resistivity analysis. A Soil Box was used in accordance with California Test Method 643. This apparatus is shown in Figure 4.

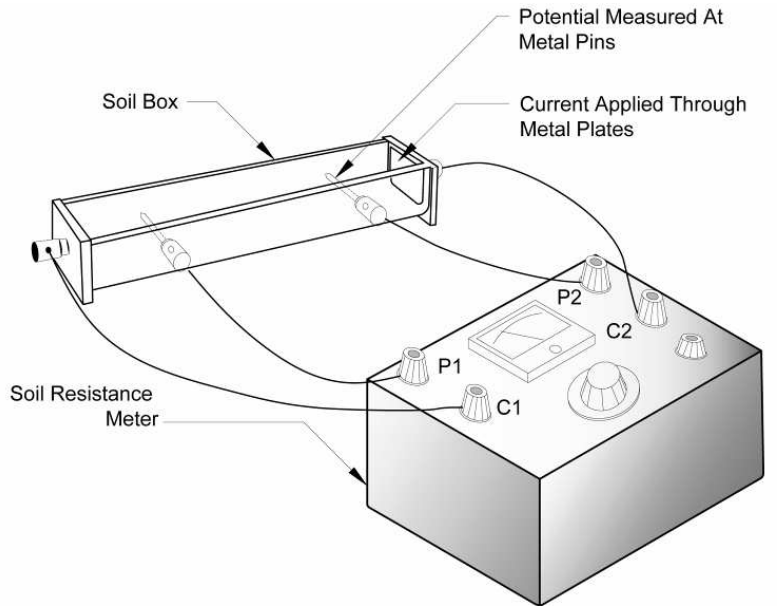


Figure 4. Soil Resistivity Measurement Using the Soil Box Method

This apparatus consists of a small plastic box with metal end plates for passing current through a tightly packed soil sample. Current is passed through the sample, causing a voltage drop across the sample. The soil resistivity is measured with a Soil Resistance Meter, similar to the AEMC Model 4500.

Soil resistivity is first measured in the "as-received" state. Distilled water is then added to the soil sample in 10-mL increments. The resistivity is measured after each addition. As the soil sample becomes more saturated, the soil resistivity decreases until the minimum soil resistivity is reached.

Soil boring samples from this study were forwarded to Cooper Testing Labs, Inc., in Palo Alto, CA., for minimum resistivity measurement, pH analysis, and analysis of water soluble chloride and sulfate ion concentrations. The analytical procedures followed California Test Methods 417, 422 and 643.

TEST RESULTS

Table 1 lists the field soil resistivity measurements from the Arroyo Mocho Bridge site and the calculated Barnes-Layer resistivities. Table 2 lists minimum resistivities and chemical analyses for the soil samples.

Table 1. Field Soil Resistivity Data

Site	Survey Station	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
15	416+00	1.5	11,481	0 to 1.5	11,481
		3.0	11,223	1.5 to 3.0	10,975
		4.5	15,541	3.0 to 4.5	67,460
		6.0	16,968	4.5 to 6.0	23,417

Table 2. Laboratory Soil Resistivity and Chemical Data

Item No.	Boring No.	Sample No.	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
					pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	NB23	2-4	1.5 to 2.0	5,347	8.4	<5	2
2	NB23	13-3	18.3 to 18.7	6,052	7.9	<5	3
3	NB24	2-X	1.5 to 2.0	14,478	9.1	<5	<2
4	NB24	13-4	18.3 to 18.7	1,978	7.8	<5	7

Based on the Guidelines, the analyzed soil samples are considered *non-corrosive* to buried metallic objects and reinforced concrete structures in regard to chloride and sulfate contents, pH and minimum soil resistivity.

Appendix 1. Soil Sample Minimum Resistivities and Chemical Analyses

Corrosivity Test Summary

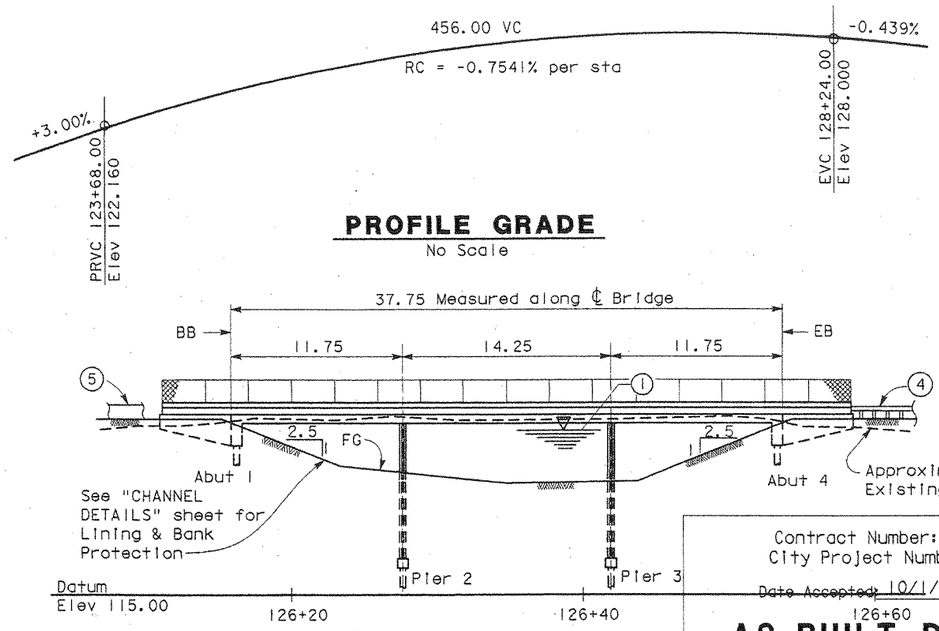
CTL # 632-005 & 006 **Date:** 6/13/2008 **Tested By:** PJ **Checked:** PJ

Client: V&A **Project:** URS-Caltrans Hwy 84 Widening **Proj. No:** 08-0216

Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Sample Description
Boring	Sample, No.	Depth, ft.	As Rec.	Minimum	Saturated	mg/kg	mg/kg	%		(Redox)	As Received	
						Dry Wt.	Dry Wt.	Dry Wt.		mv	%	
			ASTM G57	Cal 643	ASTM G57	Cal 422-mod.	Cal 417-mod.	Cal 417-mod.	Cal 643	SM 2580B	ASTM D2216	
NB03-2-3	-	5 - 6.5	-	3,302	-	6	<5	<0.0005	7.5	-	2.7	Brown Clayey SAND, trace Gravel
NB05-2-3	-	5-6.5	-	7,312	-	<2	<5	<0.0005	8.4	-	1.6	Reddish Brown SAND w/ Gravel, trace Clay
NB07-3-3	-	5 - 6.5	-	1,510	-	20	<5	<0.0005	7.1	-	3.0	Brown Sandy CLAY
NB11-5-3	-	20 - 21.5	-	7,255	-	<2	<5	<0.0005	7.4	-	1.6	Brown GRAVEL w/ Clay & Sand
NB12-2-X	-	5 - 6.5	-	10,028	-	<2	<5	<0.0005	8.6	-	0.9	Brown SAND w/ Clay & Gravel
NB13-6-3	-	25-26.5	-	7,992	-	<2	<5	<0.0005	8.3	-	1.2	Brown GRAVEL w/ Sand, trace Silt
NB14-2-3	-	5 - 6.5	-	10,586	-	<2	<5	<0.0005	8.5	-	0.7	Brown GRAVEL w/ Sand
NB20-2-3	-	3.5 - 5	-	5,340	-	<2	7	0.0007	8.2	-	2.0	Brown Clayey SAND
NB22A-1-4	-	3.5 - 5	-	5,386	-	9	<5	<0.0005	8.6	-	1.3	Brown SAND w/ Clay & Gravel
NB23-2-4	-	5 - 6.5	-	5,347	-	2	<5	<0.0005	8.4	-	1.1	Brown SAND w/ Clay & Gravel
NB23-13-3	-	60 - 61.5	-	6,052	-	3	<5	<0.0005	7.9	-	1.9	Reddish Brown Silty SAND w/ Gravel (slightly plastic)
NB24-2-X	-	5 - 6.5	-	14,478	-	<2	<5	<0.0005	9.1	-	0.6	Grayish Brown SAND w/ Clay & Gravel
NB24-13-4	-	60 - 61.5	-	1,978	-	7	<5	<0.0005	7.8	-	2.1	Reddish Brown Sandy SILT
NB25A-2-4	-	8.5 - 10	-	23,278	-	<2	<5	<0.0005	8.3	-	0.5	Brown GRAVEL w/ Silt & Sand
Arroyo del Valle		water	-	1,686	-	63.7*	19.9*	-	8.3	-	-	Water sampled at existing Arroyo del Valle bridge

Note: The Chloride and Sulfate results for the water sample are in units of mg/L.



PROFILE GRADE

No Scale

ELEVATION

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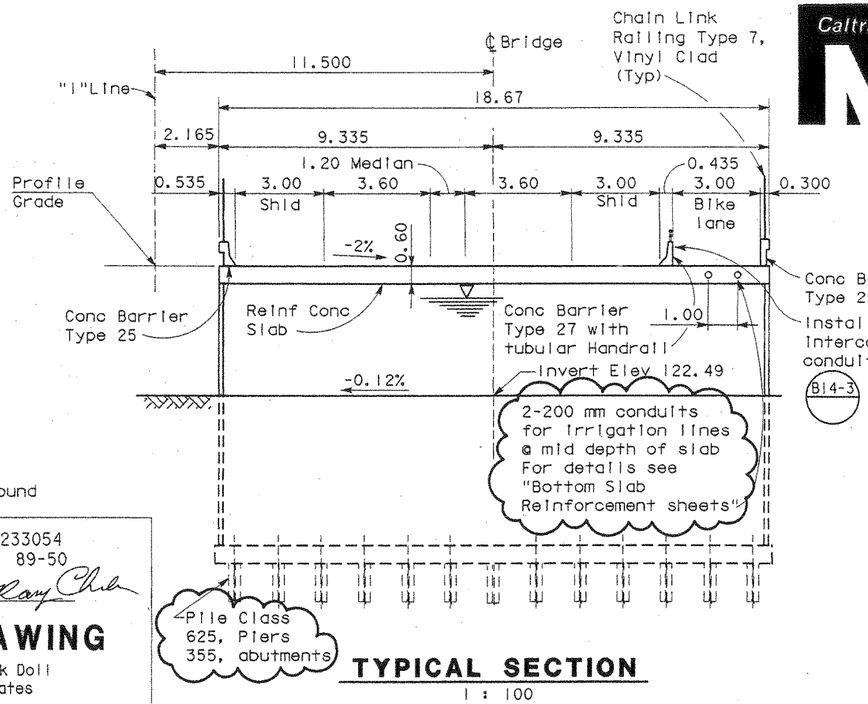


TYPICAL SECTION

1 : 100

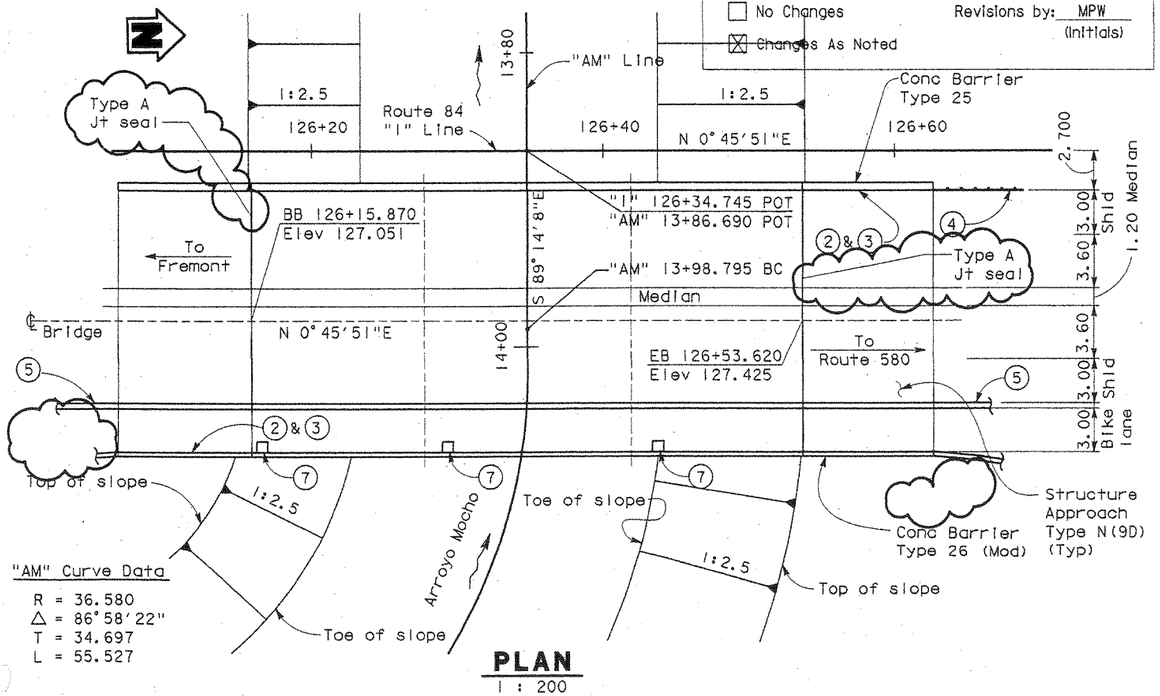
Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)



"AM" Curve Data
R = 36.580
△ = 86°58'22"
T = 34.697
L = 55.527

PLAN

1 : 200

PILE DATA TABLE						
Location	Pile Type	Design Loading	Nominal Resistance		Design Tip Elevation	Specified Tip Elevation
			Compression	Tension		
Abutment 1	HP 250x85	355 kN	710 kN	0 kN	115.0(1); 121.5(2)	115.0
Bent 2	HP 250x85	625 kN	1250 kN	0 kN	99.0(1); 113.5(2)	99.0
Bent 3	HP 250x85	625 kN	1250 kN	0 kN	99.0(1); 113.5(2)	99.0
Abutment 4	HP 250x85	355 kN	710 kN	0 kN	115.0(1); 121.5(2)	115.0

Design Tip Elevation is controlled by: (1) Compression, (2) Tension

NOTES:

1. HW Elev for Hydrologic Summary
   Frequency 100 year
   Discharge 155.74 m^3/s
   Elevation 126.10
2. Paint "ARROYO MOCHO"
3. Paint "BR. No. 33C-0407
4. MBGR, see Road Plans
5. Conc Barrier, see Road Plans
6. All dimensions shown are in Meters unless noted otherwise.
7. Type D-1 Deck Drain
8. For Standard Plan List and General Notes see "Deck Contours" sheet

INDEX TO PLANS

SHEET NO.	TITLE
1	General Plan
2	Deck Contours
3	Foundation Plan
4	Abutments
5	Typical Pier
6	Top Slab Reinforcement
7	Bottom Slab Reinforcement
8	Slab Reinforcement Details
9	Approach Slab Type N(9D)
10	Structure Approach Drainage Details
11	Concrete Barrier Type 27
12	Log of Test Borings

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		396	407

Caltrans Metric

REGISTERED CIVIL ENGINEER
DAVID V. WHITMORE No. C11359 Exp. 12-31-00 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

5/11/99
PLANS APPROVAL DATE

ALAMEDA COUNTY
TRANSPORTATION AUTHORITY
1401 Lakeside Drive, Suite 600
Oakland CA 94612

MK CENTENNIAL
5000 Hopyard Rd. Suite 100
Pleasanton, CA 94588

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

APPROXIMATE QUANTITIES

Furnish Steel Piling (HP250x85)	681 M
Drive Steel Pile (HP250x85)	48 EA

FINAL PAY QUANTITIES

Structure Excavation (Bridge)	369 M^3
Structure Backfill (Bridge)	139 M^3
Structural Concrete (Bridge)	648 M^3
Structural Concrete (Bridge Footing)	17 M^3
Structural Concrete (Approach Slab)	101 M^3
Bar Reinforcing Steel (Bridge)	94,600 Kg
Chain Link Railing (Type7) Vinyl Clad	112 M
Concrete Barrier (Type 25)	56 M
Concrete Barrier (Type 26 Mod)	56 M
Concrete Barrier (Type 27)	56 M
Tubular Handrail	56 M
Fractured Fin Finish	51 M^2
Misc. Metal Bridege	198 Kg

DESIGN OVERSIGHT	DESIGN	BY Whitmore	CHECKED M. Hicks	LOAD FACTOR DESIGN	LIVE LOADING:	HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD		
	DETAILS	BY Whitmore	CHECKED M. Hicks	LAYOUT	BY Whitmore	CHECKED A. Alegria		
SIGN OFF DATE	QUANTITIES	BY Whitmore	CHECKED A. Alegria	SPECIFICATIONS	BY R. Barlow	CHECKED Whitmore		

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Olga Rodriguez
PROJECT ENGINEER

BRIDGE NO. 33C-0407
KP/PM

CU 04256
EA 233051

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 20 40 60 80

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 6-99 5-99 6-99

SHEET 1 OF 12

ARROYO MOCHO
GENERAL PLAN

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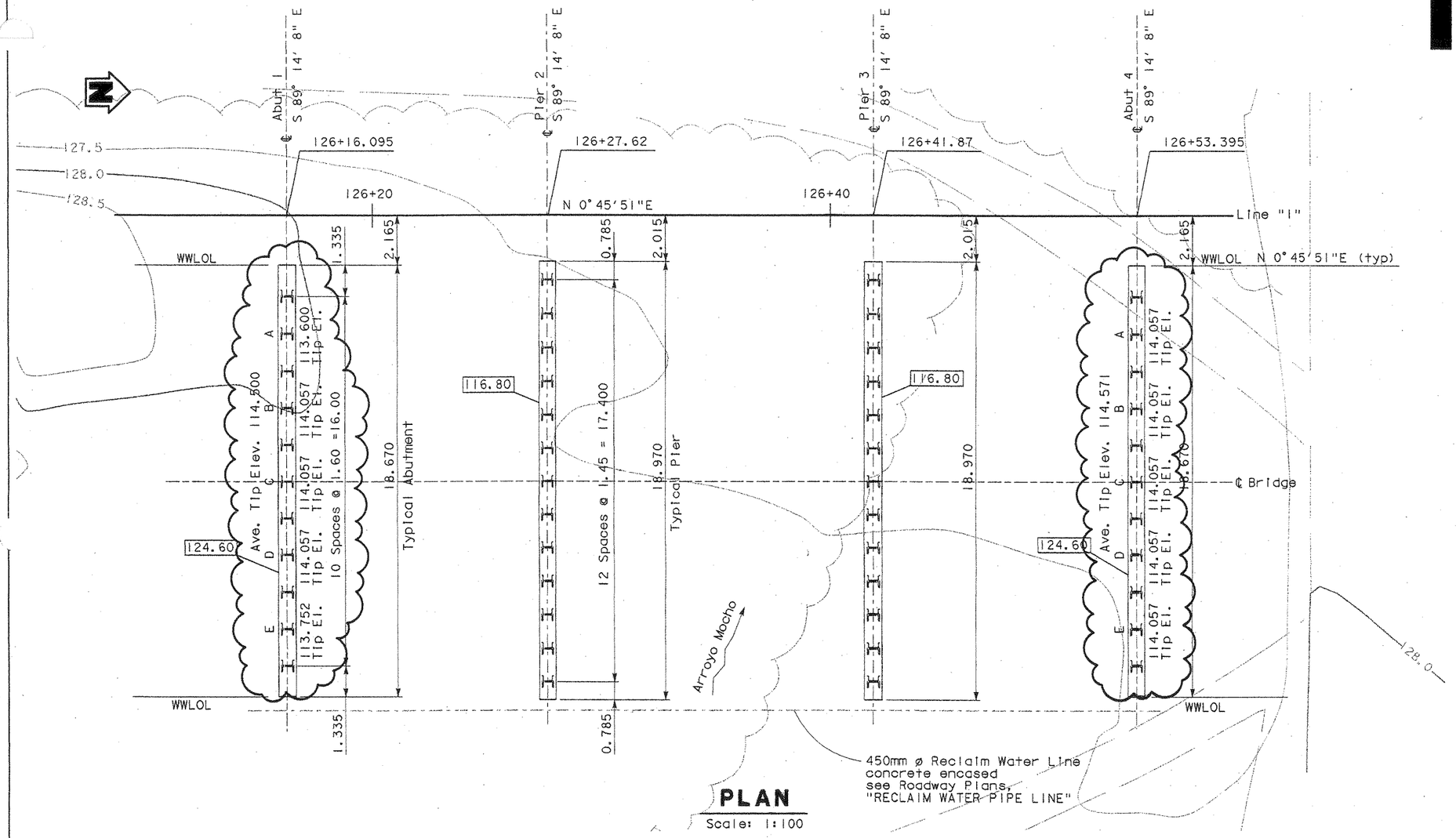
$$$$$$$$SYTIME$$$$$$$



PLAN

Scale: 1:100

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala			398	407

REGISTERED CIVIL ENGINEER

5/11/99

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — David V. Whitmore — No. C11359 — Exp. 12-31-00 — CIVIL — STATE OF CALIFORNIA

MK CENTENNIAL
5000 HOPYARD RD. SUITE 100
PLEASANTON, CALIFORNIA 94588

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

BENCHMARK :

All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).

1. Mon. No. 31
   Found 1/8" iron pin set in concrete in a Standard City Well Monument Box at the intersection of Kitty Hawk Road and Rickenbacker Circle 3.601 m left of Center Line Station "I" 139+82.625. The Elevation is 122.796.

2. Mon. No. 220
   A brass pin in Standard City Well Monument Box at the intersection of Stanley blvd. and Isabel Avenue 19.004 meters left of Center Line Station "IS" 122+19.529. The elevation is 126.311.

3. Mon. No. 36
   Found 2½" brass disc marked LS 5412 in a Standard City Well Monument Box 34 m east of Isabel Avenue on Concannon Blvd and 33.863 m right of "I" 105+34.735. The Elevation is 127.376.

LEGEND:

indicates bottom of footing Elev.

indicates vertical pile

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

PHOTOGRAMMETRY AS OF: 2-6-96		DRAWN	BY Towill Inc.	DESIGN	BY Whitmore	CHECKED	M. Hicks
SURVEYED	BY Chaudhary	TRACED	BY E. Cantiller	DETAILS	BY Whitmore	CHECKED	M. Hicks
FIELD CHECKED	BY	CHECKED	BY Whitmore	QUANTITIES	BY Whitmore	CHECKED	A. Alegria

DESIGN OVERSIGHT

SIGN OFF DATE

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Olga Rodriguez
PROJECT ENGINEER

CU 04256
EA 233051

BRIDGE NO. 33C-0407
KP/PM

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4-99 5-99

SHEET 3 OF 12

ARROYO MOCHO
FOUNDATION PLAN

Pen Table File

03:52:46 PM 10/10/2002

$$$$$$$$$$DGNSPEC $$$$$$$$$$ $$$$$$SYTIME$$$$$$

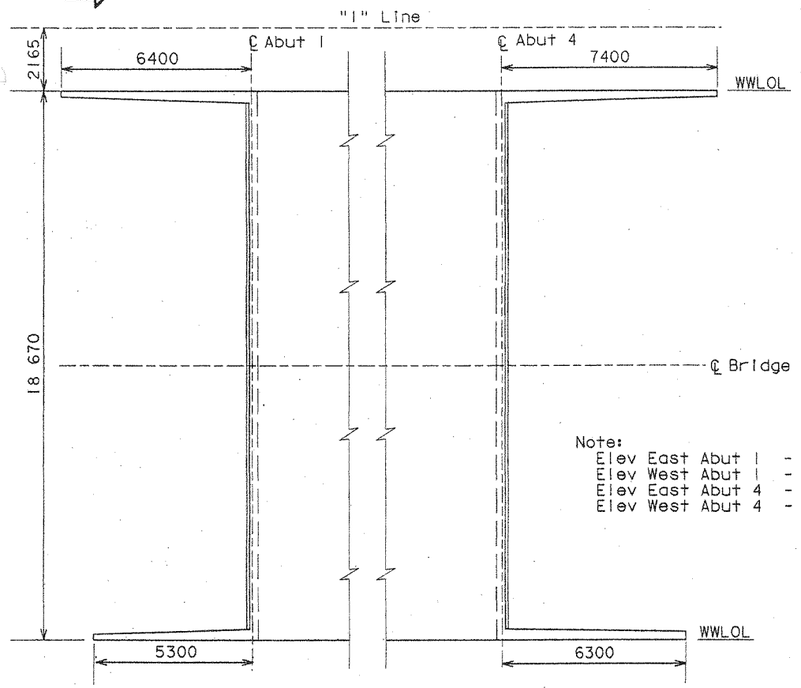
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala			399	407

REGISTERED CIVIL ENGINEER
5/11/99
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — David V. Whitmore — No. C11359 — Exp. 12-31-00 — CIVIL — STATE OF CALIFORNIA

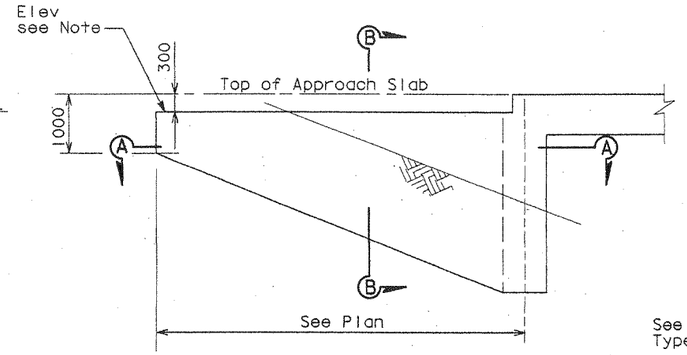
MK CENTENNIAL
5000 HOPYARD RD. SUITE 100
PLEASANTON, CALIFORNIA 94588

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

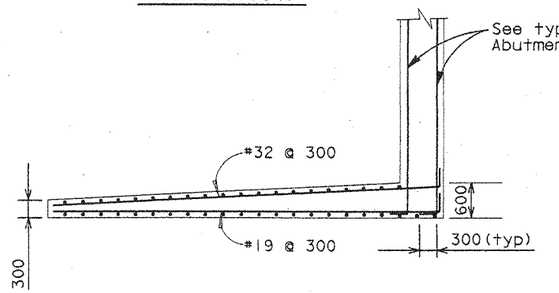


Note:
Elev East Abut 1 - 126.512
Elev West Abut 1 - 126.872
Elev East Abut 4 - 126.997
Elev West Abut 4 - 127.379

PLAN
1 : 100

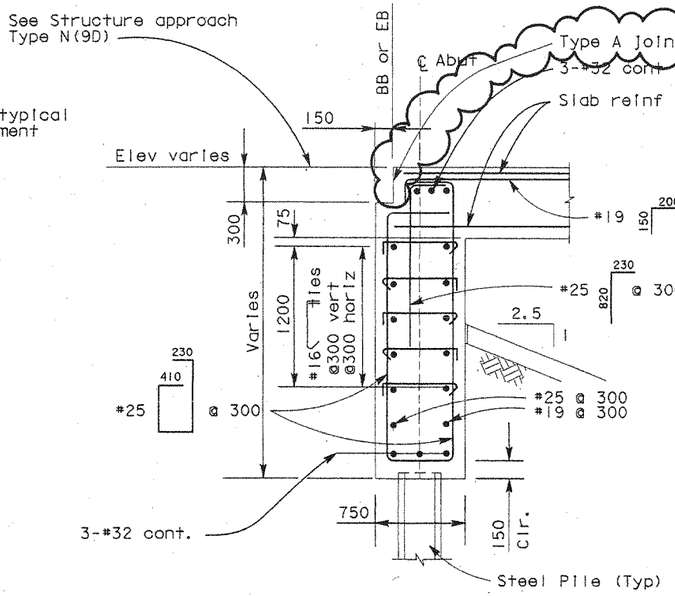


ELEVATION

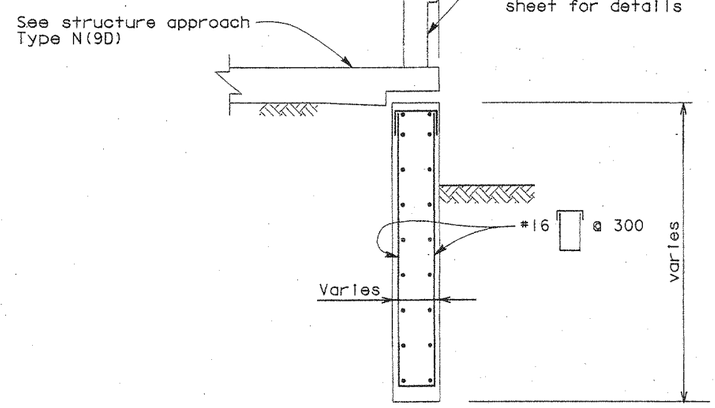


SECTION A-A
1:50

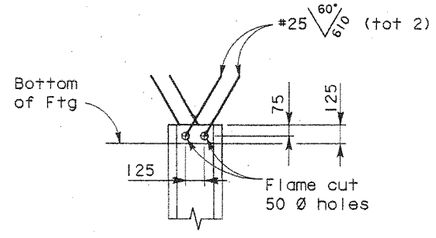
For details not shown see B0-1



TYPICAL ABUTMENT
1:25



SECTION B-B
1:25



STEEL PILE ANCHOR
1:50

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT		DESIGN	BY Whitmore	CHECKED M. Hicks	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE		DETAILS	BY Whitmore	CHECKED M. Hicks	
		QUANTITIES	BY Whitmore	CHECKED A. Alegria	

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

Olga Rodriguez — PROJECT ENGINEER

CU 04256
EA 233051

BRIDGE NO. 33C-0407
KP/PM

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4-99 5-99

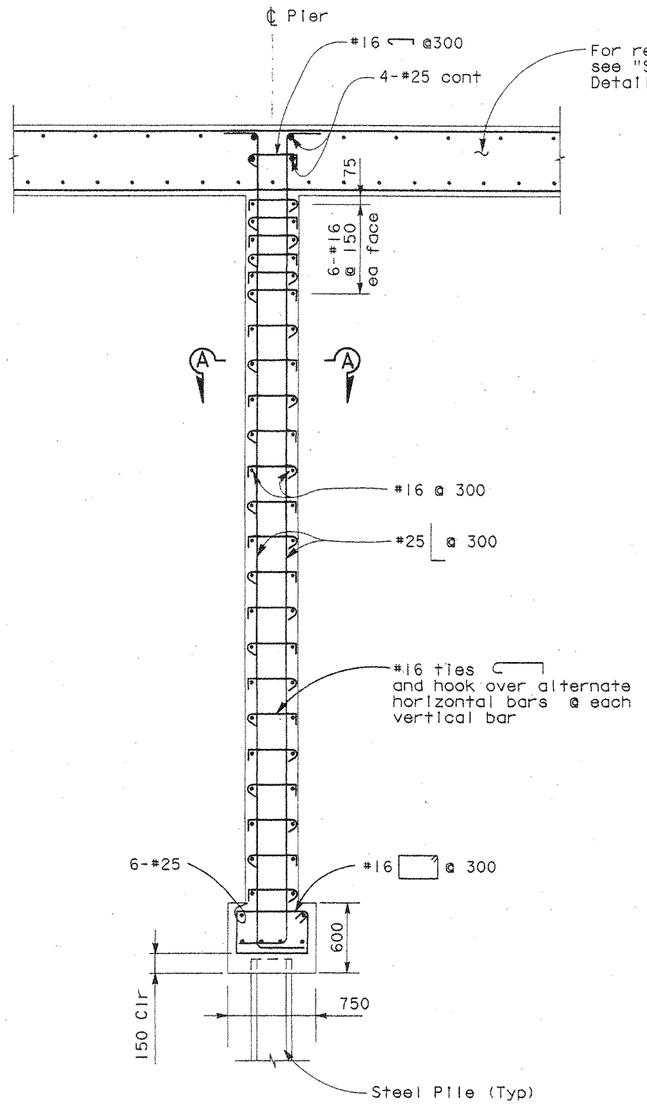
ARROYO MOCHO
ABUTMENTS

SHEET 4 OF 12

Pen Table File

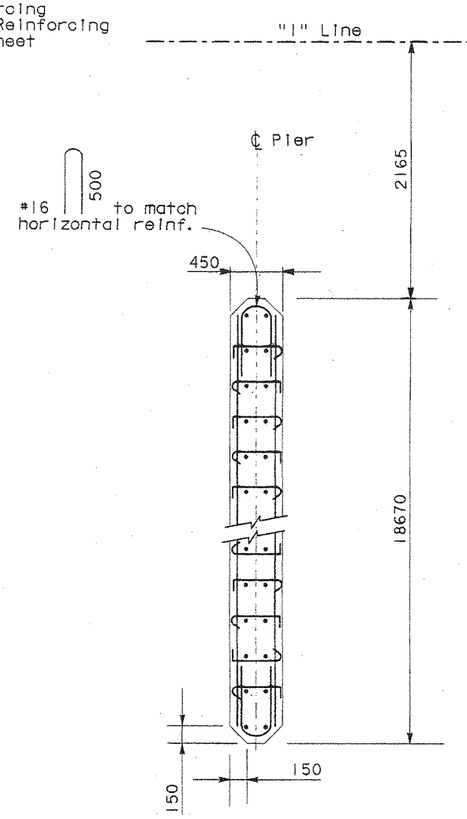
03:53:34 PM 10/10/2002

$$$$$$$$$$DGNSPEC$$$$$$$$$$ $$$$$$SYTIME$$$$$$



PIER SECTION

1:25



SECTION A-A

1:25

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala			400	407

REGISTERED CIVIL ENGINEER

5/11/99

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — David V. Whitmore — No. C11359 — Exp. 12-31-00 — CIVIL — STATE OF CALIFORNIA

MK CENTENNIAL
5000 HOPYARD RD. SUITE 100
PLEASANTON, CALIFORNIA 94588

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chiba

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates

☒ No Changes — Revisions by: MPW (Initials)

☐ Changes As Noted

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT		DESIGN	BY Whitmore	CHECKED M. Hicks	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE		DETAILS	BY Whitmore	CHECKED M. Hicks	
		QUANTITIES	BY Whitmore	CHECKED A. Alegria	

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

Olga Rodriguez — PROJECT ENGINEER

CU 04256
EA 233051

BRIDGE NO. 33C-0407

KP/PM

ARROYO MOCHO

TYPICAL PIER

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4-99 5-99

SHEET 5 OF 12

Pen Table File

03:54:18 PM 10/10/2002

$$$$$$$$$$DGNSPEC$$$$$$$$$$ $$$$$$SYTIME$$$$$$

REVISED 4-23-98

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		405	407

Caltrans Metric

REGISTERED ENGINEER - CIVIL

PLANS APPROVAL DATE

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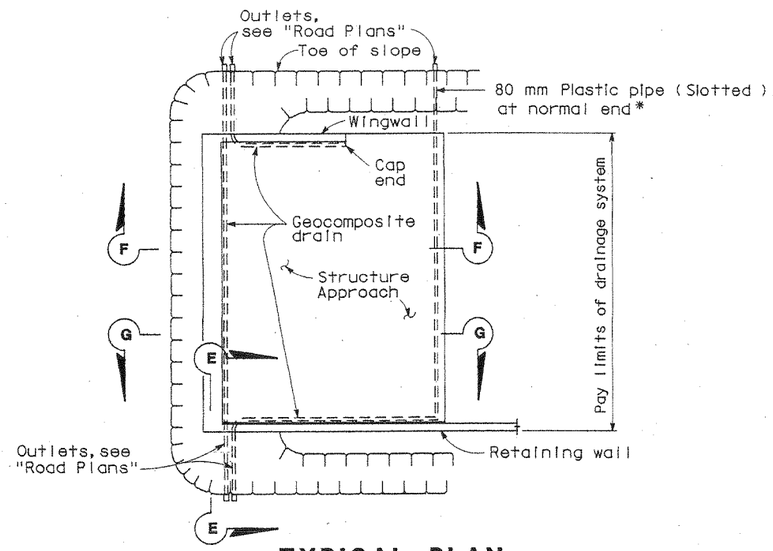
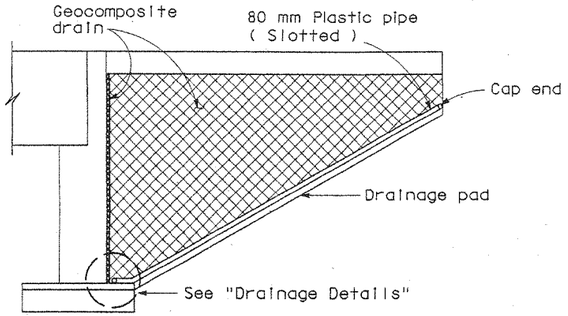
REGISTERED PROFESSIONAL ENGINEER — David V Whitmore — No. C11359 — Exp. 12-31-00 — CIVIL — STATE OF CALIFORNIA

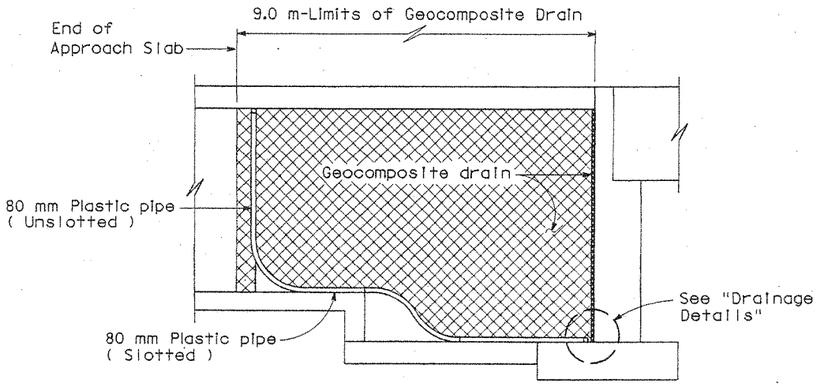


TYPICAL PLAN

*For pipe layout at staggered end, see "Detail B".



CANTILEVER WINGWALL
SECTION F-F



RETAINING WALL WINGWALL
SECTION G-G

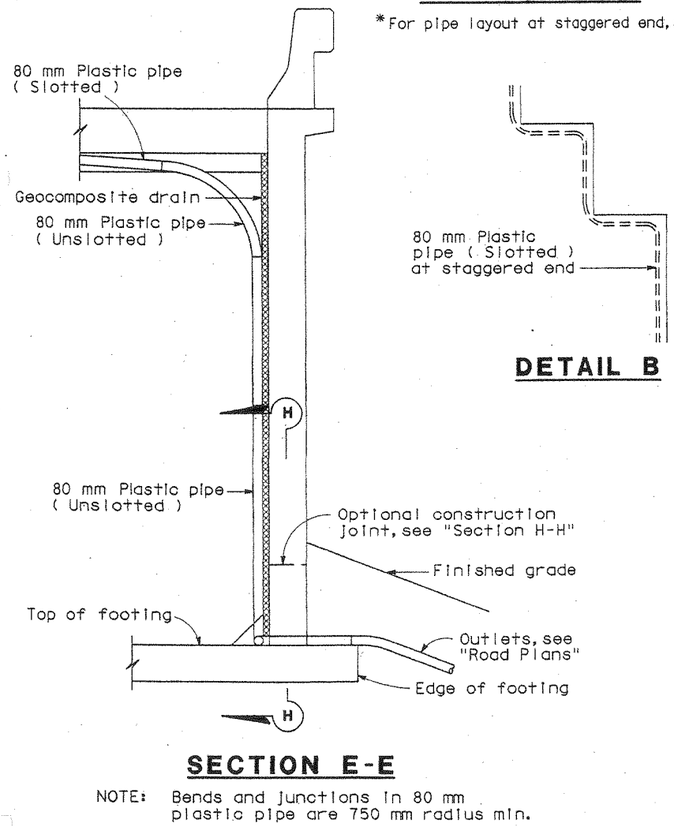
Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes
☐ Changes As Noted

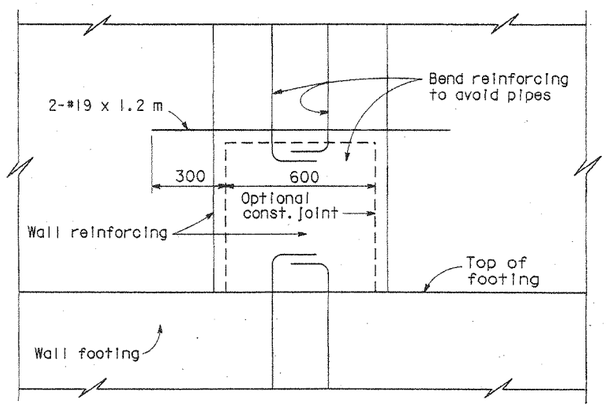
Revisions by: MPW (Initials)



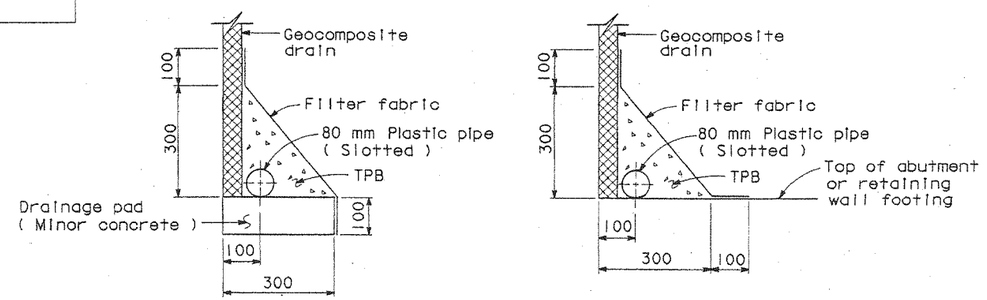
DETAIL B

SECTION E-E

NOTE: Bends and junctions in 80 mm plastic pipe are 750 mm radius min.



SECTION H-H



WITHOUT FOOTING — WITH FOOTING

DRAINAGE DETAILS

NO SCALE
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

STANDARD DRAWING				
FILE NO. XS 22-17	DESIGN BY M. TRAFFALIS	CHECKED E. THORKILDSEN	APPROVAL RECOMMENDED BY	
DRAWING DATE 4/98	DETAILS BY R. YEE	CHECKED E. THORKILDSEN	DESIGN SUPERVISOR	
	SUBMITTED BY M. HA			

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33C-0407
KILOMETER POST

ARROYO MOCHO
STRUCTURE APPROACH DRAINAGE DETAILS

CU 04256
EA 233051

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 4-99 5-99

SHEET OF

OS OSD 2147A (METRIC) (REV. 2/25/97)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84		152	407

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)

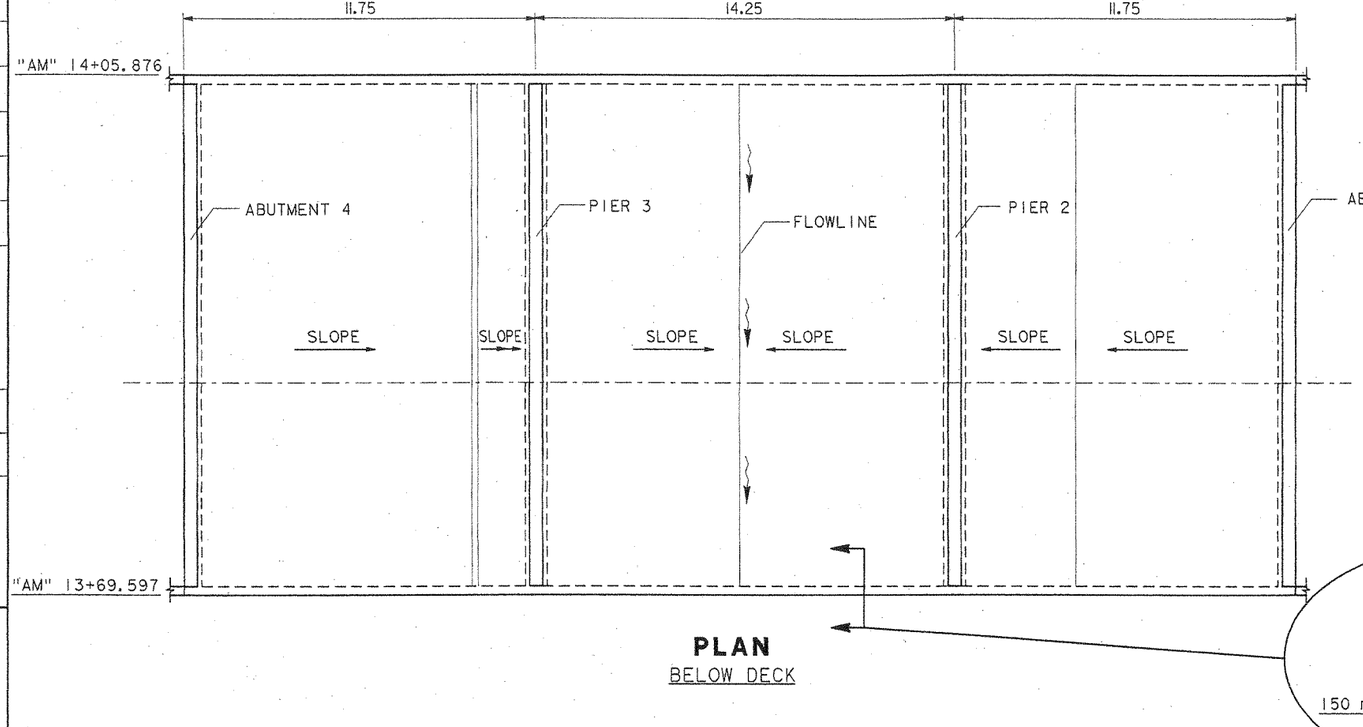
John Kwong 05/10/99
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

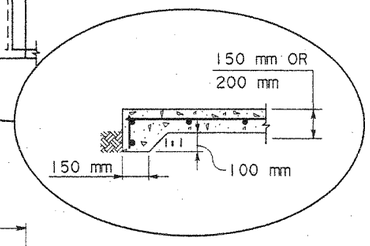
REGISTERED PROFESSIONAL ENGINEER — JOHN KWONG — No. C 55766 — Exp. 12/31/00 — CIVIL — STATE OF CALIFORNIA

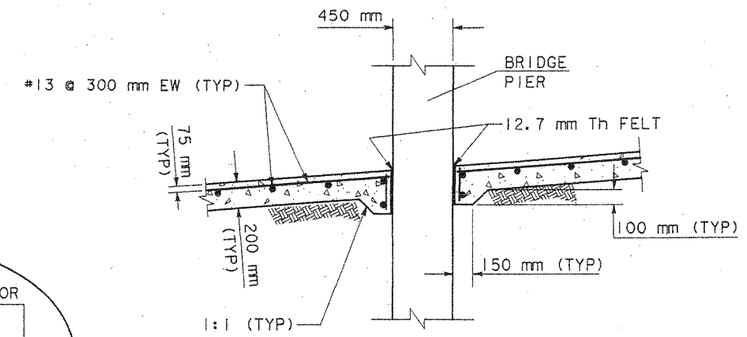
CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
Livermore, CA 94550

TRS CONSULTANTS, INC.
5000 Executive Parkway, Suite 390
San Ramon, CA 94583-4210
TEL: 510-275-9870 FAX: 510-275-9930

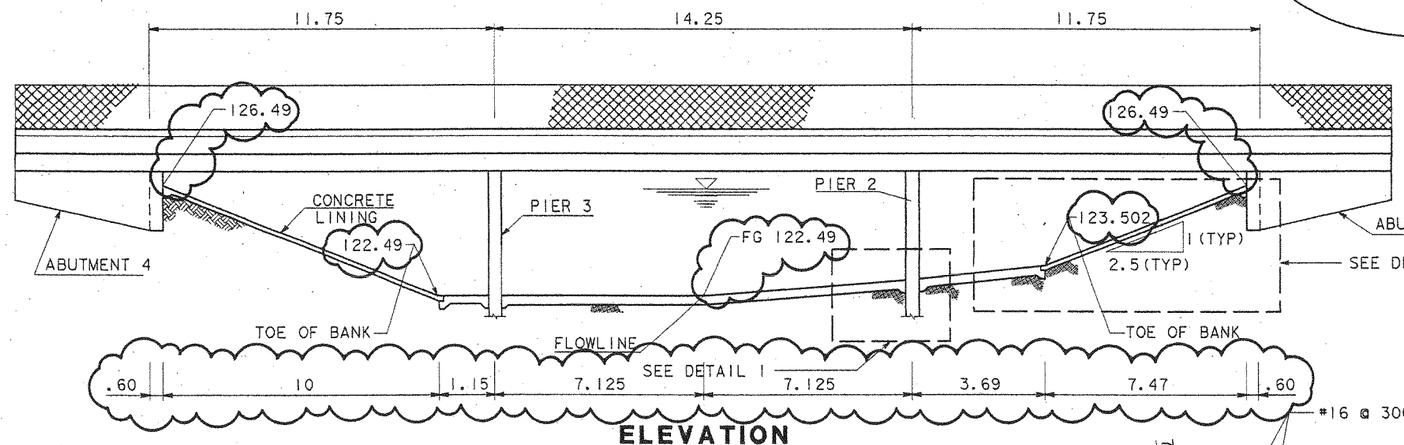


PLAN
BELOW DECK



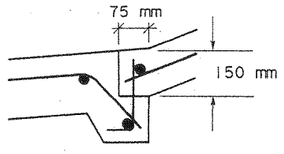


DETAIL 1

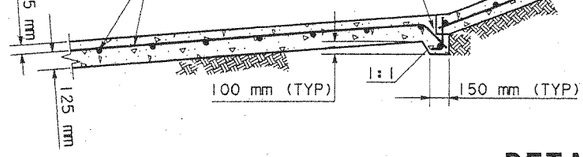


ELEVATION

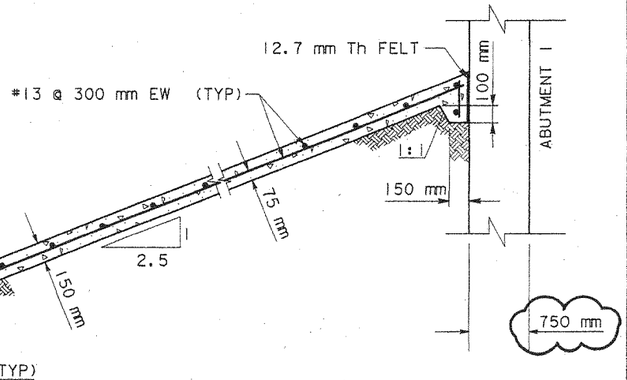
CONCRETE LINING
ARROYO MOCHO UNDER ISABEL AVENUE BRIDGE



DETAIL 3



DETAIL 2



ALL DIMENSIONS ARE IN
METERS UNLESS OTHERWISE SHOWN

CHANNEL DETAILS
NOT TO SCALE

CH-11

DESIGN OVERS. ARTHUR DAO

STA CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

	CALCULATED/ DESIGNED BY	CHECKED BY	SP	HL	DATE 5/99	5/99	REVISED BY	DATE REVISED

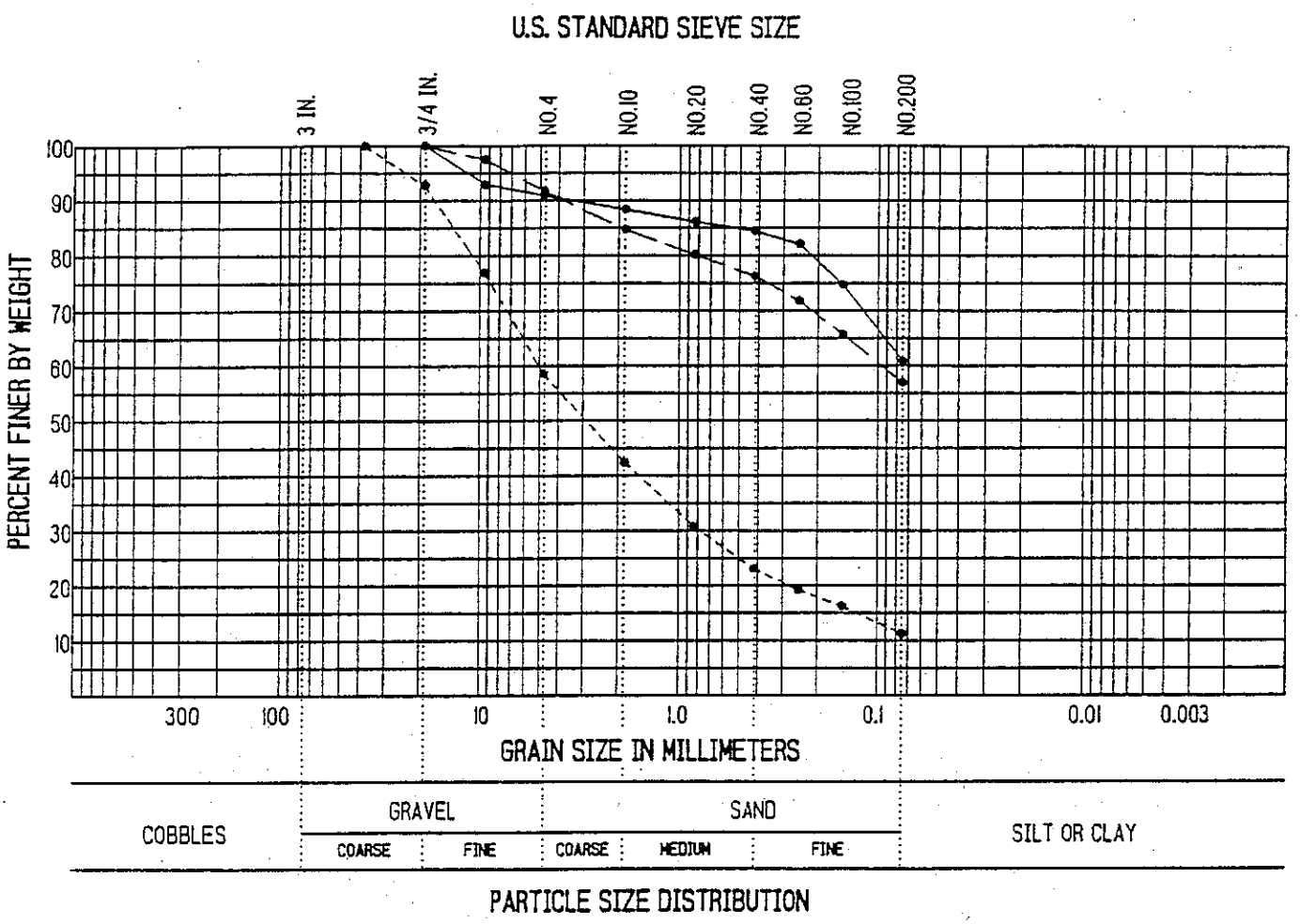
LAST REVISION 00-00-00 TIME PLOTTED => 07/09/99

CADD FILE: ||04/DRAWING/SHEET/DETAILS/||04CH10.DGN

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

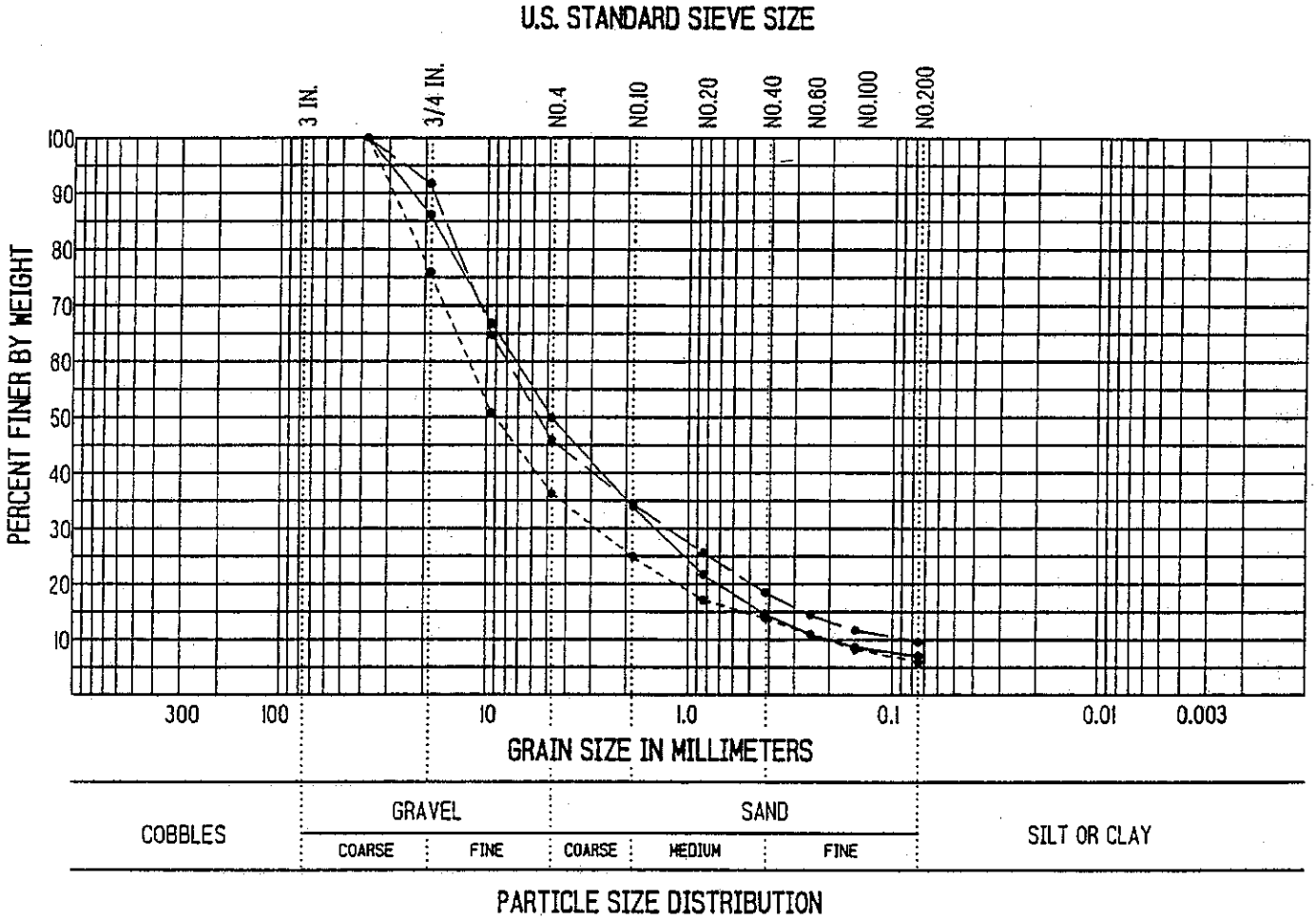
CU 042EC EA 277QEL

GRAIN-SIZE DISTRIBUTION



LINE SYMBOL	DRILL HOLE NO.	DEPTH (METERS)	CLASSIFICATION
———	B-20	1.8	ML
— — —	B-20	4.95	CL
-------	B-20	9	SP-SM
.....			

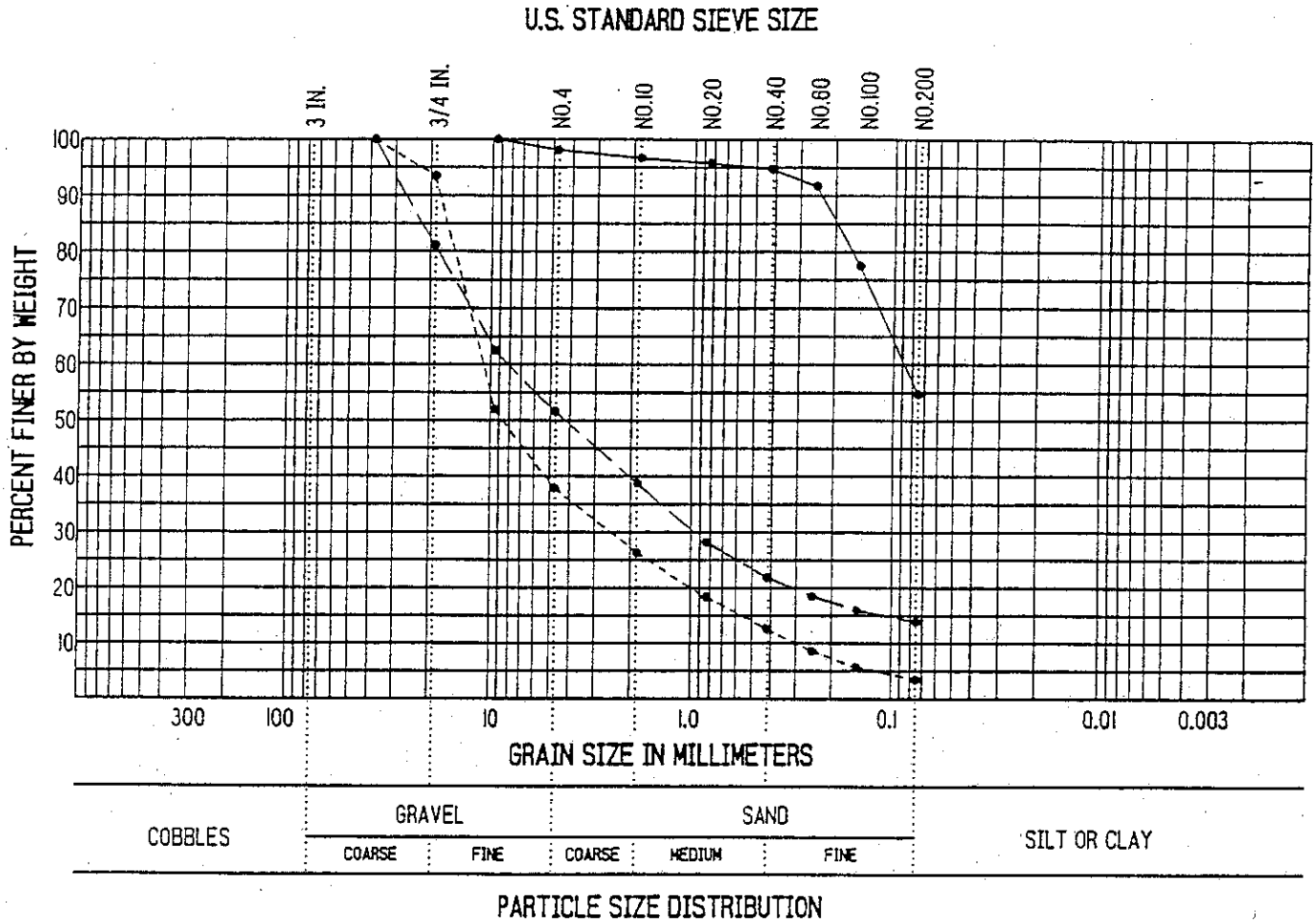
GRAIN-SIZE DISTRIBUTION



PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	DRILL HOLE NO.	DEPTH (METERS)	CLASSIFICATION
———	B-19	3	GW-GM
— — —	B-19	7.5	GW-GM
- - - - - - -	B-19	13.5	GP-GM
.....			

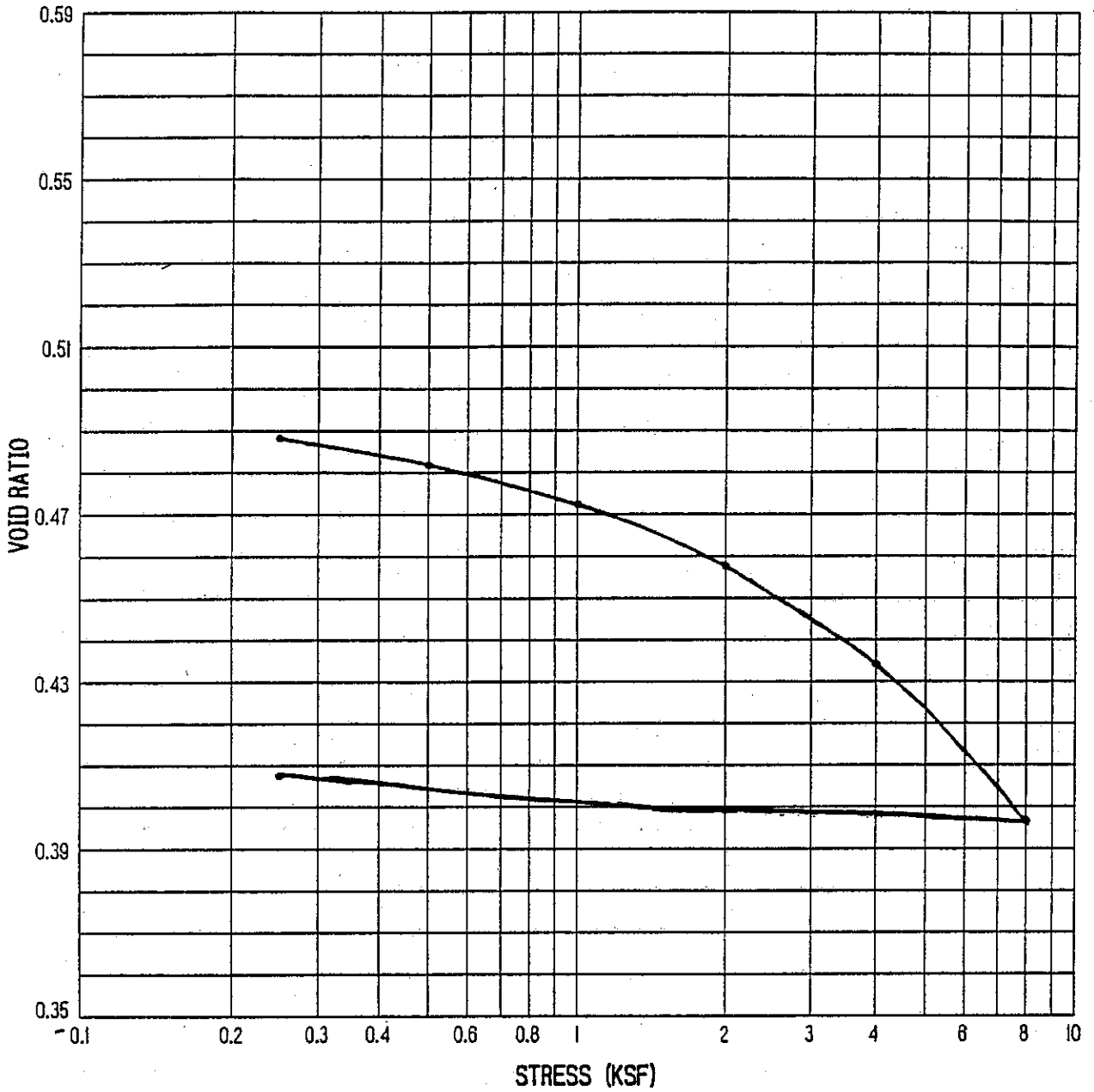
GRAIN-SIZE DISTRIBUTION



PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	DRILL HOLE NO.	DEPTH (METERS)	CLASSIFICATION
———	B-18	3.15	ML
— —	B-18	9	GM
- - - - - - -	B-18	21	GW
.....			

CONSOLIDATION TEST



DRILL HOLE NO.: B-18	DEPTH (FEET): 11
INITIAL MOISTURE CONTENT (%): 15.8	FINAL MOISTURE CONTENT (%): 24.5
INITIAL VOID RATIO: .501	FINAL VOID RATIO: .408
INITIAL SATURATION (%): 85.2	FINAL SATURATION (%):
INITIAL DRY UNIT WEIGHT (PCF): 135.6	FINAL DRY UNIT WEIGHT (PCF): 124.2
DESCRIPTION: CLAY (CL) dark brown, firm, sandy	

Route 84 Widening Arroyo Mocho Access Bridge - Abutment 1

12/14/2009

Pile Design Spreadsheet

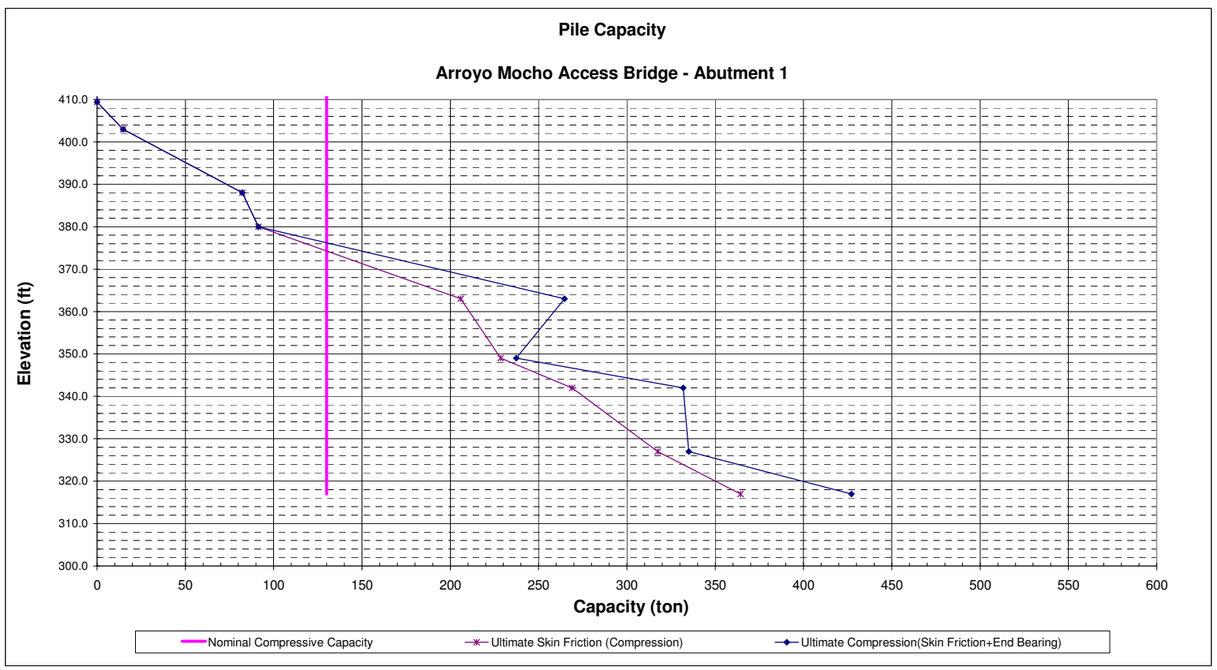
Abutment 1

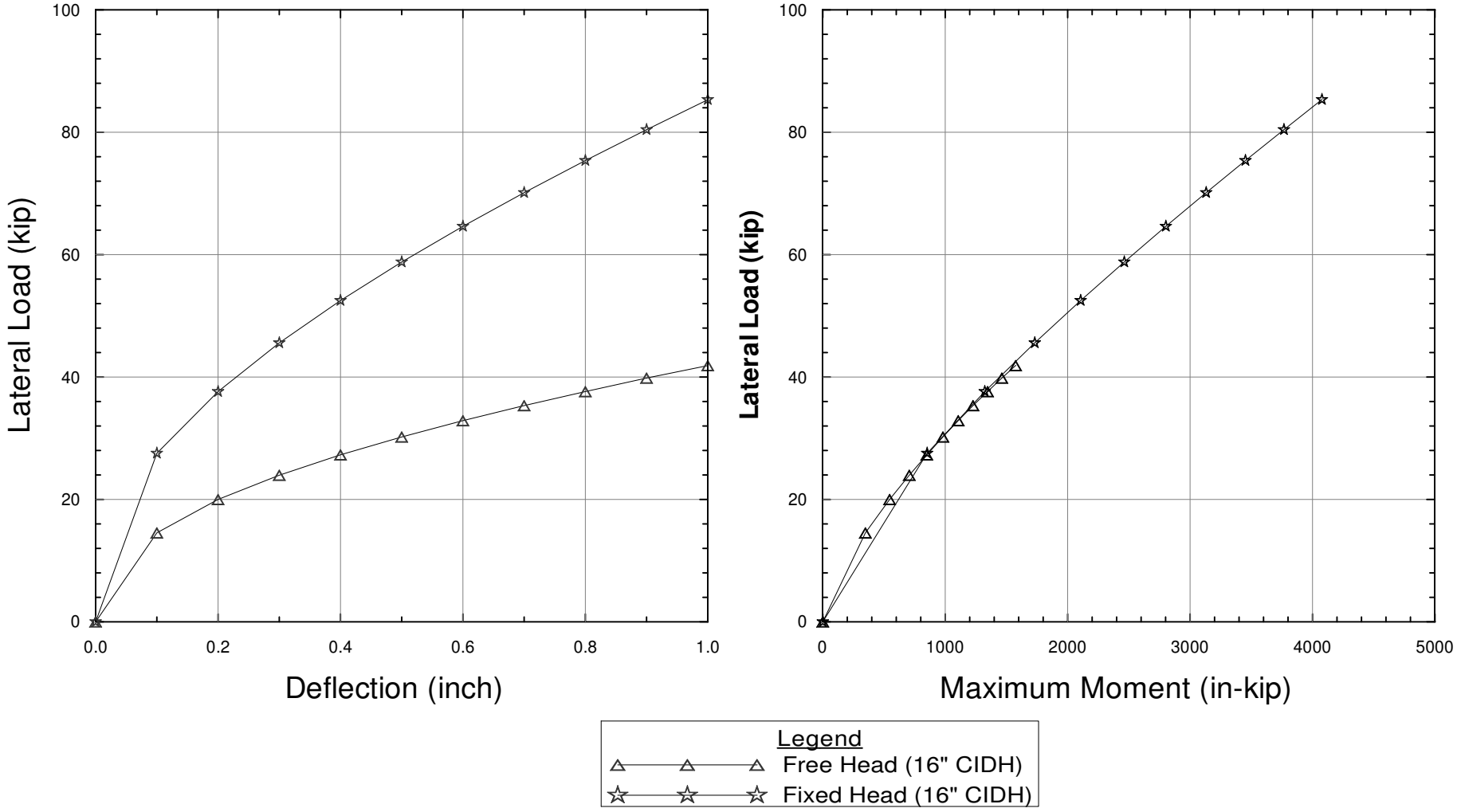
Caltrans Design Method For CIDH Pile

Project Name:	Route 84 Widening	Nominal axial compress. Capacity (ult.)	130	ton					
Project Number:	28649640	Nominal axial compress. Capacity (ult.)	1157	kN	Pile Type	CIDH			
Bridge Name:	Arroyo Mocho Access Bridge	Pile Diameter	16	inch	Pile Shape	Circular			
Boring Surface El. (m)	126.2	Pile Diameter	406	mm	Pile Surface Area	1.28	sq. m/m	Pile Tip Area	0.13 sq. m
Boring Surface El. (ft)	414.0	Pile Diameter	1.33	ft	Pile Surface Area	4.19	sq. ft/ft	Pile Tip Area	1.40 sq. ft.
Design GWS El. (ft)	376.0								
Unit Weight of Water (pcf)	62.4								
Depth with no strength									
Convert. Factor	3.281								
Bottom of Pile Cap El. (m)	124.8								
Bottom of Pile Cap El. (ft)	409.4								
Bottom of Fill El. (ft)	N/A								
Scour El. (ft)	N/A								

Soil parameters taken from boring NB23

Layer	Layer Elevation				Lateral	N_{SPT}	Cohesion	Adhesion	Ult. Load	Layer	Depth to	Effective	β	f_{max}	Soil Type	delta Lat. Res.			q_T	z/B	Nc	q_T	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res.		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?			Factor	Transfer	Thickness	Layer Center	Vert. Stress			G= gran.	Cohesive	Friction		(granular)		(cohesive)	(cohesive)	Capacity	B.C.?	to	(skin)		(Tot)				(Skin)			
							c	α	f_{sl}			(Cen. Lay.)			C=cohes.		(comp)	(tensile)					(B.C.)		midlayer										
(-)	(m)	(feet)	(m)	(feet)		blows/ft	(psf)		(psf)	(feet)	(feet)	(psf)		(psf)		(ton)	(ton)	(ton)	(psf)	(-)	(-)	(psf)	(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			126.18	414.0								0		0	g								0	n	414.0	0	0	0.0	0	130	1157	0	0	65	579
1	126.18	414.0	124.78	409.4	N	13	0	0.55	0	4.6	2.3	270.0	1.2	0	g	0.0	0.0	0.0	15600	0.0	6.02	0	11	n	412.9	0.0	0	0.0	0	130	1157	0.0	0	65	579
2	124.78	409.4	122.83	403.0	Y	13	2000	0.55	1100	6.4	7.8	909.0	1.1	1021	c	14.7	0.0	0.0	15600	4.8	9.00	18000	13	n	405.5	14.7	131	14.7	131	130	1157	14.7	131	65	579
3	122.83	403.0	118.26	388.0	Y	50	0	0.55	0	15.0	18.5	2334.0	0.9	2146	g	0.0	67.4	47.2	60000	16.1	9.00	0	42	n	393.8	82.2	731	82.2	731	130	1157	61.9	551	65	579
4	118.26	388.0	115.82	380.0	Y	10	1000	0.55	550	8.0	30	3954.0	0.8	3007	c	9.2	0.0	0.0	12000	22.1	9.00	9000	6	n	373.0	91.4	813	91.4	813	130	1157	71.1	633	65	579
5	115.82	380.0	110.64	363.0	Y	70	0	0.55	0	17.0	42.5	5192.3	0.6	3219	g	0.0	114.6	80.2	84000	34.8	9.00	0	59	y	358.8	206.0	1833	264.6	2355	130	1157	151.4	1347	65	579
6	110.64	363.0	106.37	349.0	Y	27	1400	0.55	770	14.0	58	6486.0	0.5	3061	c	22.6	0.0	0.0	32400	45.3	9.00	12600	9	y	334.0	228.5	2034	237.3	2112	130	1157	173.9	1547	65	579
7	106.37	349.0	104.24	342.0	Y	100	0	0.55	0	7.0	68.5	7212.0	0.4	2760	g	0.0	40.5	28.3	90000	50.6	9.00	0	63	y	314.8	269.0	2394	331.8	2953	130	1157	202.3	1799	65	579
8	104.24	342.0	99.66	327.0	Y	55	2800	0.55	1540	15.0	79.5	8010.6	0.3	2374	c	48.4	0.0	0.0	66000	61.8	9.00	25200	18	y	302.3	317.4	2825	335.0	2981	130	1157	250.6	2230	65	579
9	99.66	327.0	96.62	317.0	Y	100	0	1.55	0	10.0	92	8954.4	0.25	2239	g	0.0	46.9	32.8	90000	69.3	9.00	0	63	y	281.0	364.3	3242	427.1	3801	130	1157	283.5	2522	65	579
Bottom	96.62	317.0																																	





Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Mocho Access Bridge Abutments 1 Pile Lateral Resistance 16 inch CIDH Pile**	Figure G-1
	URS		

X:/Route 84/geotech/Analysis/Pile Design/Lateral/Arroyo Mocho Access Bridge/Arroyo Mocho Access Bridge_Abutment 1.grf

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo Mocho Access Bridge\
Name of input data file: ArroyoMocho Access_Abut_1_ Fixed.lpd
Name of output file: ArroyoMocho Access_Abut_1_ Fixed.lpo
Name of plot output file: ArroyoMocho Access_Abut_1_ Fixed.lpp
Name of runtime file: ArroyoMocho Access_Abut_1_ Fixed.lpr

Time and Date of Analysis

Date: December 1, 2009 Time: 15:22:28

Problem Title

SR84 Isabel Abutment - Arroyo Mocho Access Bridge - 16 inch CIDH Pile - Fixed

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 70
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 402.00 in
Depth of ground surface below top of pile = -55.20 in
Slope angle of ground surface = 26.56 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	16.000	3217.0000	201.1000	3600000.000
2	402.0000	16.000	3217.0000	201.1000	3600000.000

Soil and Rock Layering Information

The soil profile is modelled using 9 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -55.200 in
Distance from top of pile to bottom of layer = .000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 76.800 in
p-y subgrade modulus k for top of soil layer = 825.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 825.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 76.800 in
Distance from top of pile to bottom of layer = 256.800 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 256.800 in
Distance from top of pile to bottom of layer = 352.800 in
p-y subgrade modulus k for top of soil layer = 100.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 100.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 352.800 in
Distance from top of pile to bottom of layer = 556.800 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 556.800 in
Distance from top of pile to bottom of layer = 724.800 in
p-y subgrade modulus k for top of soil layer = 260.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 260.000 lbs/in**3

Layer 7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 724.800 in
Distance from top of pile to bottom of layer = 808.800 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 8 is stiff clay without free water
Distance from top of pile to top of layer = 808.800 in
Distance from top of pile to bottom of layer = 988.800 in
p-y subgrade modulus k for top of soil layer = 700.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 700.000 lbs/in**3

Layer 9 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 988.800 in
Distance from top of pile to bottom of layer = 1108.800 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

(Depth of lowest layer extends 706.80 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 18 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-55.20	.07520
2	.00	.07520
3	.00	.07230
4	76.80	.07230
5	76.80	.07810

6	256.80	.07810
7	256.80	.07230
8	352.80	.07230
9	352.80	.07810
10	556.80	.07810
11	556.80	.04200
12	724.80	.04200
13	724.80	.03910
14	808.80	.03910
15	808.80	.04200
16	988.80	.04200
17	988.80	.03910
18	1108.80	.03910

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 18 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-55.200	.00000	30.00	------	------
2	.000	.00000	30.00	------	------
3	.000	13.89000	.00	.00700	.0
4	76.800	13.89000	.00	.00700	.0
5	76.800	.00000	40.00	------	------
6	256.800	.00000	40.00	------	------
7	256.800	6.94400	.00	.00700	.0
8	352.800	6.94400	.00	.00700	.0
9	352.800	.00000	44.00	------	------
10	556.800	.00000	44.00	------	------
11	556.800	9.72200	.00	.00700	.0
12	724.800	9.72200	.00	.00700	.0
13	724.800	.00000	44.00	------	------
14	808.800	.00000	44.00	------	------
15	808.800	19.44400	.00	.00600	.0
16	988.800	19.44400	.00	.00600	.0
17	988.800	.00000	44.00	------	------
18	1108.800	.00000	44.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .100 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .200 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .300 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .400 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .500 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .600 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .700 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

Deflection at pile head = .800 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .900 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.000 in
Slope at pile head = .000 in/in
Axial load at pile head = 130000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	-6.613E+05	18745.6153	0.0000	2290.9358	-171.8164
5.743	.099058	-5.563E+05	17725.5370	-3.019E-04	2029.9659	-183.4347
11.486	.096532	-4.572E+05	16641.2129	-5.532E-04	1783.5283	-194.1906
17.229	.092704	-3.644E+05	15497.7082	-7.569E-04	1552.5963	-204.0449
22.971	.087839	-2.781E+05	14300.3140	-9.162E-04	1338.0637	-212.9581
28.714	.082181	-1.988E+05	13054.5464	-.001034	1140.7408	-220.8913
34.457	.075957	-1.266E+05	11766.1417	-.001115	961.3515	-227.8069
40.200	.069373	-61961.2839	10441.0467	-.001162	800.5292	-233.6690
45.943	.062612	-4974.1792	9085.4081	-.001179	658.8143	-238.4440
51.686	.055837	44150.7878	7705.5599	-.001169	756.2382	-242.1002
57.429	.049187	85274.8476	6308.0129	-.001137	858.5051	-244.6078
63.171	.042781	1.183E+05	4899.4463	-.001086	940.6319	-245.9378
68.914	.036711	1.432E+05	3486.7099	-.001021	1002.4791	-246.0599
74.657	.031049	1.599E+05	2076.8450	-9.463E-04	1044.0138	-244.9378
80.400	.025843	1.684E+05	1075.0882	-8.649E-04	1065.3126	-103.9327
86.143	.021116	1.735E+05	491.6437	-7.801E-04	1077.9323	-99.2569
91.886	.016883	1.752E+05	-71.0561	-6.936E-04	1082.2517	-96.7082
97.629	.013149	1.737E+05	-618.3348	-6.071E-04	1078.4782	-93.8864
103.371	.009910	1.691E+05	-1142.6737	-5.221E-04	1066.8447	-88.7192
109.114	.007153	1.614E+05	-1630.4411	-4.402E-04	1047.7792	-81.1501
114.857	.004855	1.510E+05	-2067.6340	-3.627E-04	1021.9095	-71.1062
120.600	.002987	1.382E+05	-2439.5034	-2.910E-04	990.0691	-58.4006
126.343	.001512	1.234E+05	-2722.9884	-2.262E-04	953.3117	-40.3255

132.086	3.89E-04	1.072E+05	-2870.0249	-1.690E-04	913.1333	-10.8812
137.829	-4.28E-04	90686.9542	-2865.2823	-1.199E-04	871.9639	12.5329
143.571	-9.88E-04	74511.4454	-2742.6561	-7.894E-05	831.7388	30.1728
149.314	-.001335	59303.4620	-2533.9707	-4.576E-05	793.9197	42.5037
155.057	-.001514	45475.3151	-2267.9569	-1.979E-05	759.5321	50.1379
160.800	-.001562	33283.9004	-1969.5761	-2.584E-07	729.2146	53.7758
166.543	-.001517	22853.7124	-1659.6594	1.366E-05	703.2769	54.1554
172.286	-.001406	14201.1301	-1354.8185	2.285E-05	681.7598	52.0081
178.029	-.001254	7258.5397	-1067.5793	2.817E-05	664.4950	48.0254
183.771	-.001082	1897.1594	-806.6858	3.044E-05	651.1624	42.8331
189.514	-9.05E-04	-2052.2713	-577.5223	3.040E-05	651.5481	36.9751
195.257	-7.33E-04	-4781.4879	-382.6097	2.871E-05	658.3351	30.9049
201.000	-5.75E-04	-6489.6781	-222.1319	2.591E-05	662.5830	24.9829
206.743	-4.35E-04	-7371.5202	-94.4612	2.247E-05	664.7760	19.4795
212.486	-3.17E-04	-7608.1903	3.3445	1.876E-05	665.3645	14.5822
218.229	-2.20E-04	-7361.1185	75.0904	1.505E-05	664.7501	10.4040
223.971	-1.44E-04	-6768.1932	125.0500	1.155E-05	663.2756	6.9949
229.714	-8.72E-05	-5942.0686	157.6309	8.394E-06	661.2212	4.3517
235.457	-4.74E-05	-4970.2234	177.1005	5.689E-06	658.8045	2.4287
241.200	-2.18E-05	-3916.4373	187.3658	3.485E-06	656.1839	1.1462
246.943	-7.39E-06	-2823.3977	191.7990	1.814E-06	653.4657	.3977
252.686	-9.93E-07	-1716.1981	193.0979	6.887E-07	650.7124	.054699
258.429	5.18E-07	-606.5591	147.3995	1.127E-07	647.9529	-15.9695
264.171	3.02E-07	-23.3774	60.8216	-4.344E-08	646.5027	-14.1820
269.914	1.94E-08	92.0858	2.6924	-2.640E-08	646.6736	-6.0621
275.657	-1.11E-09	7.5860	-8.0511	-1.689E-09	646.4634	2.3205
281.400	-6.13E-12	-.3848	-.6606	9.647E-11	646.4455	.2533
287.143	5.31E-16	-.002152	.033502	5.334E-13	646.4446	-.011537
292.886	3.00E-18	1.843E-07	1.873E-04	-4.621E-17	646.4446	-6.525E-05
298.629	-2.54E-22	1.054E-09	-1.604E-08	-2.614E-19	646.4446	5.524E-09
304.371	-1.47E-24	-8.821E-14	-9.180E-11	2.213E-23	646.4446	3.198E-11
310.114	0.000	-5.167E-16	7.680E-15	1.281E-25	646.4446	-2.643E-15
315.857	0.000	4.220E-20	4.499E-17	0.0000	646.4446	-1.567E-17
321.600	0.000	2.532E-22	-3.674E-21	0.0000	646.4446	1.264E-21
327.343	0.000	0.0000	-2.204E-23	0.0000	646.4446	7.678E-24
333.086	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
338.829	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
344.571	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
350.314	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = .10000000 in

Computed slope at pile head = 0.000
Maximum bending moment = -661291.026 lbs-in
Maximum shear force = 18745.615 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 9
Number of zero deflection points = 10

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .200000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	-1.052E+06	26139.0688	0.0000	3261.3762	-204.3253
5.743	.198503	-9.046E+05	24925.6801	-4.850E-04	2895.9719	-218.2479
11.486	.194429	-7.645E+05	23634.7234	-8.988E-04	2547.6344	-231.3391
17.229	.188179	-6.318E+05	22271.1097	-.001245	2217.5665	-243.5513
22.971	.180129	-5.069E+05	20840.0212	-.001527	1906.8918	-254.8377
28.714	.170636	-3.901E+05	19346.9065	-.001750	1616.6511	-265.1525
34.457	.160032	-2.820E+05	17797.4733	-.001916	1347.7978	-274.4511
40.200	.148625	-1.829E+05	16197.6813	-.002032	1101.1941	-282.6904
45.943	.136697	-92956.1762	14553.7346	-.002100	877.6069	-289.8284
51.686	.124504	-12570.4359	12872.0747	-.002126	677.7046	-295.8243
57.429	.112276	58063.5523	11159.3763	-.002115	790.8364	-300.6378
63.171	.100213	1.188E+05	9422.5453	-.002071	941.7778	-304.2287
68.914	.088488	1.694E+05	7668.7238	-.002000	1067.6585	-306.5549
74.657	.077245	2.098E+05	5905.3059	-.001906	1168.2411	-307.5707
80.400	.066600	2.401E+05	4503.3098	-.001794	1243.4050	-180.6866
86.143	.056639	2.642E+05	3468.0923	-.001669	1303.5288	-179.8369
91.886	.047430	2.824E+05	2431.4113	-.001534	1348.6600	-181.1963
97.629	.039025	2.944E+05	1388.8832	-.001391	1378.6704	-181.8732
103.371	.031459	3.004E+05	352.5752	-.001243	1393.4933	-179.0301
109.114	.024748	3.004E+05	-656.9643	-.001094	1393.3564	-172.5508
114.857	.018892	2.945E+05	-1618.6965	-9.466E-04	1378.7912	-162.3808
120.600	.013875	2.832E+05	-2511.3883	-8.034E-04	1350.6371	-148.5069
126.343	.009665	2.668E+05	-3313.7180	-6.670E-04	1310.0425	-130.9114
132.086	.006214	2.461E+05	-4003.9347	-5.398E-04	1258.4656	-109.4626
137.829	.003465	2.217E+05	-4558.3248	-4.238E-04	1197.6844	-83.6086
143.571	.001346	1.944E+05	-4916.4586	-3.207E-04	1129.8420	-41.1147
149.314	-2.19E-04	1.657E+05	-5014.5301	-2.314E-04	1058.4486	6.9604
155.057	-.001312	1.371E+05	-4869.7783	-1.563E-04	987.4735	43.4507
160.800	-.002014	1.100E+05	-4545.9520	-9.506E-05	919.9358	69.3246
166.543	-.002404	85064.6878	-4100.4359	-4.670E-05	857.9825	85.8302
172.286	-.002551	62950.9498	-3582.9794	-1.000E-05	802.9903	94.3785
178.029	-.002518	43926.5485	-3035.0519	1.649E-05	755.6806	96.4420

183.771	-.002361	28066.5816	-2489.7320	3.434E-05	716.2402	93.4704
189.514	-.002124	15278.9168	-1972.0262	4.509E-05	684.4400	86.8251
195.257	-.001843	5349.1242	-1499.5121	5.021E-05	659.7467	77.7320
201.000	-.001547	-2019.0152	-1083.2026	5.103E-05	651.4654	67.2514
206.743	-.001257	-7168.4290	-728.5390	4.875E-05	664.2709	56.2633
212.486	-9.87E-04	-10459.6028	-436.4328	4.438E-05	672.4554	45.4652
218.229	-7.47E-04	-12247.4421	-204.2913	3.875E-05	676.9014	35.3801
223.971	-5.42E-04	-12863.8984	-26.9781	3.253E-05	678.4344	26.3708
229.714	-3.74E-04	-12605.8719	102.3257	2.621E-05	677.7927	18.6604
235.457	-2.41E-04	-11727.7526	191.3784	2.018E-05	675.6090	12.3530
241.200	-1.42E-04	-10437.8838	248.2607	1.468E-05	672.4014	7.4567
246.943	-7.26E-05	-8898.2256	280.8799	9.889E-06	668.5726	3.9032
252.686	-2.84E-05	-7226.5432	296.5852	5.891E-06	664.4154	1.5663
258.429	-4.89E-06	-5500.5294	396.9951	2.735E-06	660.1232	33.4024
264.171	2.99E-06	-2670.8552	413.4258	7.095E-07	653.0864	-27.6802
269.914	3.26E-06	-753.0981	250.9728	-1.394E-07	648.3174	-28.8954
275.657	1.39E-06	211.9545	99.8609	-2.736E-07	646.9716	-23.7306
281.400	1.18E-07	394.2836	-13.1030	-1.233E-07	647.4251	-15.6101
287.143	-2.91E-08	61.6409	-35.2013	-1.027E-08	646.5978	7.9141
292.886	-2.88E-10	-10.0129	-5.3752	2.533E-09	646.4695	2.4730
298.629	2.51E-13	-.1014	.8718	2.510E-11	646.4448	-.2974
304.371	1.42E-16	8.787E-05	.008830	-2.181E-14	646.4446	-.003080
310.114	-1.22E-19	4.985E-08	-7.650E-06	-1.234E-17	646.4446	2.661E-06
315.857	-6.97E-23	-4.295E-11	-4.340E-09	1.066E-20	646.4446	1.514E-09
321.600	0.000	-2.451E-14	3.739E-12	6.066E-24	646.4446	-1.301E-12
327.343	0.000	2.099E-17	2.134E-15	0.0000	646.4446	-7.443E-16
333.086	0.000	1.205E-20	-1.828E-18	0.0000	646.4446	6.357E-19
338.829	0.000	-1.026E-23	-1.049E-21	0.0000	646.4446	3.659E-22
344.571	0.000	0.0000	8.932E-25	0.0000	646.4446	-3.107E-25
350.314	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1051529.383 lbs-in
Maximum shear force	=	26139.069 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	9

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .300000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	-1.398E+06	32158.3207	0.0000	4123.9480	-226.1231
5.743	.298009	-1.217E+06	30815.3371	-6.485E-04	3673.3153	-241.5826
11.486	.292551	-1.043E+06	29385.9394	-.001209	3241.3755	-256.2176
17.229	.284123	-8.779E+05	27875.0142	-.001685	2829.4888	-269.9752
22.971	.273194	-7.208E+05	26287.7491	-.002082	2438.9360	-282.8036
28.714	.260212	-5.728E+05	24629.6266	-.002402	2070.9139	-294.6520
34.457	.245599	-4.343E+05	22906.4175	-.002652	1726.5304	-305.4706
40.200	.229750	-3.058E+05	21124.1753	-.002836	1406.8003	-315.2108
45.943	.213029	-1.875E+05	19289.2305	-.002958	1112.6408	-323.8247
51.686	.195775	-79790.7629	17408.1865	-.003024	844.8673	-331.2652
57.429	.178294	16991.9256	15487.9181	-.003040	688.6999	-337.4850
63.171	.160860	1.026E+05	13535.5725	-.003010	901.6834	-342.4364
68.914	.143720	1.770E+05	11558.5752	-.002941	1086.4874	-346.0702
74.657	.127083	2.398E+05	9564.6430	-.002838	1242.7455	-348.3340
80.400	.111129	2.910E+05	7864.6850	-.002706	1370.2141	-243.6911
86.143	.096004	3.342E+05	6455.2839	-.002551	1477.4283	-247.1451
91.886	.081830	3.690E+05	5020.7601	-.002377	1564.0652	-252.4404
97.629	.068707	3.954E+05	3559.3066	-.002187	1629.6584	-256.5236
103.371	.056710	4.131E+05	2087.1513	-.001987	1673.8488	-256.1673
109.114	.045890	4.223E+05	630.3686	-.001779	1696.6492	-251.1699
114.857	.036272	4.230E+05	-784.0642	-.001570	1698.4610	-241.4186
120.600	.027859	4.157E+05	-2128.7520	-.001362	1680.0833	-226.8806
126.343	.020630	4.006E+05	-3376.2720	-.001159	1642.7153	-207.5791
132.086	.014542	3.786E+05	-4499.3471	-9.663E-04	1587.9537	-183.5416
137.829	.009532	3.504E+05	-5470.5262	-7.856E-04	1517.7904	-154.6800
143.571	.005519	3.169E+05	-6260.6046	-6.201E-04	1434.6184	-120.4717
149.314	.002409	2.794E+05	-6826.7640	-4.722E-04	1341.2741	-76.6983
155.057	9.53E-05	2.392E+05	-7056.0577	-3.436E-04	1241.3821	-3.1552
160.800	-.001538	1.989E+05	-6913.1626	-2.350E-04	1141.0111	52.9197
166.543	-.002604	1.602E+05	-6494.1934	-1.460E-04	1044.7972	92.9900
172.286	-.003214	1.245E+05	-5885.6601	-7.540E-05	956.0625	118.9371
178.029	-.003470	92699.1463	-5162.5745	-2.155E-05	876.9678	132.8838
183.771	-.003462	65241.4284	-4387.5035	1.761E-05	808.6862	137.0414
189.514	-.003268	42279.2383	-3610.4255	4.427E-05	751.5841	133.5828
195.257	-.002953	23707.0115	-2869.2287	6.063E-05	705.3989	124.5454
201.000	-.002571	9233.5679	-2190.6909	6.880E-05	669.4065	111.7613
206.743	-.002163	-1557.3622	-1591.7842	7.070E-05	650.3174	96.8132
212.486	-.001759	-9154.7771	-1081.1652	6.804E-05	669.2106	81.0143
218.229	-.001382	-14076.9172	-660.7295	6.228E-05	681.4509	65.4061
223.971	-.001044	-16836.7270	-327.1349	5.462E-05	688.3139	50.7711
229.714	-7.54E-04	-17915.8512	-73.2191	4.600E-05	690.9975	37.6573

235.457	-5.16E-04	-17746.3904	110.7391	3.716E-05	690.5761	26.4078
241.200	-3.27E-04	-16699.4213	235.9413	2.862E-05	687.9725	17.1950
246.943	-1.87E-04	-15079.1717	314.1863	2.074E-05	683.9433	10.0545
252.686	-8.92E-05	-13121.7376	357.1744	1.375E-05	679.0755	4.9165
258.429	-2.90E-05	-10997.2991	516.3726	7.770E-06	673.7925	50.5257
264.171	3.40E-10	-7202.4306	658.3895	3.257E-06	664.3555	-1.0671
269.914	8.45E-06	-3440.0896	548.0052	6.187E-07	654.9993	-37.3752
275.657	7.11E-06	-909.1231	336.8475	-4.597E-07	648.7054	-36.1624
281.400	3.17E-06	429.5304	145.2150	-5.786E-07	647.5127	-30.5753
287.143	4.61E-07	759.6391	-18.2755	-2.837E-07	648.3336	-26.3617
292.886	-8.72E-08	220.0465	-68.2948	-4.084E-08	646.9918	8.9421
298.629	-8.39E-09	-24.7148	-19.4141	7.590E-09	646.5060	8.0811
304.371	3.61E-12	-2.9495	2.1520	7.307E-10	646.4519	-.5705
310.114	4.12E-15	.001264	.2568	-3.141E-13	646.4446	-.089507
315.857	-1.76E-18	1.447E-06	-1.100E-04	-3.585E-16	646.4446	3.824E-05
321.600	-2.02E-21	-6.164E-10	-1.260E-07	1.532E-19	646.4446	4.392E-08
327.343	8.58E-25	-7.102E-13	5.366E-11	1.759E-22	646.4446	-1.865E-11
333.086	0.000	3.006E-16	6.184E-14	0.0000	646.4446	-2.155E-14
338.829	0.000	3.485E-19	-2.617E-17	0.0000	646.4446	9.092E-18
344.571	0.000	-1.466E-22	-3.034E-20	0.0000	646.4446	1.058E-20
350.314	0.000	0.0000	1.276E-23	0.0000	646.4446	-4.442E-24
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =      .30000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =   -1398391.071 lbs-in
Maximum shear force              =      32158.321 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =             10
Number of zero deflection points =              8
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .400000 in

Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	-1.722E+06	37495.7147	0.0000	4929.6118	-242.9851
5.743	.397548	-1.511E+06	36052.4901	-8.016E-04	4403.2967	-259.6305
11.486	.390793	-1.307E+06	34516.0406	-.001500	3896.8844	-275.4514
17.229	.380316	-1.112E+06	32891.2635	-.002100	3411.8600	-290.3914
22.971	.366672	-9.262E+05	31183.3783	-.002605	2949.6284	-304.3945
28.714	.350391	-7.500E+05	29397.9212	-.003021	2511.5091	-317.4064
34.457	.331974	-5.840E+05	27540.7389	-.003352	2098.7315	-329.3735
40.200	.311894	-4.287E+05	25617.9833	-.003603	1712.4300	-340.2429
45.943	.290593	-2.844E+05	23636.1078	-.003780	1353.6390	-349.9625
51.686	.268483	-1.515E+05	21601.8646	-.003888	1023.2884	-358.4804
57.429	.245941	-30462.8529	19522.3044	-.003933	722.1992	-365.7446
63.171	.223312	78561.5090	17404.7786	-.003921	841.8104	-371.7022
68.914	.200907	1.753E+05	15256.9461	-.003858	1082.3734	-376.2992
74.657	.179001	2.596E+05	13086.7839	-.003750	1291.9127	-379.4787
80.400	.157834	3.312E+05	11138.1914	-.003604	1470.0900	-299.1356
86.143	.137610	3.929E+05	9397.6750	-.003424	1623.4286	-307.0144
91.886	.118505	4.443E+05	7608.2051	-.003217	1751.2257	-316.1841
97.629	.100666	4.851E+05	5771.1698	-.002986	1852.6819	-323.5794
103.371	.084207	5.150E+05	3906.6144	-.002738	1927.1530	-325.7682
109.114	.069215	5.340E+05	2045.2532	-.002478	1974.4320	-322.4671
114.857	.055744	5.422E+05	219.1184	-.002211	1994.7722	-313.5003
120.600	.043817	5.398E+05	-1539.0456	-.001943	1988.9013	-298.7956
126.343	.033428	5.274E+05	-3196.3340	-.001678	1958.0277	-278.3695
132.086	.024540	5.056E+05	-4720.0929	-.001422	1903.8379	-252.2928
137.829	.017092	4.753E+05	-6078.0215	-.001179	1828.4908	-220.6176
143.571	.010998	4.376E+05	-7237.5685	-9.527E-04	1734.6120	-183.2047
149.314	.006150	3.936E+05	-8163.4605	-7.466E-04	1625.3048	-139.2452
155.057	.002423	3.449E+05	-8793.7701	-5.635E-04	1504.2150	-80.2656
160.800	-3.22E-04	2.935E+05	-8992.4520	-4.052E-04	1376.2246	11.0729
166.543	-.002231	2.423E+05	-8731.9132	-2.724E-04	1248.8722	79.6620
172.286	-.003450	1.936E+05	-8136.6083	-1.643E-04	1127.8302	127.6581
178.029	-.004118	1.490E+05	-7317.2365	-7.936E-05	1017.0800	157.6952
183.771	-.004362	1.097E+05	-6368.6543	-1.522E-05	919.1260	172.6568
189.514	-.004293	75915.9559	-5368.9956	3.079E-05	835.2315	175.4830
195.257	-.004008	47939.2925	-4379.7947	6.150E-05	765.6595	169.0148
201.000	-.003586	25519.0594	-3446.8915	7.971E-05	709.9051	155.8768
206.743	-.003092	8230.2602	-2601.9044	8.808E-05	666.9115	138.3973
212.486	-.002575	-4497.1863	-1864.0652	8.901E-05	657.6281	118.5616
218.229	-.002070	-13312.7572	-1242.2391	8.459E-05	679.5506	97.9947
223.971	-.001603	-18891.4938	-736.9773	7.660E-05	693.4237	77.9671
229.714	-.001190	-21891.8501	-342.4835	6.649E-05	700.8850	59.4188
235.457	-8.40E-04	-22924.4446	-48.4064	5.538E-05	703.4528	42.9961
241.200	-5.54E-04	-22530.5239	158.5978	4.411E-05	702.4732	29.0949
246.943	-3.33E-04	-21168.7004	293.5633	3.328E-05	699.0866	17.9080
252.686	-1.72E-04	-19208.4259	372.1788	2.327E-05	694.2119	9.4705
258.429	-6.56E-05	-16928.6993	578.0745	1.431E-05	688.5427	62.2344
264.171	-7.59E-06	-12590.1881	862.4558	6.987E-06	677.7537	36.8038
269.914	1.46E-05	-7033.2112	844.6963	2.121E-06	663.9347	-42.9887
275.657	1.68E-05	-2891.4148	591.4320	-3.393E-07	653.6349	-45.2128
281.400	1.07E-05	-239.6855	342.2320	-1.116E-06	647.0406	-41.5732

287.143	3.96E-06	1041.0303	123.4166	-9.169E-07	649.0334	-34.6312
292.886	1.77E-07	1179.2113	-70.1655	-3.664E-07	649.3770	-32.7855
298.629	-2.48E-07	235.6769	-110.1371	-1.560E-08	647.0306	18.8650
304.371	-1.72E-09	-85.7689	-20.5705	2.157E-08	646.6578	12.3273
310.114	2.57E-11	-.6220	7.4682	1.497E-10	646.4461	-2.5626
315.857	8.93E-16	.009040	.054153	-2.241E-12	646.4446	-.019407
321.600	-1.26E-17	3.224E-07	-7.871E-04	-7.774E-17	646.4446	2.741E-04
327.343	-4.62E-22	-4.428E-09	-2.807E-08	1.098E-18	646.4446	1.004E-08
333.086	6.18E-24	-1.666E-13	3.855E-10	4.024E-23	646.4446	-1.342E-10
338.829	0.000	2.169E-15	1.451E-14	-5.378E-25	646.4446	-5.183E-15
344.571	0.000	8.587E-20	-1.888E-16	0.0000	646.4446	6.575E-17
350.314	0.000	-2.775E-22	-7.496E-21	0.0000	646.4446	2.614E-21
356.057	0.000	-2.269E-22	8.665E-24	0.0000	646.4446	0.0000
361.800	0.000	-1.785E-22	8.118E-24	0.0000	646.4446	-1.214E-25
367.543	0.000	-1.340E-22	7.312E-24	0.0000	646.4446	-1.592E-25
373.286	0.000	-9.475E-23	6.321E-24	0.0000	646.4446	-1.859E-25
379.029	0.000	-6.157E-23	5.200E-24	0.0000	646.4446	-2.045E-25
384.771	0.000	-3.511E-23	3.988E-24	0.0000	646.4446	-2.176E-25
390.514	0.000	-1.582E-23	2.710E-24	0.0000	646.4446	-2.275E-25
396.257	0.000	-4.016E-24	1.379E-24	0.0000	646.4446	-2.360E-25
402.000	0.000	0.0000	0.0000	0.0000	646.4446	-2.443E-25

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection	=	.40000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1722368.633 lbs-in
Maximum shear force	=	37495.715 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	-2.031E+06	42405.1790	0.0000	5698.0497	-256.9255
5.743	.497108	-1.792E+06	40879.0861	-9.479E-04	5102.0506	-274.5497

11.486	.489113	-1.560E+06	39254.1539	-.001779	4526.9193	-291.3471
17.229	.476674	-1.338E+06	37535.3028	-.002498	3974.2462	-307.2578
22.971	.460425	-1.126E+06	35727.7924	-.003109	3445.5411	-322.2234
28.714	.440970	-9.232E+05	33837.2164	-.003617	2942.2270	-336.1862
34.457	.418886	-7.315E+05	31869.4965	-.004027	2465.6353	-349.0894
40.200	.394719	-5.511E+05	29830.8778	-.004345	2017.0009	-360.8773
45.943	.368983	-3.824E+05	27727.9260	-.004576	1597.4565	-371.4940
51.686	.342157	-2.258E+05	25567.5254	-.004727	1208.0283	-380.8843
57.429	.314689	-81706.1459	23356.8799	-.004803	849.6305	-388.9922
63.171	.286987	49615.6939	21103.5160	-.004811	769.8283	-395.7614
68.914	.259427	1.679E+05	18815.2885	-.004757	1063.8938	-401.1338
74.657	.232345	2.728E+05	16500.3911	-.004648	1324.9057	-405.0494
80.400	.206040	3.643E+05	14333.6340	-.004490	1552.4462	-349.5427
86.143	.180772	4.442E+05	12290.8848	-.004290	1750.9833	-361.8625
91.886	.156770	5.119E+05	10175.5410	-.004053	1919.4334	-374.8244
97.629	.134225	5.671E+05	7992.5068	-.003785	2056.6708	-385.4363
103.371	.113295	6.094E+05	5765.4003	-.003493	2161.7744	-390.1730
109.114	.094100	6.385E+05	3528.9956	-.003184	2234.3169	-388.6745
114.857	.076724	6.546E+05	1319.7833	-.002863	2274.3943	-380.7030
120.600	.061212	6.580E+05	-824.7286	-.002538	2282.6456	-366.1420
126.343	.047573	6.490E+05	-2866.6839	-.002214	2260.2618	-344.9867
132.086	.035783	6.283E+05	-4768.4487	-.001897	2208.9864	-317.3194
137.829	.025782	5.970E+05	-6492.9566	-.001593	2131.1075	-283.2555
143.571	.017481	5.561E+05	-8003.5629	-.001308	2029.4477	-242.8263
149.314	.010764	5.070E+05	-9262.7374	-.001044	1907.3604	-195.6921
155.057	.005491	4.513E+05	-10227.3509	-8.063E-04	1768.7566	-140.2429
160.800	.001503	3.908E+05	-10778.5703	-5.975E-04	1618.2352	-51.7240
166.543	-.001372	3.284E+05	-10786.3862	-4.192E-04	1463.1118	49.0021
172.286	-.003312	2.675E+05	-10293.7759	-2.715E-04	1311.7051	122.5537
178.029	-.004490	2.106E+05	-9448.1430	-1.529E-04	1170.1033	171.9453
183.771	-.005069	1.592E+05	-8378.2835	-6.123E-05	1042.4099	200.6426
189.514	-.005193	1.144E+05	-7192.5518	6.619E-06	931.0256	212.2988
195.257	-.004992	76606.0783	-5978.4150	5.399E-05	836.9477	210.5349
201.000	-.004573	45690.1743	-4803.1246	8.431E-05	760.0664	198.7702
206.743	-.004024	21312.8766	-3715.2287	1.009E-04	699.4452	180.0991
212.486	-.003414	2867.4292	-2746.6588	1.069E-04	653.5752	157.2138
218.229	-.002796	-10394.1030	-1915.1514	1.051E-04	672.2925	132.3658
223.971	-.002208	-19286.3077	-1226.7958	9.769E-05	694.4055	107.3600
229.714	-.001674	-24630.5956	-678.5388	8.680E-05	707.6956	83.5753
235.457	-.001211	-27209.4187	-260.5184	7.395E-05	714.1086	62.0040
241.200	-8.25E-04	-27733.2520	41.8650	6.033E-05	715.4113	43.3037
246.943	-5.18E-04	-26818.6459	246.1918	4.680E-05	713.1369	27.8549
252.686	-2.87E-04	-24975.4444	371.6025	3.396E-05	708.5532	15.8204
258.429	-1.28E-04	-22601.2320	629.7826	2.216E-05	702.6490	74.0930
264.171	-3.26E-05	-17775.0346	998.8568	1.215E-05	690.6473	54.4403
269.914	1.19E-05	-11146.7940	1048.3992	4.982E-06	674.1643	-37.1867
275.657	2.46E-05	-5740.8593	805.3361	7.948E-07	660.7209	-47.4622
281.400	2.10E-05	-1898.1207	535.6454	-1.099E-06	651.1648	-46.4600
287.143	1.20E-05	413.0524	283.7024	-1.467E-06	647.4717	-41.2814
292.886	4.16E-06	1362.5951	70.0351	-1.027E-06	649.8330	-33.1301
298.629	1.98E-07	1218.9893	-95.1331	-3.871E-07	649.4759	-24.3912
304.371	-2.89E-07	270.5020	-114.6016	-1.777E-08	647.1172	17.6111
310.114	-6.06E-09	-97.2655	-23.7379	2.518E-08	646.6864	14.0330
315.857	7.73E-11	-2.1820	8.4708	5.275E-10	646.4500	-2.8161
321.600	3.12E-15	.027157	.1900	-6.734E-12	646.4446	-.067808
327.343	-3.79E-17	1.122E-06	-.002364	-2.716E-16	646.4446	8.234E-04
333.086	-1.60E-21	-1.330E-08	-9.770E-08	3.298E-18	646.4446	3.483E-08

338.829	1.86E-23	-5.758E-13	1.158E-09	1.395E-22	646.4446	-4.033E-10
344.571	0.000	6.515E-15	5.013E-14	-1.615E-24	646.4446	-1.785E-14
350.314	0.000	7.634E-20	-5.672E-16	0.0000	646.4446	1.975E-16
356.057	0.000	6.240E-20	-2.386E-21	0.0000	646.4446	1.931E-23
361.800	0.000	4.908E-20	-2.234E-21	0.0000	646.4446	3.358E-23
367.543	0.000	3.684E-20	-2.011E-21	0.0000	646.4446	4.393E-23
373.286	0.000	2.604E-20	-1.738E-21	0.0000	646.4446	5.123E-23
379.029	0.000	1.692E-20	-1.429E-21	0.0000	646.4446	5.629E-23
384.771	0.000	9.645E-21	-1.096E-21	0.0000	646.4446	5.985E-23
390.514	0.000	4.343E-21	-7.445E-22	0.0000	646.4446	6.254E-23
396.257	0.000	1.103E-21	-3.787E-22	0.0000	646.4446	6.484E-23
402.000	0.000	0.0000	0.0000	0.0000	646.4446	6.706E-23

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-2031376.730 lbs-in
Maximum shear force	=	42405.179 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	7

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .600000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	-2.330E+06	47014.2042	0.0000	6439.6666	-268.9072
5.743	.596683	-2.064E+06	45416.8885	-.001089	5778.1988	-287.3719
11.486	.587489	-1.806E+06	43715.9177	-.002049	5138.4001	-305.0060
17.229	.573152	-1.558E+06	41916.2404	-.002883	4521.9535	-321.7473
22.971	.554376	-1.321E+06	40023.1591	-.003597	3930.4605	-337.5347
28.714	.531839	-1.093E+06	38042.3246	-.004195	3365.4347	-352.3081
34.457	.506189	-8.774E+05	35979.7302	-.004684	2828.2969	-366.0083
40.200	.478041	-6.731E+05	33841.7079	-.005068	2320.3697	-378.5766
45.943	.447975	-4.811E+05	31634.9259	-.005355	1842.8719	-389.9545
51.686	.416539	-3.018E+05	29366.3878	-.005549	1396.9134	-400.0837
57.429	.384244	-1.355E+05	27043.4336	-.005657	983.4901	-408.9054

63.171	.351563	17277.7550	24673.7432	-.005686	689.4107	-416.3600
68.914	.318932	1.564E+05	22265.3424	-.005643	1035.2585	-422.3866
74.657	.286745	2.814E+05	19826.6121	-.005535	1346.3202	-426.9225
80.400	.255360	3.923E+05	17462.9658	-.005368	1622.1087	-396.2379
86.143	.225092	4.900E+05	15139.3844	-.005149	1865.0383	-412.9695
91.886	.196220	5.739E+05	12719.9151	-.004885	2073.6470	-429.6318
97.629	.168982	6.434E+05	10213.1787	-.004583	2246.4910	-443.3610
103.371	.143576	6.981E+05	7646.1948	-.004251	2382.3802	-450.6135
109.114	.120158	7.376E+05	5057.4013	-.003895	2480.6695	-450.9564
114.857	.098841	7.620E+05	2487.3361	-.003523	2541.2945	-444.0911
120.600	.079694	7.714E+05	-22.1371	-.003143	2564.7957	-429.8547
126.343	.062743	7.664E+05	-2428.5916	-.002762	2552.3321	-408.2140
132.086	.047975	7.476E+05	-4689.7286	-.002386	2505.6830	-379.2466
137.829	.035336	7.161E+05	-6763.8909	-.002023	2427.2417	-343.0984
143.571	.024736	6.730E+05	-8610.1961	-.001679	2320.0017	-299.8934
149.314	.016053	6.197E+05	-10187.8202	-.001358	2187.5464	-249.5279
155.057	.009135	5.580E+05	-11453.0801	-.001066	2034.0553	-191.1099
160.800	.003806	4.898E+05	-12348.6394	-8.066E-04	1864.3767	-120.7764
166.543	-1.29E-04	4.174E+05	-12682.1999	-5.817E-04	1684.3416	4.6111
172.286	-.002875	3.450E+05	-12363.4736	-3.926E-04	1504.3005	106.3881
178.029	-.004639	2.759E+05	-11547.8992	-2.387E-04	1332.6673	177.6428
183.771	-.005617	2.127E+05	-10399.3561	-1.175E-04	1175.3494	222.3474
189.514	-.005989	1.567E+05	-9057.9178	-2.596E-05	1036.0716	244.8201
195.257	-.005915	1.087E+05	-7638.6879	3.983E-05	916.7286	249.4391
201.000	-.005532	68883.5334	-6232.1085	8.386E-05	817.7434	240.4144
206.743	-.004952	36982.5516	-4905.4111	1.101E-04	738.4124	221.6195
212.486	-.004267	12376.9802	-3704.8767	1.223E-04	677.2235	196.4771
218.229	-.003547	-5753.2799	-2658.6059	1.240E-04	660.7517	167.8959
223.971	-.002843	-18344.1352	-1779.5292	1.180E-04	692.0625	138.2502
229.714	-.002191	-26368.6503	-1068.4375	1.069E-04	712.0178	109.3936
235.457	-.001615	-30775.5572	-516.8575	9.276E-05	722.9769	82.6989
241.200	-.001126	-32443.6263	-109.6454	7.708E-05	727.1250	59.1162
246.943	-7.29E-04	-32150.0080	172.7795	6.107E-05	726.3948	39.2407
252.686	-4.24E-04	-30550.3121	352.6037	4.552E-05	722.4167	23.3846
258.429	-2.07E-04	-28168.0723	659.7114	3.096E-05	716.4926	83.5683
264.171	-6.88E-05	-23019.2872	1086.3450	1.827E-05	703.6887	65.0106
269.914	3.31E-06	-15717.9047	1218.1896	8.667E-06	685.5317	-19.0946
275.657	3.07E-05	-9040.4500	1022.0819	2.528E-06	668.9262	-49.2016
281.400	3.23E-05	-3982.3381	734.4166	-7.008E-07	656.3478	-50.9803
287.143	2.27E-05	-604.1041	451.7013	-1.838E-06	647.9468	-47.4777
292.886	1.12E-05	1208.5183	197.3331	-1.688E-06	649.4499	-41.1082
298.629	3.26E-06	1664.9284	-15.0144	-9.757E-07	650.5849	-32.8437
304.371	2.85E-08	1037.5236	-128.9487	-3.057E-07	649.0247	-6.8349
310.114	-2.50E-07	184.3165	-97.7941	-2.719E-09	646.9029	17.6848
315.857	-2.73E-09	-85.7077	-16.1296	2.173E-08	646.6577	10.7556
321.600	2.43E-11	-.9764	7.4629	2.379E-10	646.4470	-2.5393
327.343	1.39E-15	.008531	.085012	-2.115E-12	646.4446	-.030124
333.086	-1.19E-17	4.950E-07	-7.427E-04	-1.207E-16	646.4446	2.586E-04
338.829	-7.02E-22	-4.178E-09	-4.310E-08	1.036E-18	646.4446	1.526E-08
344.571	5.83E-24	-2.507E-13	3.638E-10	6.114E-23	646.4446	-1.267E-10
350.314	0.000	5.346E-16	2.186E-14	-8.822E-25	646.4446	-7.621E-15
356.057	-4.30E-24	4.371E-16	-1.669E-17	-6.413E-25	646.4446	1.336E-19
361.800	-7.37E-24	3.439E-16	-1.564E-17	-4.476E-25	646.4446	2.338E-19
367.543	-9.45E-24	2.582E-16	-1.409E-17	-2.984E-25	646.4446	3.067E-19
373.286	-1.08E-23	1.825E-16	-1.218E-17	-1.891E-25	646.4446	3.581E-19
379.029	-1.16E-23	1.186E-16	-1.002E-17	-1.144E-25	646.4446	3.939E-19
384.771	-1.21E-23	6.764E-17	-7.683E-18	0.0000	646.4446	4.191E-19

390.514	-1.24E-23	3.047E-17	-5.221E-18	0.0000	646.4446	4.383E-19
396.257	-1.26E-23	7.736E-18	-2.657E-18	0.0000	646.4446	4.547E-19
402.000	-1.28E-23	0.0000	0.0000	0.0000	646.4446	4.706E-19

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-2329599.414 lbs-in
Maximum shear force	=	47014.204 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	7

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .700000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	-2.619E+06	51396.3479	0.0000	7160.2374	-279.4725
5.743	.696270	-2.328E+06	49736.2308	-.001227	6436.4869	-298.6777
11.486	.685910	-2.046E+06	47968.2183	-.002311	5735.0890	-317.0480
17.229	.669723	-1.774E+06	46097.2896	-.003259	5057.8101	-334.5192
22.971	.648484	-1.512E+06	44128.7902	-.004073	4406.3337	-351.0279
28.714	.622939	-1.261E+06	42068.4260	-.004761	3782.2550	-366.5119
34.457	.593803	-1.022E+06	39922.2580	-.005327	3187.0750	-380.9098
40.200	.561758	-7.945E+05	37696.6989	-.005777	2622.1949	-394.1606
45.943	.527450	-5.801E+05	35398.5108	-.006118	2088.9106	-406.2035
51.686	.491491	-3.788E+05	33034.8050	-.006356	1588.4071	-416.9777
57.429	.454453	-1.911E+05	30613.0435	-.006497	1121.7535	-426.4219
63.171	.416870	-17473.3332	28141.0425	-.006549	689.8970	-434.4740
68.914	.379238	1.419E+05	25626.9787	-.006518	999.2311	-441.0706
74.657	.342010	2.866E+05	23079.3969	-.006411	1359.1650	-446.1469
80.400	.305598	4.165E+05	20531.8536	-.006237	1682.2441	-441.0572
86.143	.270372	5.317E+05	17941.1106	-.006002	1968.7663	-461.1916
91.886	.236660	6.315E+05	15234.3214	-.005714	2216.9743	-481.4713
97.629	.204747	7.152E+05	12421.1349	-.005380	2425.1127	-498.2454
103.371	.174870	7.822E+05	9531.7833	-.005008	2591.7290	-507.9964
109.114	.147222	8.322E+05	6608.0386	-.004608	2715.9616	-510.2231

114.857	.121943	8.650E+05	3694.1370	-.004187	2797.5819	-504.5685
120.600	.099127	8.809E+05	835.9383	-.003754	2837.0236	-490.8241
126.343	.078821	8.802E+05	-1919.9177	-.003318	2835.3991	-468.9267
132.086	.061020	8.638E+05	-4526.8021	-.002885	2794.5052	-438.9434
137.829	.045680	8.325E+05	-6938.7453	-.002465	2716.8159	-401.0368
143.571	.032711	7.878E+05	-9110.7755	-.002063	2605.4690	-355.3917
149.314	.021985	7.310E+05	-10998.5871	-.001686	2464.2493	-302.0552
155.057	.013340	6.640E+05	-12556.6040	-.001341	2297.5834	-240.5378
160.800	.006587	5.888E+05	-13731.1749	-.001030	2110.5785	-168.5168
166.543	.001510	5.078E+05	-14369.8751	-7.581E-04	1909.2107	-53.9161
172.286	-.002121	4.248E+05	-14299.3391	-5.269E-04	1702.9534	78.4809
178.029	-.004542	3.443E+05	-13574.5580	-3.362E-04	1502.7416	173.9305
183.771	-.005982	2.694E+05	-12395.1209	-1.840E-04	1316.4777	236.8188
189.514	-.006655	2.022E+05	-10933.9002	-6.706E-05	1149.3886	272.0640
195.257	-.006753	1.440E+05	-9335.0176	1.877E-05	1004.4267	284.7608
201.000	-.006440	94998.9967	-7713.6593	7.802E-05	882.6870	279.8914
206.743	-.005857	55240.1866	-6157.3526	1.153E-04	783.8152	262.1060
212.486	-.005116	24105.2884	-4728.3132	1.349E-04	706.3893	235.5695
218.229	-.004307	730.6430	-3466.4962	1.411E-04	648.2615	203.8693
223.971	-.003495	-15920.5802	-2393.0246	1.373E-04	686.0357	169.9765
229.714	-.002729	-26960.0143	-1513.7159	1.267E-04	713.4884	136.2504
235.457	-.002040	-33495.8744	-822.4853	1.117E-04	729.7417	104.4767
241.200	-.001446	-36573.6501	-304.4593	9.434E-05	737.3955	75.9304
246.943	-9.56E-04	-37133.6714	61.3121	7.607E-05	738.7882	51.4527
252.686	-5.72E-04	-35983.0136	299.6065	5.794E-05	735.9267	31.5354
258.429	-2.91E-04	-33778.9855	648.0574	4.064E-05	730.4458	89.8157
264.171	-1.06E-04	-28600.2940	1106.1656	2.517E-05	717.5674	69.7245
269.914	-1.78E-06	-21111.4727	1375.7286	1.285E-05	698.9443	24.1532
275.657	4.20E-05	-12818.2533	1285.3169	4.436E-06	678.3208	-55.6399
281.400	4.92E-05	-6355.3144	958.8916	-3.174E-07	662.2489	-58.0406
287.143	3.83E-05	-1804.2240	634.8172	-2.340E-06	650.9313	-54.8212
292.886	2.23E-05	939.5093	338.3210	-2.555E-06	648.7809	-48.4362
298.629	8.96E-06	2085.4488	85.0206	-1.805E-06	651.6306	-39.7778
304.371	1.57E-06	1918.7268	-117.6938	-8.121E-07	651.2160	-30.8192
310.114	-3.64E-07	734.8635	-165.8051	-1.541E-07	648.2720	14.0641
315.857	-2.03E-07	14.5673	-70.1618	3.168E-08	646.4808	19.2445
321.600	-3.89E-10	-71.0421	-1.2780	1.768E-08	646.6212	4.7449
327.343	1.41E-12	-.1375	6.1853	3.384E-11	646.4449	-2.1457
333.086	1.93E-16	4.961E-04	.011968	-1.230E-13	646.4446	-.004198
338.829	-6.92E-19	6.831E-08	-4.319E-05	-1.682E-17	646.4446	1.504E-05
344.571	-9.60E-23	-2.429E-10	-5.947E-09	6.023E-20	646.4446	2.086E-09
350.314	3.39E-25	-8.842E-15	2.114E-11	1.458E-23	646.4446	-7.364E-12
356.057	7.15E-23	-7.229E-15	2.761E-16	1.059E-23	646.4446	-2.218E-18
361.800	1.22E-22	-5.686E-15	2.587E-16	7.392E-24	646.4446	-3.874E-18
367.543	1.56E-22	-4.269E-15	2.329E-16	4.924E-24	646.4446	-5.077E-18
373.286	1.79E-22	-3.018E-15	2.014E-16	3.118E-24	646.4446	-5.926E-18
379.029	1.92E-22	-1.961E-15	1.656E-16	1.883E-24	646.4446	-6.516E-18
384.771	2.00E-22	-1.118E-15	1.270E-16	1.120E-24	646.4446	-6.931E-18
390.514	2.05E-22	-5.036E-16	8.631E-17	7.179E-25	646.4446	-7.246E-18
396.257	2.08E-22	-1.279E-16	4.392E-17	5.614E-25	646.4446	-7.516E-18
402.000	2.12E-22	0.0000	0.0000	5.297E-25	646.4446	-7.778E-18

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection = .70000000 in
Computed slope at pile head = 0.000
Maximum bending moment = -2619358.959 lbs-in
Maximum shear force = 51396.348 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 11
Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .800000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	-2.903E+06	55613.3640	0.0000	7865.6844	-288.9596
5.743	.795866	-2.588E+06	53896.8561	-.001361	7081.9680	-308.8292
11.486	.784363	-2.282E+06	52068.6504	-.002569	6321.1978	-327.8593
17.229	.766362	-1.986E+06	50133.7582	-.003627	5585.2163	-345.9837
22.971	.742704	-1.701E+06	48097.5680	-.004541	4875.7824	-363.1372
28.714	.714204	-1.427E+06	45965.8395	-.005317	4194.5655	-379.2558
34.457	.681640	-1.165E+06	43744.6986	-.005959	3543.1399	-394.2759
40.200	.645759	-9.155E+05	41440.6342	-.006475	2922.9786	-408.1346
45.943	.607271	-6.792E+05	39060.4965	-.006870	2335.4477	-420.7691
51.686	.566849	-4.566E+05	36611.4967	-.007152	1781.8011	-432.1164
57.429	.525127	-2.480E+05	34101.2093	-.007327	1263.1743	-442.1130
63.171	.482699	-53938.9195	31537.5756	-.007401	780.5793	-450.6947
68.914	.440116	1.253E+05	28928.9091	-.007384	957.9907	-457.7961
74.657	.397891	2.894E+05	26283.9036	-.007281	1366.0099	-463.3502
80.400	.356490	4.380E+05	23556.8415	-.007101	1735.7609	-486.3729
86.143	.316336	5.705E+05	20699.5941	-.006851	2065.2186	-508.6883
91.886	.277807	6.860E+05	17714.5884	-.006539	2352.4309	-530.8659
97.629	.241232	7.838E+05	14609.5747	-.006175	2595.4724	-550.4822
103.371	.206888	8.630E+05	11413.2287	-.005766	2792.6444	-562.6732
109.114	.175002	9.235E+05	8170.1254	-.005323	2942.8741	-566.7658
114.857	.145746	9.648E+05	4927.9606	-.004855	3045.7701	-562.3463
120.600	.119238	9.873E+05	1736.3487	-.004371	3101.6569	-549.1603
126.343	.095541	9.913E+05	-1354.0893	-.003881	3111.5952	-527.1117
132.086	.074667	9.775E+05	-4292.6014	-.003392	3077.3896	-496.2508
137.829	.056577	9.471E+05	-7029.0607	-.002915	3001.5839	-456.7450
143.571	.041184	9.012E+05	-9514.4584	-.002457	2887.4463	-408.8164
149.314	.028357	8.414E+05	-11700.8361	-.002025	2738.9498	-352.6087
155.057	.017926	7.698E+05	-13539.9386	-.001625	2560.7593	-287.8748
160.800	.009688	6.884E+05	-14978.3558	-.001264	2358.2500	-213.0665

166.543	.003410	5.996E+05	-15938.1774	-9.445E-04	2137.6322	-121.1997
172.286	-.001161	5.067E+05	-16162.8660	-6.702E-04	1906.5222	42.9500
178.029	-.004288	4.150E+05	-15568.0095	-4.417E-04	1678.4682	164.2139
183.771	-.006234	3.286E+05	-14387.8801	-2.573E-04	1463.5003	246.7764
189.514	-.007244	2.501E+05	-12828.9946	-1.139E-04	1268.4693	296.1191
195.257	-.007542	1.814E+05	-11065.4996	-6.868E-06	1097.4943	318.0334
201.000	-.007323	1.230E+05	-9238.4061	6.861E-05	952.4359	318.2678
206.743	-.006754	75166.2265	-7456.6213	1.178E-04	833.3671	302.2543
212.486	-.005970	37226.3239	-5799.3260	1.456E-04	739.0186	274.9132
218.229	-.005081	8339.3905	-4319.2691	1.569E-04	667.1829	240.5295
223.971	-.004168	-12617.8703	-3046.5886	1.559E-04	677.8225	202.6926
229.714	-.003291	-26885.5756	-1992.8242	1.461E-04	713.3033	164.2900
235.457	-.002490	-35724.9754	-1154.8494	1.305E-04	735.2850	127.5420
241.200	-.001791	-40344.7626	-518.5150	1.117E-04	746.7735	94.0670
246.943	-.001208	-41847.2453	-61.8594	9.130E-05	750.5098	64.9673
252.686	-7.43E-04	-41191.5889	242.1993	7.071E-05	748.8793	40.9238
258.429	-3.95E-04	-39170.9982	638.9267	5.079E-05	743.8546	97.2399
264.171	-1.59E-04	-33928.8934	1141.5935	3.266E-05	730.8186	77.8181
269.914	-2.02E-05	-26107.7538	1503.8627	1.778E-05	711.3690	48.3453
275.657	4.47E-05	-16682.5024	1483.2872	7.169E-06	687.9304	-55.5109
281.400	6.21E-05	-9081.8458	1149.0615	7.812E-07	669.0292	-60.8861
287.143	5.37E-05	-3485.8767	804.5733	-2.335E-06	655.1132	-59.0849
292.886	3.53E-05	162.7398	480.7857	-3.159E-06	646.8493	-53.6770
298.629	1.74E-05	2041.0073	195.5322	-2.612E-06	651.5201	-45.6650
304.371	5.30E-06	2412.4677	-36.1314	-1.508E-06	652.4439	-35.0138
310.114	7.68E-08	1628.2642	-177.1713	-5.064E-07	650.4937	-14.1045
315.857	-5.13E-07	378.2848	-155.9140	-8.853E-09	647.3853	21.5076
321.600	-2.49E-08	-162.5063	-33.6973	4.465E-08	646.8487	21.0555
327.343	1.03E-10	-8.8189	14.1520	2.169E-09	646.4665	-4.3916
333.086	1.24E-14	.036121	.7678	-8.958E-12	646.4446	-.2696
338.829	-5.04E-17	4.391E-06	-.003145	-1.080E-15	646.4446	.001095
344.571	-6.17E-21	-1.769E-08	-3.823E-07	4.386E-18	646.4446	1.342E-07
350.314	2.47E-23	-5.692E-13	1.540E-09	9.384E-22	646.4446	-5.362E-10
356.057	4.60E-21	-4.653E-13	1.778E-14	6.819E-22	646.4446	-1.428E-16
361.800	7.86E-21	-3.660E-13	1.665E-14	4.758E-22	646.4446	-2.495E-16
367.543	1.01E-20	-2.748E-13	1.500E-14	3.169E-22	646.4446	-3.269E-16
373.286	1.15E-20	-1.942E-13	1.296E-14	2.006E-22	646.4446	-3.815E-16
379.029	1.24E-20	-1.262E-13	1.066E-14	1.212E-22	646.4446	-4.195E-16
384.771	1.29E-20	-7.197E-14	8.176E-15	7.203E-23	646.4446	-4.462E-16
390.514	1.32E-20	-3.241E-14	5.556E-15	4.615E-23	646.4446	-4.665E-16
396.257	1.34E-20	-8.230E-15	2.827E-15	3.607E-23	646.4446	-4.838E-16
402.000	1.36E-20	0.0000	0.0000	3.403E-23	646.4446	-5.006E-16

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-2903036.840 lbs-in
Maximum shear force	=	55613.364 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11

Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .900000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	-3.182E+06	59700.3581	0.0000	8558.6602	-297.5947
5.743	.895470	-2.843E+06	57932.5243	-.001494	7716.8022	-318.0688
11.486	.882843	-2.514E+06	56049.5354	-.002822	6898.4131	-337.6985
17.229	.863056	-2.195E+06	54056.4357	-.003990	6105.4060	-356.4159
22.971	.837018	-1.887E+06	51958.6560	-.005002	5339.6094	-374.1542
28.714	.805606	-1.591E+06	49762.0080	-.005864	4602.7618	-390.8476
34.457	.769663	-1.307E+06	47472.6796	-.006583	3896.5050	-406.4309
40.200	.729999	-1.036E+06	45097.2318	-.007164	3222.3786	-420.8395
45.943	.687384	-7.783E+05	42642.5970	-.007613	2581.8138	-434.0085
51.686	.642554	-5.347E+05	40116.0793	-.007939	1976.1279	-445.8733
57.429	.596200	-3.056E+05	37525.3570	-.008147	1406.5182	-456.3684
63.171	.548976	-91528.3573	34878.4854	-.008246	874.0563	-465.4277
68.914	.501492	1.073E+05	32183.9030	-.008242	913.2068	-472.9841
74.657	.454313	2.904E+05	29450.4375	-.008143	1368.6901	-478.9691
80.400	.407961	4.577E+05	26546.9252	-.007958	1784.6233	-532.2044
86.143	.362913	6.072E+05	23419.8758	-.007694	2156.4861	-556.8178
91.886	.319593	7.382E+05	20155.0379	-.007360	2482.1223	-580.1904
97.629	.278376	8.497E+05	16764.2045	-.006966	2759.4945	-600.6968
103.371	.239579	9.411E+05	13272.9329	-.006522	2986.8180	-615.1689
109.114	.203461	1.012E+06	9722.9533	-.006038	3162.8219	-621.1424
114.857	.170226	1.062E+06	6164.7918	-.005524	3286.9509	-618.0183
120.600	.140014	1.091E+06	2651.5506	-.004990	3359.4155	-605.4986
126.343	.112909	1.100E+06	-762.4468	-.004447	3381.2156	-583.4557
132.086	.088935	1.089E+06	-4022.6069	-.003905	3354.1509	-551.9234
137.829	.068063	1.059E+06	-7074.9198	-.003372	3280.8176	-511.0711
143.571	.050207	1.013E+06	-9866.5852	-.002858	3164.5934	-461.1506
149.314	.035235	9.503E+05	-12346.1588	-.002371	3009.6156	-402.3825
155.057	.022969	8.743E+05	-14462.6428	-.001919	2820.7613	-334.7015
160.800	.013192	7.870E+05	-16161.8794	-.001507	2603.6515	-257.0724
166.543	.005658	6.910E+05	-17373.5384	-.001141	2364.7332	-164.8984
172.286	9.06E-05	5.892E+05	-17856.6586	-8.233E-04	2111.6546	-3.3525
178.029	-.003799	4.871E+05	-17448.5966	-5.565E-04	1857.7586	145.4636
183.771	-.006301	3.896E+05	-16314.7193	-3.391E-04	1615.3444	249.4190
189.514	-.007693	3.002E+05	-14695.5105	-1.680E-04	1393.0277	314.4845
195.257	-.008231	2.211E+05	-12795.8320	-3.879E-05	1196.2272	347.0951
201.000	-.008139	1.533E+05	-10783.4587	5.403E-05	1027.6902	353.7315
206.743	-.007610	97144.9275	-8789.7616	1.161E-04	888.0235	340.5909
212.486	-.006805	52178.3149	-6912.0294	1.532E-04	776.2010	313.3457

218.229	-.005851	17526.6538	-5216.9360	1.704E-04	690.0296	276.9853
223.971	-.004847	-7996.4060	-3744.7025	1.728E-04	666.3299	235.7328
229.714	-.003866	-25741.9417	-2513.5605	1.644E-04	710.4593	193.0231
235.457	-.002959	-37111.9657	-1524.1927	1.488E-04	738.7342	151.5328
241.200	-.002157	-43470.6371	-763.8991	1.289E-04	754.5469	113.2461
246.943	-.001479	-46078.3127	-210.3076	1.067E-04	761.0316	79.5469
252.686	-9.32E-04	-46045.4395	165.4797	8.383E-05	760.9498	51.3243
258.429	-5.16E-04	-44302.8245	613.8793	6.143E-05	756.6163	104.8348
264.171	-2.26E-04	-39086.3136	1163.7011	4.075E-05	743.6440	86.6454
269.914	-4.77E-05	-30997.7317	1599.0762	2.337E-05	723.5294	64.9778
275.657	4.24E-05	-20754.6808	1641.8504	1.054E-05	698.0571	-50.0813
281.400	7.33E-05	-12155.6477	1323.2840	2.382E-06	676.6731	-60.8622
287.143	6.97E-05	-5559.3754	973.2170	-2.010E-06	660.2695	-61.0517
292.886	5.03E-05	-974.5541	634.5017	-3.630E-06	648.8681	-56.9089
298.629	2.80E-05	1733.7500	327.5050	-3.442E-06	650.7560	-50.0054
304.371	1.07E-05	2792.2142	65.9784	-2.320E-06	653.3882	-41.0735
310.114	1.37E-06	2495.0230	-161.1864	-1.009E-06	652.6492	-38.0386
315.857	-8.74E-07	942.3796	-217.5799	-1.568E-07	648.7881	18.3991
321.600	-4.32E-07	-3.8034	-95.1598	7.594E-08	646.4540	24.2348
327.343	-1.49E-09	-150.7124	.2900	3.763E-08	646.8193	9.0065
333.086	5.74E-12	-.5284	13.1219	1.300E-10	646.4459	-4.5377
338.829	7.43E-16	.002015	.046004	-4.997E-13	646.4446	-.016143
344.571	-2.81E-18	2.628E-07	-1.754E-04	-6.467E-17	646.4446	6.108E-05
350.314	-3.67E-22	-2.578E-10	-2.290E-08	4.254E-19	646.4446	7.977E-09
356.057	2.08E-18	-2.108E-10	8.048E-12	3.092E-19	646.4446	-6.440E-14
361.800	3.55E-18	-1.658E-10	7.540E-12	2.158E-19	646.4446	-1.127E-13
367.543	4.55E-18	-1.245E-10	6.791E-12	1.439E-19	646.4446	-1.479E-13
373.286	5.20E-18	-8.800E-11	5.871E-12	9.117E-20	646.4446	-1.727E-13
379.029	5.60E-18	-5.719E-11	4.830E-12	5.518E-20	646.4446	-1.899E-13
384.771	5.84E-18	-3.261E-11	3.704E-12	3.291E-20	646.4446	-2.021E-13
390.514	5.98E-18	-1.469E-11	2.517E-12	2.118E-20	646.4446	-2.113E-13
396.257	6.08E-18	-3.730E-12	1.281E-12	1.662E-20	646.4446	-2.192E-13
402.000	6.17E-18	0.0000	0.0000	1.569E-20	646.4446	-2.269E-13

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-3181699.725 lbs-in
Maximum shear force	=	59700.358 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	-3.457E+06	63686.9522	0.0000	9242.3044	-305.5376
5.743	.995078	-3.095E+06	61871.9084	-.001624	8343.7118	-326.5673
11.486	.981342	-2.744E+06	59938.5331	-.003072	7469.0532	-346.7475
17.229	.959793	-2.402E+06	57891.9042	-.004348	6620.3074	-366.0088
22.971	.931402	-2.072E+06	55737.4948	-.005457	5799.3684	-384.2830
28.714	.897111	-1.754E+06	53481.1678	-.006406	5008.0388	-401.5025
34.457	.857825	-1.448E+06	51129.1715	-.007200	4248.0239	-417.6007
40.200	.814415	-1.156E+06	48688.1361	-.007846	3520.9252	-432.5111
45.943	.767713	-8.774E+05	46165.0732	-.008350	2828.2350	-446.1675
51.686	.718513	-6.132E+05	43567.3752	-.008719	2171.3296	-458.5034
57.429	.667566	-3.639E+05	40902.8186	-.008962	1551.4640	-469.4517
63.171	.615583	-1.300E+05	38179.5666	-.009084	969.7656	-478.9446
68.914	.563230	88152.3644	35406.1747	-.009094	865.6609	-486.9133
74.657	.511128	2.902E+05	32591.5963	-.009001	1368.1827	-493.2881
80.400	.459852	4.759E+05	29514.2945	-.008811	1829.9802	-578.4090
86.143	.409932	6.424E+05	26115.0601	-.008533	2243.9011	-605.4039
91.886	.361841	7.886E+05	22567.5189	-.008179	2607.5782	-630.0581
97.629	.315995	9.138E+05	18889.3996	-.007756	2918.8549	-650.8789
103.371	.272752	1.017E+06	15109.0071	-.007278	3175.9083	-665.6757
109.114	.232406	1.098E+06	11263.7754	-.006753	3377.4296	-673.4597
114.857	.195187	1.157E+06	7401.4422	-.006194	3522.7059	-671.6315
120.600	.161262	1.192E+06	3578.3030	-.005612	3611.8333	-659.8100
126.343	.130732	1.206E+06	-147.7938	-.005017	3645.7484	-637.8356
132.086	.103638	1.198E+06	-3718.5830	-.004421	3626.2409	-605.7228
137.829	.079955	1.170E+06	-7076.3196	-.003834	3555.9516	-563.6382
143.571	.059605	1.123E+06	-10164.5156	-.003265	3438.3582	-511.8529
149.314	.042451	1.058E+06	-12928.2552	-.002725	3277.7515	-450.6434
155.057	.028311	9.783E+05	-15313.6016	-.002220	3079.2110	-380.0743
160.800	.016957	8.855E+05	-17264.8029	-.001758	2848.5980	-299.4486
166.543	.008124	7.826E+05	-18714.6080	-.001344	2592.6103	-205.4587
172.286	.001520	6.726E+05	-19466.0998	-9.832E-04	2319.0514	-56.2549
178.029	-.003168	5.605E+05	-19279.2720	-6.774E-04	2040.2595	121.3193
183.771	-.006260	4.522E+05	-18219.3006	-4.263E-04	1770.9016	247.8250
189.514	-.008065	3.519E+05	-16561.0239	-2.270E-04	1521.4530	329.6843
195.257	-.008868	2.623E+05	-14540.5837	-7.472E-05	1298.7195	373.9516
201.000	-.008923	1.850E+05	-12353.1859	3.617E-05	1106.4143	387.8287
206.743	-.008452	1.204E+05	-10153.3723	1.119E-04	945.7467	378.2756
212.486	-.007638	68179.5648	-8057.2342	1.586E-04	815.9927	351.7227
218.229	-.006630	27576.9607	-6146.0167	1.824E-04	715.0226	313.8754
223.971	-.005544	-2684.1132	-4470.5970	1.885E-04	653.1194	269.6041
229.714	-.004465	-24052.5415	-3056.3884	1.819E-04	706.2581	222.9064
235.457	-.003455	-38060.5210	-1908.2905	1.665E-04	741.0930	176.9287
241.200	-.002553	-46219.2305	-1015.3922	1.456E-04	761.3820	134.0309
246.943	-.001782	-49940.4339	-355.2097	1.218E-04	770.6359	95.8834
252.686	-.001154	-50480.8762	102.6780	9.686E-05	771.9798	63.5800
258.429	-6.70E-04	-48905.7362	604.0762	7.222E-05	768.0628	111.0363
264.171	-3.25E-04	-43650.4676	1190.1108	4.927E-05	754.9941	93.0553

269.914	-1.04E-04	-35310.0368	1661.5243	2.970E-05	734.2532	71.1185
275.657	1.65E-05	-24611.0158	1753.6869	1.484E-05	707.6470	-39.0221
281.400	6.67E-05	-15189.8482	1467.0507	4.972E-06	684.2185	-60.8015
287.143	7.37E-05	-7768.3144	1111.4828	-7.203E-07	665.7627	-63.0282
292.886	5.85E-05	-2422.5994	758.2297	-3.247E-06	652.4690	-59.9953
298.629	3.64E-05	945.3439	431.0228	-3.613E-06	648.7954	-53.9574
304.371	1.70E-05	2533.4002	144.5403	-2.751E-06	652.7446	-45.8126
310.114	4.76E-06	2609.5997	-91.3271	-1.476E-06	652.9341	-36.3302
315.857	3.88E-09	1486.6470	-196.3774	-4.600E-07	650.1415	-.2544
321.600	-5.21E-07	354.7522	-143.1892	-3.421E-09	647.3267	18.7777
327.343	-3.54E-08	-157.9778	-31.9740	4.537E-08	646.8374	19.9539
333.086	1.73E-10	-12.5598	13.7600	3.084E-09	646.4758	-4.0267
338.829	1.77E-14	.060894	1.0935	-1.510E-11	646.4447	-.3845
344.571	-8.49E-17	6.272E-06	-.005302	-1.540E-15	646.4446	.001846
350.314	-8.76E-21	-7.791E-09	-5.466E-07	1.286E-17	646.4446	1.905E-07
356.057	6.27E-17	-6.370E-09	2.433E-10	9.345E-18	646.4446	-1.947E-12
361.800	1.07E-16	-5.011E-09	2.279E-10	6.523E-18	646.4446	-3.408E-12
367.543	1.38E-16	-3.762E-09	2.053E-10	4.348E-18	646.4446	-4.469E-12
373.286	1.57E-16	-2.660E-09	1.774E-10	2.756E-18	646.4446	-5.219E-12
379.029	1.69E-16	-1.728E-09	1.460E-10	1.668E-18	646.4446	-5.740E-12
384.771	1.76E-16	-9.857E-10	1.120E-10	9.947E-19	646.4446	-6.108E-12
390.514	1.81E-16	-4.440E-10	7.608E-11	6.402E-19	646.4446	-6.387E-12
396.257	1.84E-16	-1.127E-10	3.872E-11	5.022E-19	646.4446	-6.626E-12
402.000	1.86E-16	0.0000	0.0000	4.742E-19	646.4446	-6.858E-12

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-3456610.124 lbs-in
Maximum shear force	=	63686.952 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	6

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .100000	S= 0.000	1.300E+05	.100000	-6.613E+05	18745.6153
5	y= .200000	S= 0.000	1.300E+05	.2000	-1.052E+06	26139.0688
5	y= .300000	S= 0.000	1.300E+05	.3000	-1.398E+06	32158.3207
5	y= .400000	S= 0.000	1.300E+05	.4000	-1.722E+06	37495.7147
5	y= .500000	S= 0.000	1.300E+05	.5000	-2.031E+06	42405.1790
5	y= .600000	S= 0.000	1.300E+05	.6000	-2.330E+06	47014.2042
5	y= .700000	S= 0.000	1.300E+05	.7000	-2.619E+06	51396.3479
5	y= .800000	S= 0.000	1.300E+05	.8000	-2.903E+06	55613.3640
5	y= .900000	S= 0.000	1.300E+05	.9000	-3.182E+06	59700.3581
5	y= 1.000	S= 0.000	1.300E+05	1.0000	-3.457E+06	63686.9522

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = .10000 in
Slope = .00000
Axial Load = 130000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
402.000	.10000000	-661291.026	18745.615
381.900	.10000000	-664081.151	18816.140
361.800	.10000000	-652801.061	18538.230
341.700	.10000000	-658106.893	18659.196
321.600	.10000000	-658361.846	18665.108
301.500	.10000000	-657640.753	18645.064
281.400	.10000000	-662927.335	18782.561
261.300	.10000000	-659621.113	18696.080
241.200	.10000000	-661289.554	18738.934
221.100	.10000000	-661061.713	18731.102

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo Mocho Access Bridge\
Name of input data file: ArroyoMocho Access_Abut_1_ Free.lpd
Name of output file: ArroyoMocho Access_Abut_1_ Free.lpo
Name of plot output file: ArroyoMocho Access_Abut_1_ Free.lpp
Name of runtime file: ArroyoMocho Access_Abut_1_ Free.lpr

Time and Date of Analysis

Date: December 1, 2009 Time: 15:23:21

Problem Title

SR84 Isabel Abutment - Arroyo Mocho Access Bridge - 16 inch CIDH Pile - Free

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 70
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 402.00 in
Depth of ground surface below top of pile = -55.20 in
Slope angle of ground surface = 26.56 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	16.000	3217.0000	201.1000	3600000.000
2	402.0000	16.000	3217.0000	201.1000	3600000.000

Soil and Rock Layering Information

The soil profile is modelled using 9 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -55.200 in
Distance from top of pile to bottom of layer = .000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 76.800 in
p-y subgrade modulus k for top of soil layer = 825.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 825.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 76.800 in
Distance from top of pile to bottom of layer = 256.800 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 256.800 in
Distance from top of pile to bottom of layer = 352.800 in
p-y subgrade modulus k for top of soil layer = 100.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 100.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 352.800 in
Distance from top of pile to bottom of layer = 556.800 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 556.800 in
Distance from top of pile to bottom of layer = 724.800 in
p-y subgrade modulus k for top of soil layer = 260.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 260.000 lbs/in**3

Layer 7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 724.800 in
Distance from top of pile to bottom of layer = 808.800 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 8 is stiff clay without free water
Distance from top of pile to top of layer = 808.800 in
Distance from top of pile to bottom of layer = 988.800 in
p-y subgrade modulus k for top of soil layer = 700.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 700.000 lbs/in**3

Layer 9 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 988.800 in
Distance from top of pile to bottom of layer = 1108.800 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

(Depth of lowest layer extends 706.80 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 18 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-55.20	.07520
2	.00	.07520
3	.00	.07230
4	76.80	.07230
5	76.80	.07810

6	256.80	.07810
7	256.80	.07230
8	352.80	.07230
9	352.80	.07810
10	556.80	.07810
11	556.80	.04200
12	724.80	.04200
13	724.80	.03910
14	808.80	.03910
15	808.80	.04200
16	988.80	.04200
17	988.80	.03910
18	1108.80	.03910

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 18 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-55.200	.00000	30.00	------	------
2	.000	.00000	30.00	------	------
3	.000	13.89000	.00	.00700	.0
4	76.800	13.89000	.00	.00700	.0
5	76.800	.00000	40.00	------	------
6	256.800	.00000	40.00	------	------
7	256.800	6.94400	.00	.00700	.0
8	352.800	6.94400	.00	.00700	.0
9	352.800	.00000	44.00	------	------
10	556.800	.00000	44.00	------	------
11	556.800	9.72200	.00	.00700	.0
12	724.800	9.72200	.00	.00700	.0
13	724.800	.00000	44.00	------	------
14	808.800	.00000	44.00	------	------
15	808.800	19.44400	.00	.00600	.0
16	988.800	19.44400	.00	.00600	.0
17	988.800	.00000	44.00	------	------
18	1108.800	.00000	44.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .100 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .200 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .300 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .400 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .500 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .600 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .700 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Deflection at pile head = .800 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .900 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .100000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	0.0000	9929.7973	-.001807	646.4446	-171.8164
5.743	.089620	55541.5346	8922.7388	-.001794	784.5646	-178.9005
11.486	.079398	1.052E+05	7878.0158	-.001754	907.9610	-184.9334
17.229	.069475	1.486E+05	6801.8491	-.001691	1016.0932	-189.8511
22.971	.059976	1.858E+05	5700.8373	-.001608	1108.5178	-193.5859
28.714	.051006	2.165E+05	4581.9834	-.001508	1184.8944	-196.0647
34.457	.042653	2.407E+05	3452.7325	-.001395	1244.9913	-197.2067
40.200	.034985	2.583E+05	2321.0295	-.001271	1288.6926	-196.9187
45.943	.028052	2.692E+05	1195.4081	-.001140	1316.0059	-195.0887
51.686	.021887	2.737E+05	85.1370	-.001006	1327.0710	-191.5728
57.429	.016500	2.717E+05	-999.5306	-8.705E-04	1322.1722	-186.1721
63.171	.011888	2.635E+05	-2046.8995	-7.378E-04	1301.7543	-178.5832
68.914	.008026	2.493E+05	-3042.9079	-6.107E-04	1266.4472	-168.2853
74.657	.004874	2.295E+05	-3968.9738	-4.920E-04	1217.1087	-154.2252
80.400	.002375	2.045E+05	-4499.5293	-3.844E-04	1154.9100	-30.5454
86.143	4.59E-04	1.784E+05	-4614.4613	-2.895E-04	1090.0179	-9.4807
91.886	-9.50E-04	1.519E+05	-4581.7863	-2.076E-04	1024.1841	20.8601
97.629	-.001926	1.261E+05	-4393.3033	-1.387E-04	959.9212	44.7807
103.371	-.002542	1.016E+05	-4085.5106	-8.221E-05	899.2150	62.4108
109.114	-.002870	79254.5296	-3693.3717	-3.735E-05	843.5338	74.1551
114.857	-.002971	59280.0722	-3248.9416	-3.005E-06	793.8616	80.6216
120.600	-.002904	41942.6020	-2780.3992	2.209E-05	750.7470	82.5524
126.343	-.002718	27312.2150	-2311.4590	3.926E-05	714.3643	80.7601

132.086	-.002453	15335.2194	-1861.1213	4.984E-05	684.5800	76.0739
137.829	-.002145	5861.4944	-1443.7083	5.509E-05	661.0209	69.2938
143.571	-.001821	-1329.0627	-1069.1284	5.622E-05	649.7497	61.1569
149.314	-.001500	-6502.1479	-743.3081	5.427E-05	662.6140	52.3128
155.057	-.001197	-9947.5269	-468.7361	5.020E-05	671.1820	43.3092
160.800	-9.23E-04	-11960.8666	-245.0669	4.476E-05	676.1887	34.5855
166.543	-6.83E-04	-12829.1338	-69.7396	3.862E-05	678.3479	26.4737
172.286	-4.79E-04	-12819.5374	61.4234	3.226E-05	678.3240	19.2049
178.029	-3.12E-04	-12171.8087	153.6667	2.606E-05	676.7133	12.9196
183.771	-1.80E-04	-11093.4792	212.8191	2.029E-05	674.0317	7.6807
189.514	-7.94E-05	-9757.7303	244.8880	1.512E-05	670.7100	3.4876
195.257	-6.43E-06	-8303.3470	255.7373	1.065E-05	667.0932	.2907
201.000	4.29E-05	-6836.3008	250.8443	6.892E-06	663.4450	-1.9948
206.743	7.27E-05	-5432.5118	235.1325	3.850E-06	659.9541	-3.4770
212.486	8.71E-05	-4141.3846	212.8681	1.476E-06	656.7433	-4.2768
218.229	8.97E-05	-2989.7743	187.6104	-2.918E-07	653.8795	-4.5194
223.971	8.38E-05	-1986.1097	162.2036	-1.525E-06	651.3836	-4.3287
229.714	7.22E-05	-1124.4722	138.7966	-2.297E-06	649.2409	-3.8230
235.457	5.74E-05	-388.5029	118.8785	-2.672E-06	647.4107	-3.1136
241.200	4.15E-05	244.9222	103.3208	-2.707E-06	647.0536	-2.3045
246.943	2.63E-05	802.2533	92.4138	-2.448E-06	648.4396	-1.4940
252.686	1.34E-05	1310.0156	85.8929	-1.924E-06	649.7023	-.7770
258.429	4.18E-06	1791.6673	-5.5599	-1.155E-06	650.9001	-31.0722
264.171	9.67E-08	1247.8808	-130.0738	-4.014E-07	649.5478	-12.2908
269.914	-4.32E-07	298.2761	-115.0662	-1.808E-08	647.1863	17.5174
275.657	-1.11E-07	-73.7096	-29.3567	3.760E-08	646.6279	12.3317
281.400	-1.79E-13	-38.9628	6.4175	9.664E-09	646.5414	.1270
287.143	2.06E-11	-.014528	3.3929	1.559E-14	646.4446	-1.1803
292.886	4.04E-17	.007233	.001265	-1.793E-12	646.4446	-8.790E-04
298.629	-1.01E-17	2.129E-08	-6.297E-04	-3.521E-18	646.4446	2.193E-04
304.371	-3.96E-23	-3.543E-09	-1.853E-09	8.785E-19	646.4446	8.603E-10
310.114	4.94E-24	-1.737E-14	3.085E-10	3.446E-24	646.4446	-1.074E-10
315.857	0.000	1.736E-15	1.512E-15	-4.303E-25	646.4446	-6.319E-16
321.600	0.000	1.191E-20	-1.511E-16	0.0000	646.4446	5.263E-17
327.343	0.000	-8.502E-22	-1.037E-21	0.0000	646.4446	4.127E-22
333.086	0.000	0.0000	7.402E-23	0.0000	646.4446	-2.578E-23
338.829	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
344.571	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
350.314	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = .10000000 in

Computed slope at pile head = -.00180748
Maximum bending moment = 273696.900 lbs-in
Maximum shear force = 9929.797 lbs
Depth of maximum bending moment = 51.686 in
Depth of maximum shear force = 0.000 in
Number of iterations = 13
Number of zero deflection points = 10

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .200000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	0.0000	13561.6520	-.003165	646.4446	-204.3253
5.743	.181824	76876.1817	12361.8603	-.003146	837.6194	-213.5126
11.486	.163866	1.467E+05	11112.2949	-.003091	1011.2122	-221.6594
17.229	.146327	2.091E+05	9819.0881	-.003002	1166.4904	-228.7111
22.971	.129383	2.639E+05	8488.6904	-.002885	1302.8183	-234.6114
28.714	.113190	3.109E+05	7127.8802	-.002742	1419.6615	-239.3026
34.457	.097883	3.499E+05	5743.7747	-.002579	1516.5920	-242.7242
40.200	.083573	3.808E+05	4343.8475	-.002397	1593.2932	-244.8126
45.943	.070346	4.034E+05	2935.9529	-.002203	1649.5655	-245.4989
51.686	.058269	4.178E+05	1528.3640	-.001999	1685.3318	-244.7062
57.429	.047381	4.239E+05	129.8316	-.001791	1700.6438	-242.3449
63.171	.037700	4.219E+05	-1250.3192	-.001581	1695.6895	-238.3047
68.914	.029221	4.119E+05	-2602.0269	-.001374	1670.8022	-232.4393
74.657	.021915	3.941E+05	-3914.2029	-.001174	1626.4721	-224.5374
80.400	.015731	3.687E+05	-4835.7341	-9.854E-04	1563.3636	-96.3939
86.143	.010597	3.400E+05	-5358.0108	-8.096E-04	1492.0100	-85.4936
91.886	.006432	3.084E+05	-5806.4801	-6.489E-04	1413.3315	-70.6897
97.629	.003145	2.743E+05	-6155.7588	-5.044E-04	1328.5714	-50.9496
103.371	6.39E-04	2.384E+05	-6347.0748	-3.773E-04	1239.3802	-15.6779
109.114	-.001188	2.020E+05	-6303.9101	-2.681E-04	1148.6837	30.7103
114.857	-.002440	1.664E+05	-6025.5952	-1.767E-04	1060.3199	66.2153
120.600	-.003218	1.330E+05	-5572.7738	-1.025E-04	977.2336	91.4837
126.343	-.003618	1.026E+05	-5001.3891	-4.408E-05	901.5279	107.5060
132.086	-.003725	75639.8368	-4361.0378	1.031E-07	834.5449	115.5019
137.829	-.003616	52485.5913	-3693.9511	3.187E-05	776.9651	116.8169
143.571	-.003359	33164.5826	-3034.5341	5.311E-05	728.9179	112.8309
149.314	-.003007	17552.5047	-2409.3812	6.568E-05	690.0939	104.8840
155.057	-.002604	5393.0472	-1837.6720	7.137E-05	659.8559	94.2187
160.800	-.002187	-3661.0368	-1331.8494	7.180E-05	655.5488	81.9385
166.543	-.001780	-10011.4017	-898.4884	6.841E-05	671.3408	68.9833
172.286	-.001401	-14082.9629	-539.2690	6.244E-05	681.4659	56.1180
178.029	-.001063	-16298.5170	-251.9816	5.490E-05	686.9755	43.9324

183.771	-7.70E-04	-17059.1297	-31.5036	4.663E-05	688.8670	32.8510
189.514	-5.27E-04	-16729.9876	129.2961	3.825E-05	688.0485	23.1489
195.257	-3.31E-04	-15631.1911	238.7578	3.023E-05	685.3160	14.9721
201.000	-1.80E-04	-14032.8229	305.7530	2.288E-05	681.3412	8.3596
206.743	-6.83E-05	-12153.5573	339.1362	1.638E-05	676.6679	3.2664
212.486	8.46E-06	-10162.0651	347.3228	1.085E-05	671.7155	-.4153
218.229	5.63E-05	-8180.5081	337.9835	6.303E-06	666.7878	-2.8372
223.971	8.09E-05	-6289.4944	317.8379	2.715E-06	662.0852	-4.1787
229.714	8.75E-05	-4533.9675	292.5305	3.167E-08	657.7196	-4.6348
235.457	8.12E-05	-2929.6198	266.5665	-1.819E-06	653.7299	-4.4074
241.200	6.66E-05	-1469.5449	243.2861	-2.910E-06	650.0990	-3.7002
246.943	4.78E-05	-130.9606	224.8585	-3.306E-06	646.7702	-2.7174
252.686	2.86E-05	1118.0523	212.2770	-3.062E-06	649.2249	-1.6642
258.429	1.26E-05	2311.7642	89.9883	-2.211E-06	652.1934	-40.9239
264.171	3.22E-06	2154.9335	-111.0425	-1.104E-06	651.8034	-29.0868
269.914	-4.60E-08	1038.0102	-169.2177	-3.122E-07	649.0259	8.8268
275.657	-3.61E-07	211.8130	-96.9912	-2.271E-09	646.9713	16.3267
281.400	-7.21E-08	-76.0001	-20.6420	3.140E-08	646.6336	10.2626
287.143	3.61E-12	-25.3216	6.6169	6.280E-09	646.5075	-.7694
292.886	1.55E-11	-.009648	2.2051	-3.141E-13	646.4446	-.7670
298.629	2.87E-17	.005457	8.398E-04	-1.353E-12	646.4446	-6.234E-04
304.371	-7.61E-18	1.542E-08	-4.752E-04	-2.497E-18	646.4446	1.655E-04
310.114	-2.90E-23	-2.673E-09	-1.342E-09	6.629E-19	646.4446	6.296E-10
315.857	3.73E-24	-1.279E-14	2.328E-10	2.522E-24	646.4446	-8.106E-11
321.600	0.000	1.310E-15	1.114E-15	-3.247E-25	646.4446	-4.673E-16
327.343	0.000	8.832E-21	-1.140E-16	0.0000	646.4446	3.971E-17
333.086	0.000	-6.415E-22	-7.690E-22	0.0000	646.4446	3.067E-22
338.829	0.000	0.0000	5.586E-23	0.0000	646.4446	-1.945E-23
344.571	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
350.314	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	-.00316503
Maximum bending moment	=	423919.867 lbs-in
Maximum shear force	=	13561.652 lbs
Depth of maximum bending moment	=	57.429 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	9

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .300000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	0.0000	16333.3715	-.004418	646.4446	-226.1231
5.743	.274626	93370.0260	15004.4141	-.004395	878.6361	-236.6979
11.486	.249518	1.789E+05	13617.7309	-.004328	1091.3288	-246.2266
17.229	.224919	2.562E+05	12179.4787	-.004220	1283.6625	-254.6572
22.971	.201050	3.251E+05	10696.1165	-.004076	1454.8745	-261.9366
28.714	.178107	3.852E+05	9174.4124	-.003900	1604.3044	-268.0102
34.457	.156261	4.363E+05	7621.4511	-.003696	1731.3988	-272.8221
40.200	.135657	4.782E+05	6044.6448	-.003469	1835.7158	-276.3144
45.943	.116415	5.109E+05	4451.7479	-.003224	1916.9307	-278.4258
51.686	.098628	5.342E+05	2850.8792	-.002965	1974.8399	-279.0906
57.429	.082362	5.481E+05	1250.5557	-.002696	2009.3677	-278.2360
63.171	.067657	5.526E+05	-340.2552	-.002424	2020.5713	-275.7778
68.914	.054526	5.478E+05	-1912.0509	-.002151	2008.6483	-271.6138
74.657	.042954	5.338E+05	-3454.6535	-.001883	1973.9444	-265.6110
80.400	.032903	5.109E+05	-4650.7642	-.001624	1916.9649	-150.9450
86.143	.024306	4.828E+05	-5490.7479	-.001377	1847.1352	-141.5867
91.886	.017085	4.499E+05	-6264.7959	-.001146	1765.2488	-127.9823
97.629	.011144	4.126E+05	-6947.8059	-9.321E-04	1672.4516	-109.8819
103.371	.006379	3.715E+05	-7512.1774	-7.377E-04	1570.2627	-86.6654
109.114	.002672	3.274E+05	-7922.5736	-5.644E-04	1460.6238	-56.2586
114.857	-1.03E-04	2.813E+05	-8076.0677	-4.135E-04	1346.0694	2.8030
120.600	-.002077	2.353E+05	-7898.4814	-2.854E-04	1231.4860	59.0430
126.343	-.003381	1.910E+05	-7440.4371	-1.797E-04	1121.5283	100.4749
132.086	-.004141	1.501E+05	-6783.2212	-9.511E-05	1019.6353	128.4062
137.829	-.004473	1.133E+05	-5999.5990	-2.981E-05	928.1354	144.4970
143.571	-.004483	81204.1643	-5152.2185	1.841E-05	848.3822	150.6106
149.314	-.004262	54070.5364	-4292.8195	5.195E-05	780.9066	148.6826
155.057	-.003887	31820.5031	-3462.1309	7.324E-05	725.5754	140.6120
160.800	-.003421	14196.1296	-2690.3253	8.465E-05	681.7473	128.1761
166.543	-.002914	793.7991	-1997.8944	8.837E-05	648.4186	112.9690
172.286	-.002406	-8883.0603	-1396.8127	8.636E-05	668.5349	96.3629
178.029	-.001923	-15378.5431	-891.8685	8.035E-05	684.6877	79.4883
183.771	-.001483	-19246.7758	-482.0574	7.176E-05	694.3072	63.2320
189.514	-.001098	-21022.4666	-161.9515	6.178E-05	698.7230	48.2476
195.257	-7.73E-04	-21199.1475	77.0205	5.131E-05	699.1624	34.9764
201.000	-5.09E-04	-20214.4433	245.4304	4.104E-05	696.7136	23.6738
206.743	-3.02E-04	-18441.4835	354.8708	3.146E-05	692.3046	14.4398
212.486	-1.48E-04	-16185.4675	417.1500	2.287E-05	686.6944	7.2495
218.229	-3.94E-05	-13684.3680	443.6602	1.547E-05	680.4747	1.9829
223.971	3.00E-05	-11112.8055	444.9046	9.317E-06	674.0798	-1.5495
229.714	6.77E-05	-8588.2324	430.1624	4.433E-06	667.8017	-3.5846

235.457	8.09E-05	-6178.7012	407.2644	7.713E-07	661.8097	-4.3898
241.200	7.65E-05	-3911.6611	382.4510	-1.730E-06	656.1720	-4.2517
246.943	6.10E-05	-1783.3945	360.2819	-3.143E-06	650.8795	-3.4689
252.686	4.04E-05	231.1265	343.5711	-3.527E-06	647.0193	-2.3508
258.429	2.05E-05	2168.0323	204.2789	-2.933E-06	651.8360	-46.1589
264.171	6.75E-06	2581.7946	-28.4829	-1.755E-06	652.8649	-34.9024
269.914	3.46E-07	1843.5061	-175.6972	-6.577E-07	651.0290	-16.3663
275.657	-8.06E-07	564.7685	-164.1506	-6.056E-08	647.8490	20.3875
281.400	-3.49E-07	-41.7905	-59.0983	6.911E-08	646.5485	16.1979
287.143	-1.19E-08	-114.1209	3.2495	3.045E-08	646.7283	5.5153
292.886	4.64E-10	-4.5134	9.9502	1.038E-09	646.4558	-3.1817
298.629	2.18E-13	.1628	.3930	-4.039E-11	646.4450	-.1467
304.371	-2.27E-16	7.655E-05	-.014171	-1.894E-14	646.4446	.004930
310.114	-1.07E-19	-7.958E-08	-6.664E-06	1.975E-17	646.4446	2.326E-06
315.857	1.11E-22	-3.765E-11	6.929E-09	9.317E-21	646.4446	-2.411E-09
321.600	0.000	3.891E-14	3.278E-12	-9.657E-24	646.4446	-1.144E-12
327.343	0.000	1.852E-17	-3.388E-15	0.0000	646.4446	1.179E-15
333.086	0.000	-1.903E-20	-1.613E-18	0.0000	646.4446	5.628E-19
338.829	0.000	-9.111E-24	1.656E-21	0.0000	646.4446	-5.763E-22
344.571	0.000	0.0000	7.932E-25	0.0000	646.4446	-2.768E-25
350.314	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	.30000000 in
Computed slope at pile head	=	-.00441836
Maximum bending moment	=	552570.736 lbs-in
Maximum shear force	=	16333.371 lbs
Depth of maximum bending moment	=	63.171 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	9

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .400000 in

Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	0.0000	18696.6344	-.005617	646.4446	-242.9851
5.743	.367744	1.076E+05	17267.7927	-.005590	913.9199	-254.6215
11.486	.335794	2.067E+05	15775.1563	-.005512	1160.4135	-265.2022
17.229	.304432	2.970E+05	14224.9339	-.005387	1384.9661	-274.6762
22.971	.273917	3.781E+05	12623.6314	-.005220	1586.7176	-282.9913
28.714	.244478	4.498E+05	10978.0579	-.005015	1764.9114	-290.0940
34.457	.216320	5.117E+05	9295.3332	-.004776	1918.8990	-295.9296
40.200	.189619	5.637E+05	7582.8966	-.004510	2048.1448	-300.4414
45.943	.164523	6.055E+05	5848.5201	-.004220	2152.2308	-303.5703
51.686	.141151	6.371E+05	4100.3255	-.003912	2230.8620	-305.2537
57.429	.119594	6.585E+05	2346.8107	-.003590	2283.8712	-305.4231
63.171	.099912	6.694E+05	596.8889	-.003261	2311.2247	-304.0024
68.914	.082137	6.702E+05	-1140.0510	-.002929	2313.0292	-300.9021
74.657	.066270	6.607E+05	-2854.0489	-.002599	2289.5380	-296.0126
80.400	.052285	6.413E+05	-4278.4119	-.002276	2241.1610	-200.0342
86.143	.040125	6.150E+05	-5404.2014	-.001965	2175.7878	-192.0318
91.886	.029717	5.821E+05	-6470.1203	-.001668	2094.0988	-179.1838
97.629	.020967	5.432E+05	-7447.9593	-.001389	1997.1781	-161.3571
103.371	.013764	4.987E+05	-8308.4445	-.001131	1886.5236	-138.3143
109.114	.007981	4.494E+05	-9019.7579	-8.956E-04	1764.0661	-109.4068
114.857	.003477	3.964E+05	-9541.8620	-6.859E-04	1632.2218	-72.4205
120.600	1.03E-04	3.409E+05	-9758.2140	-5.031E-04	1494.0730	-2.9260
126.343	-.002301	2.851E+05	-9570.2796	-3.479E-04	1355.3704	68.3758
132.086	-.003893	2.315E+05	-9027.3166	-2.198E-04	1222.0132	120.7158
137.829	-.004826	1.817E+05	-8233.0919	-1.174E-04	1098.3435	155.8799
143.571	-.005241	1.371E+05	-7279.9197	-3.835E-05	987.2910	176.0706
149.314	-.005266	98162.0545	-6246.8115	1.997E-05	890.5529	183.7183
155.057	-.005012	65283.9824	-5198.6365	6.049E-05	808.7920	181.3177
160.800	-.004572	38361.6749	-4186.1385	8.619E-05	741.8419	171.2935
166.543	-.004022	17074.4953	-3246.6352	9.994E-05	688.9052	155.8967
172.286	-.003424	922.5318	-2405.2242	1.044E-04	648.7387	137.1320
178.029	-.002823	-10707.1042	-1676.3274	1.020E-04	673.0709	116.7126
183.771	-.002252	-18483.5456	-1065.4217	9.474E-05	692.4092	96.0406
189.514	-.001735	-23085.6863	-570.8253	8.443E-05	703.8538	76.2069
195.257	-.001283	-25165.9458	-185.4360	7.247E-05	709.0270	58.0083
201.000	-9.02E-04	-25323.7521	101.6592	5.995E-05	709.4194	41.9751
206.743	-5.94E-04	-24087.8267	303.7556	4.770E-05	706.3459	28.4067
212.486	-3.55E-04	-21906.1182	435.3147	3.629E-05	700.9204	17.4099
218.229	-1.77E-04	-19142.1157	510.9687	2.611E-05	694.0470	8.9373
223.971	-5.46E-05	-16076.2703	544.7409	1.738E-05	686.4228	2.8241
229.714	2.23E-05	-12911.3324	549.4592	1.020E-05	678.5523	-1.1809
235.457	6.25E-05	-9780.5616	536.3358	4.569E-06	670.7667	-3.3894
241.200	7.48E-05	-6757.9550	514.6745	4.686E-07	663.2502	-4.1543
246.943	6.78E-05	-3869.8569	491.6711	-2.166E-06	656.0681	-3.8569
252.686	4.99E-05	-1107.5267	472.2672	-3.401E-06	649.1987	-2.9007
258.429	2.88E-05	1559.5463	319.5247	-3.288E-06	650.3228	-50.2932
264.171	1.21E-05	2567.3530	58.7966	-2.265E-06	652.8290	-40.5077
269.914	2.77E-06	2238.2495	-138.1176	-1.074E-06	652.0106	-28.0694
275.657	-2.14E-07	982.5767	-179.5106	-2.752E-07	648.8880	13.6539
281.400	-3.95E-07	176.8525	-93.1855	1.231E-08	646.8843	16.4095

287.143	-7.26E-08	-87.7442	-17.6130	3.440E-08	646.6628	9.9092
292.886	1.47E-11	-25.4974	7.6394	6.323E-09	646.5080	-1.1149
298.629	2.16E-11	-.010031	2.2206	-1.282E-12	646.4446	-.7723
304.371	3.52E-17	.007600	8.731E-04	-1.884E-12	646.4446	-7.649E-04
310.114	-1.06E-17	1.980E-08	-6.617E-04	-3.064E-18	646.4446	2.304E-04
315.857	-3.80E-23	-3.723E-09	-1.724E-09	9.231E-19	646.4446	8.262E-10
321.600	5.19E-24	-1.700E-14	3.241E-10	3.310E-24	646.4446	-1.129E-10
327.343	0.000	1.824E-15	1.480E-15	-4.522E-25	646.4446	-6.259E-16
333.086	0.000	1.190E-20	-1.588E-16	0.0000	646.4446	5.530E-17
338.829	0.000	-8.934E-22	-1.036E-21	0.0000	646.4446	4.150E-22
344.571	0.000	0.0000	7.778E-23	0.0000	646.4446	-2.709E-23
350.314	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection	=	.40000000 in
Computed slope at pile head	=	-.00561676
Maximum bending moment	=	670175.335 lbs-in
Maximum shear force	=	18696.634 lbs
Depth of maximum bending moment	=	68.914 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	9

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .500000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	0.0000	20811.9592	-.006780	646.4446	-256.9255
5.743	.461065	1.203E+05	19300.5614	-.006750	945.7168	-269.4320

11.486	.422473	2.318E+05	17720.4025	-.006663	1222.7807	-280.8721
17.229	.384541	3.338E+05	16077.7530	-.006522	1476.5955	-291.1949
22.971	.347560	4.262E+05	14379.1785	-.006334	1706.2205	-300.3485
28.714	.311792	5.084E+05	12631.5470	-.006102	1910.8199	-308.2794
34.457	.277473	5.804E+05	10842.0366	-.005832	2089.6677	-314.9331
40.200	.244806	6.417E+05	9018.1445	-.005529	2242.1518	-320.2532
45.943	.213966	6.922E+05	7167.6986	-.005198	2367.7795	-324.1807
51.686	.185097	7.318E+05	5298.8743	-.004845	2466.1822	-326.6536
57.429	.158313	7.603E+05	3420.2177	-.004475	2537.1206	-327.6049
63.171	.133693	7.777E+05	1540.6783	-.004094	2580.4904	-326.9610
68.914	.111288	7.841E+05	-330.3406	-.003707	2596.3285	-324.6376
74.657	.091116	7.795E+05	-2182.9069	-.003319	2584.8194	-320.5347
80.400	.073164	7.640E+05	-3807.8652	-.002937	2546.3039	-245.3712
86.143	.057388	7.401E+05	-5197.8403	-.002564	2486.9609	-238.6998
91.886	.043719	7.081E+05	-6533.8687	-.002205	2407.3595	-226.5838
97.629	.032066	6.684E+05	-7784.3616	-.001863	2308.5229	-208.9112
103.371	.022318	6.215E+05	-8917.0467	-.001543	2191.9370	-185.5562
109.114	.014338	5.682E+05	-9898.4288	-.001249	2059.5605	-156.2187
114.857	.007977	5.097E+05	-10691.4778	-9.813E-04	1913.8486	-119.9675
120.600	.003068	4.469E+05	-11246.4486	-7.441E-04	1757.8282	-73.3059
126.343	-5.69E-04	3.816E+05	-11408.3897	-5.387E-04	1595.3842	16.9085
132.086	-.003119	3.167E+05	-11082.1082	-3.655E-04	1433.9757	96.7219
137.829	-.004767	2.549E+05	-10362.1921	-2.238E-04	1280.2083	153.9951
143.571	-.005690	1.980E+05	-9371.1394	-1.116E-04	1138.8362	191.1476
149.314	-.006049	1.474E+05	-8216.3623	-2.592E-05	1012.9589	211.0136
155.057	-.005988	1.037E+05	-6988.4363	3.633E-05	904.2522	216.6223
160.800	-.005632	67063.1593	-5760.5171	7.866E-05	813.2165	211.0112
166.543	-.005084	37389.8125	-4588.7215	1.046E-04	739.4251	197.0768
172.286	-.004431	14202.2974	-3513.2560	1.173E-04	681.7627	177.4634
178.029	-.003736	-3137.6602	-2560.0800	1.201E-04	654.2473	154.4884
183.771	-.003051	-15381.3647	-1742.9030	1.155E-04	684.6948	130.1006
189.514	-.002410	-23328.6046	-1065.3411	1.059E-04	704.4579	105.8662
195.257	-.001835	-27775.6962	-523.0865	9.323E-05	715.5168	82.9786
201.000	-.001339	-29475.8353	-105.9740	7.904E-05	719.7447	62.2844
206.743	-9.27E-04	-29110.8967	200.1377	6.451E-05	718.8372	44.3216
212.486	-5.98E-04	-27273.4357	411.7225	5.053E-05	714.2678	29.3646
218.229	-3.47E-04	-24457.4203	546.2080	3.771E-05	707.2650	17.4711
223.971	-1.65E-04	-21056.1461	620.8617	2.642E-05	698.8067	8.5277
229.714	-4.33E-05	-17365.8300	651.9274	1.689E-05	689.6297	2.2912
235.457	2.90E-05	-13593.5198	653.9806	9.218E-06	680.2488	-1.5762
241.200	6.26E-05	-9868.1595	639.4634	3.401E-06	670.9846	-3.4796
246.943	6.81E-05	-6253.9044	618.3534	-5.961E-07	661.9967	-3.8722
252.686	5.58E-05	-2765.0395	597.9216	-2.832E-06	653.3206	-3.2434
258.429	3.56E-05	617.8810	436.4699	-3.365E-06	647.9811	-52.9836
264.171	1.71E-05	2253.1522	157.7108	-2.653E-06	652.0477	-44.0967
269.914	5.11E-06	2433.2631	-62.2961	-1.491E-06	652.4956	-32.5227
275.657	1.46E-08	1539.8626	-176.2162	-5.057E-07	650.2739	-7.1510
281.400	-6.97E-07	410.0490	-140.7160	-2.224E-08	647.4643	19.5143
287.143	-2.41E-07	-76.3282	-42.9295	6.051E-08	646.6344	14.5408
292.886	-1.99E-09	-83.1171	6.5802	2.097E-08	646.6512	2.7014
298.629	1.19E-10	-.7809	7.2402	1.729E-10	646.4465	-2.4716
304.371	4.78E-15	.041809	.067985	-1.037E-11	646.4447	-.026212
310.114	-5.83E-17	1.718E-06	-.003640	-4.158E-16	646.4446	.001268
315.857	-2.45E-21	-2.048E-08	-1.496E-07	5.078E-18	646.4446	5.333E-08
321.600	2.86E-23	-8.817E-13	1.783E-09	2.136E-22	646.4446	-6.209E-10
327.343	0.000	1.003E-14	7.676E-14	-2.487E-24	646.4446	-2.734E-14
333.086	0.000	4.516E-19	-8.733E-16	0.0000	646.4446	3.041E-16

338.829	0.000	-4.913E-21	-3.932E-20	0.0000	646.4446	1.399E-20
344.571	0.000	-2.308E-25	4.277E-22	0.0000	646.4446	-1.489E-22
350.314	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection = .50000000 in
Computed slope at pile head = -.00677967
Maximum bending moment = 784097.064 lbs-in
Maximum shear force = 20811.959 lbs
Depth of maximum bending moment = 68.914 in
Depth of maximum shear force = 0.000 in
Number of iterations = 11
Number of zero deflection points = 9

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .600000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	0.0000	22756.5756	-.007917	646.4446	-268.9072
5.743	.554535	1.322E+05	21174.2333	-.007884	975.1081	-282.1573
11.486	.509447	2.550E+05	19518.8917	-.007788	1280.5087	-294.3299
17.229	.465085	3.680E+05	17796.8842	-.007634	1561.5351	-305.3742
22.971	.421771	4.708E+05	16014.8397	-.007426	1817.1773	-315.2383
28.714	.379797	5.630E+05	14179.6904	-.007169	2046.5317	-323.8685
34.457	.339427	6.443E+05	12298.6799	-.006870	2248.8057	-331.2099
40.200	.300892	7.145E+05	10379.3723	-.006533	2423.3221	-337.2057
45.943	.264391	7.733E+05	8429.6650	-.006164	2569.5247	-341.7969
51.686	.230093	8.206E+05	6457.8035	-.005769	2686.9828	-344.9211
57.429	.198132	8.561E+05	4472.4041	-.005353	2775.3967	-346.5116

63.171	.168608	8.799E+05	2482.4836	-.004923	2834.6031	-346.4955
68.914	.141590	8.920E+05	497.5033	-.004483	2864.5816	-344.7911
74.657	.117113	8.923E+05	-1472.5675	-.004041	2865.4607	-341.3032
80.400	.095176	8.811E+05	-3279.3588	-.003601	2837.5262	-287.9277
86.143	.075749	8.600E+05	-4917.5663	-.003170	2785.1661	-282.5924
91.886	.058770	8.293E+05	-6507.8731	-.002751	2708.8373	-271.2458
97.629	.044154	7.894E+05	-8015.4156	-.002349	2609.4987	-253.7690
103.371	.031785	7.408E+05	-9404.7426	-.001970	2488.6204	-230.0762
109.114	.021526	6.843E+05	-10639.7050	-.001617	2348.1903	-200.0102
114.857	.013216	6.210E+05	-11682.2878	-.001293	2190.7264	-163.0783
120.600	.006675	5.521E+05	-12488.2486	-.001002	2019.3158	-117.6046
126.343	.001705	4.791E+05	-12971.4276	-7.466E-04	1837.7516	-50.6667
132.086	-.001900	4.042E+05	-12947.7035	-5.276E-04	1651.5909	58.9288
137.829	-.004355	3.311E+05	-12374.5944	-3.453E-04	1469.8912	140.6615
143.571	-.005866	2.626E+05	-11404.8536	-1.981E-04	1299.4230	197.0592
149.314	-.006630	2.004E+05	-10174.9173	-8.327E-05	1144.8750	231.2768
155.057	-.006822	1.458E+05	-8802.1015	2.586E-06	1009.1106	246.8183
160.800	-.006600	99329.0419	-7383.2861	6.337E-05	893.4549	247.2965
166.543	-.006095	60940.1569	-5994.8586	1.031E-04	797.9899	236.2354
172.286	-.005416	30319.8520	-4693.6632	1.257E-04	721.8436	216.9172
178.029	-.004650	6842.3406	-3518.6984	1.350E-04	663.4600	192.2745
183.771	-.003866	-10296.4120	-2493.3173	1.341E-04	672.0496	164.8234
189.514	-.003110	-21995.4112	-1627.7089	1.261E-04	701.1425	136.6323
195.257	-.002417	-29180.0780	-921.4696	1.134E-04	719.0092	109.3217
201.000	-.001808	-32748.4686	-366.1134	9.804E-05	727.8831	84.0859
206.743	-.001291	-33531.5467	52.5955	8.161E-05	729.8304	61.7331
212.486	-8.70E-04	-32266.2294	352.5653	6.530E-05	726.6839	42.7340
218.229	-5.41E-04	-29579.5812	553.5982	4.996E-05	720.0027	27.2774
223.971	-2.96E-04	-25982.3616	675.9252	3.619E-05	711.0572	15.3240
229.714	-1.26E-04	-21870.1303	739.0441	2.432E-05	700.8310	6.6577
235.457	-1.71E-05	-17530.2297	760.8307	1.455E-05	690.0385	.9297
241.200	4.15E-05	-13153.1775	756.8812	6.947E-06	679.1537	-2.3052
246.943	6.27E-05	-8847.2808	740.0341	1.492E-06	668.4459	-3.5620
252.686	5.86E-05	-4655.5849	720.0185	-1.856E-06	658.0220	-3.4086
258.429	4.13E-05	-574.5828	552.6765	-3.153E-06	647.8734	-54.8697
264.171	2.24E-05	1697.0074	260.0819	-2.875E-06	650.6647	-47.0289
269.914	8.32E-06	2416.9359	19.7047	-1.855E-06	652.4550	-36.6845
275.657	1.11E-06	1926.0989	-150.6431	-7.778E-07	651.2344	-22.6406
281.400	-6.15E-07	687.8539	-164.4585	-1.297E-07	648.1551	17.8292
287.143	-3.81E-07	37.3687	-69.0959	5.012E-08	646.5375	15.3817
292.886	-3.95E-08	-105.8371	-4.4675	3.315E-08	646.7077	7.1257
298.629	1.94E-10	-13.9937	9.2203	3.438E-09	646.4794	-2.3588
304.371	1.23E-11	.059506	1.2187	-1.690E-11	646.4447	-.4278
310.114	-7.09E-17	.004335	-.005181	-1.075E-12	646.4446	.001541
315.857	-6.05E-18	-2.066E-08	-3.774E-04	6.175E-18	646.4446	1.314E-04
321.600	2.29E-23	-2.124E-09	1.799E-09	5.265E-19	646.4446	-4.976E-10
327.343	2.96E-24	5.959E-15	1.849E-10	-1.993E-24	646.4446	-6.439E-11
333.086	0.000	1.040E-15	-5.188E-16	-2.579E-25	646.4446	1.176E-16
338.829	0.000	-8.806E-22	-9.058E-17	0.0000	646.4446	3.154E-17
344.571	0.000	-5.096E-22	7.669E-23	0.0000	646.4446	4.199E-24
350.314	0.000	0.0000	4.437E-23	0.0000	646.4446	-1.545E-23
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	-.00791672
Maximum bending moment	=	892321.851 lbs-in
Maximum shear force	=	22756.576 lbs
Depth of maximum bending moment	=	74.657 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .700000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	0.0000	24573.8695	-.009033	646.4446	-279.4725
5.743	.648123	1.433E+05	22928.9794	-.008998	1002.7012	-293.3748
11.486	.596653	2.768E+05	21207.3758	-.008894	1334.7648	-306.1886
17.229	.545972	4.001E+05	19415.4553	-.008726	1641.4614	-317.8633
22.971	.496431	5.128E+05	17559.9107	-.008500	1921.7199	-328.3463
28.714	.448349	6.145E+05	15647.7399	-.008220	2174.5770	-337.5839
34.457	.402018	7.048E+05	13686.2542	-.007893	2399.1812	-345.5206
40.200	.357694	7.835E+05	11683.0890	-.007524	2594.7986	-352.0992
45.943	.315601	8.502E+05	9646.2149	-.007119	2760.8172	-357.2600
51.686	.275929	9.049E+05	7583.9545	-.006684	2896.7522	-360.9402
57.429	.238834	9.473E+05	5505.0028	-.006224	3002.2515	-363.0729
63.171	.204437	9.774E+05	3418.4556	-.005747	3077.1012	-363.5853
68.914	.172823	9.952E+05	1333.8497	-.005258	3121.2314	-362.3968
74.657	.144044	1.001E+06	-738.7815	-.004763	3134.7234	-359.4150
80.400	.118114	9.938E+05	-2713.5399	-.004269	3117.8166	-328.3118
86.143	.095014	9.758E+05	-4587.5426	-.003780	3073.0683	-324.3260
91.886	.074693	9.468E+05	-6419.8729	-.003304	3000.8220	-313.7990
97.629	.057068	9.070E+05	-8172.5730	-.002844	2901.9677	-296.5941
103.371	.042025	8.571E+05	-9807.0849	-.002407	2777.9532	-272.6389
109.114	.029424	7.980E+05	-11284.4004	-.001996	2630.7890	-241.8491

114.857	.019095	7.305E+05	-12564.4733	-.001617	2463.0549	-203.9475
120.600	.010847	6.561E+05	-13603.6750	-.001274	2277.9214	-157.9636
126.343	.004467	5.762E+05	-14345.0998	-9.681E-04	2079.2285	-100.2440
132.086	-2.73E-04	4.927E+05	-14608.6552	-7.031E-04	1871.7836	8.4586
137.829	-.003609	4.094E+05	-14249.6254	-4.794E-04	1664.5788	116.5767
143.571	-.005779	3.298E+05	-13357.3971	-2.962E-04	1466.5582	194.1496
149.314	-.007011	2.564E+05	-12097.6494	-1.508E-04	1284.1572	244.5685
155.057	-.007512	1.911E+05	-10615.0789	-3.985E-05	1121.5785	271.7495
160.800	-.007468	1.346E+05	-9031.2353	4.089E-05	981.1115	279.8378
166.543	-.007042	87272.0029	-7443.9185	9.589E-05	863.4716	272.9592
172.286	-.006367	48936.0513	-5927.8527	1.297E-04	768.1382	255.0240
178.029	-.005553	18992.7773	-4536.3396	1.465E-04	693.6756	229.5826
183.771	-.004684	-3385.8007	-3303.5974	1.504E-04	654.8643	199.7306
189.514	-.003826	-19175.9271	-2247.5182	1.448E-04	694.1310	168.0581
195.257	-.003021	-29416.3294	-1372.6114	1.327E-04	719.5968	136.6358
201.000	-.002301	-35139.5361	-672.9366	1.167E-04	733.8292	107.0320
206.743	-.001681	-37319.7754	-134.8814	9.876E-05	739.2510	80.3505
212.486	-.001167	-36836.2079	260.3262	8.037E-05	738.0484	57.2840
218.229	-7.58E-04	-34449.7535	534.4305	6.270E-05	732.1138	38.1752
223.971	-4.47E-04	-30791.5115	710.3189	4.652E-05	723.0165	23.0795
229.714	-2.23E-04	-26360.6995	810.5453	3.235E-05	711.9981	11.8252
235.457	-7.50E-05	-21530.1281	856.1804	2.048E-05	699.9854	4.0676
241.200	1.20E-05	-16557.4352	865.9458	1.104E-05	687.6194	-.6667
246.943	5.18E-05	-11600.6004	855.5750	4.055E-06	675.2928	-2.9450
252.686	5.86E-05	-6736.5995	837.3401	-4.920E-07	663.1971	-3.4054
258.429	4.62E-05	-1982.4168	665.6689	-2.654E-06	651.3744	-56.3806
264.171	2.81E-05	913.0458	361.0343	-2.919E-06	648.7151	-49.7111
269.914	1.26E-05	2168.6781	101.8137	-2.155E-06	651.8376	-40.5647
275.657	3.34E-06	2085.6660	-97.5829	-1.100E-06	651.6312	-28.8769
281.400	-8.44E-09	1049.5114	-162.0144	-3.227E-07	649.0545	6.4380
287.143	-3.67E-07	225.2969	-97.4552	-6.589E-09	647.0048	16.0453
292.886	-8.41E-08	-69.8213	-22.1824	3.196E-08	646.6182	10.1691
298.629	4.99E-12	-29.5311	6.0783	7.326E-09	646.5180	-.3271
304.371	2.93E-11	-.018791	2.5720	-4.345E-13	646.4446	-.8940
310.114	5.49E-17	.010271	.001636	-2.547E-12	646.4446	-.001193
315.857	-1.43E-17	2.933E-08	-8.943E-04	-4.777E-18	646.4446	3.114E-04
321.600	-5.50E-23	-5.032E-09	-2.553E-09	1.248E-18	646.4446	1.194E-09
327.343	7.02E-24	-2.423E-14	4.381E-10	4.785E-24	646.4446	-1.526E-10
333.086	0.000	2.465E-15	2.109E-15	-6.111E-25	646.4446	-8.840E-16
338.829	0.000	1.670E-20	-2.146E-16	0.0000	646.4446	7.474E-17
344.571	0.000	-1.207E-21	-1.454E-21	0.0000	646.4446	5.795E-22
350.314	0.000	0.0000	1.051E-22	0.0000	646.4446	-3.661E-23
356.057	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
361.800	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
367.543	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
373.286	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
379.029	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
384.771	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
390.514	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	-.00903337
Maximum bending moment	=	1000599.114 lbs-in
Maximum shear force	=	24573.870 lbs
Depth of maximum bending moment	=	74.657 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .800000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	0.0000	26293.9959	-.010134	646.4446	-288.9596
5.743	.741799	1.538E+05	24592.9475	-.010096	1028.9220	-303.4453
11.486	.684037	2.975E+05	22811.8652	-.009984	1386.3708	-316.8321
17.229	.627121	4.307E+05	20957.2068	-.009804	1717.5605	-329.0689
22.971	.571432	5.529E+05	19035.7276	-.009560	2021.3650	-340.1030
28.714	.517318	6.636E+05	17054.4901	-.009258	2296.7668	-349.8802
34.457	.465093	7.626E+05	15020.8735	-.008905	2542.8621	-358.3445
40.200	.415041	8.495E+05	12942.5836	-.008505	2758.8656	-365.4381
45.943	.367407	9.240E+05	10827.6656	-.008065	2944.1156	-371.1005
51.686	.322404	9.859E+05	8684.5201	-.007592	3098.0790	-375.2685
57.429	.280209	1.035E+06	6521.9236	-.007091	3220.3571	-377.8745
63.171	.240962	1.071E+06	4349.0558	-.006569	3310.6907	-378.8456
68.914	.204765	1.095E+06	2175.5367	-.006031	3368.9669	-378.1013
74.657	.171686	1.105E+06	11.4777	-.005486	3395.2251	-375.5510
80.400	.141755	1.103E+06	-2120.2328	-.004938	3389.6648	-366.8357
86.143	.114966	1.088E+06	-4219.3072	-.004395	3353.0027	-364.1852
91.886	.091275	1.061E+06	-6282.9346	-.003862	3285.4699	-354.4910
97.629	.070607	1.022E+06	-8270.2008	-.003346	3187.8864	-337.5918
103.371	.052849	9.712E+05	-10139.5161	-.002851	3061.6743	-313.4135
109.114	.037857	9.098E+05	-11848.9418	-.002385	2908.8634	-281.9089
114.857	.025456	8.387E+05	-13355.9517	-.001951	2732.0941	-242.9204
120.600	.015443	7.593E+05	-14615.8011	-.001555	2534.6295	-195.8331
126.343	.007593	6.731E+05	-15575.5998	-.001200	2320.4045	-138.4251
132.086	.001659	5.822E+05	-16120.8259	-8.889E-04	2094.2069	-51.4546
137.829	-.002616	4.893E+05	-16025.9070	-6.232E-04	1863.2532	84.5110
143.571	-.005499	3.990E+05	-15252.8401	-4.029E-04	1638.7802	184.7163
149.314	-.007244	3.147E+05	-13996.7524	-2.260E-04	1429.0894	252.7272
155.057	-.008094	2.386E+05	-12430.2356	-8.878E-05	1239.8364	292.8259
160.800	-.008264	1.721E+05	-10700.2439	1.304E-05	1074.3799	309.6587

166.543	-.007944	1.157E+05	-8926.8651	8.440E-05	934.1617	307.9359
172.286	-.007295	69426.0517	-7203.6487	1.303E-04	819.0925	292.1892
178.029	-.006448	32764.6594	-5599.1547	1.556E-04	727.9233	266.5898
183.771	-.005507	4883.3777	-4159.3844	1.650E-04	658.5885	234.8228
189.514	-.004553	-15255.1615	-2910.7804	1.624E-04	684.3809	200.0144
195.257	-.003642	-28791.4952	-1863.5162	1.515E-04	718.0429	164.7044
201.000	-.002813	-36885.1502	-1014.8406	1.352E-04	738.1701	130.8542
206.743	-.002089	-40649.5244	-352.2937	1.160E-04	747.5313	99.8835
212.486	-.001481	-41104.6516	143.3414	9.570E-05	748.6631	72.7258
218.229	-9.90E-04	-39146.0359	495.4386	7.580E-05	743.7925	49.8951
223.971	-6.11E-04	-35527.3666	729.3225	5.729E-05	734.7936	31.5570
229.714	-3.32E-04	-30854.7818	870.4667	4.083E-05	723.1739	17.5977
235.457	-1.42E-04	-25590.3959	943.0704	2.683E-05	710.0825	7.6872
241.200	-2.40E-05	-20063.0094	968.9719	1.551E-05	696.3370	1.3332
246.943	3.65E-05	-14484.2245	966.8376	6.948E-06	682.4638	-2.0766
252.686	5.58E-05	-8968.5631	951.5586	1.133E-06	668.7475	-3.2445
258.429	4.95E-05	-3556.5857	778.0049	-1.973E-06	655.2890	-57.1971
264.171	3.31E-05	-29.6751	465.5108	-2.862E-06	646.5184	-51.6317
269.914	1.67E-05	1794.4112	192.8718	-2.424E-06	650.9069	-43.3172
275.657	5.30E-06	2189.2148	-24.2180	-1.437E-06	651.8887	-32.2862
281.400	1.62E-07	1518.3954	-153.6756	-5.175E-07	650.2205	-12.7985
287.143	-6.48E-07	424.9129	-137.0486	-3.565E-08	647.5012	18.5890
292.886	-2.48E-07	-55.6528	-44.1918	5.591E-08	646.5830	13.7491
298.629	-5.96E-09	-82.7455	4.6526	2.159E-08	646.6503	3.2614
304.371	2.20E-10	-2.2462	7.2110	5.187E-10	646.4501	-2.3704
310.114	2.68E-13	.076925	.1956	-1.912E-11	646.4447	-.072767
315.857	-1.07E-16	9.431E-05	-.006697	-2.336E-14	646.4446	.002327
321.600	-1.32E-19	-3.750E-08	-8.211E-06	9.320E-18	646.4446	2.862E-06
327.343	5.22E-23	-4.627E-11	3.265E-09	1.146E-20	646.4446	-1.134E-09
333.086	0.000	1.828E-14	4.029E-12	-4.543E-24	646.4446	-1.404E-12
338.829	0.000	2.270E-17	-1.591E-15	0.0000	646.4446	5.529E-16
344.571	0.000	-8.910E-21	-1.977E-18	0.0000	646.4446	6.889E-19
350.314	0.000	-2.903E-24	7.756E-22	0.0000	646.4446	-2.701E-22
356.057	0.000	-2.374E-24	0.0000	0.0000	646.4446	0.0000
361.800	0.000	-1.868E-24	0.0000	0.0000	646.4446	0.0000
367.543	0.000	-1.403E-24	0.0000	0.0000	646.4446	0.0000
373.286	0.000	-9.919E-25	0.0000	0.0000	646.4446	0.0000
379.029	0.000	-6.447E-25	0.0000	0.0000	646.4446	0.0000
384.771	0.000	-3.678E-25	0.0000	0.0000	646.4446	0.0000
390.514	0.000	-1.657E-25	0.0000	0.0000	646.4446	0.0000
396.257	0.000	0.0000	0.0000	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	-.01013446
Maximum bending moment	=	1105353.394 lbs-in
Maximum shear force	=	26293.996 lbs
Depth of maximum bending moment	=	74.657 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10

Number of zero deflection points = 8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .900000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	0.0000	27934.1780	-.011222	646.4446	-297.5947
5.743	.835555	1.639E+05	26182.0201	-.011181	1054.0106	-312.6095
11.486	.771576	3.174E+05	24346.8197	-.011062	1435.7870	-326.5150
17.229	.708501	4.601E+05	22435.0941	-.010869	1790.4920	-339.2601
22.971	.646736	5.913E+05	20453.6600	-.010608	2116.9489	-350.7916
28.714	.586656	7.108E+05	18409.6436	-.010286	2414.0911	-361.0549
34.457	.528599	8.181E+05	16310.4908	-.009906	2680.9669	-369.9934
40.200	.472872	9.129E+05	14163.9772	-.009477	2916.7444	-377.5486
45.943	.419746	9.950E+05	11978.2222	-.009004	3120.7166	-383.6596
51.686	.369452	1.064E+06	9761.7041	-.008494	3292.3069	-388.2621
57.429	.322189	1.120E+06	7523.2810	-.007952	3431.0742	-391.2882
63.171	.278114	1.162E+06	5272.2171	-.007387	3536.7190	-392.6644
68.914	.237349	1.191E+06	3018.2181	-.006803	3609.0893	-392.3104
74.657	.199977	1.207E+06	771.4780	-.006208	3648.1874	-390.1364
80.400	.166042	1.209E+06	-1508.3968	-.005609	3654.1770	-403.8498
86.143	.135552	1.198E+06	-3823.8811	-.005012	3625.9312	-402.5377
91.886	.108473	1.173E+06	-6110.2432	-.004424	3563.5682	-393.7078
97.629	.084735	1.135E+06	-8323.7703	-.003852	3467.8352	-377.1723
103.371	.064228	1.083E+06	-10419.9735	-.003302	3340.1237	-352.8487
109.114	.046806	1.020E+06	-12354.0500	-.002781	3182.4761	-320.7102
114.857	.032288	9.455E+05	-14080.8884	-.002294	2997.5864	-280.6763
120.600	.020462	8.615E+05	-15554.0063	-.001846	2788.8065	-232.3498
126.343	.011090	7.696E+05	-16721.5113	-.001441	2560.1773	-174.2440
132.086	.003909	6.716E+05	-17509.7231	-.001084	2316.5490	-100.2576
137.829	-.001359	5.701E+05	-17671.5223	-7.760E-04	2064.0797	43.9097
143.571	-.005004	4.698E+05	-17062.7171	-5.182E-04	1814.6868	168.1120
149.314	-.007311	3.749E+05	-15847.5984	-3.088E-04	1578.6492	255.0637
155.057	-.008551	2.882E+05	-14226.9033	-1.444E-04	1363.1856	309.3575
160.800	-.008970	2.117E+05	-12373.5170	-2.045E-05	1172.8288	336.1005
166.543	-.008786	1.461E+05	-10430.5331	6.826E-05	1009.8424	340.5606
172.286	-.008186	91768.1951	-8511.1623	1.272E-04	874.6527	327.8770
178.029	-.007324	48184.5787	-6700.1107	1.619E-04	766.2694	302.8375
183.771	-.006326	14570.8278	-5056.0497	1.775E-04	682.6791	269.7210
189.514	-.005286	-10152.8069	-3614.8165	1.786E-04	671.6924	232.2010
195.257	-.004274	-27214.6006	-2393.0199	1.693E-04	714.1215	193.3004
201.000	-.003341	-37891.1945	-1391.7766	1.532E-04	740.6720	155.3914
206.743	-.002515	-43428.8905	-600.3555	1.330E-04	754.4430	120.2279
212.486	-.001813	-44985.3430	.4350	1.111E-04	758.3136	89.0026

218.229	-.001239	-43589.7989	435.2292	8.915E-05	754.8432	62.4182
223.971	-7.89E-04	-40119.5387	731.5152	6.840E-05	746.2134	40.7660
229.714	-4.53E-04	-35289.9482	917.4959	4.970E-05	734.2032	24.0035
235.457	-2.18E-04	-29655.6492	1020.3813	3.360E-05	720.1919	11.8272
241.200	-6.72E-05	-23620.3041	1065.0684	2.039E-05	705.1833	3.7354
246.943	1.62E-05	-17453.0181	1073.1478	1.020E-05	689.8465	-.9217
252.686	5.00E-05	-11309.6694	1062.1607	3.072E-06	674.5693	-2.9046
258.429	5.15E-05	-5257.9303	887.8188	-1.036E-06	659.5199	-57.8114
264.171	3.81E-05	-1110.8888	568.1115	-2.615E-06	649.2071	-53.5294
269.914	2.15E-05	1271.1413	281.6207	-2.575E-06	649.6056	-46.2435
275.657	8.47E-06	2127.5721	44.2400	-1.733E-06	651.7354	-36.4264
281.400	1.55E-06	1781.8571	-127.4745	-7.635E-07	650.8757	-23.3747
287.143	-2.94E-07	664.5761	-149.5939	-1.569E-07	648.0972	15.6714
292.886	-2.49E-07	63.8987	-64.1228	2.370E-08	646.6035	14.0946
298.629	-2.21E-08	-71.9558	-6.2404	2.170E-08	646.6235	6.0634
304.371	5.37E-11	-7.8089	6.2666	1.927E-09	646.4640	-1.7078
310.114	1.93E-12	.017499	.6799	-4.675E-12	646.4446	-.2378
315.857	-2.25E-17	6.780E-04	-.001524	-1.681E-13	646.4446	4.895E-04
321.600	-9.46E-19	-7.244E-09	-5.903E-05	1.961E-18	646.4446	2.056E-05
327.343	9.18E-24	-3.321E-10	6.307E-10	8.235E-20	646.4446	-1.995E-10
333.086	4.63E-25	2.898E-15	2.892E-11	-7.992E-25	646.4446	-1.007E-11
338.829	0.000	1.627E-16	-2.523E-16	0.0000	646.4446	7.800E-17
344.571	0.000	-1.101E-21	-1.417E-17	0.0000	646.4446	4.934E-18
350.314	0.000	-2.078E-23	9.436E-23	0.0000	646.4446	-3.263E-23
356.057	0.000	-1.699E-23	6.484E-25	0.0000	646.4446	0.0000
361.800	0.000	-1.337E-23	6.076E-25	0.0000	646.4446	0.0000
367.543	0.000	-1.004E-23	5.474E-25	0.0000	646.4446	0.0000
373.286	0.000	-7.100E-24	4.734E-25	0.0000	646.4446	0.0000
379.029	0.000	-4.615E-24	3.896E-25	0.0000	646.4446	0.0000
384.771	0.000	-2.633E-24	2.989E-25	0.0000	646.4446	0.0000
390.514	0.000	-1.186E-24	2.032E-25	0.0000	646.4446	0.0000
396.257	0.000	-3.013E-25	1.034E-25	0.0000	646.4446	0.0000
402.000	0.000	0.0000	0.0000	0.0000	646.4446	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	-.01122184
Maximum bending moment	=	1209484.404 lbs-in
Maximum shear force	=	27934.178 lbs
Depth of maximum bending moment	=	80.400 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = 1.000000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 130000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	0.0000	29508.2823	-.012298	646.4446	-305.5376
5.743	.929377	1.736E+05	27709.1154	-.012254	1078.1622	-321.0380
11.486	.859248	3.366E+05	25824.1449	-.012128	1483.3900	-335.4194
17.229	.790078	4.883E+05	23859.9453	-.011923	1860.7985	-348.6303
22.971	.722299	6.284E+05	21823.3919	-.011647	2209.1643	-360.6172
28.714	.656309	7.564E+05	19721.6719	-.011303	2527.3755	-371.3251
34.457	.592472	8.718E+05	17562.2948	-.010900	2814.4360	-380.6968
40.200	.531119	9.744E+05	15353.1038	-.010442	3069.4709	-388.6732
45.943	.472540	1.064E+06	13102.2887	-.009937	3291.7317	-395.1927
51.686	.416991	1.140E+06	10818.4026	-.009390	3480.6013	-400.1905
57.429	.364687	1.202E+06	8510.3818	-.008810	3635.5999	-403.5978
63.171	.315806	1.251E+06	6187.5720	-.008202	3756.3907	-405.3409
68.914	.270487	1.285E+06	3859.7617	-.007573	3842.7860	-405.3393
74.657	.228828	1.306E+06	1537.2260	-.006930	3894.7540	-403.5040
80.400	.190888	1.313E+06	-883.6371	-.006281	3912.4259	-439.5827
86.143	.156689	1.305E+06	-3408.1822	-.005631	3892.8362	-439.6121
91.886	.126208	1.283E+06	-5910.0199	-.004990	3835.9898	-431.6747
97.629	.099378	1.245E+06	-8342.7795	-.004363	3742.5586	-415.5550
103.371	.076095	1.193E+06	-10659.1989	-.003759	3613.8993	-391.1582
109.114	.056209	1.128E+06	-12811.6958	-.003183	3452.0605	-358.4677
114.857	.039537	1.051E+06	-14752.5596	-.002643	3259.7832	-317.4551
120.600	.025857	9.627E+05	-16433.2779	-.002143	3040.5023	-267.8697
126.343	.014918	8.653E+05	-17801.6256	-.001690	2798.3656	-208.6693
132.086	.006444	7.608E+05	-18790.9220	-.001287	2538.3182	-135.8618
137.829	1.37E-04	6.514E+05	-19193.7291	-9.368E-04	2266.4277	-4.4193
143.571	-.004316	5.417E+05	-18790.1294	-6.410E-04	1993.5749	144.9764
149.314	-.007225	4.366E+05	-17650.0629	-3.984E-04	1732.1138	252.0617
155.057	-.008892	3.396E+05	-16002.5794	-2.060E-04	1490.9236	321.6887
160.800	-.009591	2.531E+05	-14046.9187	-5.905E-05	1275.8042	359.3872
166.543	-.009570	1.783E+05	-11949.7876	4.792E-05	1089.9271	370.9570
172.286	-.009041	1.158E+05	-9844.7796	1.208E-04	934.3099	362.1303
178.029	-.008182	65080.6703	-7833.5252	1.657E-04	808.2864	338.3065
183.771	-.007138	25536.8668	-5988.1508	1.881E-04	709.9494	304.3612
189.514	-.006021	-3978.4351	-4354.6410	1.935E-04	656.3381	264.5228
195.257	-.004916	-24768.1926	-2956.7331	1.864E-04	708.0378	222.3107
201.000	-.003881	-38216.8825	-1800.0261	1.707E-04	741.4819	180.5226
206.743	-.002955	-45697.7160	-876.0425	1.499E-04	760.0851	141.2628
212.486	-.002159	-48502.7283	-166.0476	1.266E-04	767.0606	105.9991
218.229	-.001501	-47793.8897	355.5125	1.027E-04	765.2979	75.6387
223.971	-9.79E-04	-44572.7620	718.0339	7.980E-05	757.2876	50.6125
229.714	-5.84E-04	-39665.9106	952.2704	5.891E-05	745.0853	30.9623
235.457	-3.03E-04	-33723.2242	1088.3305	4.072E-05	730.3071	16.4218
241.200	-1.17E-04	-27226.4555	1154.1160	2.561E-05	714.1510	6.4886
246.943	-8.50E-06	-20505.6121	1174.1345	1.377E-05	697.4377	.4831
252.686	4.14E-05	-13761.2454	1168.6102	5.276E-06	680.6659	-2.4070
258.429	5.21E-05	-7091.1665	995.2007	1.058E-07	664.0788	-57.9844
264.171	4.26E-05	-2330.8121	670.4550	-2.230E-06	652.2408	-55.1111

269.914	2.65E-05	612.8178	371.9555	-2.656E-06	647.9685	-48.8439
275.657	1.21E-05	1945.3291	116.7931	-2.022E-06	651.2822	-40.0186
281.400	3.26E-06	1957.2893	-80.3547	-1.054E-06	651.3119	-28.6398
287.143	-5.67E-09	1023.9722	-151.3106	-3.151E-07	648.9910	3.9288
292.886	-3.57E-07	219.8499	-94.9930	-6.752E-09	646.9913	15.6843
298.629	-8.32E-08	-67.0796	-21.6808	3.113E-08	646.6114	9.8473
304.371	9.36E-12	-29.2160	5.8388	7.250E-09	646.5172	-.2634
310.114	4.46E-11	-.028019	2.5450	-8.148E-13	646.4446	-.8837
315.857	8.28E-17	.015653	.002439	-3.881E-12	646.4446	-.001799
321.600	-2.18E-17	4.439E-08	-.001363	-7.205E-18	646.4446	4.746E-04
327.343	-8.33E-23	-7.668E-09	-3.865E-09	1.901E-18	646.4446	1.811E-09
333.086	1.07E-23	-3.677E-14	6.676E-10	7.255E-24	646.4446	-2.325E-10
338.829	0.000	3.756E-15	3.201E-15	-9.313E-25	646.4446	-1.343E-15
344.571	0.000	2.537E-20	-3.270E-16	0.0000	646.4446	1.139E-16
350.314	0.000	-4.797E-22	-2.243E-21	0.0000	646.4446	7.865E-22
356.057	0.000	-3.923E-22	1.497E-23	0.0000	646.4446	-1.194E-25
361.800	0.000	-3.087E-22	1.403E-23	0.0000	646.4446	-2.091E-25
367.543	0.000	-2.318E-22	1.264E-23	0.0000	646.4446	-2.745E-25
373.286	0.000	-1.639E-22	1.093E-23	0.0000	646.4446	-3.207E-25
379.029	0.000	-1.065E-22	8.993E-24	0.0000	646.4446	-3.530E-25
384.771	0.000	-6.077E-23	6.900E-24	0.0000	646.4446	-3.759E-25
390.514	0.000	-2.738E-23	4.691E-24	0.0000	646.4446	-3.934E-25
396.257	0.000	-6.955E-24	2.388E-24	0.0000	646.4446	-4.085E-25
402.000	0.000	0.0000	0.0000	0.0000	646.4446	-4.232E-25

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.01229754
Maximum bending moment	=	1313332.752 lbs-in
Maximum shear force	=	29508.282 lbs
Depth of maximum bending moment	=	80.400 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	11
Number of zero deflection points	=	8

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .100000	M= 0.000	1.300E+05	.100000	2.737E+05	9929.7973
4	y= .200000	M= 0.000	1.300E+05	.2000	4.239E+05	13561.6520
4	y= .300000	M= 0.000	1.300E+05	.3000	5.526E+05	16333.3715
4	y= .400000	M= 0.000	1.300E+05	.4000	6.702E+05	18696.6344
4	y= .500000	M= 0.000	1.300E+05	.5000	7.841E+05	20811.9592
4	y= .600000	M= 0.000	1.300E+05	.6000	8.923E+05	22756.5756
4	y= .700000	M= 0.000	1.300E+05	.7000	1.001E+06	24573.8695
4	y= .800000	M= 0.000	1.300E+05	.8000	1.105E+06	26293.9959
4	y= .900000	M= 0.000	1.300E+05	.9000	1.209E+06	27934.1780
4	y= 1.000	M= 0.000	1.300E+05	1.0000	1.313E+06	29508.2823

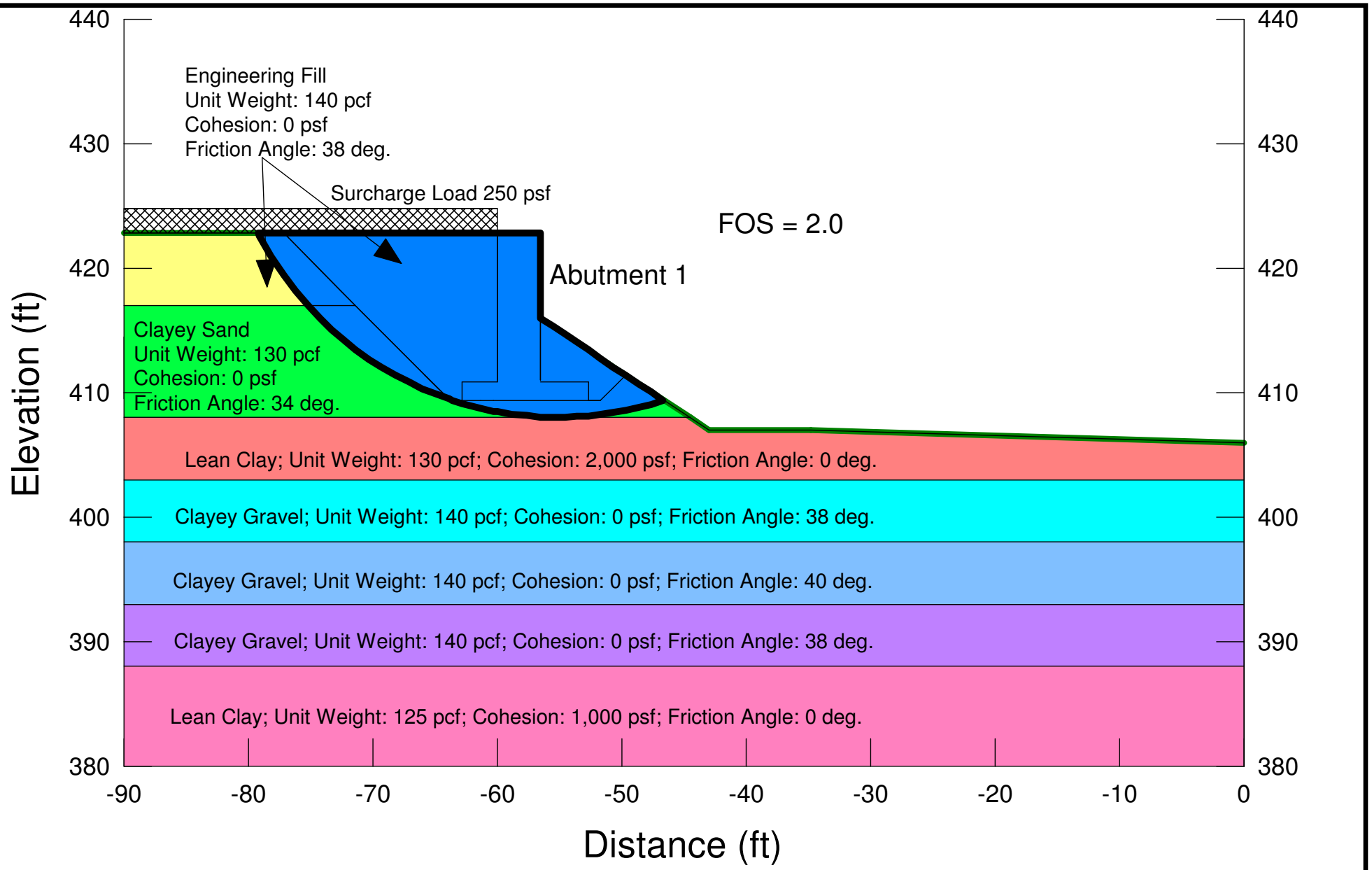
Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = .10000 in
Moment = 0. in-lbs
Axial Load = 130000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
402.000	.10000000	273696.900	9929.797
381.900	.10000000	274698.532	9949.974
361.800	.10000000	271561.444	9893.356
341.700	.10000000	272230.358	9906.464
321.600	.10000000	271994.275	9907.965
301.500	.10000000	271923.198	9901.142
281.400	.10000000	274351.201	9942.167
261.300	.10000000	272906.856	9917.660
241.200	.10000000	273591.690	9931.358
221.100	.10000000	273487.827	9929.527

The analysis ended normally.



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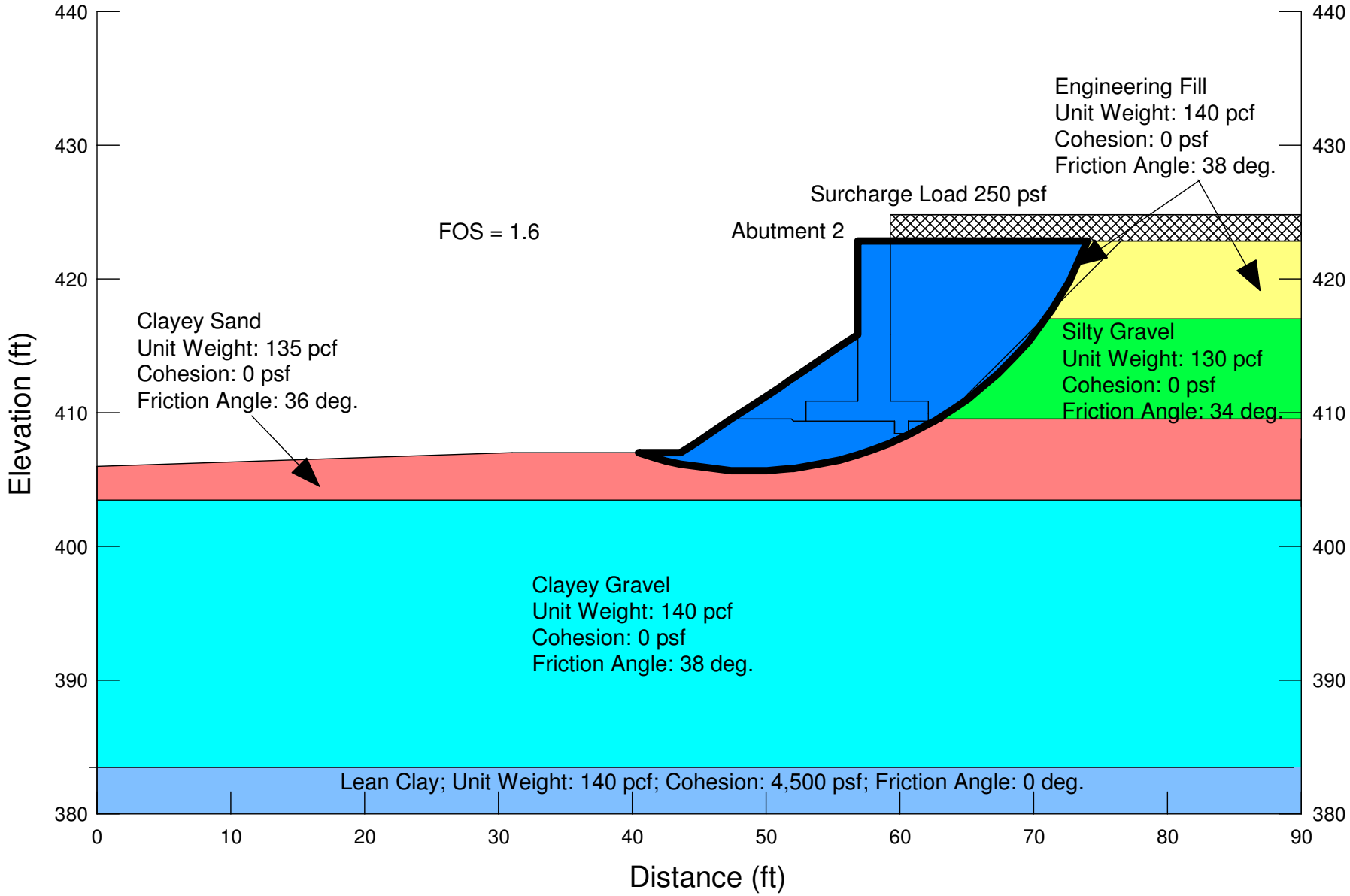
PROJECT No 28649640	CALCULATED BY M. Thummaluru	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS ARROYO MOCHO ACCESS BRIDGE ABUTMENT 1
Date December 2, 2009	CHECKED BY Stephen Huang	

FIGURE

H-1



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PROJECT No 28649640	CALCULATED BY M. Thummaluru	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS ARROYO MOCHO ACCESS BRIDGE ABUTMENT 2
Date March 19, 2009	CHECKED BY Stephen Huang	

FIGURE

H-2

FOR CONTRACT NO. 297614

MATERIALS INFORMATION

ARROYO MOCHO BRIDGE FOUNDATION REPORT

DATED 10/19/2010

04-ALA-84, PM 22.9/27.1

OCTOBER 19, 2010

FOUNDATION REPORT

ARROYO MOCHO BRIDGE (WIDEN) (BRIDGE NO. 33-0713) LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Improvement Authority (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

URS

100 West San Fernando Street, Suite 200
San Jose, California 95113

URS

October 19, 2010
Project 28649640

File No.04-ALA-84-PM 26.6
EA297601

Ms. Stefan Garcia
Project Coordinator
Alameda County Transportation Improvement Authority (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

Subject: **Foundation Report**
Arroyo Mocho Bridge (Widen), Bridge No. 33C-0713
Route 84 Expressway Widening
Pleasanton and Livermore, California

Dear Ms. Garcia:

URS has completed the accompanying Foundation Report for the Arroyo Mocho Bridge (widen) in Livermore, California. The report was prepared in accordance with Caltrans Guidelines for Foundation Investigation Reports, Version 2.0, dated March 2006. We also prepared a Geotechnical Design and Materials Report for the Route 84 Expressway Widening project from Ruby Hill Drive in Pleasanton to Jack London Boulevard in Livermore; a Foundation Report for special retaining walls to support cuts and fills along both sides of the Route 84 alignment has also been prepared.

The Foundation Report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed bridge widening. The opinions and recommendations have been based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Ms. Anne-Marie Moore, G.E., and Madhu Thummaluru, P.E., performed the engineering analysis and assisted with the preparation of this report. Mr. Mark Schmoll, C.E.G, prepared the site geology and geologic hazards portion of this report. Mr. Michael Larson, G.E., provided review, consultation and guidelines for the project.

Our responses to comments received from Caltrans are incorporated into this report.

If any questions should arise, or if we can be of further service, please contact the undersigned at (408) 297-9585.

Sincerely,

Stephen Huang, G.E. 2150
Geotechnical Task Leader

URS Corporation
100 W. San Fernando Street, Suite 200
San Jose, CA 95113
Tel: 408.297.9585
Fax: 408.297.6962
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1.1 GENERAL

The project proposes to widen and upgrade State Route (SR) 84 to expressway standards (55 mph) from Ruby Hill Drive in Pleasanton to Jack London Boulevard in Livermore for the purpose of 1) reducing congestion along SR 84 and improving local traffic circulation, 2) reducing impacts of regional traffic diverting to local streets, and 3) improving safety and operations on SR 84. In addition, the project also proposes to improve pedestrian and bicycle access along this section of SR 84 by connecting multi-use trails.

SR 84 will be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment, with some alternative potential changes in roadway curvature at the southern limit in the section between Ruby Hill Drive and Vallecitos Road. As an expressway, access on to SR 84 would be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Discovery Drive (proposed) and Jack London Boulevard would be widened and upgraded to accommodate future traffic movements. At the intersection of SR 84/Stanley Boulevard the northbound ramp will be widened. A multi-use trail located on the east side of SR 84 between Jack London Boulevard and Concannon Boulevard would remain.

Improvements to SR 84 would include widening of two existing bridge structures, two new bridge structures and constructing retaining walls. The bridge structures include:

- Arroyo Del Valle Bridge, 33-0710
- Arroyo Del Valle Trail Bridge (new structure)
- Arroyo Mocho Bridge, 33-0713
- Arroyo Mocho Access Bridge (new structure)

Retaining Walls are planned at the following locations:

Table 1-1: Summary of Planned Retaining Walls

Wall No.	Approximate Beginning Station	Length (ft)*
RW236	'A1' Line Sta. 235+60	440
RW245	'A1" Line Sta. 245+00	1,505
RW246	'A1' Line Sta. 246+00	1,154
RW314	'A1' Line Sta. 314+40	429
RW317	'A1' Line Sta. 316+66	192
RW320	'A1' Line Sta. 320+36	161
RW391	'A1' Line Sta. 391+05	920
RW400N	'A3' Line Sta. 400+00	1,180
RW400S	'A3' Line Sta. 400+10	247

Wall No.	Approximate Beginning Station	Length (ft)*
RW403	'A3' Line Sta. 402+98	882
RW437	'A2' Line Sta. 435+85	1,120
RW109	'V' Line Sta. 109+05	396
RW110	'V' Line Sta. 110+30	546

* Length measured along retaining wall layout line

The subject of this Foundation Report (FR) is widening of the Arroyo Mocho Bridge (Bridge No. 33-0713) located at PM 26.6 in Livermore, California. Figure 1-1 shows the location of this structure.

1.2 SCOPE OF INVESTIGATION

The geotechnical services performed for the Arroyo Mocho Bridge (widen) were as follows:

- Reviewed existing subsurface information and as-built plans, including as-built LOTBs of three borings, B-18, B-19 and B-20
- Geotechnical field investigation including two exploratory borings, NB23 and NB24
- Laboratory testing to estimate pertinent engineering properties
- Design recommendations and opinions were developed for the following topics:
  - Driven pile design recommendations
  - Resistance to lateral loads
  - Approach fill settlement, if any
  - Abutment grading and approach fill construction
  - Earthquake information consistent with Caltrans Response Spectra Design Techniques
  - Assessment of the potential for earthquake induced liquefaction, settlement, and lateral spreading
  - Corrosion testing and analysis
  - Address construction issues, including:
    - ▪Earthwork for abutments and new bridge approaches
    - ▪Construction dewatering

Review related to environmental and hazardous waste issues was performed by Baseline Environmental and the findings are presented in a separate report.

1.3 CALTRANS REVIEW COMMENTS

We reviewed comments prepared by Caltrans (dated June 2, 2008) for the Arroyo Mocho Bridge Foundation Report dated April 11, 2008, and for the Foundation Report (65% submittal) dated March 23, 2009. Our responses to these comments are incorporated into this report. Our responses to these comments are incorporated into this report. We also reviewed comments prepared by Caltrans (dated April 27, 2010) for the 95% PS&E submittal dated March 16, 2010. The Log of Test Boring sheet (Figures 3-4c) is revised to show the new boring identification

numbers consistent with Caltrans Logging, Classification, and Presentation Manual, dated June 2007. The following table shows the new boring identification numbers that correspond to the boring numbers referenced in this report.

Boring Number (Old)	Boring Number (New)*
NB23	R-08-023
NB24	R-07-024

* As described in Caltrans Logging, Classification, and Presentation Manual, dated June 2007

Copies of the review comments and our responses are presented in Appendix A.

2.1 PROJECT DESCRIPTION

SR 84 is to be widened to the east between Vineyard Avenue and Concannon Boulevard, and to the west for the remainder of the alignment, which will require widening of two existing bridges at Arroyo Del Valle and Arroyo Mocho. The location of Arroyo Mocho Bridge is shown on Figure 1-1. The existing bridge is approximately 124 feet long and 61 feet wide and is located between 'A3' line Stations 413+91 and 415+14. The existing three-span bridge at Arroyo Mocho is to be widened approximately 71 feet to the west, and a new, separate single span access bridge across Arroyo Mocho is to be constructed just west of the roadway widening. The 71 feet widening would include a 26 feet wide median, three 12 feet wide (each) travel lanes and a 10 feet wide shoulder. The Arroyo Mocho Bridge (widen), the subject of this foundation report, is to be a cast-in-place reinforced concrete slab bridge, supported on two abutments and two piers; driven steel H-piles (HP 10x57) are the planned foundation type. The bridge is to have a deck at about Elevation 421 feet and soffit at about Elevation 417 feet. Based on the project hydraulic report (Wreco, 2008), the 100-year water surface is estimated at about Elevation 415 feet. The abutment piles will have a design service load of 75 kips (based on LRFD Service-1 Limit State) and nominal resistance in compression of 150 kips. Piles at the piers will have a maximum nominal resistance in compression (based on a strength limit state condition) of 290 kips. There is no tension demand on pier piles. Bottom of pilecap is planned to be at Elevation 411.46 feet for both Abutments 1 and 4; bottom of pilecap is planned to be at Elevation 385.86 feet for both piers 2 and 3. Excavations at the piers are about 18 feet in depth to match the existing pilecap elevation.

The portion of the channel located beneath the existing and proposed bridge is concrete lined, with side slopes between the abutments and center piers inclined at about 2.5:1 (horizontal:vertical). Finish grade for the concrete slab between the center piers is at about Elevation 404.5 feet. Concrete lining is approximately 8 inches thick at the channel bottom and 6 inches thick along side slopes with reinforcement. Flow in the channel passes primarily between the center piers.

The plan and elevation sections for the proposed widen bridge are shown on the General Plan, Figure 2-1. The Foundation Plan for the proposed bridge is presented as Figure 2-2.

3.1 GEOLOGIC SETTING

3.1.1 Regional Geology

The SR 84 alignment lies within the Livermore Valley within the central portion of the Coast Ranges geomorphic province of California. Northwest-southeast-trending valleys and ridges characterize the regional morphology of the Coast Ranges province. These topographic features are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent predominantly strike-slip faulting along the San Andreas fault system between the Pacific and North American plates. Regional geologic mapping shows the project alignment to be underlain by Holocene alluvium and channel sand and gravel deposits along the active channel of Arroyo Del Valle (Dibblee, 1980; Gramer et al., 1996). More recent mapping by Witter and others (2006) subdivide the alluvium into latest Holocene alluvial fan deposits extending from about Jack London Boulevard south to Stanley Boulevard, Holocene alluvial fan deposits extending from about Stanley Boulevard to just north of Concannon Boulevard, and historic stream channel deposits within the active channels of Arroyo Mocho and Arroyo Del Valle. The geologic map (Figure 3-1) shows the aerial extent of these various geologic units. Witter (2006) also maps a small area of stream terrace deposits and Pleistocene alluvial fan deposits, mostly east of SR 84 and north of Arroyo Del Valle in the vicinity of Concannon Boulevard South of Arroyo Del Valle the road alignment crosses through Holocene alluvium deposits and alluvial fan deposits as it enters the mouth of a canyon at the south end of the alignment. The surrounding low hills south of the intersection of Vallecitos Road are mapped as older alluvium deposits and the Pleistocene Livermore Gravels Formation. The project alignment does not cross into these older formations.

In this portion of southeastern Alameda County, the underlying "bedrock" is the non-marine sedimentary Livermore Gravels Formation (Graymer, et al.1996; Dibblee, 1980). The Livermore Gravels Formation is up to about 4,000 feet thick and lies as much as 400 feet below the alluvium in the central Livermore Valley (Hall, 1958). It contains poorly to moderately consolidated cobble conglomerate, conglomeratic sandstone, and coarse-grained sandstone with some siltstone and claystone (Graymer et al., 1996). The Livermore Gravels may have been encountered at depth in some of the deeper borings completed near the southern portion of the project alignment, however it is difficult to distinguish between the gravelly alluvium soils and the older Livermore Gravels in the borings.

3.1.2 Regional Tectonic Setting and Seismicity

The project alignment lies between known active and potentially active geologic faults. In general, earthquakes occur as a result of movement along active faults. For the purpose of activity classification, faults are generally grouped into the following categories by the California Division of Mines and Geology (renamed the California Geological Survey, CGS) (Jennings, 1994):

- Holocene: displacement has occurred within the last 10,000 to 11,000 years.
- Late Quaternary: displacement has occurred within the last 700,000 years, but evidence of Holocene activity is lacking.

- Quaternary: evidence of displacement within the last 1.6 million years, but evidence of Holocene activity is lacking.
- Pre-quaternary: no recognized evidence of displacement in the last 1.6 million years.

Generally, faults with Holocene movement are considered to be "active" while faults with late Quaternary to Quaternary movement are considered to be "potentially active".

The closest active faults to the project alignment are the Greenville, Calaveras, and Verona Williams faults (Mualchin, 1996). The California Geological Survey (2000) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. All three of these faults are included as Alquist-Priolo (A-P) zoned faults. The Greenville fault is located about 5.2 miles (8.3 km) east of the project alignment. The Calaveras fault is located about 4.5 miles (7.3 km) west of the alignment and the Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. More distant active faults include the Hayward fault located 10.5 miles (16.9 km) southwest of the southern end of the project alignment, and the San Andreas fault located 29 miles (46.7 km) southwest of the southern end of the project alignment. Figure 3-2 shows active faults within the site region relative to the project. The project alignment does not cross any mapped A-P zoned faults.

Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1 mile (1.6 km) southeast of the southern end of the project alignment, and the Livermore fault, located about 1,000 feet northeast of the intersection of SR 84 and Jack London Boulevard (Dibblee, 1980). The geologic map (Figure 3-1) shows the location of the Livermore fault as mapped by Dibblee (1980) and on the Seismic Safety Element of the Alameda County General Plan (1982). The California Geological Survey (2000) includes a portion of the Las Positas fault as an A-P zoned fault south of the Lawrence Livermore complex, but does not extend the A-P zone as far west as Dibblee (1980) and Wagner et al. (1990) map the fault. Both Dibblee and Wagner also map the Livermore fault as a concealed fault trending northwesterly. The Seismic Safety Element of the Alameda County General Plan (1982) also shows this fault on hazard maps, indicating its location is based on a groundwater barrier. They classify the fault as "potentially uncertain", meaning the activity of the fault is insufficient to give it an activity classification. Wagner et al. (1990) map the Livermore fault as an early Quaternary fault (2,000,000 to 700,000 years old). The project alignment does not cross either the Los Positas fault or the Livermore fault.

The following is a brief description of the nearby active faults.

3.1.2.1 Calaveras Fault

The Calaveras fault is a dextral strike-slip fault that is part of the larger San Andreas fault system and is located along the eastern side of the East Bay Hills. The fault is located about 4.5 miles (7.3 km) west of the project alignment and is predominantly a vertical fault with a slip rate of 12 to 18 mm/year (WGCEP, 2003). Active seismicity, including a moderate magnitude earthquake in 1856, has been recorded along the Calaveras fault resulting in surface ruptures and large earthquakes (Kelson and others, 1996; Simpson and others, 1999). In addition to seismic events, fault creep continues to be present along the Calaveras fault as indicated by a seismic surficial fault rupture in numerous localities.

3.1.2.2 Greenville Fault

The Greenville fault lies 5.2 miles (8.3 km) east of the project alignment. Recent investigations of the Greenville fault and Mount Diablo thrust indicate that these two structures are geometrically linked, with the Mount Diablo thrust acting to transfer strain from the Greenville fault to the Concord-Green Valley fault (Unruh and Sawyer, 1997). This suggests that the Greenville fault does not continue to the north as previously mapped, but dies out near Morgan Territory Road. Two earthquakes during January 1980 on this fault measured Richter magnitudes of 5.9 and 5.8.

Available data on the late Quaternary slip rate of the Greenville fault are sparse and have significant uncertainties. The Working Group on California Earthquake Probabilities estimates the slip rate on the Greenville fault to be about 2 mm/yr (WGCEP, 2003). Based on correlation of terraces south of Livermore Valley offset by the Greenville fault, Wright et al. (1982) documented approximately 90 m of Pleistocene displacement. The deformed terraces were estimated to be 125,000 to 180,000 years old, based on soil profile development, thus implying a slip rate of 0.5 to 0.7 mm/yr (Wright et al., 1982). Paleoseismic trench investigations across one of the strands of the northern Greenville fault documented evidence for Holocene surface-rupturing events. Wright et al. (1982) estimated a horizontal slip rate of approximately 0.1 to 0.3 mm/yr with a recurrence interval estimated to be on the order of 550 years. Recent investigations by Unruh and Sawyer (1998) and Sawyer and Unruh (2002) indicate a 70-km length for the active Greenville fault. Preliminary Holocene slip rate estimates from a site at the northern end of the Livermore Valley are 4.1 ± 1.8 mm/yr (Sawyer and Unruh, 2002). However, Unruh cites strong geomorphic and structural evidence to support a more limited rupture length for a MCE on the Greenville fault. Detailed geomorphic and preliminary paleoseismic investigations support a maximum rupture length of 43 km along the northern part of the Greenville fault, equivalent to rupture of the Livermore and Arroyo Mocho sections investigated by Unruh and Sawyer (1998). A rupture of this length would generate a MCE of **M** 7.

3.1.2.3 Verona Williams Fault

The Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. This fault is shown as an uncertain trace over a curving length of about 4 miles (6½ km) along the base of the hills on the north side of the Vallecitos Valley (CGS, 2000). Because the CGS believes that there is insufficient evidence to indicate that this fault is inactive and that there is sufficient evidence to indicate that this fault is potentially active, it is included within an Alquist-Priolo Earthquake Fault Zone (Hart, 1975; CDMG, 1982a).

3.1.2.4 Las Positas Fault

The Las Positas fault was originally mapped in 1975 and 1977 by Herd as a northeast-trending, 15-km long zone of left-lateral strike slip faults. Herd showed the southwest end of the fault (the end closest to the project alignment) covered by alluvium and landslides. Herd cites geomorphic features including scarps and several drainages that have been deflected as evidence for recent movement along the fault. Radiometric dating of buried charcoal from a faulted stream terrace indicated that faulting had occurred 17,400 ± 250 years ago (Carpenter et al., 1980). Bonilla et al. (1980) described several en echelon fractures that they attributed to tectonic movement along

the Las Positas fault following the two 1980 Livermore earthquakes on the Greenville fault. An analysis of seismicity in the Livermore Valley area following these two earthquakes showed that the movement along the Las Positas fault was left-lateral and that this fault is "probably seismically active", although the analysis of the limited data set compiled for this study could not prove seismic activity (Ellsworth and Marks, 1980).

California Division of Mines and Geology Fault Evaluation Report 112 by Smith (1981) summarizes the exploratory work and mapping that were performed by numerous authors to evaluate the activity of the Las Positas fault and this document was used to justify the delineation of the Earthquake Fault Zone along a portion of this fault. The Alquist-Priolo Earthquake Fault Zone delineated along the Las Positas fault is located about 3.5 miles (5.6 km) northeast end of the project alignment (CGS, 2000).

3.1.3 Local Geology

Based on a review of the borings completed along the project alignment, the soil profile typically consists of road base/fill overlying alluvium. The road base, where encountered, ranged from about 6 inches thick to as much as 18 inches thick. Alluvium was encountered in all of the borings underlying the road base. The alluvium consists of complexly interbedded sand, silt and clay with gravel and extensive channel deposits of sandy gravel, clayey gravel and poorly graded sand/gravel mixtures. More recent mapping by Witter and others (2006) shows that the subject site to be predominantly underlain by historic stream channel deposits and latest holocene alluvian fan deposits. In general the alluvium encountered below 50 feet consists primarily of silty clay to lean clay interbedded with thin sand/gravel deposits. The uncorrected N-values from borings were nearly all above 40 blows per foot and most were well above 50 blows per foot in cohesionless soils, even in the silts and clays located below Elevation 350 feet. Silts and clays encountered at shallow depths typically have N-values in the range of 10 to 28 blows per foot.

3.2 SITE AND SUBSURFACE CONDITIONS

3.2.1 Site Topography

The SR 84 alignment between Jack London Boulevard and Ruby Hill Drive crosses the relatively flat Livermore Valley. The topography along the existing roadway ranges in elevation from approximately 410 to 420 feet between Jack London Boulevard at Station 448+00 to the drainage crossing of Arroyo Del Valle at Station 320+00. The incised Arroyo Del Valle and Arroyo Mocho drainage crossings are at about Elevation 400 feet in the channel bottom. South of Arroyo Del Valle crossing the road alignment gradually climbs a gentle alluvial fan, rising to about Elevation 590 feet south of Ruby Hill Drive at Station 227+00. South of the intersection with Vallecitos Road, the road alignment is surrounded by low rolling hills as it enters the mouth of a canyon.

Development along the project is mixed, including agricultural, scattered commercial and industrial (mainly at the north end), residential communities and gravel quarries. The gravel quarries are extensive and extend between about Station 314+00 north of Vineyard Avenue to

Station 415+00 at the Arroyo Mocho bridge crossing. The majority of the gravel quarries are located along the west side of SR 84.

3.2.2 Field Exploration

Subsurface exploration for the existing Arroyo Mocho Bridge was performed in November 1996 by others and included three rotary wash borings, B-18, B-19, and B-20, which extended to a maximum depth of 100 feet. These borings reportedly encountered alluvial deposits consisting of dense to very dense sands and gravels and stiff to hard clays and silts to the maximum depth of each boring. Free groundwater was reportedly observed at a depth of about 88 feet (Elevation 332 feet) in Boring B-20. Groundwater levels were not recorded in either of the other borings due to the rotary wash drilling method used.

To supplement available data, a subsurface investigation for design of the bridge widening and adjacent new Zone 7 access bridge was performed between December 26, 2007 and January 2, 2008, and included two borings, NB23 and NB24, which extended to terminal depths of 101.5 feet. The borings were initially drilled with a 4-inch solid flight auger so that the depth to groundwater could be measured. Thereafter, the drilling method was switched to 4⅞ inch rotary wash. Please refer to Figure 3-3 for relative location of recent borings performed for this study, as well as those completed by others in 1996.

A representative of URS supervised the drilling operations and soil sampling. Visual classifications of the soils encountered were made from cuttings and soil samples. The soil samples collected from the borings were sealed immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. All borings were backfilled with a mixture of cement and bentonite in accordance with the requirements of the Alameda County Flood Control and Water Conservation District, also known as Zone 7 Water Agency. For details of field exploration refer to Appendix B.

The Unified Soil Classification System and the guidelines summarizing soil consistency and relative density are presented on the Log of Test Borings (LOTBs) legend in Figures 3-4a and 3-4b. Descriptions of the soils encountered in the current borings by URS and previous borings by others are presented on Figures 3-4c and 3-4d, respectively. The logging method used in preparing the LOTBs is consistent with Caltrans Soil and Rock Logging, Classification and Presentation Manual, dated June 2007. These logs also illustrate the notation used for the size of samplers and the methods of advancing them.

3.2.3 Laboratory Testing

The water content, dry density, plasticity index (PI) and grain size distribution (PA), and unconfined compressive strength (UC) were determined for selected samples to estimate the strength and compressibility of the underlying soils. The locations of these tests, together with the resistance to penetration of the samplers are shown at the corresponding locations on the LOTBs. One consolidation test was performed on a sample as part of the study performed by others in 1996. The laboratory test results are provided in tabular form and/or graphically in Appendix B.

3.2.4 Soil Conditions

3.2.4.1 Fill

Embankment fills at the site consists of about 6 inches of aggregate base at Borings NB23 and NB24.

3.2.4.2 Native

Native soils were encountered below the aggregate base fill in Borings NB23 and NB24 and beginning at ground surface in the borings performed in 1996. Borings B-18 through B-20 encountered mostly silty sand to sandy silt in the upper 3 to 6 feet of the borings; NB23 encountered primarily clayey sand. Underlying the surficial loose to medium dense sand and silt layer were dense to very dense clayey gravel, silty gravel, clayey sand, silty sand and poorly graded sand deposits; these sand and gravel deposits extended to the terminal depths of the borings. Scattered cobbles were encountered in Borings NB23 (at depth of 3 feet), NB24 (between depths of 3 and 8 feet), B-18 (depths between 25 and 30 feet, at depth of 97 feet) and B-20 (between depths of 20 and 33 feet). Numerous interbedded layers of very stiff to hard, sandy clay and clayey silt ranged in thickness from 3 to 24 feet in the 1996 and current borings.

3.2.5 Groundwater

Free groundwater was reportedly encountered at a depth of approximately 88 feet (Elevation 332 feet) in Boring B-20 drilled in 1996. Free groundwater levels were not recorded in either of the other two borings (B-18 and B-19) due to the rotary wash drilling method used. Groundwater was reportedly measured by others at a depth of about 91 feet (Elevation 334 feet), and 66 feet (Elevation 358 feet) in November 1996 and February 1997, respectively in a monitoring well (Alameda County Flood Control and Water Conservation District, Zone 7, well No. 32/SE 7N1) located near the site of Abutment 4. Groundwater was reportedly measured at a depth of about 42 feet (Elevation 376 feet) in February 1997 in a nearby piezometer that was installed as part of the 1996 study and located just south of Stanley Boulevard. Groundwater levels measured in February 1997 were taken following two months of heavy rains. These water levels indicate that groundwater recharge responds rapidly to rainfall infiltration.

Free groundwater was not encountered in either of the two borings drilled at Arroyo Mocho for this investigation above a depth of 8 feet where the drilling method was switched to rotary wash, thereby precluding a reliable groundwater measurement. However, drilling fluid was measured at depth of 42.5 feet (Elevation 375 feet), five days after temporarily stopped drilling NB23, prior to resuming drilling on January 2, 2008. Wet soils were noted at a depth of about 24½ feet in a nearby hollow stem auger boring, NB22A, drilled near Station 408+00 for proposed retaining wall structures; however, at the completion of drilling to a depth of 30 feet, the boring was noted to be dry.

None of the shallow “RB” borings completed for pavement design and completed using hollow stem auger methods encountered groundwater. These borings were generally 10 to 15 feet in depth. No groundwater springs or seeps were observed on or near the project alignment, and the stream channels crossed by the alignment flow only during the rainy season and shortly afterwards.

In our opinion, a design groundwater level at Elevation 376 feet would be appropriate for the site.

3.3 GEOLOGIC HAZARDS

3.3.1 Surface Fault Displacement and Ground Shaking

The project alignment does not cross any Alquist-Priolo Earthquake Fault Zones; surface rupture due to faulting along the alignment, therefore, is not expected to occur. However, the short distance to the Earthquake Fault Zones along the Calaveras, Verona Williams, Greenville and Hayward faults does create a high risk for ground shaking from fault movement. The intensity of the ground shaking is dependent upon the size of the earthquake, the distance of the epicenter from the site, the direction that the earthquake propagates along the fault, and the site geologic conditions.

3.3.2 Landslide and Slope Failure

No landslides were noted in the vicinity of the Arroyo Del Valle creek crossing and a review of the U.S. Geological Survey landslide map for the Livermore quadrangle (Nilsen, 1975) does not show any other landslides.

3.3.3 Scour

The channel bottom and side slopes beneath the existing and proposed SR 84 bridge widening over Arroyo Mocho are reportedly lined with concrete based on the as-built plans for construction of the existing bridge. The portion of the channel at the proposed access bridge crossing, however, is unlined. Based on the project hydraulic analysis (Wreco 2008), we understand that total scour to a depth of 1.1 feet bgs is anticipated at the access bridge abutments. No potential scour is anticipated at the Arroyo Mocho Bridge widening as the channel bottom and slopes are concrete-lined. We understand that recommendations for scour mitigation are provided in the project hydraulic report. The executive summary section of Hydraulic Study Report by Wreco, dated May 2009 is attached to this report in Appendix C.

3.3.4 Flooding

With the exception of the active channels of Arroyo Del Valle and Arroyo Mocho, the project alignment is located outside of the 100-year flood zone as shown on the FEMA flood hazard zone maps (ABAG, 2007).

3.3.5 Subsidence and Seismic Compaction

Subsidence typically occurs as a result of subsurface fluid extraction (e.g. groundwater, petroleum) or compression of soft, geologically young sediments. Groundwater extraction for high volume municipal and agricultural use has the potential to cause future ground subsidence in the region. However, we are not aware of subsidence in the area and no active petroleum wells are present within many miles of the site (California Division of Oil, Gas, and Geothermal Resources, 2001).

Compaction settlement, or seismic densification, occurs when loose granular soils above the groundwater table increase in density as a result of earthquake shaking. This soil densification can result in differential settlement because of variations in soil composition, thickness, and initial density. With the exception of some loose to medium dense cohesionless soils encountered in the upper 20 feet in B-19, B-20, and NB24, the cohesionless materials are dense to very dense at the Arroyo Mocho crossing. For design, we estimated the potential post-earthquake settlement at borings NB23 and NB24, using the computer program LIQUEFY PRO. In our analyses we used a peak ground acceleration (PGA) of 0.5g and design earthquake moment magnitude (Mw) of 7.5. The results of these studies indicated that the magnitude of seismic compaction settlement at abutments will be less than ¼ inch. We believe that compaction settlement of the native soils due to seismic densification during strong ground shaking at bents to be nil.

3.3.6 Liquefaction Potential

Liquefaction is a phenomenon whereby sediments temporarily lose shear strength and collapse. This condition is caused by cyclic loading during earthquake shaking that generates high pore water pressures within the sediments. The soil type most susceptible to liquefaction is loose, cohesionless, granular soil below the water table and within about 50 feet of the ground surface. Liquefaction can result in loss of foundation support and settlement of overlying structures, ground subsidence and translation due to lateral spreading, lurch cracking, and differential settlement of affected deposits. Lateral spreading occurs when a layer liquefies at depth and causes horizontal movement or displacement of the overburden mass toward a free face such as a stream bank or excavation, or toward an open body of water.

In a regional study of the nine-county San Francisco Bay region for the U.S. Geological Survey, Witter et al. (2006) mapped the liquefaction susceptibility of the soils along the project alignment. The alluvium between Jack London Boulevard and Stanley Boulevard (Station 401+00) is mapped as having “high” liquefaction susceptibility. Between Stanley Boulevard and Arroyo Del Valle (Station 321+00) the alluvium is mapped as having “moderate” liquefaction susceptibility. From Arroyo Del Valle extending south about 1,500 feet to Station 304+00, the alluvium is mapped as having “high” liquefaction susceptibility and south of this point to the southern end of the project alignment the soils are mapped as having “moderate” liquefaction susceptibility. The historic channel deposits at both Arroyo Del Valle and Arroyo Mocho are mapped as having “very high” liquefaction susceptibility.

Based on a review of the borings completed at Arroyo Mocho, several relatively thin discontinuous strata of loose to medium dense clayey and silty sand and sandy silt were encountered in the upper 20 feet in current Boring NB24 and in previous borings B-19 and B-20. These upper granular soils could be subject to liquefaction if saturated, however the depth to groundwater is likely at least 25 feet or greater based on the borings drilled in this area. The granular soils encountered below a depth of 25 feet are mostly dense to very dense, and therefore the potential for liquefaction and lateral spreading of these materials to occur is considered to be low.

3.4 GEOLOGICAL PROFILES AND ENGINEERING PARAMETERS

A generalized soil profile is presented as Figure 3-5 illustrating the layering of the various soil strata and summarizing the corresponding geotechnical parameters. It should be noted that this profile was developed based on extrapolation of available data from the borings drilled for this investigation and, therefore, may differ from actual conditions. Engineering soil parameters presented on the profile were selected from laboratory test results as well as engineering judgment and local experience.

The undrained shear strength, relative density, dry unit weight and moisture content are the engineering soil parameters used in our foundation design and analysis. Atterberg limits tests and particle analyses were performed for classification of soils. In general, unconfined compression tests were performed on cohesive soil samples to estimate the undrained shear strength. Some disturbance may occur while sampling cohesive soils; therefore unconfined compressive strengths in localized areas can be lower than the insitu field conditions. Consequently, engineering judgment and local experience were applied in our interpretation of the laboratory test results. The relative density of cohesionless soils was estimated from vertical effective stress and Standard Penetration Resistance, N blows per 1 foot based on correlations developed by Gibbs and Holtz (DM7.1 – 87, 1986). Where non-standard sampler sizes were used, such as the modified California sampler (2½ inch outside diameter), a correction factor was applied to the observed blows per 1 foot to estimate the Standard Penetration Resistance, N values.

4.1 CORROSION EVALUATION

An assessment of the potential for corrosion of various buried foundation and pipe structures was performed by V& A Consulting Engineers (V&A). The results of their investigation are presented in Appendix D. The following paragraphs include their summary, conclusions, and recommendations.

4.2 SUMMARY

The objective of this investigation is to measure various soil parameters and evaluate the results with respect to possible levels of corrosion at proposed Arroyo Mocho Bridge (Widen) site. Corrosivity was determined for materials of the proposed project structure to depths ranging from 0 to 20 feet below grade.

The California Department of Transportation, Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch has published "Corrosion Guidelines" (Guidelines) to define corrosive soil. The Guidelines consider soil to be corrosive to structural elements (steel reinforced concrete) if one or more of the following conditions exist for water or soil samples:

1) The chloride concentration is 500 ppm (mg/kg) or greater,
2) The sulfate concentration is 2,000 mg/kg or greater, or
3) The pH is 5.5 or less.

A wide variety of soluble salts is typically found in soils. Two soils having the same resistivity may have significantly different corrosion characteristics, depending on the specific ions available. The major constituents that accelerate corrosion are chlorides, sulfates and the acidity (pH) of the soil. Chloride ions tend to break down otherwise protective surface deposits, and can result in corrosion of reinforcing steel in concrete structures. Sulfates in soil can be highly aggressive to portland cement concrete by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. High concentrations of bicarbonates tend to decrease soil resistivities. Although bicarbonates are not aggressive to concrete, lower resistivity environments can promote corrosion activity.

Acidity, as indicated by the pH value, is another important factor of soil. The lower the pH (the more acidic the environment), the higher will be the corrosivity with respect to buried metallic and concrete structures. As pH increases above 7 (the neutral value), conditions become increasingly more alkaline and passive to buried structures.

Evaluation of the in-situ soil environment was made in terms of potential damage to structures due to corrosion. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, soil samples collected by URS during the geotechnical investigation were forwarded to Cooper Testing Laboratory in Palo Alto, California for chemical analysis. The soil samples were analyzed for minimum resistivity, pH, water soluble chloride ion concentration, and water soluble sulfate ion concentration in accordance with the Guidelines.

The results are summarized in the following table.

Table 4-1: Soil Corrosion Test Results Summary

Sample ID	Minimum Resisitivity (ohm-cm)	pH	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
NB23, 2-4	5,347	8.4	2	<5
NB23, 13-3	6,052	7.9	3	<5
NB24, 2-X	14,478	9.1	<2	<5
NB24, 13-4	1,978	7.8	7	<5

As shown above, the pH of the soil samples analyzed ranged from 7.8 to 9.1. The water soluble chloride ion concentration of the soil samples analyzed ranges from less than 2 milligrams per kilogram (mg/kg) to 7 mg/kg. The water soluble sulfate ion concentration of the soil samples was below the minimum detection level of 5 mg/kg. In addition, the minimum (saturated) resistivity of the four samples selected from the borings ranged from 1,978 ohm-cm to 14,478 ohm-cm.

No water was sampled at the Arroyo Mocho Bridge (widen) site since the streambed was dry at the time field resistivity readings were taken (May 2008). The bridge structure is not located within 1,000 feet (300 meters) of salt or brackish water.

4.3 CONCLUSIONS

Soil samples were obtained for corrosion analysis at Boring Locations NB23 and NB24. As shown in the preceding Table 4-1, the soil boring chemical analyses resulted in pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg and soluble sulfate concentrations less than 2,000 mg/kg. Therefore, according to the Guidelines, the soil at the site is considered non-corrosive. According to the Guidelines, no corrosion mitigation for steel piles is required for non-corrosive soil conditions.

4.4 RECOMMENDATIONS

4.4.1 Buried Reinforced Concrete Structures

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A concrete cover of a minimum of 2 inches should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.
- The concrete should be allowed to cure according to the manufacturer's recommendations.

4.4.2 Steel Piles

Based on the results of the corrosion analyses, the site is considered non-corrosive to steel piles and corrosion mitigation is not required. Fill materials should be tested for corrosivity, and if they are found to be corrosive, then the recommendations in the Guidelines for steel piles in corrosive soil should be followed.

5.1 SEISMIC DESIGN METHODOLOGY AND RESOURCES

The seismic design methodology adopted for this project is based on the following current Caltrans standards:

- Seismic Design Criteria (SDC), v 1.4, June 2006
- Guidelines for Foundation Investigations and Reports, v 2.0, dated March 2006
- California Seismic Hazard Map (Mualchin, 1996)

5.2 PEAK BEDROCK ACCELERATION

The active faults close to the SR 84 alignment between Ruby Hill Drive and Jack London Boulevard are the Greenville, Calaveras, and Verona Williams faults. The Greenville fault, Calaveras fault, and Verona Williams fault are designated with Maximum Credible Earthquake (MCE) magnitudes of 7.25, 7.5 and 6.0, respectively, by the California Seismic Hazard Map (Mualchin, 1996). The locations of these faults and associated peak bedrock acceleration (PBA) contours were obtained from the California Seismic Hazard Map and transferred to a topographical map showing the SR 84 structure. Three faults contribute the same level of ground shaking at the site (0.5g) even though the Verona Williams fault is closest to the site. The MCE, nevertheless, is the earthquake on the Calaveras fault since it potentially releases the highest energy (M=7.5). The SR 84 alignment is roughly parallel to the Calaveras fault, and the distance from the site to the Calaveras fault is approximately 4.5 miles.

Table 5-1: Seismic Source Parameters

Fault	Type	MCE	Distance (miles)	Near Field Effects?	Design PBA (g)
Calaveras	strike-slip	7.5	4.5	Y	0.5
Greenville	strike-slip	7.25	5.2	Y	0.5
Verona Williams	Unknown	6	1.7	Y	0.5

5.3 FAULT TYPE, NEAR-FIELD, AND SPECTRAL ACCELERATION INCREASES

The technical report that accompanies the California Seismic Hazard Map (Mualchin, 1996) indicates that the controlling fault (Calaveras) has strike-slip displacement. Therefore, in accordance with Caltrans design procedures referenced above, an increase in design spectral accelerations is not required for fault type. However, since the project alignment is less than 9.5 miles from the nearest active fault, design spectral accelerations should be modified to account for near-fault effects as follows:

Table 5-2: Spectral Acceleration Increase for Near Field Effects

Period (sec)	Increase in Spectral Acceleration (%)
< 0.5	0
0.5 – 1.0	0 – 20 (determined by linear interpolation)
≥1	20

At the time of this study, no bridge structures with fundamental period of vibration greater than 1.5 seconds are anticipated, and therefore no adjustments are required for long period effects.

5.4 SOIL PROFILE TYPE AND DEPTH TO ROCK-LIKE MATERIALS

Borings performed during this study for SR 84 between Ruby Hill Drive and Jack London Boulevard indicate a soil profile consisting of dense to very dense and stiff to hard alluvial deposits that extend to a depth of at least 100 feet. Recorded SPT blow counts over the depth of exploration in the vicinity of the Arroyo Mocho creek crossing generally range from about 30 to over 100 blows per foot or more (uncorrected). Although the maximum depth of our recent exploration did not extend much beyond 100 feet, the regional geology suggests the soils become stiffer and denser with increasing depth.

The standard penetration resistance was used to classify the soil profile based on the guidelines given in SDC Table B.1. No potentially liquefiable soils were identified based on the current information. Accordingly, the project site is classified as Soil Profile Type D.

5.5 DESIGN ACCELERATION RESPONSE SPECTRA

Based on Caltrans SDC (Version 1.4), the design seismic response spectrum for the site can be estimated with spectral acceleration values generated by:

- Soil Profile Type D
- Maximum Credible Earthquake (MCE) Magnitude 7.25 ± 0.25
- Peak bedrock acceleration 0.5 g
- No ARS increase for fault-type or long period structure
- ARS increase for near-field effect

The Design Acceleration Response Spectrum (ARS) corresponding to Soil Profile Type D, magnitude of controlling event 7.25 ± 0.25, and a PBA of 0.5 g were obtained from SDC Figure B.8 and modified to account for near field effects as described above. Spectral values are provided in Table 5-3.

Table 5-3: Spectral Acceleration Values
(PBA = 0.5 g, M = 7.5, Soil Type D)

Period	Soil Type D	
	Sa (g)	Sa* (g)
0.010	0.50	0.50
0.020	0.50	0.50
0.030	0.50	0.50
0.050	0.50	0.50
0.075	0.72	0.72
0.100	0.92	0.92
0.120	1.04	1.04
0.150	1.16	1.16
0.170	1.21	1.21
0.200	1.26	1.26
0.240	1.27	1.27
0.300	1.25	1.25
0.400	1.19	1.19
0.500	1.12	1.12
0.750	0.94	1.04
1.000	0.77	0.93
1.500	0.48	0.58
2.000	0.32	0.39
3.000	0.17	0.20
4.000	0.11	0.13

*Modified for near-field effects

6.1 AS-BUILT FOUNDATION DATA

Based on as-built plans from Caltrans dated May 1999 and approved in October 2002, the Isabel Avenue Bridge over Arroyo Mocho is a three-span reinforced concrete slab bridge supported at abutments on the south and north ends (Abut 1 and Abut 4) and two middle piers (Pier 2 and Pier 3). The abutments and piers are supported on driven steel H-piles. The table below presents a summary of the design capacities and bottom of pile cap elevations:

Table 6-1: As-built Pile Data Table, Arroyo Mocho Bridge

Location	Pile Type	Bottom of Pile Cap (feet)*	Design Loading (Service) (tons)	Nominal Resistance Compression (tons)	Nominal Resistance Tension (tons)	Design Tip Elevation (feet)*	Specified Tip Elevation (feet)*
Abut 1	HP 10x57	411.4	40	80	0	380.0 (1) 401.0 (2)	380.0
Pier 2	HP 10x57	385.8	70	140	0	327.5 (1) 375.0 (2)	327.5
Pier 3	HP 10x57	385.8	70	140	0	327.5 (1) 375.0 (2)	327.5
Abut 4	HP 10x57	411.4	40	80	0	380.0 (1) 401.0 (2)	380.0

Design tip elevation is controlled by the following demands:
(1) Compression, (2) Tension
* Elevation converted from NGVD29 datum shown on as-built plans to NGVD88 datum

Based on the as-built plans, piles were driven to an average tip elevation, converted to NGVD88 datum, of 378.2 feet at Abutment 1 and 378.4 feet at Abutment 4; average tip elevations were not provided on the as-built plans for piles at Piers 2 or 3.

The as-built plans also indicate that the channel beneath the bridge is lined with reinforced concrete having side slopes between each abutment and outside of adjacent pier of 2.5:1 (horizontal:vertical) and finish grade at Elevation 404.5 feet (converted to NGVD88 datum). Concrete lining is approximately 8 inches thick at the channel bottom and 6 inches thick along slope with reinforcement. Available as-built plans for the bridge and channel lining details are provided in Appendix E.

The geotechnical design report prepared by others for the existing bridge indicates a design scour depth to Elevation 386.0 feet, assuming that the channel bottom was unlined. The bottom of pile cap elevations presented in the table above appear to be based on the presumption that the channel bottom would not be protected from scour.

7.1 DISCUSSION

The proposed bridge is underlain predominantly by very dense sands and gravels embedded with occasional lenses of silty and clayey deposits.

The principal geotechnical issues at the site are:

- Selection of the type and depth of foundation that will be compatible with the underlying soils; and
- Settlement of underlying soils due to new structural dead and live loads.

Based on the available subsurface data, an H-pile foundation system is appropriate for the proposed bridge widening. Furthermore, we believe that installation of H-piles in gravel and cobbles will be less problematic than that for larger diameter steel pipe or CISS piles.

The following sections present the geotechnical design parameters for driven steel H-piles that are consistent with the LRFD design procedure adopted by Caltrans.

7.2 PILE DESIGN CAPACITY AND TIP ELEVATIOIN

7.2.1 Axial Pile Capacity Analysis

We understand that the Structural Engineer has elected to use 10x57 steel H-piles for support of the proposed bridge widening to match the existing bridge foundations. Current Caltrans practice is to design abutments in accordance with Working Stress Design (WSD) methodology and piers in accordance with the Load and Resistant Factor Design (LRFD). Table 7-1 presents a summary of the foundation design data provided by the Structural Engineer.

Table 7-1: Foundation Design Data for Arroyo Mocho Bridge (Widen)

Location	Design Method	Pile Type	Finished Grade Elevation (ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	No. of Piles per Support
Abut 1	WSD	HP 10x57	416.00	411.87	2.5	70.58	1	13
Pier 2	LRFD	HP 10x57	406.00	386.27	2.5	70.58	1	16
Pier 3	LRFD	HP 10x57	404.00	386.27	2.5	70.58	1	16
Abut 4	WSD	HP 10x57	417.00	411.87	2.5	70.58	1	13

Based on the Foundation design data provided above, bottom of pile cap elevations are to match those of the existing bridge pile caps as shown in Table 6-1. The design loading conditions and nominal resistance are developed in accordance with the LRFD approach. Loads from LRFD Service-I Limit State are used as design loads for WSD at abutments. Table 7-2 presents the design loads.

Table 7-2: Foundation Design Loads for Arroyo Mocho Bridge (Widen)

Location	Service Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Limit State (Controlling Group, kips)			
	Total Load			Compression		Tension		Compression		Tension	
	Per Support	Max per Pile	Per Support	Per Support	Max per Pile	Per Support	Max per Pile	Per Support	Max per Pile	Per Support	Max per Pile
Abut 1	950	75	650	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pier 2	2,010	135	1,615	2,715	200	0	0	1,615	101	0	0
Pier 3	2,010	135	1,615	2,715	200	0	0	1,615	101	0	0
Abut 4	950	75	650	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The specified tip elevations presented in the following "Pile Data Table" (Table 7-3) are based on frictional and end-bearing resistance developed in the subgrade soils that underlie the site.

Table 7-3: Pile Data Table for Arroyo Mocho Bridge (Widen)

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	HP 10x57	150	0	377.0 (a) 390.0 (b)	377.0	150
Pier 2	HP 10x57	290	0	331.0 (a) 360.0 (b)	331.0	290
Pier 3	HP 10x57	290	0	331.0 (a) 360.0 (b)	331.0	290
Abut 4	HP 10x57	150	0	377.0 (a) 390.0 (b)	377.0	150

Design tip elevation is based on the following demands:
(a) Compression, (b) Lateral

The results of our axial pile capacity analysis, which form the basis for the design tip elevations provided above, are presented in Appendix F. No group reduction factor needs to be applied to single pile compression load capacities presented above, provided a center-to-center spacing of at least three pile diameters is used.

7.2.2 Lateral Load Capacity

The driven pile foundations are capable of resisting lateral loads. Resistance to lateral loads can be developed by bending of the pile and by pile-soil interaction. The magnitude of the lateral load resistance that can develop depends upon several factors such as the pile size, the physical properties of the surrounding soils, the structural design of the pile, and the direction of loading (strong or weak axis). We used LPILE 4.0 (Reese et al., October 2000) to assist in estimating the lateral load resistance of HP 10x57 steel piles.

Output files for laterally loaded piles at the abutments and bents are presented in Appendix G and include deflection versus depth, bending moment versus depth, shear versus depth, and total stress versus depth. Charts showing load versus deflection for free and fixed head condition and bending across the weak axis for piles at the abutments and piers are presented in Appendix G as Figures G-1 and G-2.

Based on the foundation plan provided, it appears that piles will be installed in single row; therefore, no reduction would be required to the group efficiency provided that a minimum three pile widths spacing is used between piles.

If additional lateral capacity is needed beyond the lateral load capacity of the piles, passive resistance against the abutment walls can be utilized. For abutments, Caltrans limits the soil resistance at the back wall to a 5.5 feet wall height and a maximum uniform soil pressure of 5,000 pounds per square foot. For wall heights less than 5.5 feet, the average unit pressure should be reduced linearly in proportion to the height. The recommended values presented above are ultimate values, and should be used with an appropriate factor of safety.

7.3 PILE INSTALLATION

All piles should be installed under the direct observation of the Geotechnical Engineer and in accordance with Section 49 of the Caltrans Standard Specifications, Piling. Specific additions and modifications to these requirements are discussed below.

The Contractor should submit evidence of compatibility of the proposed pile hammer with the pile type (10x57 steel H-piles) and soil conditions at the site. The Contractor's hammer submittal should include, as a minimum, a dynamic analysis of the pile driving system that is based on wave equation analysis using computer programs such as WEAP. Acceptance criteria for driven piles should follow Caltrans Standard Specifications Section 49-1.08, Bearing Value and Penetration. Driven piles reaching refusal within 5 feet of the specified tip elevation and meeting the acceptance criteria may be cut-off above the tip elevation required by the compression loads. This assumes that the design lateral load tip elevations have been reached (see Pile Data Table 7-3). Preliminarily, we recommend that the refusal criteria be two times the minimum required blowcount. However, refusal criteria will be defined later based on the pile driving system proposed by the Contractor.

7.4 APPROACH EMBANKMENT SETTLEMENT

Based on the plans provided it appears that new fill at the access bridge approach will be less than 2 feet; we estimate the corresponding settlement to be less than ⅛ inch. The settlement will

predominantly be immediate and should occur during fill placement; long-term consolidation settlement should be negligible.

7.5 SLOPE STABILITY

Based on the as-built plans and consistent with Caltrans standards, the inclination of concrete slope paving along the channel slopes at the Arroyo Mocho Bridge are flatter than 2:1 (horizontal:vertical). The embankment soils consist primarily of medium dense to very dense silty and clayey sands and gravels with interbeds of very stiff lean clay, which in our opinion, are sufficiently strong to support the embankment slopes at this inclination. Based on our analyses, the computed minimum (critical) factor of safety at both abutments is slightly higher than 2. In addition, because liquefaction potential at this location is considered to be low, we believe that potential for lateral spreading at this site is also low.

7.6 APPROACH FILL EARTHWORK

All earthwork should be completed in accordance with the applicable sections of the Caltrans Standard Specifications and as described in URS' companion Geotechnical Design and Materials Report for the SR 84 Expressway Widening project.

7.7 APPROACH FILLS AND ABUTMENT EXCAVATION

Expansive soil materials should not be placed as part of the embankment within the limits of the abutments for the full width of the embankment. Expansive soil materials for this requirement are defined as having either an Expansion Index (EI) greater than 50 (EI to be determined in accordance with ASTM D 4829), or a Sand Equivalent (SE) less than 20 (SE to be determined in accordance with California Test 217). This requirement is exclusive of the structure backfill and pervious backfill requirements as shown on the plans and set forth under Sections 19-3.06 and 19-3.065, respectively, in the Standard Specifications (Caltrans, 2006). Refer to Figure 7-1 for the minimum limits for non-expansive soils within an embankment near a bridge.

Footing/pile cap areas should be excavated as required to bring those areas to their finish subgrade elevations. All loose soil should be removed prior to footing construction. We do not anticipate that groundwater will be encountered in abutment and center piers pilecap footing excavations; therefore, we recommend all excavations be classified as Structure Excavations (Bridge) in accordance with Section 11 of Bridge Design Aids, March 2005.

8.1 TEMPORARY CONSTRUCTION EXCAVATION

We anticipate that excavation into the native soils for construction of the abutments and bents will result in temporary near vertical unsupported soil faces as high as about 6 to 18 feet. Safety standards set by OSHA limit the height of unshored vertical excavations to 5 feet if construction personnel will be working in the excavations. The set of guidelines published by OSHA (Department of Labor, Occupational Safety and Health Administration, 1989), classifies soils in detail as Type A, B, or C. In general, Type A soils are stronger and more cohesive, Type B soils are intermediate, and Type C soils are weaker or more granular. Based on the soil type, depth, duration the excavation is open, and sequence of soils exposed in the excavation, OSHA recommends maximum allowable slopes. For example, for excavations 20 feet or less in depth through homogeneous soils, they state that maximum allowable slopes (horizontal to vertical) should be ¾:1, 1:1, and 1½:1 for Type A, B, and C soils, respectively. Based on the granular nature of the soils encountered in our recent borings, the soils at the abutments and bents are considered to be OSHA Type C.

The guidelines provided by OSHA are for trench excavations; they state that there is uncertainty as to when and to what degree an employer must slope, shore, or otherwise protect employees in a "non-trench" excavation. In consideration of these factors, we recommend that temporary cut slopes in the existing embankment and at piers not exceed 1½:1 during construction.

For locations where excavation with sloping sides is not viable because of space limitations or in areas where temporary slopes steeper than 1½:1 are planned, shoring will be required. The Contractor should retain an experienced Registered Civil Engineer to design the shoring system.

8.2 CONSTRUCTION DEWATERING

The bottom of pile cap for the center piers is planned at Elevation 385.86 feet. Free groundwater was reportedly measured in a nearby piezometer in 1997 following prolonged rains at Elevation 376 feet. Assuming that construction is performed during periods of low flow in the channel, it appears unlikely that free groundwater will be encountered in excavations for the center piers or abutment pile caps. We anticipate that any water that accumulates in the excavations could be removed using standard sumping methods.

8.3 PILE CUT-OFF

When driven piles develop the required compressive capacities before reaching the specified tip elevation, the Contractor may be given the option, with the Geotechnical Engineer's approval, to stop driving and cut-off the piles. Pile cut-off should be approved only if the piles have satisfied the lateral demand requirements and the structural capacity has not been compromised.

8.4 EFFECTS OF CONSTRUCTION WORK ON ADJACENT STRUCTURES

Efforts should be made to minimize effects of construction work on adjacent structures. These situations may result from pile-driving vibration and settlement due to dewatering of excavation. A monitoring program may be required for pile driving at, or adjacent to, existing structures that

are susceptible to damage or sensitive to noise and/or vibration to assure a presumptive threshold will not be exceeded.

The opinions, conclusions and recommendations presented in this Foundation Report are based on information obtained from new and previous explorations made at widely separated locations, site reconnaissance, review of available historic data, and upon local experience and engineering judgment.

The recommendations presented in this report are based on the assumption that the soil and geologic conditions do not deviate substantially from those encountered in the exploratory borings. If any variations are encountered during construction, URS should be contacted so that supplementary recommendations can be made.

If the planned construction is changed from that presently conceived, URS should be retained to review the changes and make modifications to the original recommendations represented in this report in order to meet the project needs.

The Geotechnical Engineer should review the final specifications and drawings to verify that these documents are consistent with the intent of the geotechnical recommendations. Geotechnical issues may arise which are not apparent at this time. URS should be retained during construction to review the soil conditions encountered and the construction procedures. All earthwork, pile installation and testing should be completed under the direct observation of a representative of our firm.

Specific review and investigation for environmental issues and subsurface environmental contamination were beyond the scope of our services.

The elevations shown on the new LOTBs are based on interpolation from spot and contour elevations shown on available topographic maps.

The opinions and recommendations presented in this Foundation Report were developed with the standard of care commonly used as state of the practice in the profession. No other warranties are included, either express or implied, as to the professional advice provided in this report.

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INDEX OF PLANS

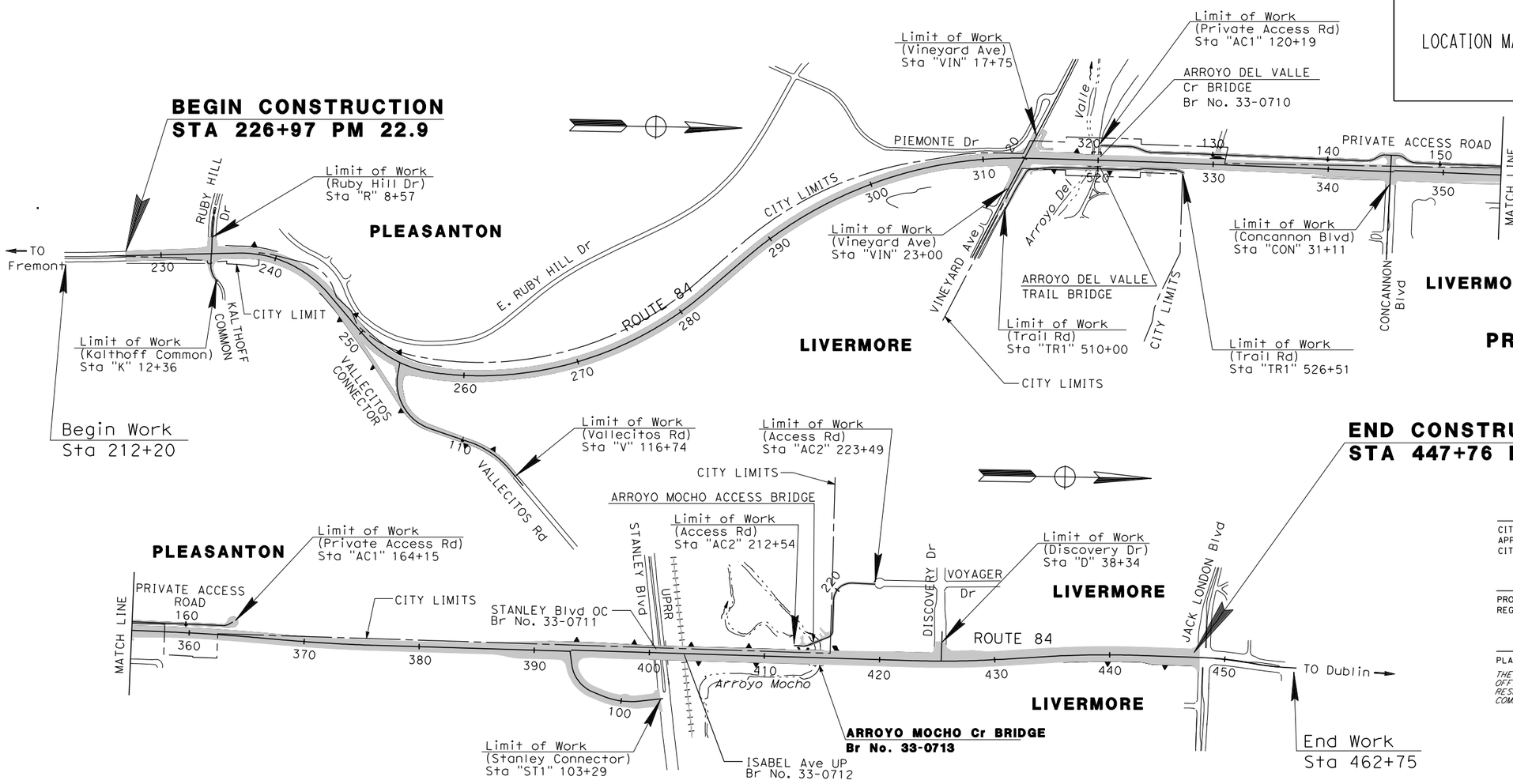
Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY
IN ALAMEDA COUNTY
IN AND NEAR LIVERMORE AND PLEASANTON
FROM 0.1 MILE SOUTH OF RUBY HILL DRIVE TO JACK LONDON BOULEVARD

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

LOCATION MAP



PROJECT VICINITY MAP
FIGURE 1-1

NO SCALE

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

CITY ENGINEER
APPROVE AS TO FEATURES AFFECTING CITY OF LIVERMORE — DATE

PROJECT ENGINEER — DATE
REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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1333 BROADWAY, SUITE 800
OAKLAND, CA 94612

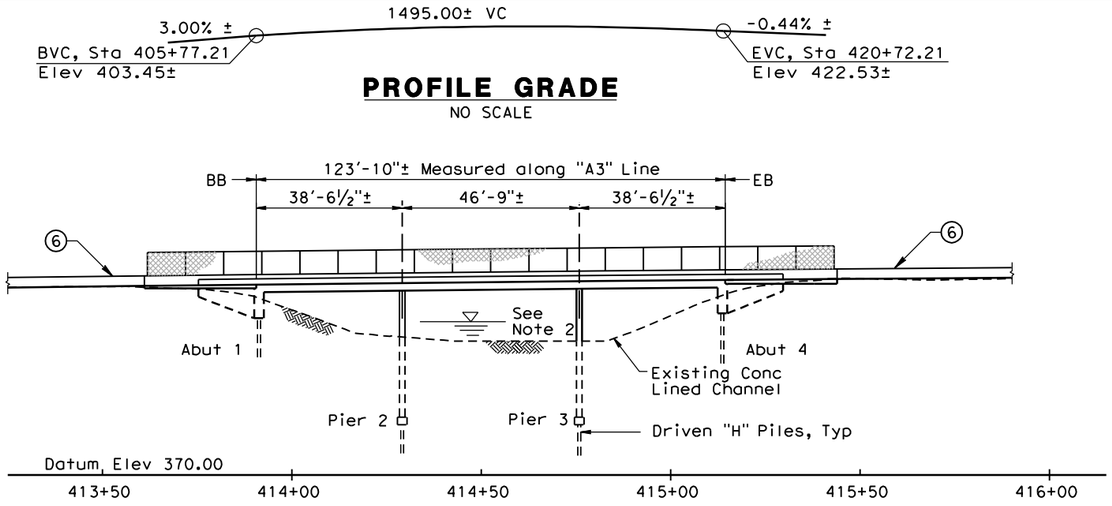
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

CONTRACT No. **04-297604**

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

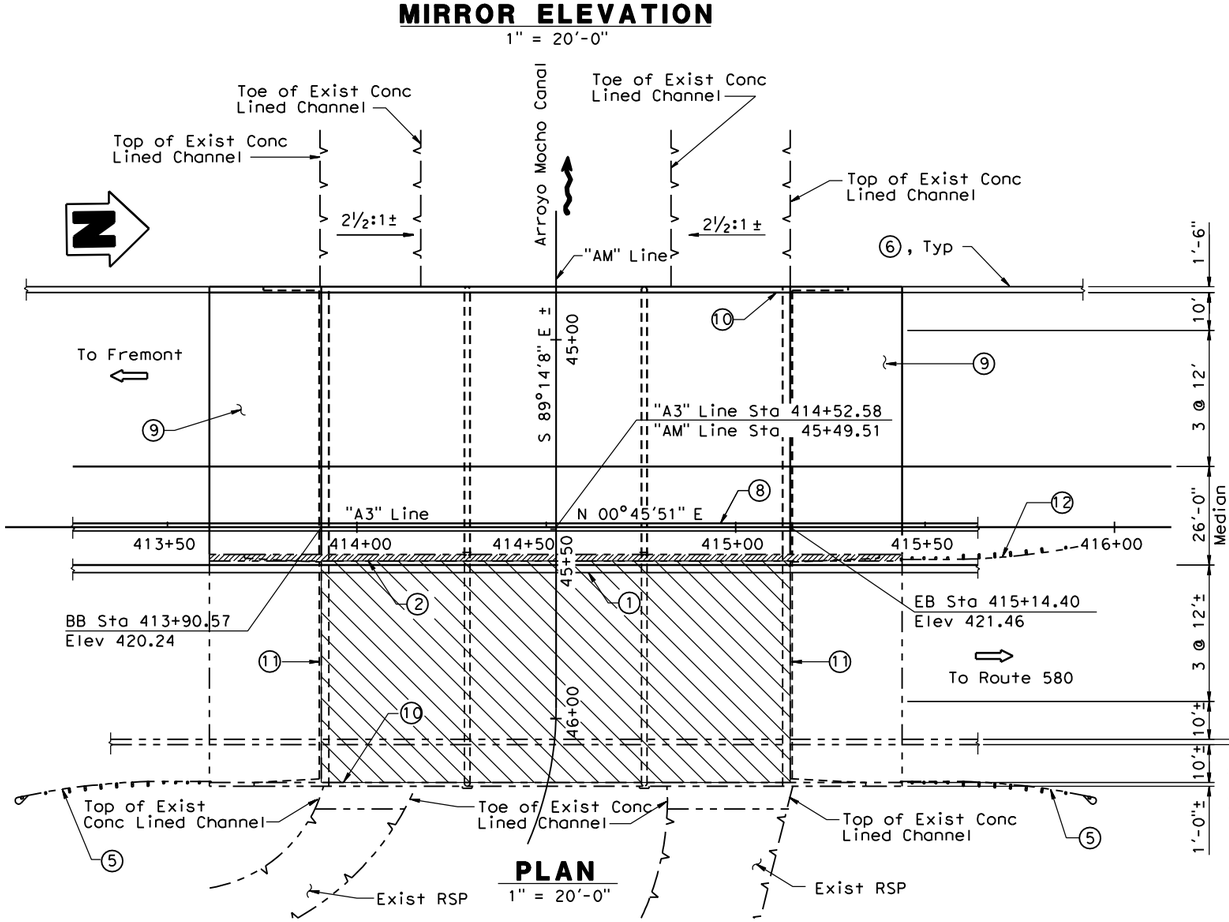
CONSULTANT DESIGN ENGINEER — BEN RAZEGHI — LICENSE Exp DATE
CALTRANS DESIGN OVERSIGHT APPROVAL — NESTOR P. PEREZ — REGISTRATION No. — DATE SIGNED

LAST REVISION 00-00-00 — DATE PLOTTED => 12/9/2009 — TIME PLOTTED => 9:48:58 AM



PROFILE GRADE

NO SCALE



MIRROR ELEVATION

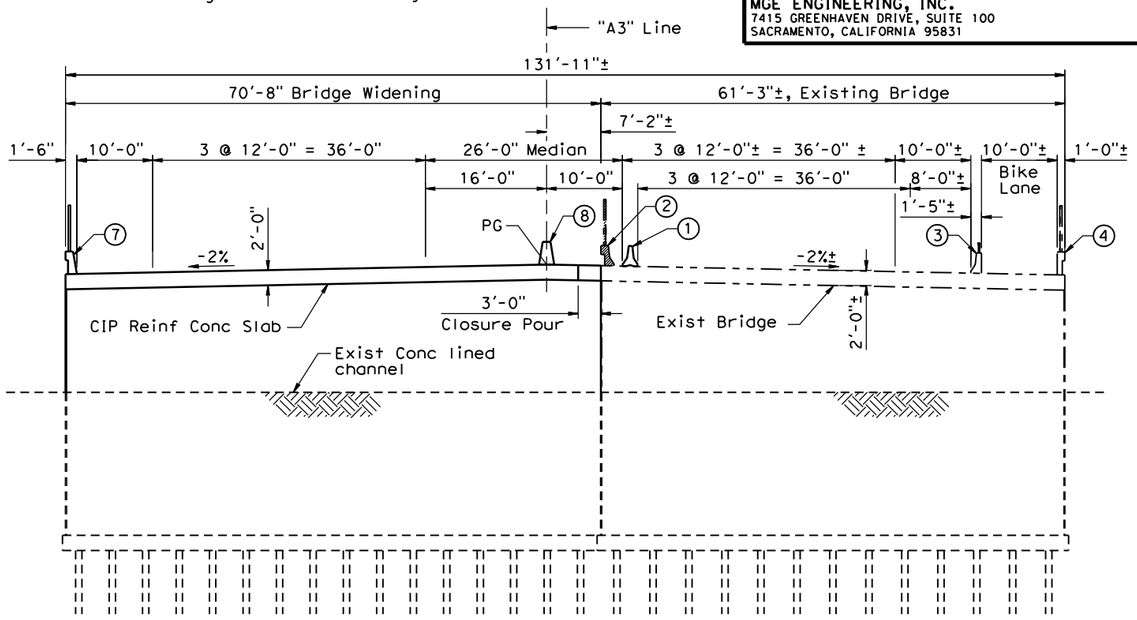
1" = 20'-0"

PLAN

1" = 20'-0"

LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Concrete Removal
- Indicates limits of remove unsound concrete and replace with rapid setting concrete, clean and treat bridge deck with Methacrylate



TYPICAL SECTION

1" = 10'-0"

NOTES:

1. Temporary Railing (Type K), see "Road Plans"
2. Remove Existing Concrete Barrier Type 25 and Chain Link Railing
3. Exist Conc Barrier Type 27 w/ Tubular Handrail to remain
4. Exist Conc Barrier Type 26 (Mod) w/ Chain Link Railing (Type 7) to remain
5. Existing Metal Beam Guard Rail to remain
6. Concrete Barrier (Type 60C), see "Road Plans"
7. Concrete Barrier Type 736 w/ Type 7 Chain Link Railing, Vinyl Clad
8. Concrete Barrier Type 60A
9. Structure Approach Type N(30D)
10. Paint "Bridge No. 33-0713 PM R27.10 2003"
11. Remove and Replace Exist Joint Seal
12. Existing Metal Beam Guard Rail to be removed, see "Road Plans"

FIGURE 2-1

NOTES:

1. For General Notes and Index to Plans, see "INDEX TO PLANS" sheet.
2. For Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
3. The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/10 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN	BY G. Xu	CHECKED R. Sennett	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/ "LOW-BOY" AND PERMIT DESIGN VEHICLE		
DETAILS	BY P. Zhao	CHECKED R. Sennett	LAYOUT	BY G. Xu	CHECKED R. Sennett	
QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY K. Chen	PLANS AND SPECS COMPARED G. Xu	

DESIGN OVERSIGHT

SIGN OFF DATE

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO. 33-0713
POST MILES 26.6

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/09/08 | 04/07/08 | 09/15/08 | 05/04/09 | 01/22/10 | 08/16/10

ARROYO MOCHO BRIDGE (WIDEN)

GENERAL PLAN

SHEET 1 OF 16

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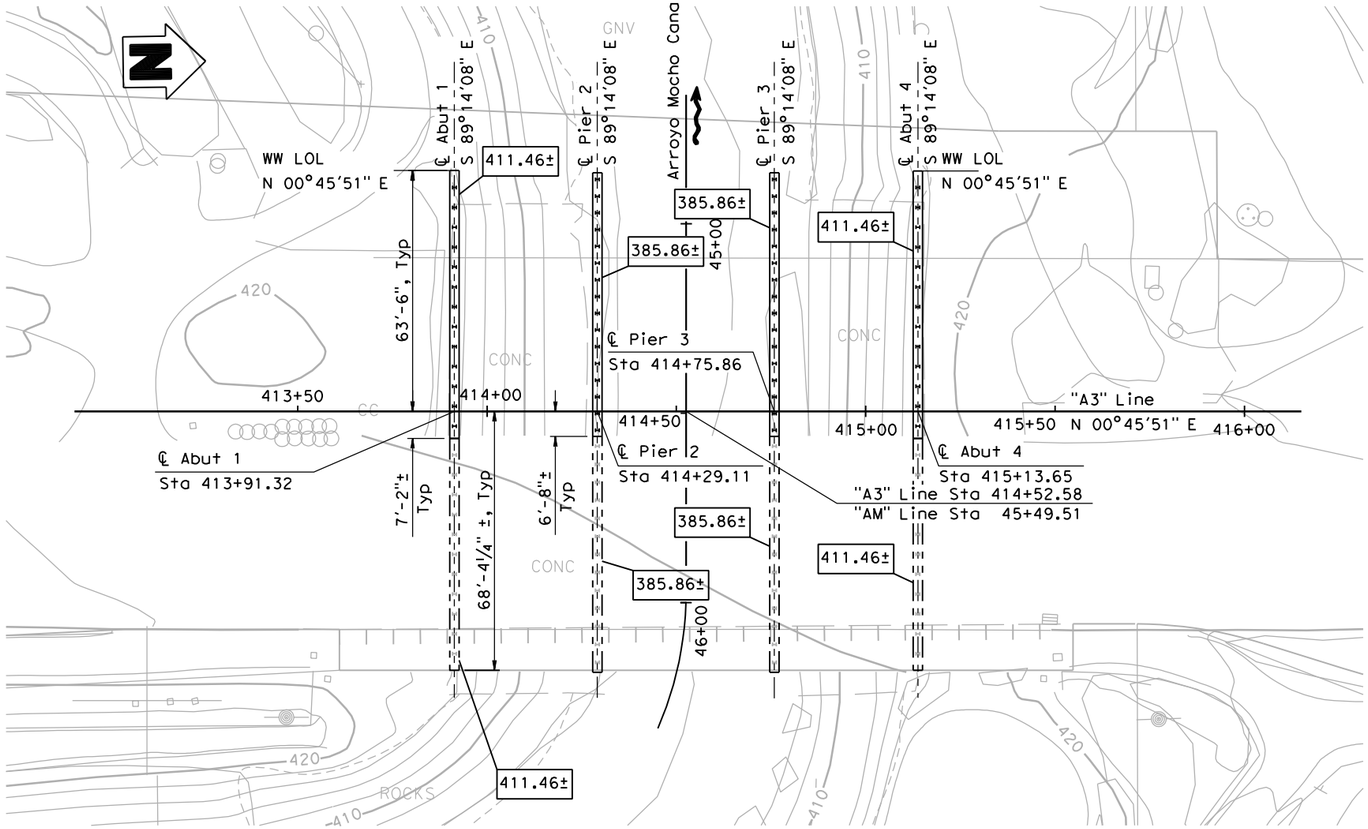

FOUNDATION PLAN

1" = 20'-0"

LEGEND

- Indicates Existing Structure
- Indicates New Construction
- Indicates Direction of Flow
- XXX.XX Indicates Bottom of Footing Elevation
- Indicates New Pile
- Indicates Exist Pile

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/10 — CIVIL — STATE OF CALIFORNIA

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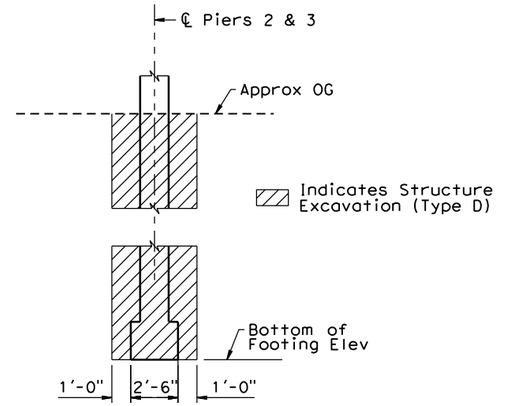
SACRAMENTO, CALIFORNIA 95831



PIER EXCAVATION PAY LIMITS

No Scale

HYDROLOGIC SUMMARY

Drainage Area: 50 square miles

	Design Flood	Base Flood
Frequency (Years)	50	100
Discharge (Cubic feet per second)	3,900	4,800
Water Surface (Elevation at bridge)	413.76	414.80

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.

PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevations (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	HP 10x57	150	0	377.0 (1) 390.0 (2)	377.0	150
Pier 2	HP 10x57	290	0	331.0 (1) 360.0 (2)	331.0	290
Pier 3	HP 10x57	290	0	331.0 (1) 360.0 (2)	331.0	290
Abut 4	HP 10x57	150	0	377.0 (1) 390.0 (2)	377.0	150

Design tip elevation is controlled by the following demands:
(1) Compression, (2) Tension.

BENCHMARK DATA

B-32 - MONUMENT GTS204 MONUMENT IS A SET MAG NAIL WITH WASHER IN AC STAMPED "GTS CONTROL POINT." MONUMENT IS LOCATED ON THE WEST SIDE OF ISABEL +/-100 FT. NORTH OF CREEK THAT IS SOUTH OF DISCOVERY DR. IT IS 4 FT FROM THE EDGE OF PAVEMENT NEAR THE END OF THE AC BERM.
ELEVATION: 422.07' NORTHING: 2072840.013
EASTING: 6183917.613

B-34 - MONUMENT GTS306 MONUMENT IS A SET ⅝" REBAR WITH PLASTIC CAP LABELED "GTS CTRL PT." MONUMENT IS LOCATED NEAR THE SE CORNER OF BRIDGE SOUTH OF DISCOVERY DRIVE, 4 FT SE OF FENCE ANGLE POING, 6 FT NE OF JOINT POLE, 4 FT WEST OF TOP OF BANK..
ELEVATION: 422.29' NORTHING: 2072540.345
EASTING: 6184.845

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

FIGURE 2-2

Stephen Huang — GEOTECHNICAL PROFESSIONAL — APPROVAL DATE 08/10/2010

DESIGN OVERSIGHT — SIGN OFF DATE

SCALE: 1"=20'-0" | VERT.DATUM NAVD88 | HORZ.DATUM NAD83
PHOTOGRAMMETRY AS OF: 11/20/2005 | ALIGNMENT TIES
SURVEYED BY Dan Scott | DRAFTED BY Abhijeet Bhoi
FIELD CHECKED BY Dan Scott | CHECKED BY

DESIGN BY G. Xu | CHECKED R. Sennett
DETAILS BY P. Zhao | CHECKED R. Sennett
QUANTITIES BY W. Sennett | CHECKED R. Huang

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO. 33-0713
POST MILE 26.6

ARROYO MOCHO BRIDGE (WIDEN)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/09/08 | 04/07/08 | 09/25/08 | 12/19/08 | 05/07/09 | 01/22/10 | 08/16/10

SHEET 3 OF 16

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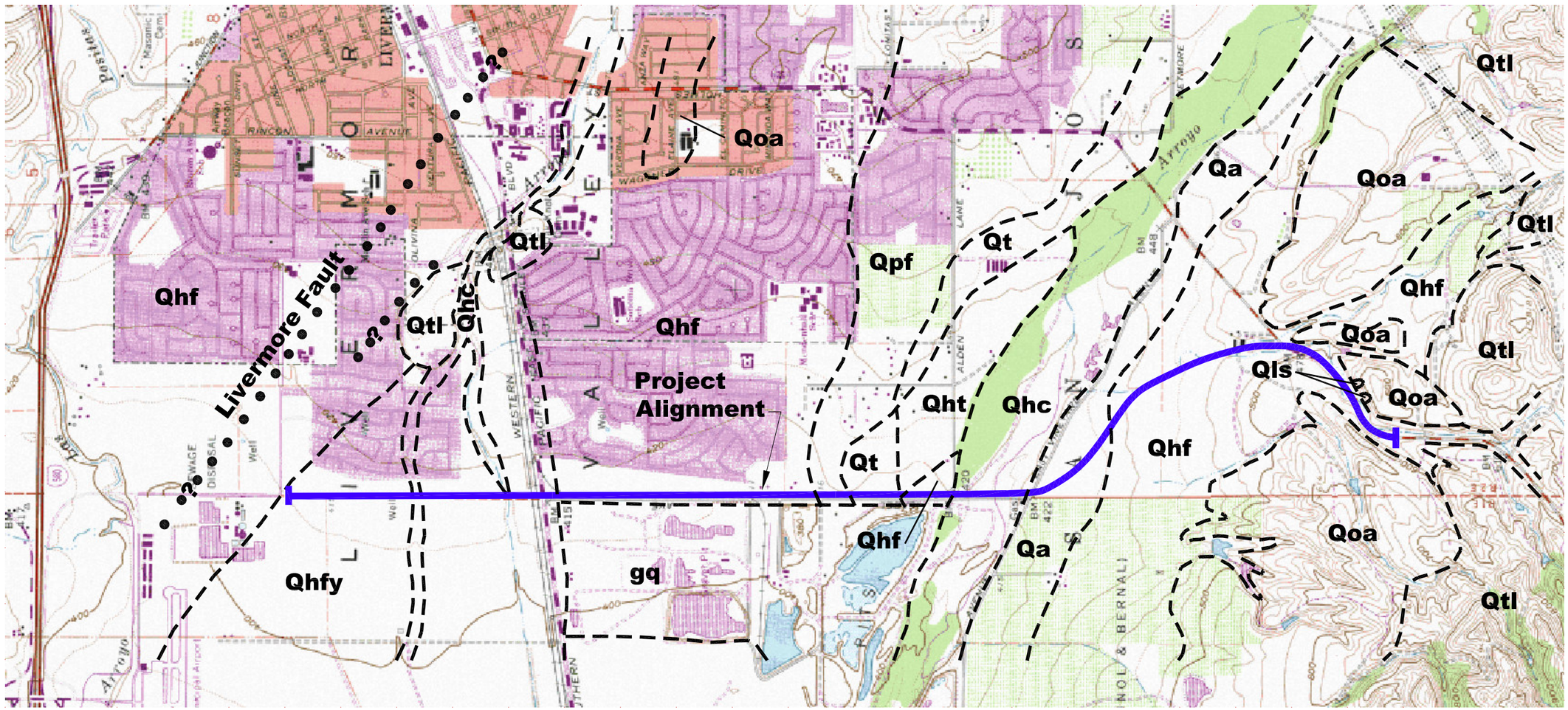


LEGEND:

-----	Approximate geologic contact
?• • • • •	Concealed fault
gq	Gravel quarries
Qhc	Historical stream channel deposits
Qls	Holocene landslide deposits
Qhfy	Latest Holocene alluvial fan deposits
Qhf	Holocene alluvial fan deposits
Qa	Holocene alluvium deposits, undifferentiated
Qht	Holocene stream terrace deposits
Qt	Holocene to latest Pleistocene stream terrace deposits
Qpf	Latest Pleistocene alluvial fan deposits
Qoa	Early to late Pleistocene older alluvium deposits
Qtl	Pleistocene Livermore Gravels Formation

0 0.2 0.4 0.6 0.8 1.0 mile

Approximate Scale in Mile

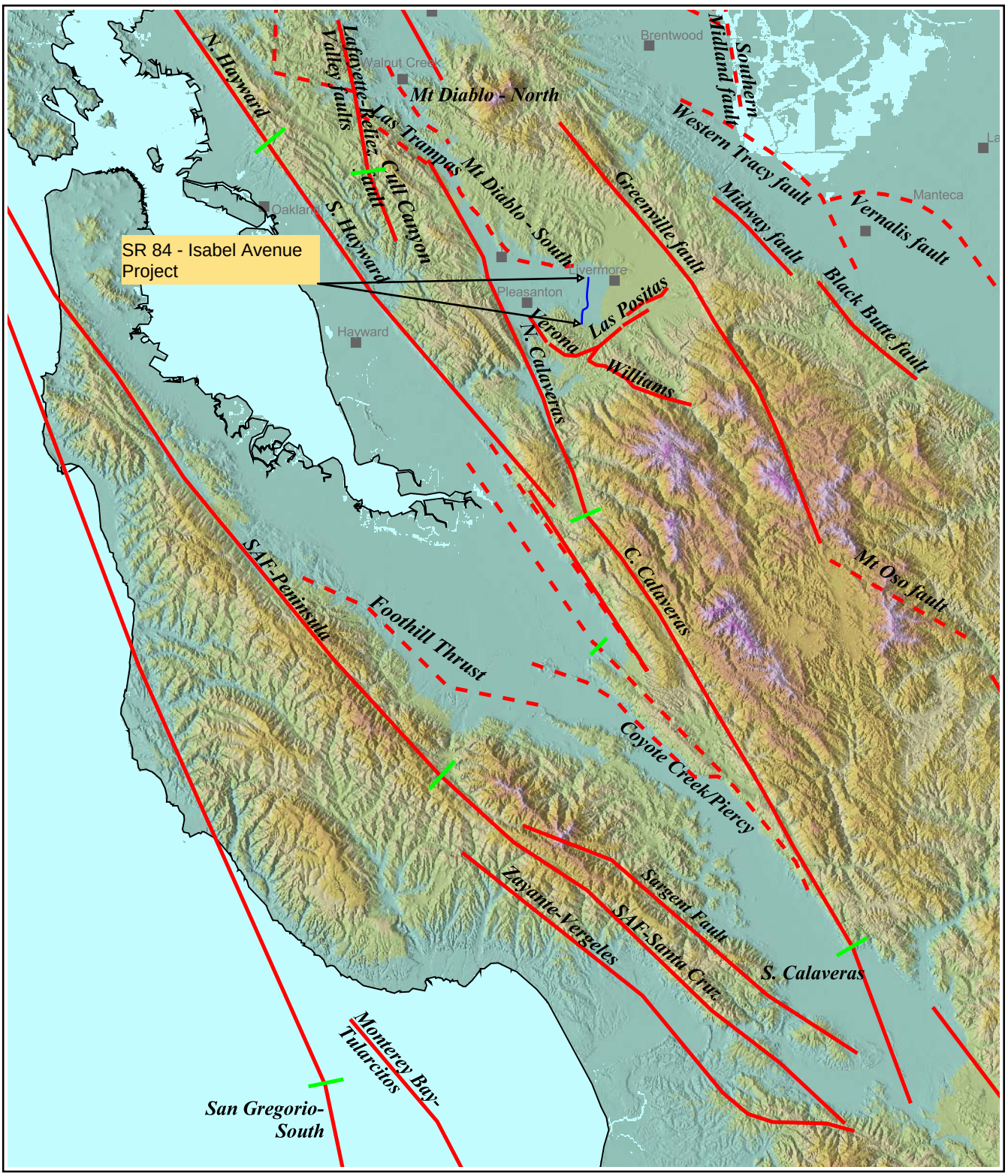
Geologic map modified from Dibblee, T.W., 1980 and Witter, R.C., et al, 2006

URS

SR 84 Isabel Ave
Livermore, California
Alameda County

SITE AND GEOLOGIC MAP

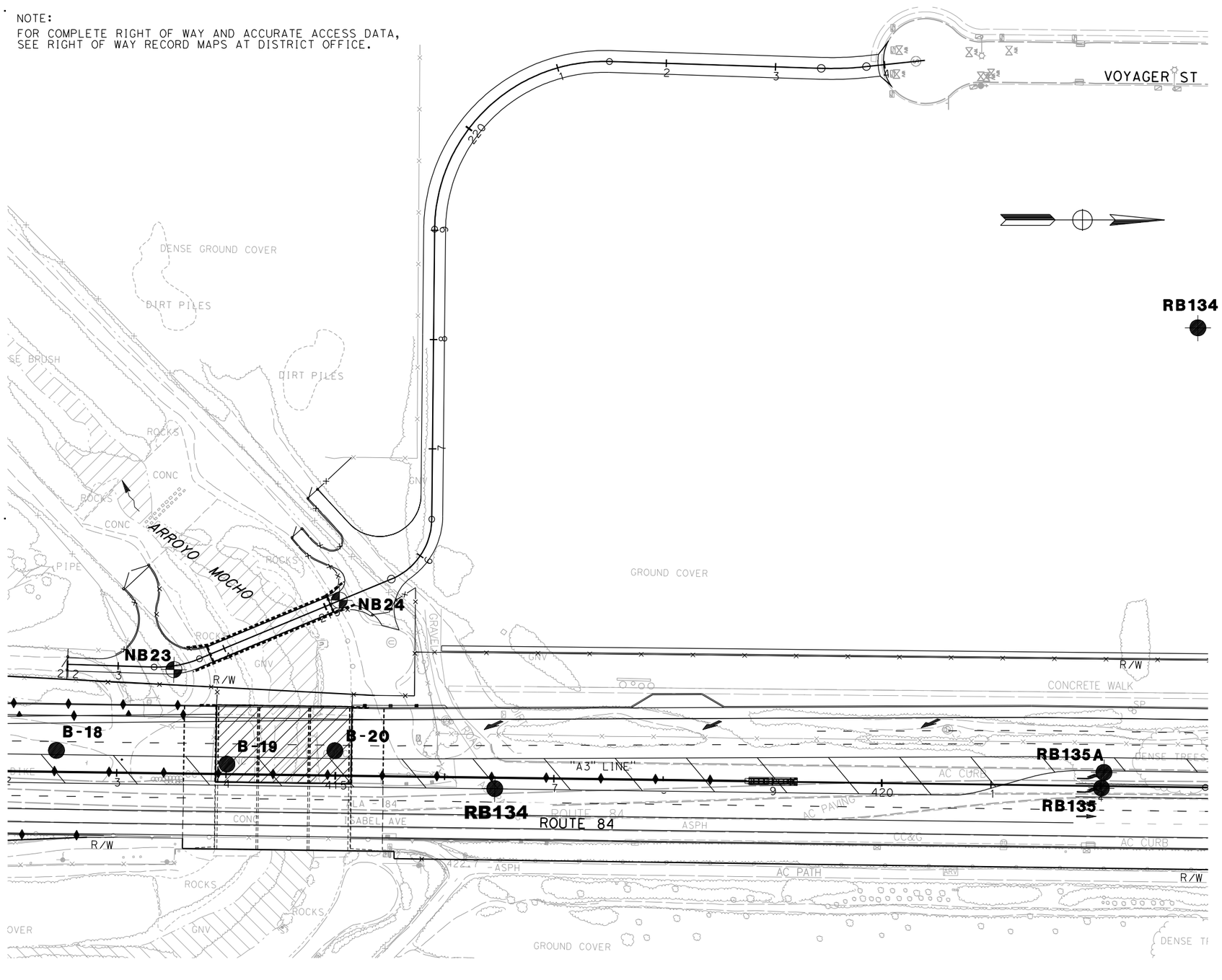
SCALE
Figure
3-1
April /2008



Fault Sources: URS Seismic Hazard Model

URS	28649640 SR 84 - Isabel Ave Livermore, CA	REGIONAL FAULT MAP	Figure **3-2**

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



LEGEND:

RB134 **NB24** EXPLORATORY BORING FROM CURRENT STUDY

B-20 EXPLORATORY BORING BY OTHERS (1996)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 3/12/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp 09-30-11 — CIVIL — STATE OF CALIFORNIA

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ARROYO MOCHO BRIDGE WIDEN
SITE AND BORING LOCATION PLAN

SCALE 1"=50'

FIGURE 3-3

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

CALCULATED-DESIGNED BY
CHECKED BY
REVISED BY
DATE REVISED
ABHIJEET BHOI
ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR
BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Gtrans

LAST REVISION 08-31-10
DATE PLOTTED => 9/13/2010
TIME PLOTTED => 10:09:30 AM

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 04256
PROJECT NUMBER & PHASE 297601

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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Suite 800
Oakland, CA 94612

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size (square)	A	Auger Boring
Size (square)	R P	Rotary drilled boring Rotary percussion boring (air)
Size (diamond)	R	Rotary drilled diamond core
Size (square)	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

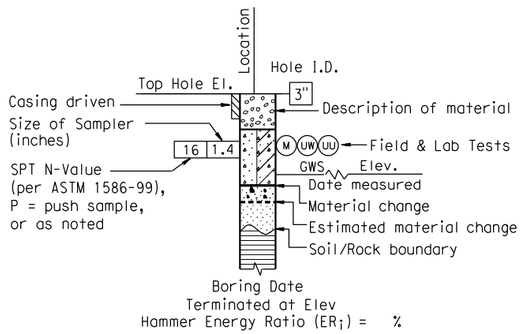
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

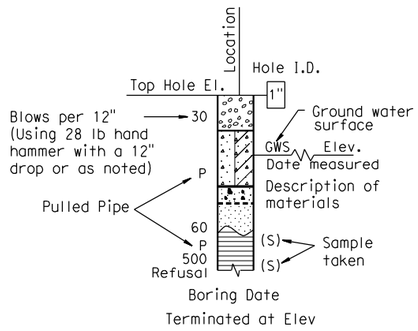
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

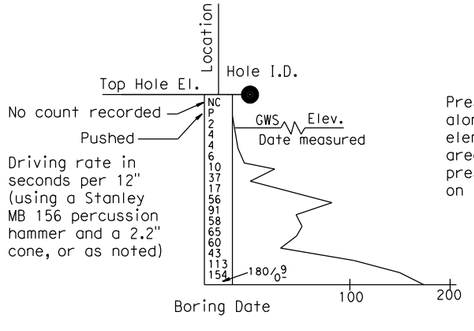
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



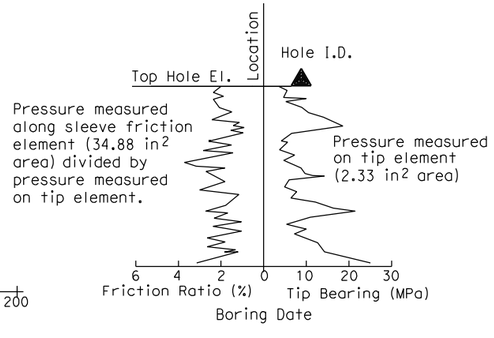
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ARROYO MOCHO BRIDGE (WIDEN)

FIGURE 3-4a

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33-0713	SOIL LEGEND
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO	DESIGN BRANCH	POST MILES 26.6	LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 13 OF 16

FILE => ...\Widen\legend-soil Widen.dgn

USERNAME => andrew_cheung DATE PLOTTED => 8/18/2010 TIME PLOTTED => 3:33:17 PM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42789 — Exp. 03/31/12 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ARROYO MOCHO BRIDGE (WIDEN)
FIGURE 3-4b

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33-0713	SOIL LEGEND
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO	DESIGN BRANCH	POST MILES 26.6	LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 14 OF 16

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USERNAME => andrew_cheung DATE PLOTTED => 8/18/2010 TIME PLOTTED => 3:29:54 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/12 — CIVIL — STATE OF CALIFORNIA

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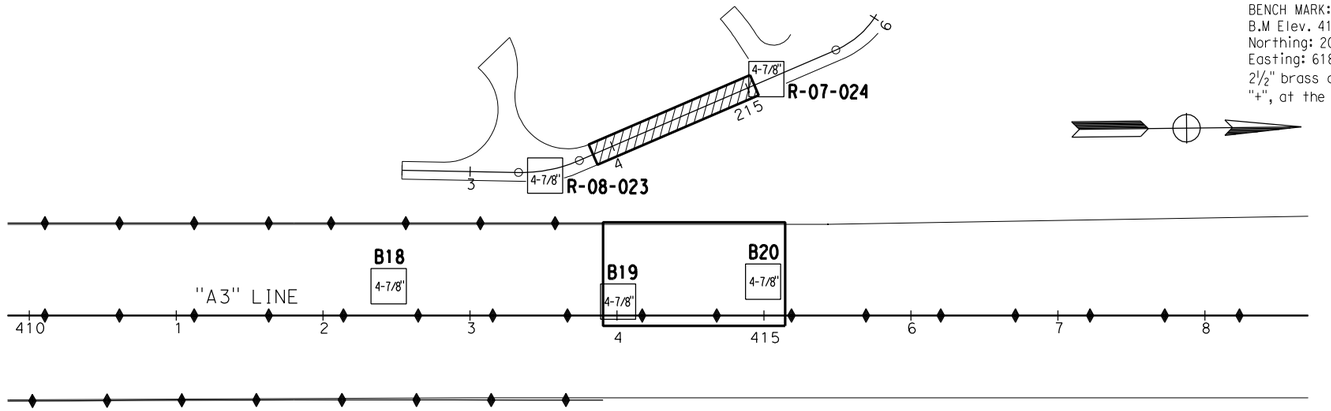
1333 Broadway, Suite 300
Oakland, CA 94612

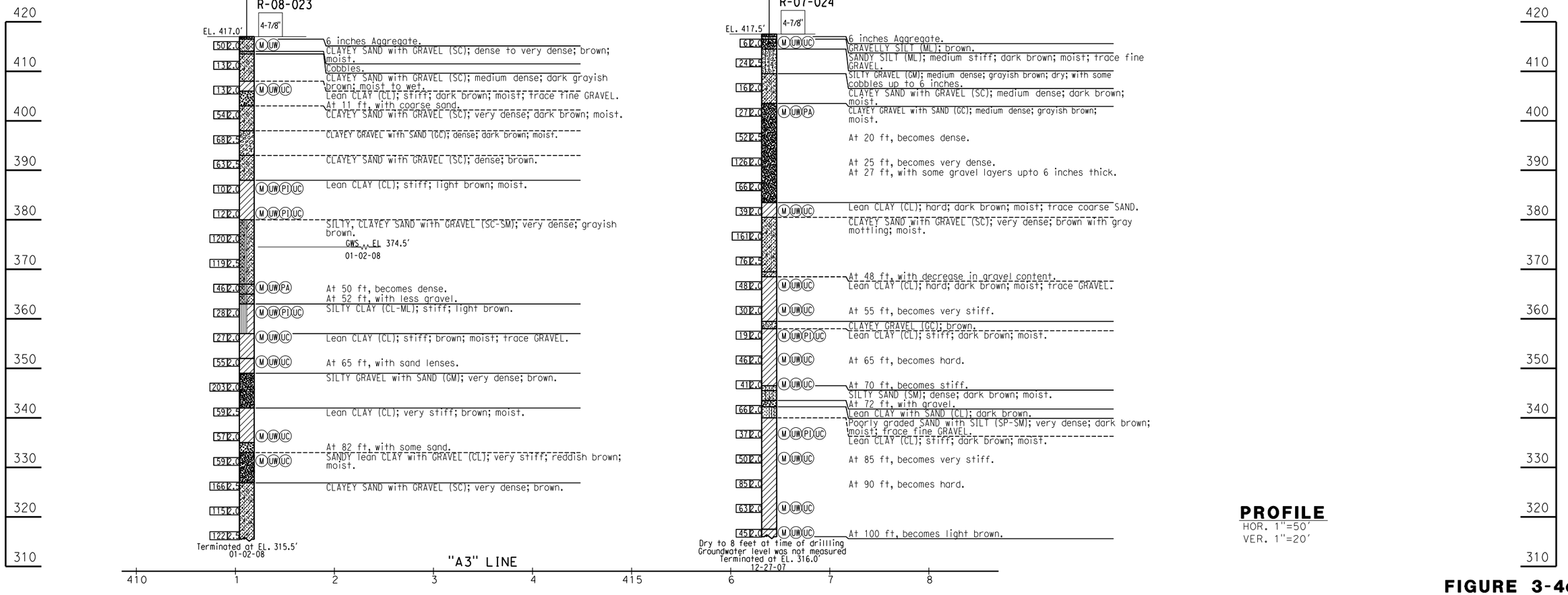
URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
2½" brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive

NOTE:
1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (JUNE 2007)
2. Drilling fluid was measured at EL. 374.5 feet in NB23, 5 days after temporyily stopped drilling.
3. Design groundwater level at El. 376 feet.



PLAN
Scale: 1"=50'



PROFILE
HOR. 1"=50'
VER. 1"=20'

FIGURE 3-4c

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO.	ARROYO MOCHO BRIDGE (WIDEN)
FUNCTIONAL SUPERVISOR	DRAWN BY: E. Garnica	FIELD INVESTIGATION BY:		DESIGN BRANCH	33-0713	LOG OF TEST BORINGS
NAME:	CHECKED BY: M. Thummaluru	C. Rambo			POST MILES 26.6	

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 15 OF 16

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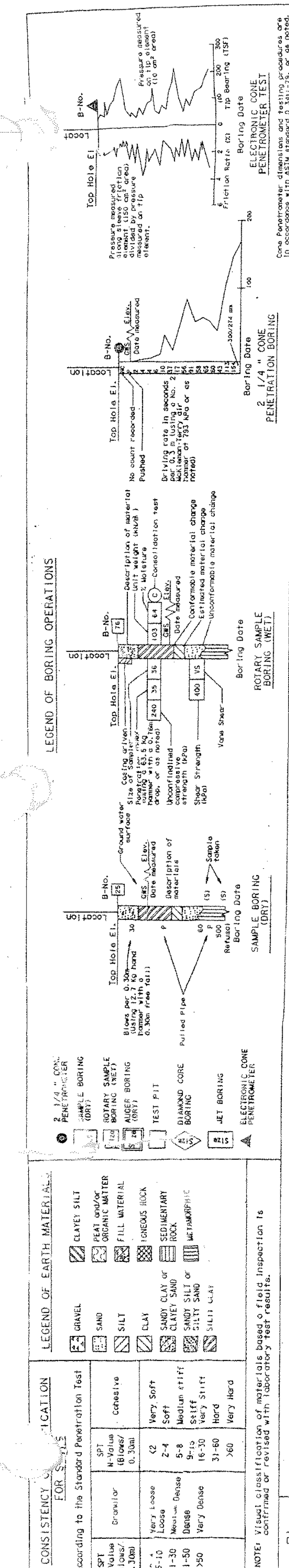


NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.
2. Soil classification and description conform to ASTM D2487.

BENCHMARK:
All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).
TBM No. 2: Mon. No. 220
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.064 meters right of Center Line Station "I5" 122+19.529. The elevation is 126.311 meters (414.41 feet).

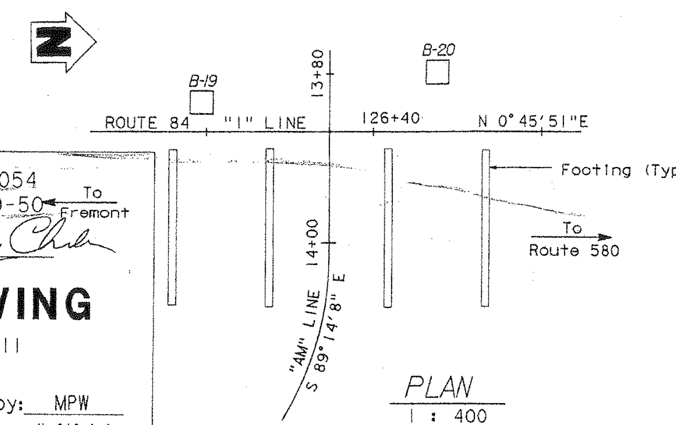
Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

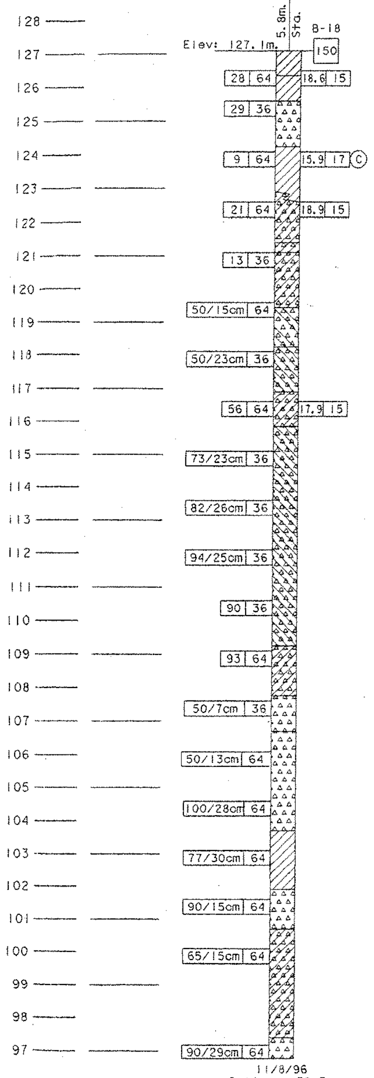
AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

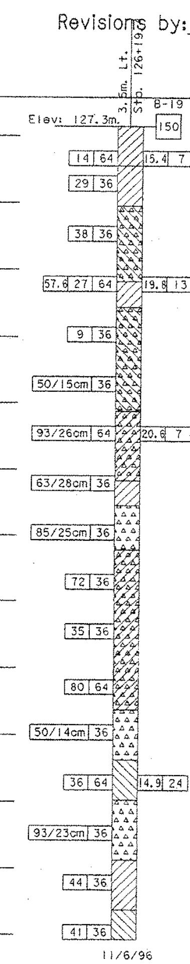
[X] No Changes
[ ] Changes As Noted

Revisions by: MPW (Initials)





SILTY SAND (SM) medium brown, very fine grained, poorly graded, medium dense, dry.
SANDY SILT (ML) with gravel, light to medium brown, gap graded, medium dense, moist.
SANDY GRAVEL/GRAVELLY SAND (GP/SP) medium brown to light gray @ 1.65m, gap graded, medium dense, dry, gravel is fine to coarse grained, sand is primarily fine grained.
SANDY SILT (ML) with minor gravel, medium brown, loose, non plastic, moist, grading to CLAY (CL) with minor sand and gravel.
GRAVELLY LEAN CLAY (CL) brown, stiff, low to moderate plasticity, fine to coarse gravel, subrounded to rounded.
CLAYEY GRAVEL (GC) lens.
Local sandy layers.
GRAVEL AND COBBLES (GC) with silty clay matrix, fine to coarse gravel and small cobbles, gap graded, very dense.
SILTY GRAVEL (GM) brown, medium to coarse grained sand, primarily fine gravel, moderately graded, very dense.
CLAYEY GRAVEL (GC) medium brown, coarse grained, poorly graded, dense, subrounded to rounded gravel, clay is low to medium plasticity.
SILTY GRAVEL (GM) with sand, brown to gray, fine to coarse grained, moderately graded, very dense, primarily fine gravel.
Local lenses of fine to coarse grained, very dense, SANDY GRAVEL (GP).
Fine to coarse gravel, moderately gap graded.
CLAYEY GRAVEL (GC) brown, low to moderate plasticity clay matrix, gravel is coarse grained, subrounded to rounded, very dense.
GRAVELLY SAND (SP) fine to coarse sand, fine gravel, moderately graded, very dense.
SANDY GRAVEL (GW) light brown, moist, very dense, sand, silt and minor clay matrix, coarse gravel is subangular.
5-7.5cm layers of Gravelly Sand (SP).
CLAY (CL) brown, hard.
No recovery.
SANDY GRAVEL (GM) with clay, brown, moist to wet, very dense.
CLAYEY GRAVEL (GC) brown, moist, very dense.
Scattered cobbles.
SANDY CLAYEY GRAVEL (GM/GC) brown, damp, very dense, medium to coarse gravel, subangular to angular.



SANDY SILT (ML) gray-brown, damp, loose.
SILTY SAND (SM) with gravel, gray-brown, damp, medium dense, medium to coarse sand, fine gravel.
WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, damp, dense, fine to coarse gravel.
LEAN CLAY (CL) brown, moist, stiff.
WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, moist, loose, rounded fine to coarse gravel in cuttings at 5.7m.
6m: No recovery, clayey sand to clayey gravel cuttings.
Very dense.
CLAYEY GRAVEL (GC) with sand, brown, moist, very dense, fine to coarse gravel.
LEAN CLAY (CL) yellow-brown, moist, very stiff.
WELL GRADED GRAVEL (GW) with sand, brown, moist to wet, very dense, fine to coarse gravel, medium to coarse sand.
WELL GRADED GRAVEL WITH CLAY AND SAND (GW-GC) brown to yellow-brown, moist, very dense, fine to coarse gravel, medium to coarse grained sand.
Lens of LEAN CLAY (CL) from 15.3 to 15.45m.
No recovery.
GRAVELLY SAND TO SANDY GRAVEL (SW/GW) gray-brown, wet, very dense.
SILT (ML) brown, moist to wet, very stiff, slightly plastic.
POORLY GRADED SAND (SP) with gravel, gray-brown, wet, very dense, coarse sand and gravel.
LEAN CLAY (CL) dark yellow-brown, moist, hard.
SILT (ML) dark yellow-brown, moist, hard.

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	MILE POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84	22.9/27.1		

REGISTERED GEOTECHNICAL ENGINEER — DATE 3/9/09

ARROYO MOCHO BRIDGE (WIDEN)

LOG OF TEST BORINGS 4 OF 4

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE ANDINVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04 276
EA: 297600
BRIDGE No. 33-0713
Sheet 15 of 15

DATE PLOTTED => 8/18/2010

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		407	407

REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

REGISTERED PROFESSIONAL ENGINEER — G. NEELAKANTAN — No. 2391 — Exp. 9/30/01 — GEOTECHNICAL — STATE OF CALIFORNIA

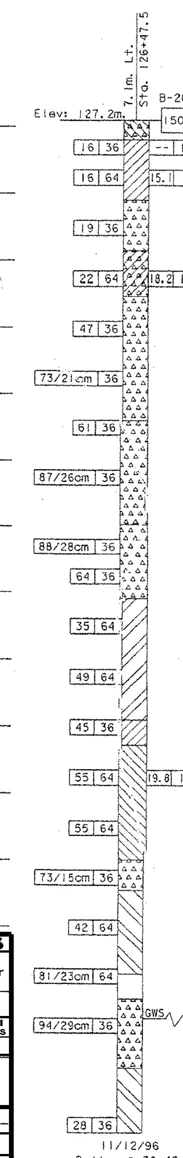
REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/12 — GEOTECHNICAL — STATE OF CALIFORNIA

Caltrans Metric

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

Notes:

1. See the plans dated May 11, 1999 for stationing. For example I Line Sta 136+62 (Metric) = A3 Line Sta 448+23 (English).
2. Structure Design produced the data presented in the table below. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.



SILT (ML) with gravel, dark brown, damp, stiff, minor string, plastic.
SILT (ML) with sand, dark brown, damp, stiff, open-pore structure, gravel at 1m.
SANDY GRAVEL (GM/GP) brown, damp, medium dense, fine to coarse gravel, moderate amount of sand and silt matrix.
LEAN CLAY (CL) with gravel, brown, damp to moist, stiff.
SANDY GRAVEL (GP) gray-brown, moist, dense, minor silt, fine to coarse gravel.
Coarse gravel and cobbles.
Cobble layer, minor caving.
Cobble in sampler.
Coarse gravel and cobbles.
GRAVELLY SAND (SP-SM) moderate sand and silt matrix, dense, scattered cobbles.
Very dense, coarse gravel and cobbles, local clay lens.
SANDY SILTY GRAVEL (GM) brown, damp, very dense.
Very dense.
CLAYEY SILT (ML) brown, damp, very stiff.
CLAYEY SILT (ML) with sand, brown, moist, very stiff, fractured, sand is very fine to fine grained.
SILTY SAND (SM) brown, moist, dense, sand is very fine to medium grained.
SANDY CLAY (CL) with gravel, brown, moist, hard, minor fine to coarse gravel throughout. Layers of Clayey Silt (ML) with fine grained sand.
Increasing sand and gravel.
SANDY GRAVEL (GP/GM) green-brown, moist, very dense.
SILTY CLAY (CL) brown, moist, very stiff.
POORLY GRADED SAND (SP) gray-brown, moist, very dense, sand is coarse to very coarse grained, minor silt.
SANDY GRAVEL (GM/GP) brown, moist to wet, very dense, coarse gravel.
SILTY CLAY (CL) brown, moist, very stiff, slightly plastic.

Revisions made to this Log of Test Borings from the original ____ Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from A3 Line (84)
B-18	412+45	19.0 ft. Lt
B-19	414+00	11.5 ft. Lt
B-20	415+00	23.0 ft. Lt

124+00 125+00 126+00 127+00 128+00

DESIGN OVERSIGHT	DRAWN BY J. HULSE	N. MACE, V. THILAKARATNE, J. THURBER
SIGN OFF DATE	CHECKED BY T. HUBER	FIELD INVESTIGATION BY: DATE:

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

O. RODRIGUEZ
PROJECT ENGINEER

BRIDGE NO. 33C-0407
KILOMETER POST

ARROYO MOCHO BRIDGE

LOG OF TEST BORINGS

REV. DATE: 6-2-97

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 12 OF 12

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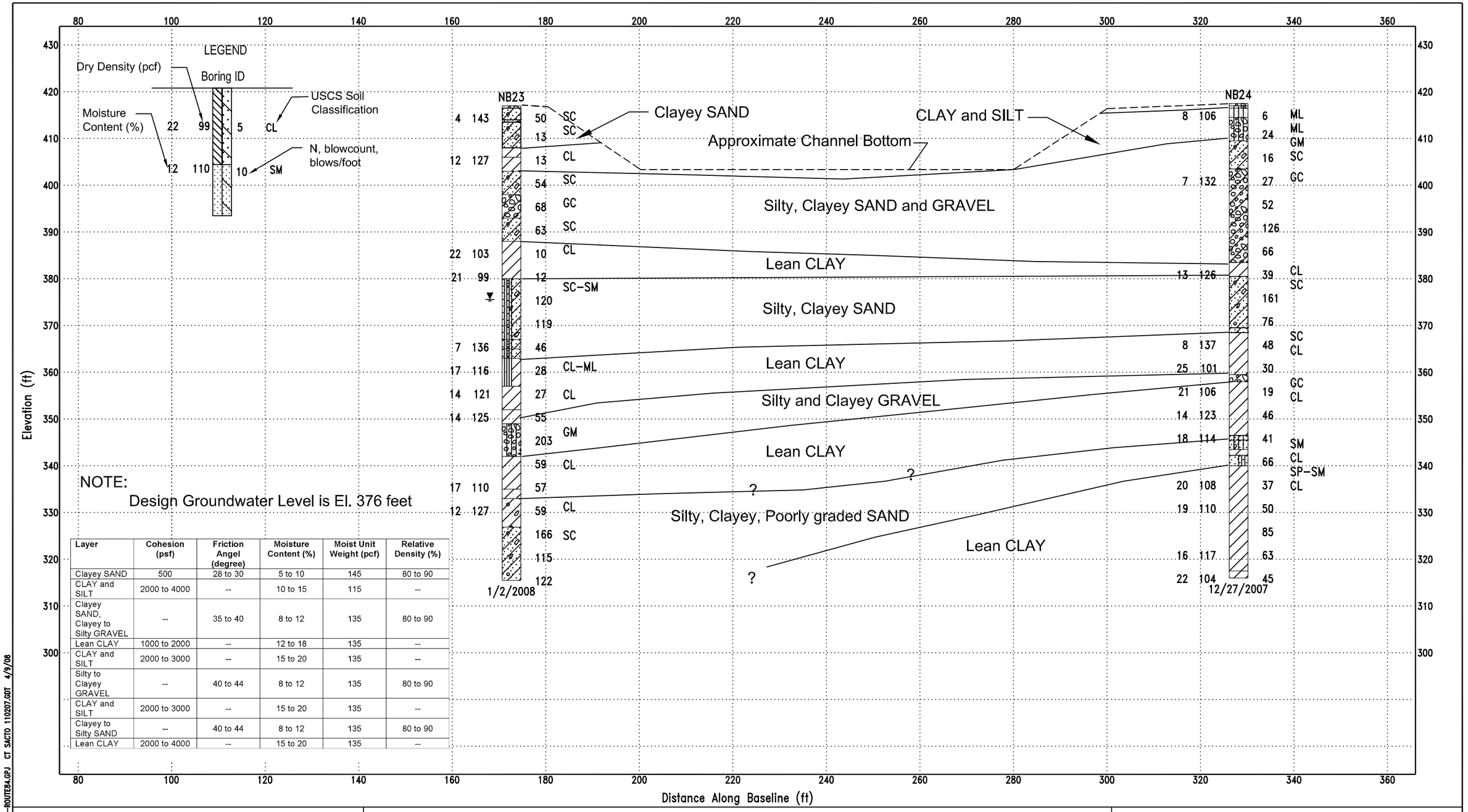
TIME PLOTTED => $$$$$$SYTIME$$$$$$

FIGURE 3-4d



NOTE:

Design Groundwater Level is El. 376 feet

Layer	Cohesion (psf)	Friction Angel (degree)	Moisture Content (%)	Moist Unit Weight (pcf)	Relative Density (%)
Clayey SAND	500	28 to 30	5 to 10	145	80 to 90
CLAY and SILT	2000 to 4000	--	10 to 15	115	--
Clayey SAND, Clayey to Silty GRAVEL	--	35 to 40	8 to 12	135	80 to 90
Lean CLAY	1000 to 2000	--	12 to 18	135	--
CLAY and SILT	2000 to 3000	--	15 to 20	135	--
Silty to Clayey GRAVEL	--	40 to 44	8 to 12	135	80 to 90
CLAY and SILT	2000 to 3000	--	15 to 20	135	--
Clayey to Silty SAND	--	40 to 44	8 to 12	135	80 to 90
Lean CLAY	2000 to 4000	--	15 to 20	135	--

URS Corporation
55 S. Market Street, Suite 1500
San Jose, CA 95113
Telephone:
Fax:

Project Number: 28649640

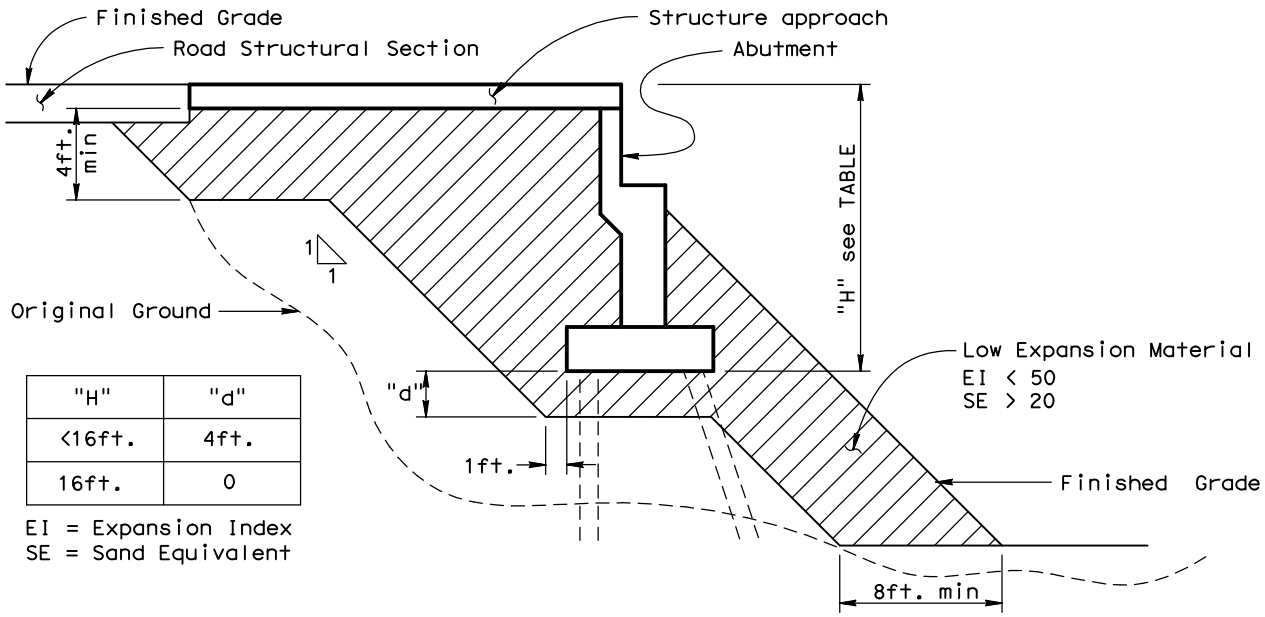
LITHOLOGY GRAPHICS

USCS Poorly Graded Gravel with sand
USCS Clayey Sand with gravel
Boulders and cobbles
USCS Lean Clay
USCS Lean Clay with sand
USCS Clayey Gravel
USCS Silty, Clayey Sand with gravel
USCS Silty Clay
USCS Silty Gravel with sand
USCS Sandy Lean Clay with gravel
USCS Gravelly Silt
USCS Sandy Silt
USCS Silty Gravel (poorly graded)
USCS Clayey Gravel with sand
USCS Silty Sand

GENERALIZED SOIL PROFILE
ARROYO MOCHO CREEK CROSSING
Route 84 Expressway Widening
Alameda County, California

Figure 3-5

SIMPLE FENCE 2 - B SIZE 28649640-ROUTE84.GPJ CT SACTO 110207.GDT 4/9/08



"H"	"d"
<16ft.	4ft.
16ft.	0

EI = Expansion Index
SE = Sand Equivalent

EXPANSIVE SOIL EXCLUSION ZONE DETAIL

NO SCALE

08/19/09	Route 84 Expressway Improvements Livermore, California	EXPANSIVE SOIL EXCLUSION ZONE IN BRIDGE EMBANKMENT	Figure 7-1
	URS		

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. OVERCOMER Y. HOR
Liaison Engineer
Office of Special Funded Projects
Structures Design Services & Earthquake Engineering

Date: June 2, 2008

File: 04-ALA-84 PM 22.5/27.3
04-297601
Rte 84 Expressway
Widening Project
Various Structures

From: EDUARDO ORTEGA
Associate Materials and Research Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Type Selection Reports Review

Per your request, we have completed the review of Type Selection Reports prepared by URS and MGE Consultants for the above referenced project. The project site is located in the City of Livermore, Alameda County, California. The Route 84 Expressway Widening Project will require the following structures work:

Existing Bridge Widenings
Arroyo Del Valle Bridge (Widen)
Arroyo Mocho Bridge (Widen)

New Bridges
Arroyo Mocho Access Bridge
Arroyo Del Valle Trail Bridge

Retaining Walls
Retaining Wall 246 at East Ruby Hill Drive
Retaining Walls 400N and 400S at Isabel Avenue Undercrossing

Based in our review, we have the following comments on the project:

1. All shallow and deep pile support foundations for bridge should be designed based on LRFD. Refer to Memo to Designers 3-1 for deep foundations and 4-1 for spread footings.

2. Settlement calculations should be included for the shallow footing support abutments located within clay.

3. Lateral condition bearing capacity of shallow footing should be addressed.

4. Do the shallow footing of bents who are within clay layer should be deepened?

5. In the tieback walls, looks like the soldier beam embedment depth is too shallow, could you please clarify.

6. Typical section for tie back walls does not show walers, could you please clarify.

7. Is there any horizontal boring drilling program for Soil Nail Walls?

8. Note that soil nail wall standard special provisions (SSP) have been revised by Caltrans. Use new SSP in your recommendations for the proposed soil nail walls.

* * * * *

Should you have any questions, please call me at (510) 286-4821.

c: TPokrywka, MMomenzadeh, E☺rtega, Daily File, Route File, Translab File

Eduardo ☺rtega/mm/297601 Type Selection. doc

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES • OFFICE OF SPECIAL FUNDED PROJECTS

Comments

(DRAFT REVISION 01/2008)

Structure:	**Rte 84 Express Way Widening**	Route:	**84**		
Bridge No:	**33-0710, 33-0711, Arroyo Del Valle Trail Bridge, Arroyo Mocho Access Bridge and Retaining wall No. 400N, 400S AND 246.**	EA:	**297601**	Liaison:	**Overcomer Hor**
District	**04**	Reviewer:	**Mahmood Momenzadeh**	Reviewed Date:	**June 2,2008**
Review Level:	**Type Selection Pack.**	Consultant	**URS**	Response Date:	**January 12, 2009**

ABBREVIATIONS: BDA Bridge Design Aids; BDD Bridge Design Details; GP General Plan; IPG OSFP Information and Procedures Guide; MTD Memo to Designers; SDC Seismic Design Criteria; SDS Suctural Detailing Standards

Item	Comment	Response	Notes
	Structure Type Selection Report		
1	All shallow and deep pile support foundations for bridge should be designed based on LRFD. Refer to Memo to Designers 3-1 for deep foundations and 4-1 for spread footings.	Will comply.	
2	Settlement calculations should be included for the shallow footing support abutments located within clay.	Will comply.	
3	Lateral condition bearing capacity of shallow footing should be addressed.	Will include estimate of passive resistance and discuss applicability in the shallow footing design.	
4	Do the shallow footing of bents who are within clay layer should be deepened?	Bent support has been revised to deep pile foundation to address erosion issues and support of shallow footing in fine grained soils such as clays.	
5	In the tieback walls, looks like the soldier beam embedment depth is too shallow, could you please clarify.	The planned tieback wall system uses continuous horizontal support elements (soldier pileless wall) based on Bridge Design Specifications, Section 5, Figure 5.8.1-2b. The embedment depth for the continuous horizontal elements presented on the general plans was a minimum value; the required embedment depth will be based on structural analysis with geotechnical parameters provided in the draft Foundation Report. Will include the relevant parameters in the updated Foundation Report for the walls.	
6	Typcial section for tie back walls does not show walers, could you please clarify.	The planned tieback wall system uses continuous horizontal support elements (soldier pileless wall) based on Bridge Design Specifications, Section 5, Figure 5.8.1-2b. Thus, no	

Item	Comment	Response	Notes
		walers are planned.	
7	Is ther any horizontal boring drilling program for Soil Nail Walls?	Because of site access restrictions from Ruby Hill Property management, it is currently unfeasible to include horizontal borehole in the field exploration program. Will develop an SSP to require Contractor to pre-drill, submit and review results, modify design if necessary, and seek Caltrans approval prior to actual soil nail installation.	
8	Note that soil nail wall standard special provisions (SSP) have been revised by Caltrans. Use new SSp in your recommendations for the proposed soil nail walls.	Will comply.	

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. OVERCOMER Y. HOR
Liaison Engineer
Office of Special Funded Projects
Structures Design Services
& Earthquake Engineering

Date: July 22, 2009

File: 04-ALA-84, PM 22.5/27.3
04-297601
Rte 84 Expressway
Widening Project
Various Structures

From: EDUARDO ORTEGA
Associate Materials and Research Engineer
Office of Geotechnical Design – West
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GRANT WILCOX
Branch Chief, Branch B
Office of Geotechnical Design - West
Geotechnical Services
Division of Engineering Services

Subject: 65% PS&E and Foundation Report Review

Per your request, we have completed the review of 65% PS&E and Foundation Report prepared by URS and MGE Consultants for the above referenced project. The project site is located in the City of Livermore, Alameda County, California. The Route 84 Expressway Widening Project will require the following structures work:

Existing Bridge Widenings
Arroyo Del Valle Bridge (Widen)
Arroyo Mocho Bridge (Widen)

New Bridges
Arroyo Mocho Access Bridge
Arroyo Del Valle Trail Bridge

Retaining Walls
Retaining Wall 246 at East Ruby Hill Drive
Retaining Walls 400N and 400S at Isabel Avenue Undercrossing

Based in our review, we have the following comments on the project:

GENERAL

- Please provide a legend on the General Soil Profiles that identify the values found on either side of the vertical soil profiles.

FIGURES ON FOUNDATION REPORT
(Retaining Walls 246, 391, 400N, 400S, and 403)

1. Figure 2-1: Change index to include Retaining Wall No.'s found in this report

2. Figure 5-2: Horizontal reference line in Profile on LOTBs should be "A2" and "A3", not "A1".

3. Figure 5-2: The north arrow is not correctly aligned.

4. Retaining Wall 400N LOTBs: 400N is referenced on the wrong side of the "A3" line on the plan figure at top of sheet.

5. Retaining Wall 400N LOTBs: Horizontal reference line in Profile should read "A3" instead of "A1".

6. Figure 8-1: Horizontal reference line in Profile should read "A3" and not "A1".

7. Figure 8-1: The north arrow is misaligned.

8. Figure 8-1: Please reference all walls along the "A3" line on the Plan drawing at top of sheet.

RETAINING WALLS

1. Retaining walls No: 109, 110. 236, 245, 314, 317, 320, 400S, and 437 (mentioned on Table 1-1 "Summary of Planned Retaining Walls" on the Foundation Report for Arroyo Mocho Access Bridge dated March 23, 2009) are not part of this submittal. Please clarify.

2. An horizontal drilling program is needed for tie back retaining wall 400N Type A and for soil nail retaining walls No: 246, 391, 403, and 400N Type D. SSP has to be developed for this program to prepare the LOTBs and revise the wall design details, if it is planned to include this work as part of the construction program. Contractor has to submit results of the horizontal drilling and provide calculations and drawings to be reviewed by this Office prior to start of construction.

3. No vertical drilling program reported for pile foundations of retaining wall No 400N Type B. Please clarify.

ARROYO MOCHO BRIDGE (WIDEN)

1. Sheet 2/13 shows Pier 2 & 3 at specified tip elevation of 340.0 ft. Foundation Report Table 7-2 and sheet 2/12 shows the same tip elevation at 336.0 ft. Correct the discrepancy. If it was a round up it should be at a lower elevation (335.0 ft).

2. Provide details and calculations for the retaining wall shown on "Typical Plan" Sheet 11/13.

ARROYO DEL VALLE BRIDGE (WIDEN)

1. Provide details and calculations for the retaining wall shown on "Typical Plan" sheet 13/14.

UTILITY CROSSINGS

Contractor should request a permit for a trenchless construction method based on soil and groundwater conditions to buried proposed utilities, as bore & jack, micro tunneling or other method.

GRAVEL MINING OPERATIONS

There is an ongoing mining operation anticipated for the next 25 years adjacent to the west side of SR 84 Isabel Avenue, between approximately Stanley Boulevard and Arroyo Del Valle by Vulcan Materials Quarry and at both side of SR 84 between Vineyard Avenue and Alden Lane by Cemex Quarry, both up to 50 feet of existing right-of-way line. Is there any program to install slope inclinometers to monitor the stability of the slopes adjacent to SR 84 that could be impacted due to the mining operations? This Office has to review the details of the program.

* * * * *

Should you have any questions, please call me at (510) 286-4821.

c: TPokrywka, MMomenzadeh, GWilcox, CRisden, E©rtega, Daily File, Route File, Translab File

Eduardo ©rtega/mm/297601 65% FR. doc

Office of Special Funded Projects
Comment & Response Form

General Project Information	Review Phase	Reviewer Information
Dist: 04 EA: 297601 **Project Name: Rte 84 Expressway Widening Project** **OSFP Liaison: Overcomer Y. Hor** **Phone: (916) 227-8419** **e-mail: overcomer_hor@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection ☒ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☐ Other:_____ **Structure Information** (Use when necessary to document comments by individual structure) **Structure Name: Arroyo Mocho Br (Widening)** **Br No: 33-0173**	**Reviewer Name: Eduardo Ortega** **Functional Unit: Geotechnical** **Cost Center: 59-327** **Phone Number: (510) 286-4821** **e-mail: eduardo_ortega@dot.ca.gov** **Date of Review: 7-22-09**

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1		Table 7-2	Sheet 2/13 shows Pier 2 & 3 at specified tip elevation of 340.0 ft. FR Table 7-2 and sheet 2/12 shows the same tip elevation at 336.0 ft. Correct the discrepancy. If it was a round up it should be at a lower elevation (335.0 ft).	Specified pile tip should be El. 336 feet. Pile data table on plan sheet 2/13 will be revised accordingly.	
2			Provide details and calculations for the retaining wall shown on "Typical Plan" Sheet 11/13.	No retaining walls are planned at the location shown on sheet 11/13. Plan will be revised accordingly.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

Office of Special Funded Projects
Comment & Response Form

General Project Information	Review Phase	Reviewer Information
Dist: 04 EA: 297601 **Project Name: Route 84 Widening** **OSFP Liaison: Overcommer Hor** **Phone: 916-227-8419** **e-mail:** **Overcomer_Hor@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection ☐ 65% PS&E Unchecked Details ☒ PS&E (Review No. _) ☐ Construction Support ☐ Other:_____ **Structure Information** (Use when necessary to document comments by individual structure) **Structure Name: Arroyo Mocho Bridge (Widen)** **Br No: 33-0713**	**Reviewer Name: Eduardo Ortega** **Functional Unit: Geotechnical** **Cost Center: 327** **Phone Number: 510-286-4821** **e-mail: Eduardo_Ortega@dot.ca.gov** **Date of Review: 03/22/10**

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	Found. Report	LOTB	Log of Test Boring (LOTB) shall follow the requirements of Caltrans Logging, Classification, and Presentation Manual dated June 2007 or obtain an exception. Holes shall be identified using the following convention: HHH-YY-NNN HHH: Hole type according Figure 2-2 of the Manual YY: 2-digit year NNN: 3-digit number (001-199)	Will comply to modify LOTBs..	
2	Found. Report	Seismic	The bridge was type selected about a year before the new Caltrans Seismic Design Criteria (SDC) was implemented. Therefore, the seismic procedure and information used is based on the 1996 Seismic Hazard Map (SHM) and the 2001 SDC. The seismic related findings in the report are proper and consistent with the 2001 SDC and 1996 SHM and I have no further comments/questions.	Comment noted.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

FIELD EXPLORATION PROGRAM

The geotechnical field investigation consisted of two geotechnical borings extending to terminal depths of 101.5 feet below the existing ground surface. The explorations were performed between December 26, 2007 and January 2, 2008, by Pitcher Drilling of Redwood City, California (rotary wash boring).

Boring locations were carefully selected to obtain subsurface information for geotechnical design recommendations for the proposed structure while avoiding underground utilities and subsurface obstructions. Layout of the explorations was performed by representatives of URS, and exploration locations were checked for conflict with underground utilities by contacting Underground Service Alert (USA) Network. USA, in turn, alerted the various municipalities and utility companies that a subsurface investigation was to be conducted near their utilities.

After underground utility clearance, URS obtained drilling permits from the Alameda County Flood Control and Water Conservation District, and coordinated with appropriate personnel to accommodate the required inspection during and following exploration at each location.

Rotary Wash Borings (NB23 and NB24)

The rotary wash borings were drilled to provide the necessary information to evaluate the subsurface stratigraphy and to allow acquisition of high-quality soil samples for laboratory testing. The borings were drilled and sampled at the locations indicated on the Site and Boring Location Plan, Figure 3-3. Both borings were advanced to a depth of 101.5 feet below existing ground surface using a truck-mounted drill rig under the supervision of a URS representative who maintained a record of all field activities, classified the soils encountered using the Unified Soil Classification System (USCS), and prepared logs of the borings.

The drilling operation proceeded carefully, with particular attention to potential interference with utilities or other buried structures. During drilling, both disturbed and undisturbed samples were obtained for identification and laboratory testing. Soil samples were generally obtained at 5-foot intervals and at changes in strata. Samples were obtained using an unlined split spoon sampler (SPT), having an outside diameter of 2 inches, lined/unlined Modified California (MC) sampler, having an outside diameter of 2½ inches, and lined/unlined Standard California Sampler, having an outside diameter of 3 inches. A 140-pound hammer falling through a distance of 30 inches was used to drive the samplers. The blow count recorded on the boring logs adjacent to the sample depth is the number of blows required to drive the sampler for the final 1 foot of a maximum 18 inch drive.

One of the objectives of the field investigation was to obtain high-quality undisturbed samples for laboratory testing. Effort was made to minimize sample disturbance during sample handling and transportation. After careful withdrawal from the ground, the sample was placed upright and the ends of the sample were cleaned of disturbed soil. If possible, pocket penetrometer tests were performed on the bottom end of cohesive soil samples. Both ends of the samples were covered with plastic caps, and carefully transported to the URS laboratory in San Jose.

LABORATORY TESTING PROGRAM

A laboratory testing program was carried out to determine the index and engineering properties of the major subsurface strata encountered at the site. The laboratory testing program included conventional tests to confirm the existing information on the engineering characteristics of the major strata and to refine some of the engineering parameters where it was deemed appropriate. These tests were performed at the URS laboratory in San Jose.

This appendix briefly describes the testing program and procedures for the different types of tests, and then presents detailed test results.

Index Tests

Index tests were performed on both cohesive and cohesionless soil samples to aid in soil classification and in correlation with other engineering parameters. Index tests included Atterberg Limits, gradation analyses, moisture content and dry density determinations. Atterberg Limits tests were performed in accordance with ASTM D 4318. Particle analyses were performed in accordance with ASTM D 422. The moisture content tests were performed in accordance with ASTM D 2216. Dry density was determined in accordance with ASTM D 2937. The locations of these tests are indicated on the Logs of Test Borings adjacent to the appropriate sample depths. The results are summarized in Table B-1.

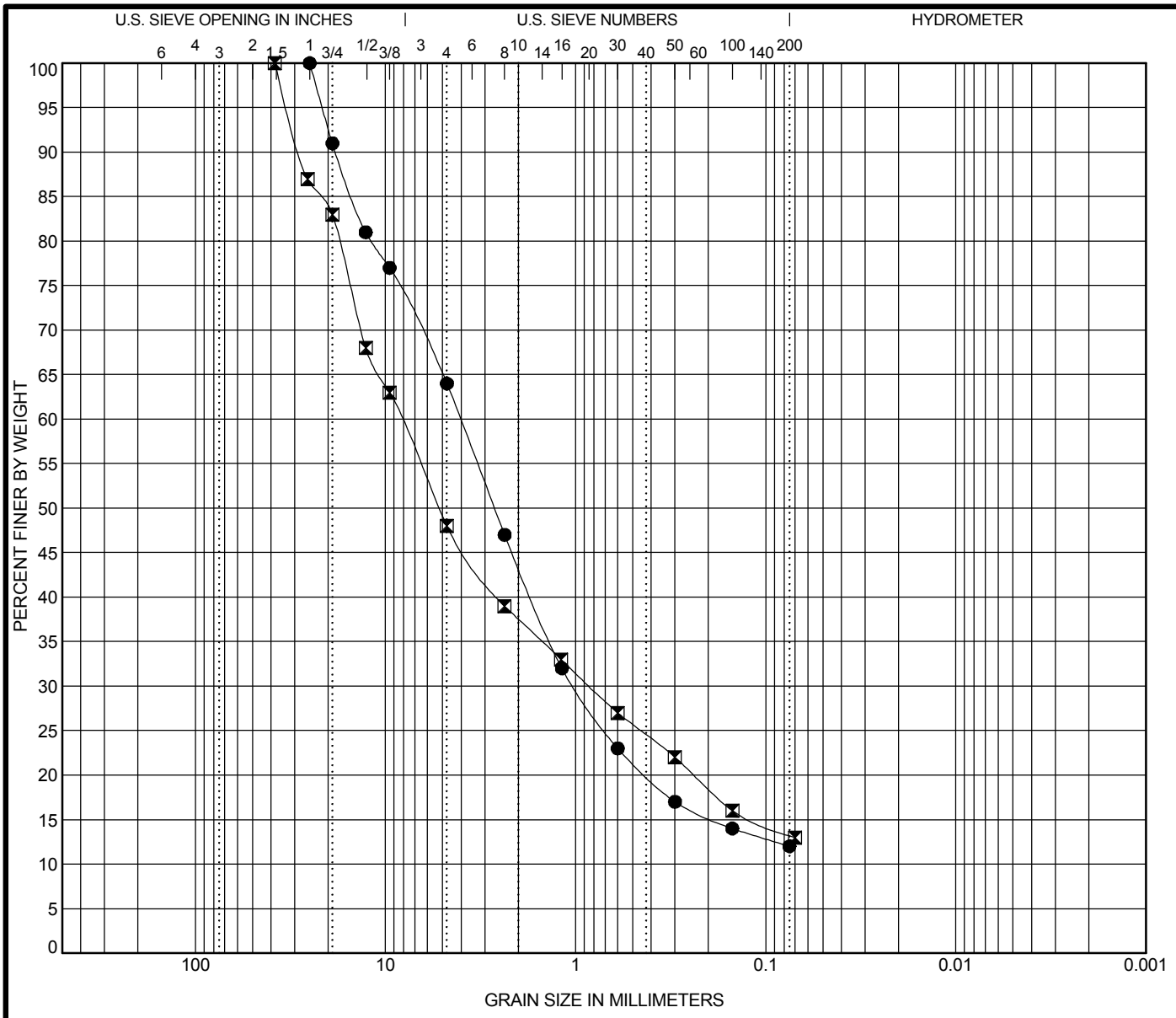
A plasticity chart graphically presenting the results of the Atterberg Limits tests is included on Figure B-1. Grain size distribution curves are presented graphically on Figure B-2.

Unconfined Compression Tests

Unconfined compression tests were performed on select cohesive soil samples to assist in determining shear strength parameters. These tests were performed in accordance with ASTM D 2166. The locations of these tests are indicated on the Logs of Test Borings adjacent to the appropriate sample depths. The results are summarized in Table B-1.

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	Depth (feet)	Sieve Analysis Results (Percent Passing)												Atterberg Limits			Unconfined Compressive Strength (psf)	In-Place Conditions	
			%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200	Liquid Limit	Plastic Limit	Plasticity Index		Water Content (%)	Dry Unit Weight (pcf)
NB23	27-Dec-07	1																	4.5	143
NB23		10																6680	12	127
NB23		30													31	18	13	1960	22.4	103
NB23		35													27	18	9	2020	21	99
NB23		50			91	81	77	64	47	32	23	17	14	12					7.5	136
NB23		55													23	18	5	2860	17.5	116
NB23		60																3430	13.7	121
NB23		65																2390	13.5	125
NB23		80																5630	17.5	110
NB23		85																5590	12.1	127
NB24	26-Dec-07	1																1230	8	106
NB24		15	100	87	83	68	63	48	39	33	27	22	16	13					7.2	132
NB24		35																9640	13.2	126
NB24		50																3140	8.2	137
NB24		55																5350	25	101
NB24		60													28	18	10	3130	21.5	106
NB24		65																12830	13.8	123
NB24		70																3150	17.8	114
NB24		80													27	19	8	3740	20	108
NB24		85																6450	18.9	110
NB24		95																9890	16.3	117
NB24		100																7210	22.3	104



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**NB23**	**50.0**	**Poorly graded SAND (SP-SC) with clay and gravel**				**6.82**	**107.44**
⊠	**NB24**	**15.0**	**Clayey GRAVEL (GC) with sand**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**NB23**	**50.0**	**25**	**4.029**	**1.015**		**36.0**	**52.0**	**12.0**	
⊠	**NB24**	**15.0**	**38.1**	**8.277**	**0.845**		**52.0**	**34.7**	**13.3**	

URS GRAIN SIZE 28649640-ROUTE84.GPJ CT SACTO 061407.GDT 2/12/09

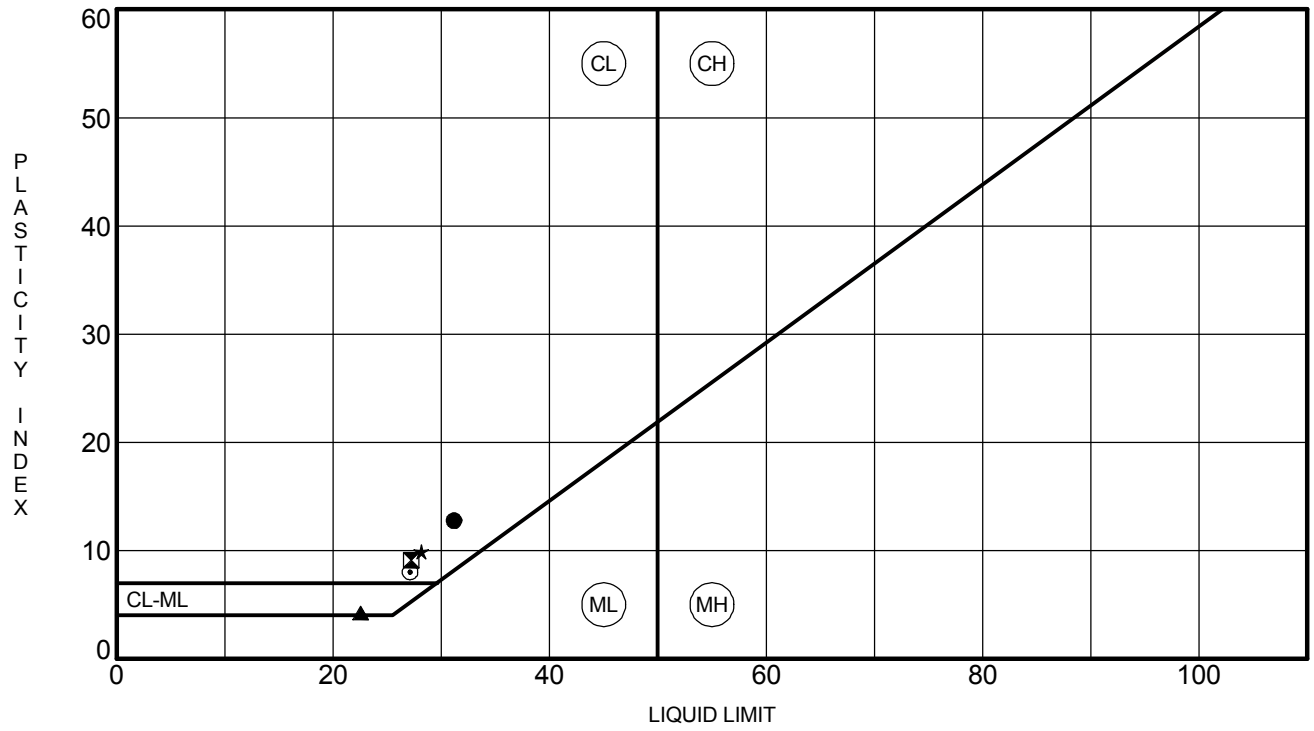
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: Route 84 Expressway Widening
Location: 04 Alameda 84
Number: 28649640

FIGURE B-1



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**NB23**	**30.0**	**31**	**18**	**13**		**Lean CLAY (CL)**
⊠	**NB23**	**35.0**	**27**	**18**	**9**		**Lean CLAY (CL)**
▲	**NB23**	**55.0**	**23**	**18**	**5**		**Sandy, silty CLAY (CL-ML)**
★	**NB24**	**60.0**	**28**	**18**	**10**		**Lean CLAY (CL)**
⊙	**NB24**	**80.0**	**27**	**19**	**8**		**Lean CLAY (CL)**

URS

55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: Route 84 Expressway Widening
Location: 04 Alameda 84
Number: 28649640

FIGURE B-2

URS ATTERBERG LIMITS 28649640-ROUTE84.GPJ CT SACTO 061407.GDT 2/12/09

04-ALA-84
EA 297601
33C-0710/33C-0713

State Route 84 Expressway Widening Project
Cities of Livermore and Pleasanton, Alameda County, California

Bridge Design Hydraulic Study Report

Prepared for:

Caltrans

and

ACTIA
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY

Prepared by:

WRECO

May 2009

Executive Summary

This study represents the hydrologic and hydraulic assessment for the proposed State Route 84 (SR 84) Expressway Bridge widening at Arroyo del Valle, the new Trail Bridge over Arroyo del Valle, the proposed SR 84 Expressway Bridge widening at Arroyo Mocho, and the new Access Bridge over Arroyo Mocho in the City of Livermore, Alameda County, California. The bridges are located on the SR 84 Expressway Widening Project.

Hydraulic analyses were performed for the existing and proposed conditions using the design flows from the Zone 7 Water Agency (Zone 7). For Arroyo del Valle and Arroyo Mocho, the design flood simulation in the model was controlled by the normal depth calculated from the average channel slope at the downstream straight channel reach. The Zone 7 design criterion is 100-year plus 2 ft of freeboard. The results from the hydraulic analyses for the proposed conditions are summarized in Table 1 through Table 4, below.

Table 1: SR 84 Expressway at Arroyo del Valle Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	7,000	417.48	411.18	6.30	11.68
50-year	5,400	417.48	410.06	7.42	10.34

Table 2: Trail Bridge at Arroyo del Valle Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	7,000	415.58	411.71	3.87	8.31
50-year	5,400	415.58	410.55	5.03	7.62

Table 3: SR 84 Expressway at Arroyo Mocho Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	4,800	416.87	415.01	1.86	6.02
50-year	3,900	416.87	413.97	2.90	5.70

Table 4: Access Bridge at Arroyo Mocho Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	4,800	417.02	414.66	2.36	6.31
50-year	3,900	417.02	413.62	3.40	6.00

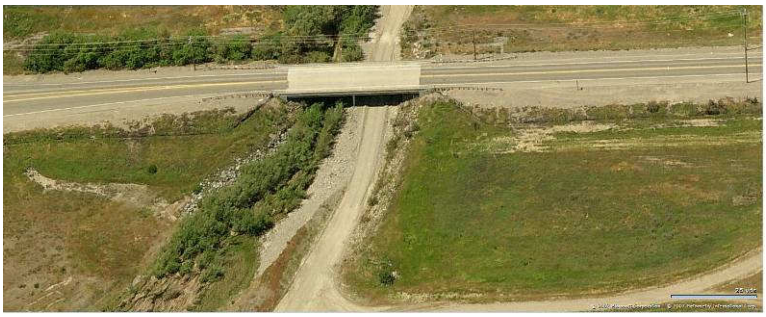


Photo 1. Aerial of SR 84 Expressway at Arroyo del Valle (maps.live.com)

The existing Arroyo del Valle Bridge was declared scour critical by Caltrans HQ. The scour analysis was conducted using the methodology recommended by the FHWA. The calculated potential scour depths at the bridge structures are summarized in Table 5 through Table 7.

Table 5: SR 84 Expressway at Arroyo del Valle Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	1.15	12.74	**13.89**
Pier #2	Negligible	1.15	13.37	**14.52**
Abutment #3	Negligible	1.15	6.31	**7.46**

Table 6: Trail Bridge at Arroyo del Valle Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	2.90	21.58	**24.48**
Pier #2	Negligible	2.90	22.43	**25.33**
Abutment #3	Negligible	2.90	22.09	**24.99**

Table 7: Access Bridge at Arroyo Mocho Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	1.1	-	**1.1**
Abutment #2	Negligible	1.1	-	**1.1**

Photo 2. Aerial of SR 84 Expressway at Arroyo Mocho (maps.live.com)

Extensive coordination has been made between Caltrans and the Design Team over the recommended countermeasures in scour prevention for the bridges within this Project. According to Caltrans, rock slope protection (RSP) alone is insufficient for scour protection. Supporting the piers of the SR 84 Bridge at Arroyo del Valle and the Trail Bridge at Arroyo del Valle on piles, as well as piles for the abutments of the new Trail Bridge, are the primary scour countermeasures proposed. The piers for the widened SR 84 Expressway bridge at Arroyo del Valle and the Trail Bridge at Arroyo del Valle should have piles as deep as the estimated total scour. The Access Bridge at Arroyo Mocho should have spread footings located as deep as the estimated total scour. RSP shall also be placed along the proposed embankments for the existing SR 84 Expressway bridge at Arroyo del Valle. RSP generally consists of rock on channel and structure boundaries to limit the effects of erosion. It is the most common type of countermeasure due to its general availability, ease of installation, and relatively low cost.

Per Caltrans recommendation, the existing RSP at the Arroyo del Valle bridge appears to be substandard and will be removed and replaced with new RSP meeting the current standards in HEC-23. The rock size at the toe of embankment was determined using the Isbash Formula per HEC-23. For the Trail Bridge, just upstream of the Trail Bridge, in between the bridges, and on the upstream face of the SR 84 Bridge, at least ¼-Ton rock with a thickness of 3.3 feet and Backing Class Number 1 or 2 with a minimum thickness of 1.8 feet and 1.25 feet, respectively, would be required. For the downstream face of the SR 84 Bridge and just downstream of the SR 84 Bridge, at least 1-Ton rock with a thickness of 5.4 feet and Light rock (inner layer) with a minimum thickness of 2.5 ft would be required. ¼-Ton rock would also be required for the Access Bridge.

The proposed embankment will only fill up to the edge of the low flow channel. There will be no fill in the low flow channel. Permitting agencies may require mitigation for any impacted areas in the channel and/or habitats, which would prohibit certain countermeasures.

ROUTE 84 EXPRESSWAY WIDENING PROJECT

LIVERMORE, CA.

RUBY HILL DRIVE TO JACK LONDON BOULEVARD

Proposed Arroyo Mocho Bridge Widening

FOUNDATION INVESTIGATION REPORT

Prepared for:

URS Corporation
55 South Market Street, Suite 1500
San Jose, CA 95113

Prepared By:

V&A
Lake Merritt Plaza
1999 Harrison Street, Suite 975
Oakland, CA 94612

July 2008

Hwy 84 Found Report_Arroy Mocho Brdg.doc

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INTRODUCTION

V&A was retained by URS Corporation to perform a corrosion survey on State Highway 84, from Ruby Hill Drive to Jack London Boulevard, in Livermore, California. The objective of the investigation was to measure various soil parameters and evaluate the results with respect to possible levels of corrosion at the site. The soil was tested at depths ranging from 0 to 19 meters below existing grade. This report provides recommendations for corrosion control of structural foundation materials under consideration for the existing Arroyo Mocho Bridge widening on Highway 84 (Isabel Avenue). The materials being considered as part of this investigation include buried reinforced concrete, prestressed concrete piles and steel piles.

The investigation was conducted in accordance with California Department of Transportation's Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch "Corrosion Guidelines" (Guidelines) dated September 2003. These Guidelines consider representative soil or water samples to be corrosive to structural elements if one or more of the following conditions exist:

1) **The chloride concentration is 500 ppm or greater,**
2) **The sulfate concentration is 2000 ppm or greater,**
3) **The pH is 5.5 or less.**

Evaluation of the soil environment was made in terms of potential corrosion damage to concrete and metal structures. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, soil samples taken during a geotechnical investigation were provided to V&A for laboratory testing. The soil samples were analyzed for minimum (saturated) resistivity, as well as for pH, chloride and sulfate ion concentrations. All of these affect the corrosion rate of buried structures.

The minimum (saturated) resistivity of four soil samples selected from two borings at the Arroyo Mocho Bridge ranged from 1,978 ohm-cm to 14,478 ohm-cm. The soil pH analyses ranged from 7.8 to 9.1 and the water-soluble chloride concentrations were from below the detection limit of 2 mg/kg to 7 mg/kg. The water-soluble sulfate concentrations were below the detection limit of 5 mg/kg. The pH, chloride and sulfate ion concentrations all indicate the sampled soils are *non-corrosive*, as defined by the Guidelines.

No water was sampled was at the Arroyo Mocho Bridge site because the streambed was dry at the time field resistivity readings were taken (May 14, 2008).

CONCLUSIONS

- The soil boring chemical analyses and the stream water analysis all gave pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg and soluble sulfate concentrations less than 2,000 mg/kg. According to the Guidelines, the soils and water are considered *non-corrosive*.
- No corrosion mitigation for steel piles is required by the Guidelines for non-corrosive soil conditions.
- This structure is not within 300 meters (1,000 feet) of salt or brackish water.

RECOMMENDATIONS

The test data and a review of the project requirements were used to make recommendations for each structural foundation material alternative listed below.

Buried Reinforced Concrete Structures and Cast in Place Piles

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following for installations in *non-corrosive* soil:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 5.1 centimeters should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

Prestressed Concrete Piles

Prestressed concrete piles should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 5.1 centimeters should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Type I-P (MS) modified or Type II modified cement should be used.

Steel Piles

No corrosion mitigation is required for non-corrosive soils

TEST METHODS

When predicting potential corrosion problems associated with a particular type of structure prior to installation, it is necessary to investigate the soil conditions the structure will encounter. Since corrosion is an electrochemical process accompanied by current flow, the electrochemical characteristics of a soil are of primary importance. Test methods utilized during this investigation reflect the most practical methods of evaluating corrosivity.

Resistivity is a measure of the ability of a soil to conduct an electric current. The higher the resistivity the more difficult it is for the soil to conduct current. Resistivity is primarily dependent on the soluble chemical and moisture content of the soil. Soils with high dissolved ion contents generally have low resistivity. As moisture is added to a soil, its resistivity will decrease as more ions are taken into solution. The soil resistivity decreases until the maximum solubility of the dissolved ions is reached. Increasing the moisture

content beyond this point increases the soil resistivity by diluting the solution. Since corrosion rate depends on current flow through the soil, corrosivity normally increases as soil resistivity decreases.

Soils can contain a wide variety of soluble salts. Therefore, soils with similar resistivities can have significantly different corrosion characteristics, depending on the ions present. In most soils, the principle agents of corrosion are the chloride and sulfate ions, as well as pH. Chloride ions break down the protective surface films on metals and can corrode reinforcing steel in concrete structures. Sulfates attack the Portland cement in concretes. This is an expansive reaction that disrupts the concrete matrix and softens the surface. A high bicarbonate ion concentration lowers soil resistivity and facilitates other forms of corrosion; however, bicarbonate is not corrosive to metals. Soil pH is another measure of corrosivity. Acid (low pH) soils are corrosive to buried metallic and concrete structures. Neutral (pH 7) and alkaline (pH greater than 7) soils are passive to metal surfaces; therefore, corrosion rates become negligible.

Field Soil Resistivity

Field (in-situ) soil resistivity was measured at 17 locations along the Highway 84 project alignment. The same testing configuration was used at each location. At the Arroyo Mocho Bridge crossing, one resistivity station was set up at the northwest end of the existing bridge. Figure 1 is a vicinity and project location map. Figure 2 shows the soil resistivity test site and the soil boring locations.

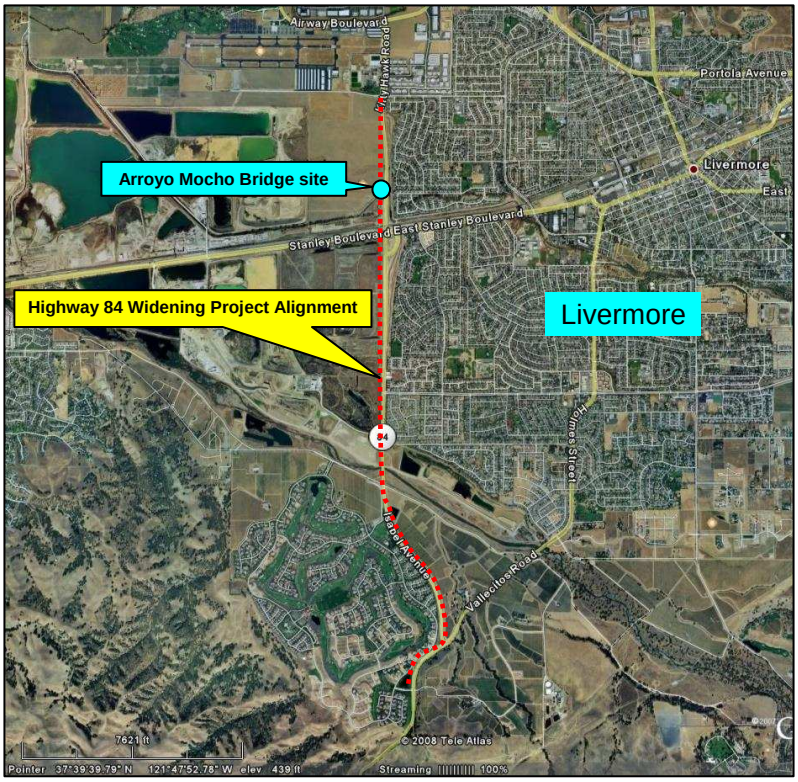


Figure 1. Vicinity Map for Arroyo Mocho Bridge Foundation Investigation, Livermore, CA.

Figure 2. In-Situ Soil Resistivity Testing and Soil Boring Locations

In-situ soil resistivity measurements were conducted by the Wenner Electrode Method using an AEMC Soil Resistance Meter, Model 4500. The Wenner Electrode Method uses four equally spaced metal pins, driven into the ground in a straight line, as electrodes (see Figure 3).

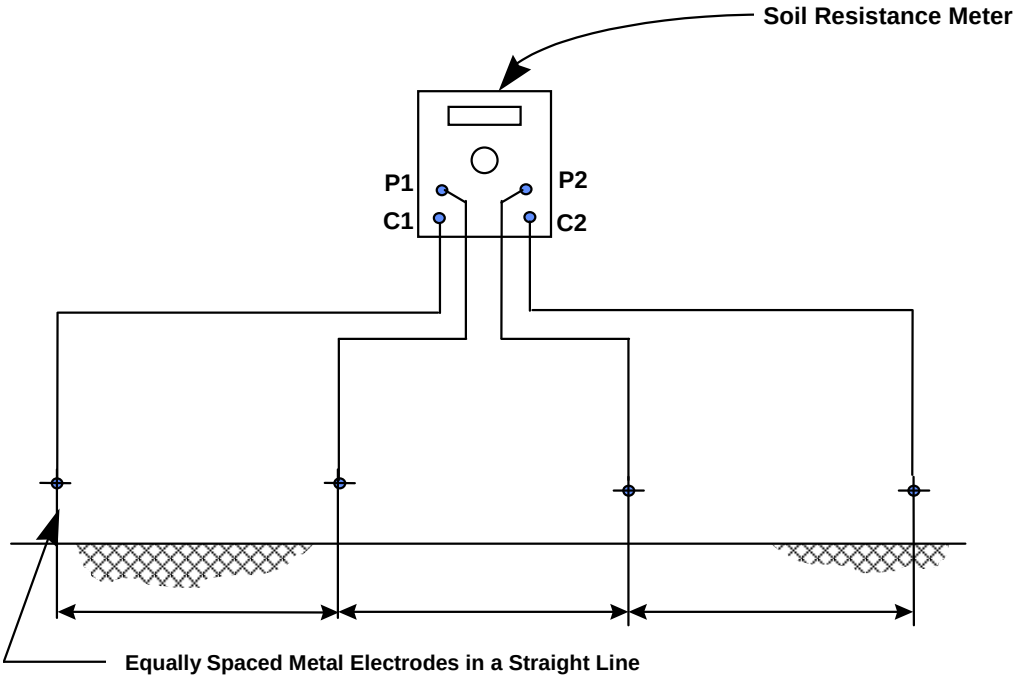


Figure 3. Wenner Electrode Method for Soil Resistivity Measurement

An alternating current from the Soil Resistance Meter causes a current to flow through the soil between the outside electrodes, C1 and C2. The current flowing through the soil creates a voltage gradient, which is proportional to the average resistance of the soil mass to a depth equal to the distance between electrodes. The voltage drop is measured across electrodes P1 and P2. Resistivity of the soil is then computed from the instrument reading according to the following formula:

$$\rho = 2\pi AR$$

where: ρ = soil resistivity in ohm-cm
A = the distance between probes in cm
R = soil resistance in ohms (instrument reading)
π = 3.1416

Soil resistivity measurements were conducted at rod spacings of 1.5, 3.0, 4.5 and 6.0 meters. Another method of calculating the soil resistivity using the data from the Wenner Electrode Method is the Barnes-Layer Resistivity calculation. The Barnes-Layer calculation is used to determine the resistivity for each soil layer. While the Wenner Electrode Method with 6.0 meter electrode spacings will consider the entire six meters below the surface, the Barnes-Layer method will calculate the resistivity of layers 0 to 1.5 meters, 1.5 to 3.0 meters, 3.0 to 4.5 meters and 4.5 to 6.0 meters below the surface. This method assumes the soil layers have a uniform thickness and are parallel to the surface. This may not always be true.

The Barnes-Layer method uses the following parameters to calculate layer resistivities:

$$\rho_{b-a} = KR_{b-a}$$

and

$$\frac{1}{R_{b-a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

Where:

ρ_{b-a}	=	Soil resistivity of layer depth b-a (ohm-cm)
a	=	Soil depth to top of layer (cm)
b	=	Soil depth to bottom of layer (cm)
R_a	=	Soil resistance read at depth a (ohms)
R_b	=	Soil resistance read at depth b (ohms)
R_{b-a}	=	Resistance of soil layer from a to b (ohms)
K	=	Layer constant (cm)
	=	$2\pi (b-a)$

Soil resistivities measured at the Arroyo Mocho Bridge and Barnes-Layer resistivities calculated from this data are listed in Table 1.

Laboratory Soil Analysis

To supplement the field resistivity test data, soil samples were obtained from soil borings NB23 and NB24 for laboratory soil resistivity analysis. A Soil Box was used in accordance with California Test Method 643. This apparatus is shown in Figure 4.

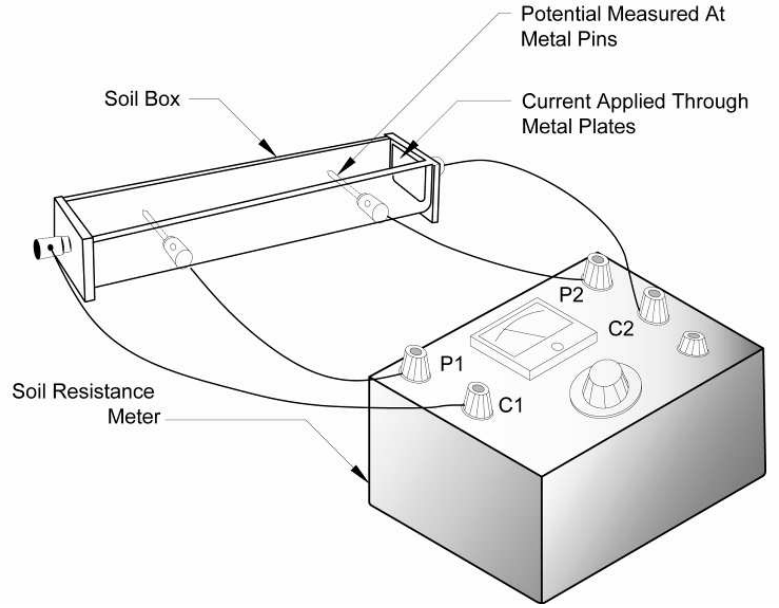


Figure 4. Soil Resistivity Measurement Using the Soil Box Method

This apparatus consists of a small plastic box with metal end plates for passing current through a tightly packed soil sample. Current is passed through the sample, causing a voltage drop across the sample. The soil resistivity is measured with a Soil Resistance Meter, similar to the AEMC Model 4500.

Soil resistivity is first measured in the "as-received" state. Distilled water is then added to the soil sample in 10-mL increments. The resistivity is measured after each addition. As the soil sample becomes more saturated, the soil resistivity decreases until the minimum soil resistivity is reached.

Soil boring samples from this study were forwarded to Cooper Testing Labs, Inc., in Palo Alto, CA., for minimum resistivity measurement, pH analysis, and analysis of water soluble chloride and sulfate ion concentrations. The analytical procedures followed California Test Methods 417, 422 and 643.

TEST RESULTS

Table 1 lists the field soil resistivity measurements from the Arroyo Mocho Bridge site and the calculated Barnes-Layer resistivities. Table 2 lists minimum resistivities and chemical analyses for the soil samples.

Table 1. Field Soil Resistivity Data

Site	Survey Station	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
15	416+00	1.5	11,481	0 - 1.5	11,481
		3.0	11,223	1.5 – 3.0	10,975
		4.5	15,541	3.0 - 4.5	67,460
		6.0	16,968	4.5 – 6.0	23,417

Table 2. Laboratory Soil Resistivity and Chemical Data

Item No.	Boring No.	Sample No.	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
					pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	NB23	2-4	1.5 - 2.0	5,347	8.4	<5	2
2	NB23	13-3	18.3 - 18.7	6,052	7.9	<5	3
3	NB24	2-X	1.5 - 2.0	14,478	9.1	<5	<2
4	NB24	13-4	18.3 - 18.7	1,978	7.8	<5	7

Based on the Guidelines, the analyzed soil samples are considered *non-corrosive* to buried metallic objects and reinforced concrete structures in regard to chloride and sulfate contents, pH and minimum soil resistivity.

Appendix 1. Soil Sample Minimum Resistivities and Chemical Analyses

Corrosivity Test Summary

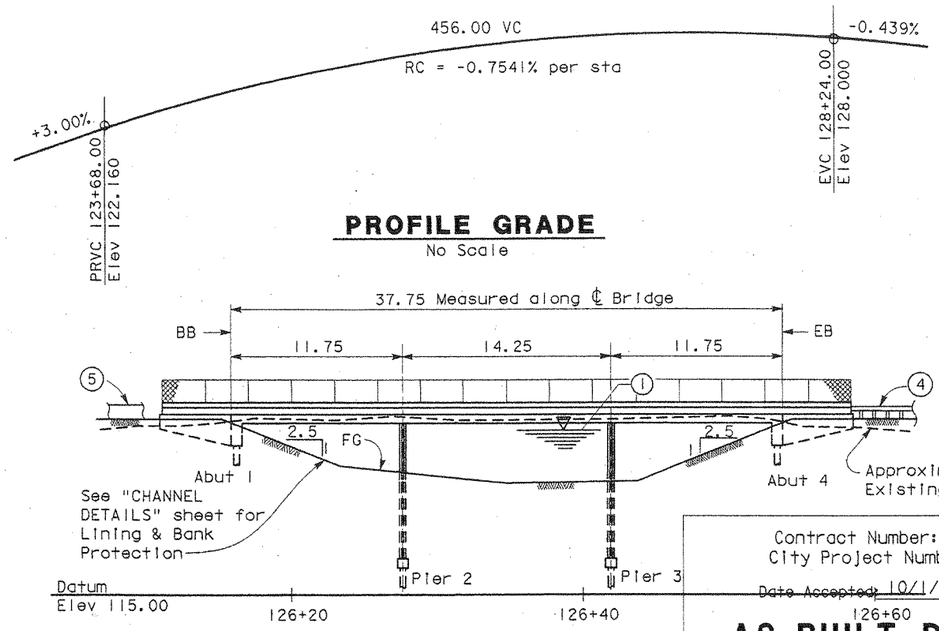
CTL # 632-005 & 006 **Date:** 6/13/2008 **Tested By:** PJ **Checked:** PJ

Client: V&A **Project:** URS-Caltrans Hwy 84 Widening **Proj. No:** 08-0216

Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Sample Description
Boring	Sample, No.	Depth, ft.	As Rec.	Minimum	Saturated	mg/kg	mg/kg	%		(Redox)	As Received	
						Dry Wt.	Dry Wt.	Dry Wt.		mv	%	
			ASTM G57	Cal 643	ASTM G57	Cal 422-mod.	Cal 417-mod.	Cal 417-mod.	Cal 643	SM 2580B	ASTM D2216	
NB03-2-3	-	5 - 6.5	-	3,302	-	6	<5	<0.0005	7.5	-	2.7	Brown Clayey SAND, trace Gravel
NB05-2-3	-	5-6.5	-	7,312	-	<2	<5	<0.0005	8.4	-	1.6	Reddish Brown SAND w/ Gravel, trace Clay
NB07-3-3	-	5 - 6.5	-	1,510	-	20	<5	<0.0005	7.1	-	3.0	Brown Sandy CLAY
NB11-5-3	-	20 - 21.5	-	7,255	-	<2	<5	<0.0005	7.4	-	1.6	Brown GRAVEL w/ Clay & Sand
NB12-2-X	-	5 - 6.5	-	10,028	-	<2	<5	<0.0005	8.6	-	0.9	Brown SAND w/ Clay & Gravel
NB13-6-3	-	25-26.5	-	7,992	-	<2	<5	<0.0005	8.3	-	1.2	Brown GRAVEL w/ Sand, trace Silt
NB14-2-3	-	5 - 6.5	-	10,586	-	<2	<5	<0.0005	8.5	-	0.7	Brown GRAVEL w/ Sand
NB20-2-3	-	3.5 - 5	-	5,340	-	<2	7	0.0007	8.2	-	2.0	Brown Clayey SAND
NB22A-1-4	-	3.5 - 5	-	5,386	-	9	<5	<0.0005	8.6	-	1.3	Brown SAND w/ Clay & Gravel
NB23-2-4	-	5 - 6.5	-	5,347	-	2	<5	<0.0005	8.4	-	1.1	Brown SAND w/ Clay & Gravel
NB23-13-3	-	60 - 61.5	-	6,052	-	3	<5	<0.0005	7.9	-	1.9	Reddish Brown Silty SAND w/ Gravel (slightly plastic)
NB24-2-X	-	5 - 6.5	-	14,478	-	<2	<5	<0.0005	9.1	-	0.6	Grayish Brown SAND w/ Clay & Gravel
NB24-13-4	-	60 - 61.5	-	1,978	-	7	<5	<0.0005	7.8	-	2.1	Reddish Brown Sandy SILT
NB25A-2-4	-	8.5 - 10	-	23,278	-	<2	<5	<0.0005	8.3	-	0.5	Brown GRAVEL w/ Silt & Sand
Arroyo del Valle		water	-	1,686	-	63.7*	19.9*	-	8.3	-	-	Water sampled at existing Arroyo del Valle bridge

Note: The Chloride and Sulfate results for the water sample are in units of mg/L.



PROFILE GRADE

No Scale

ELEVATION

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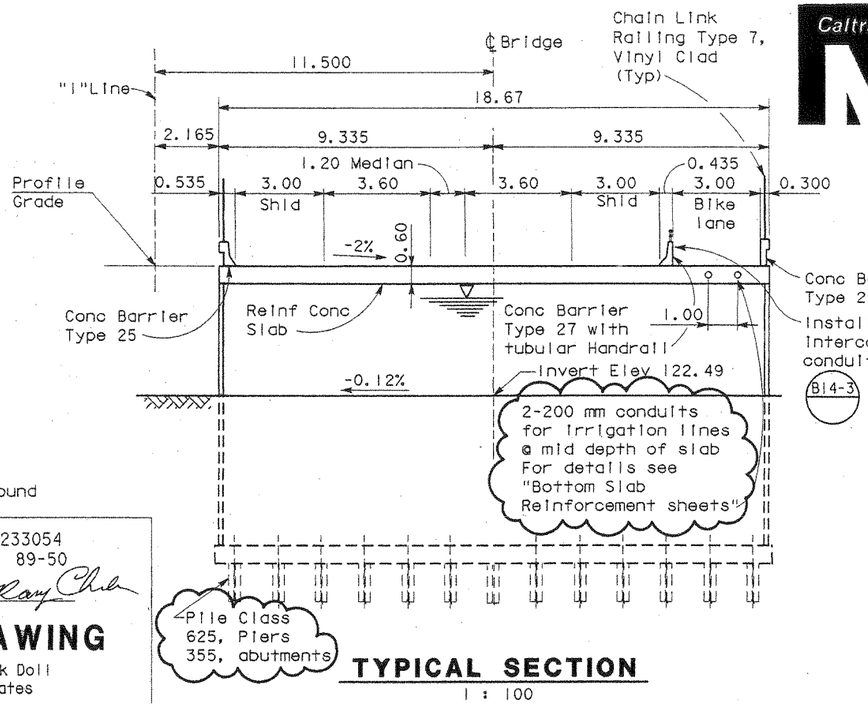


TYPICAL SECTION

1 : 100

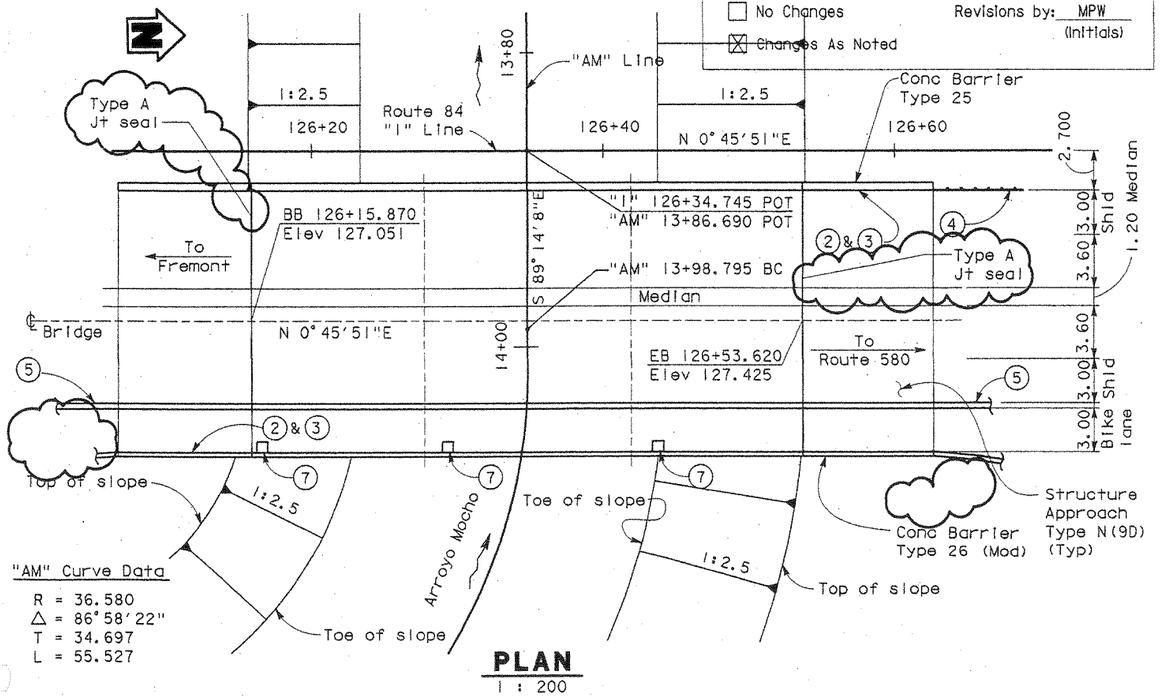
Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)



"AM" Curve Data
R = 36.580
△ = 86°58'22"
T = 34.697
L = 55.527

PLAN

1 : 200

PILE DATA TABLE						
Location	Pile Type	Design Loading	Nominal Resistance		Design Tip Elevation	Specified Tip Elevation
			Compression	Tension		
Abutment 1	HP 250x85	355 kN	710 kN	0 kN	115.0(1); 121.5(2)	115.0
Bent 2	HP 250x85	625 kN	1250 kN	0 kN	99.0(1); 113.5(2)	99.0
Bent 3	HP 250x85	625 kN	1250 kN	0 kN	99.0(1); 113.5(2)	99.0
Abutment 4	HP 250x85	355 kN	710 kN	0 kN	115.0(1); 121.5(2)	115.0

Design Tip Elevation is controlled by: (1) Compression, (2) Tension

NOTES:

1. HW Elev for Hydrologic Summary
   Frequency 100 year
   Discharge 155.74 m^3/s
   Elevation 126.10
2. Paint "ARROYO MOCHO"
3. Paint "BR. No. 33C-0407
4. MBGR, see Road Plans
5. Conc Barrier, see Road Plans
6. All dimensions shown are in Meters unless noted otherwise.
7. Type D-1 Deck Drain
8. For Standard Plan List and General Notes see "Deck Contours" sheet

INDEX TO PLANS

SHEET NO.	TITLE
1	General Plan
2	Deck Contours
3	Foundation Plan
4	Abutments
5	Typical Pier
6	Top Slab Reinforcement
7	Bottom Slab Reinforcement
8	Slab Reinforcement Details
9	Approach Slab Type N(9D)
10	Structure Approach Drainage Details
11	Concrete Barrier Type 27
12	Log of Test Borings

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		396	407

Caltrans Metric

REGISTERED CIVIL ENGINEER
DAVID V. WHITMORE No. C11359 Exp. 12-31-00 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

5/11/99
PLANS APPROVAL DATE

ALAMEDA COUNTY
TRANSPORTATION AUTHORITY
1401 Lakeside Drive, Suite 600
Oakland CA 94612

MK CENTENNIAL
5000 Hopyard Rd. Suite 100
Pleasanton, CA 94588

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

APPROXIMATE QUANTITIES

Furnish Steel Piling (HP250x85)	681 M
Drive Steel Pile (HP250x85)	48 EA

FINAL PAY QUANTITIES

Structure Excavation (Bridge)	369 M^3
Structure Backfill (Bridge)	139 M^3
Structural Concrete (Bridge)	648 M^3
Structural Concrete (Bridge Footing)	17 M^3
Structural Concrete (Approach Slab)	101 M^3
Bar Reinforcing Steel (Bridge)	94,600 Kg
Chain Link Railing (Type7) Vinyl Clad	112 M
Concrete Barrier (Type 25)	56 M
Concrete Barrier (Type 26 Mod)	56 M
Concrete Barrier (Type 27)	56 M
Tubular Handrail	56 M
Fractured Fin Finish	51 M^2
Misc. Metal Bridege	198 Kg

DESIGN OVERSIGHT	DESIGN	BY Whitmore	CHECKED M. Hicks	LOAD FACTOR DESIGN	LIVE LOADING:	HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD		
	DETAILS	BY Whitmore	CHECKED M. Hicks	LAYOUT	BY Whitmore	CHECKED A. Alegria		
SIGN OFF DATE	QUANTITIES	BY Whitmore	CHECKED A. Alegria	SPECIFICATIONS	BY R. Barlow	CHECKED Whitmore		

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Olga Rodriguez
PROJECT ENGINEER

BRIDGE NO. 33C-0407
KP/PM

CU 04256
EA 233051

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 20 40 60 80

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 6-99 5-99 6-99

SHEET 1 OF 12

ARROYO MOCHO
GENERAL PLAN

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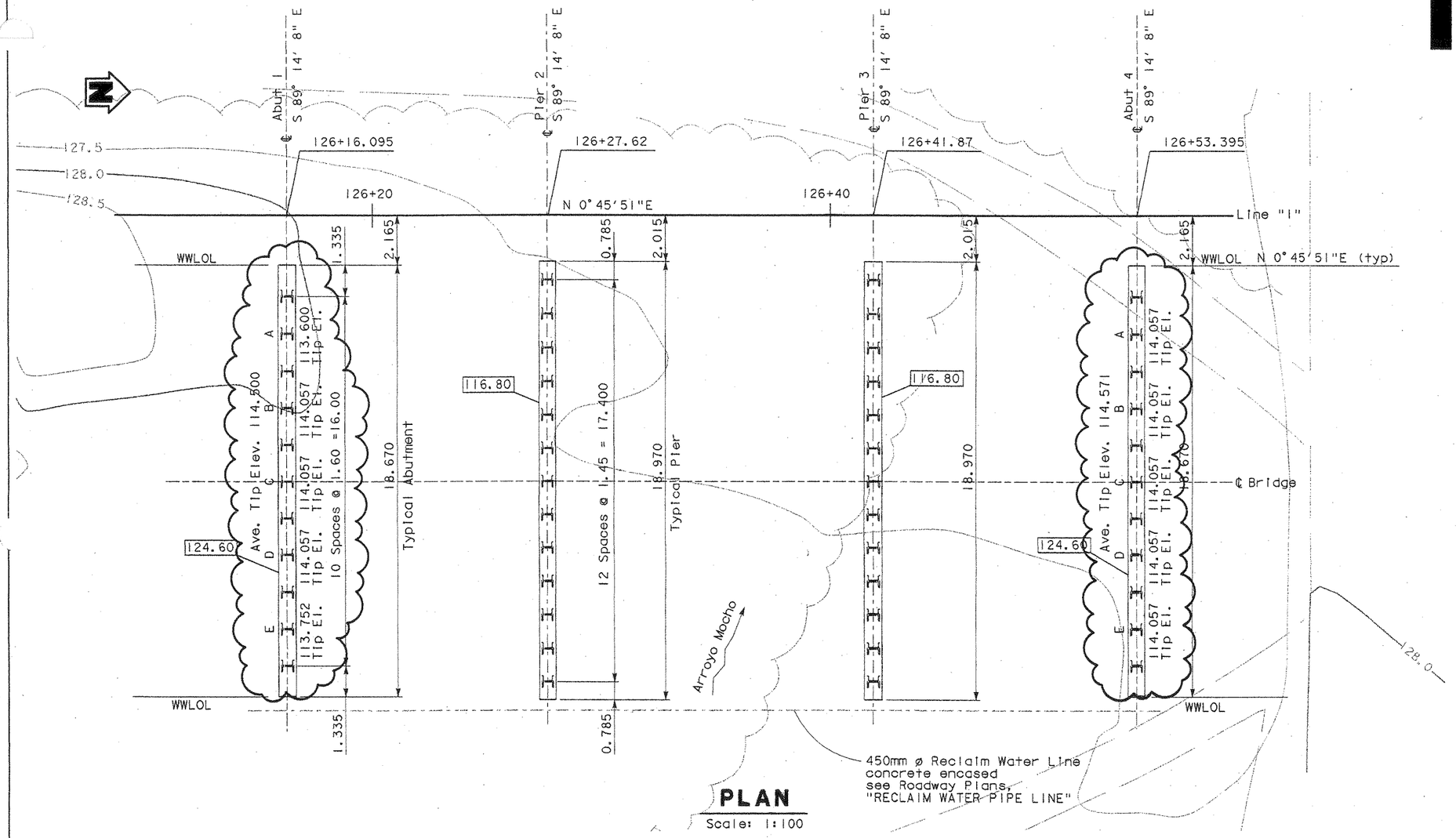
$$$$$$$$SYTIME$$$$$$$



PLAN

Scale: 1:100

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala			398	407

REGISTERED CIVIL ENGINEER

5/11/99

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — David V. Whitmore — No. C11359 — Exp. 12-31-00 — CIVIL — STATE OF CALIFORNIA

MK CENTENNIAL
5000 HOPYARD RD. SUITE 100
PLEASANTON, CALIFORNIA 94588

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BENCHMARK :

All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).

1. Mon. No. 31
   Found 1/8" iron pin set in concrete in a Standard City Well Monument Box at the intersection of Kitty Hawk Road and Rickenbacker Circle 3.601 m left of Center Line Station "I" 139+82.625. The Elevation is 122.796.

2. Mon. No. 220
   A brass pin in Standard City Well Monument Box at the intersection of Stanley blvd. and Isabel Avenue 19.004 meters left of Center Line Station "IS" 122+19.529. The elevation is 126.311.

3. Mon. No. 36
   Found 2½" brass disc marked LS 5412 in a Standard City Well Monument Box 34 m east of Isabel Avenue on Concannon Blvd and 33.863 m right of "I" 105+34.735. The Elevation is 127.376.

LEGEND:

indicates bottom of footing Elev.

indicates vertical pile

Contract Number: 04-233054
City Project Numbers: 89-50

Date Accepted: 10/1/02 Ray Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

PHOTOGRAMMETRY AS OF: 2-6-96		DRAWN	BY Towill Inc.	DESIGN	BY Whitmore	CHECKED	M. Hicks
SURVEYED	BY Chaudhary	TRACED	BY E. Cantiller	DETAILS	BY Whitmore	CHECKED	M. Hicks
FIELD CHECKED	BY	CHECKED	BY Whitmore	QUANTITIES	BY Whitmore	CHECKED	A. Alegria

DESIGN OVERSIGHT

SIGN OFF DATE

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Olga Rodriguez
PROJECT ENGINEER

CU 04256
EA 233051

BRIDGE NO. 33C-0407
KP/PM

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4-99 5-99

SHEET 3 OF 12

ARROYO MOCHO
FOUNDATION PLAN

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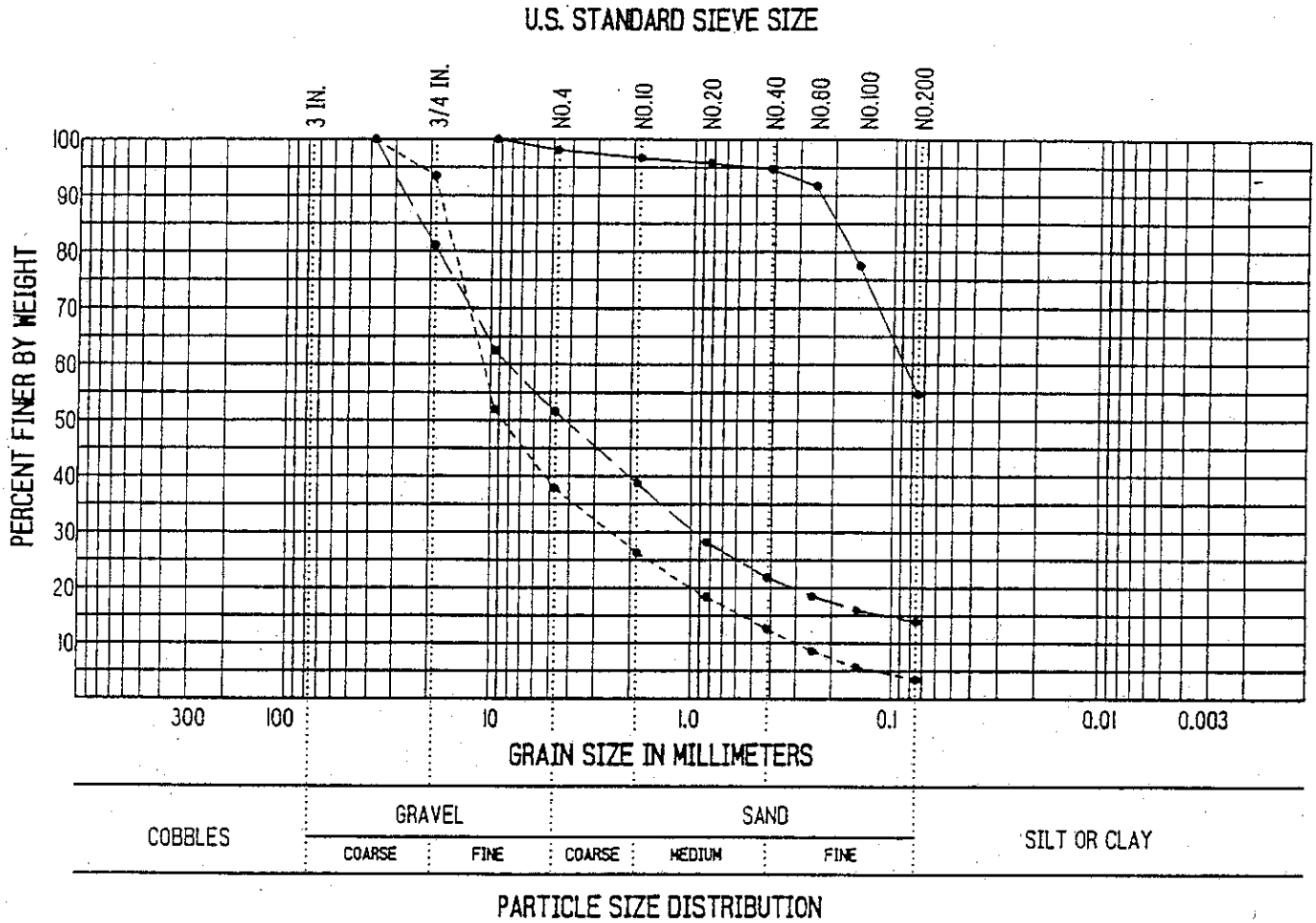
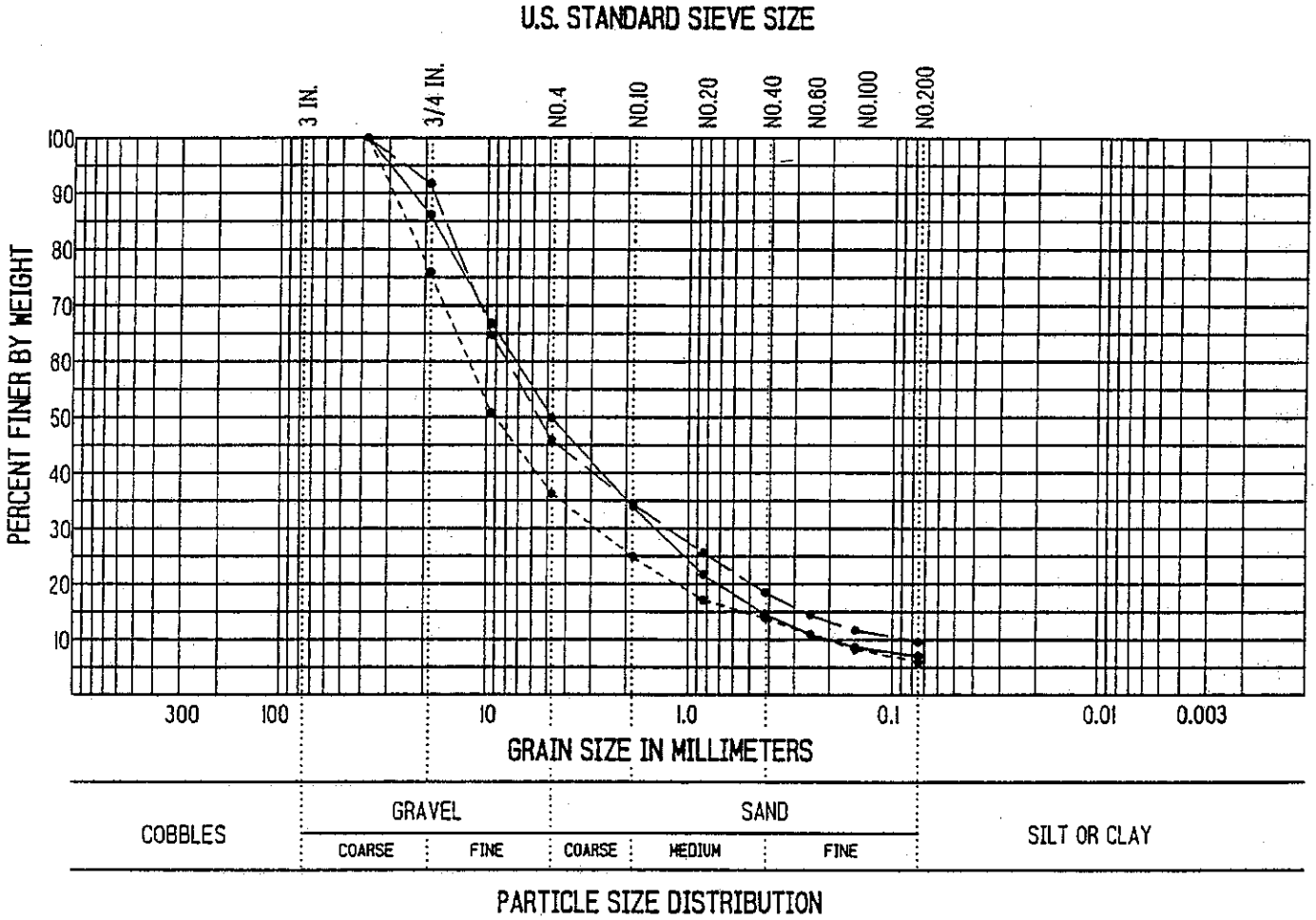
GRAIN-SIZE DISTRIBUTION



PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	DRILL HOLE NO.	DEPTH (METERS)	CLASSIFICATION
———	B-18	3.15	ML
— —	B-18	9	GM
- - - - - - -	B-18	21	GW
.....			

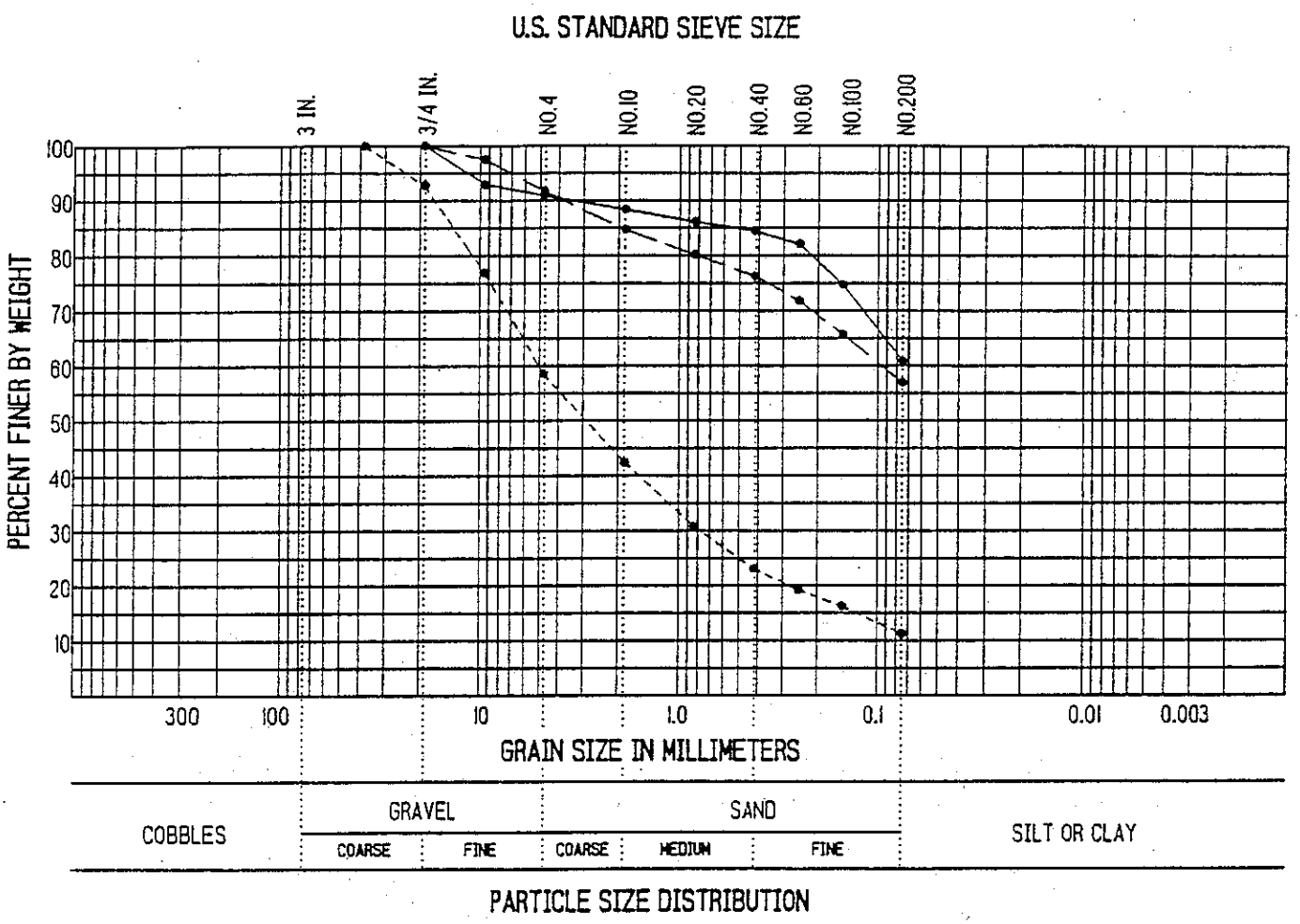
GRAIN-SIZE DISTRIBUTION



PARTICLE SIZE DISTRIBUTION

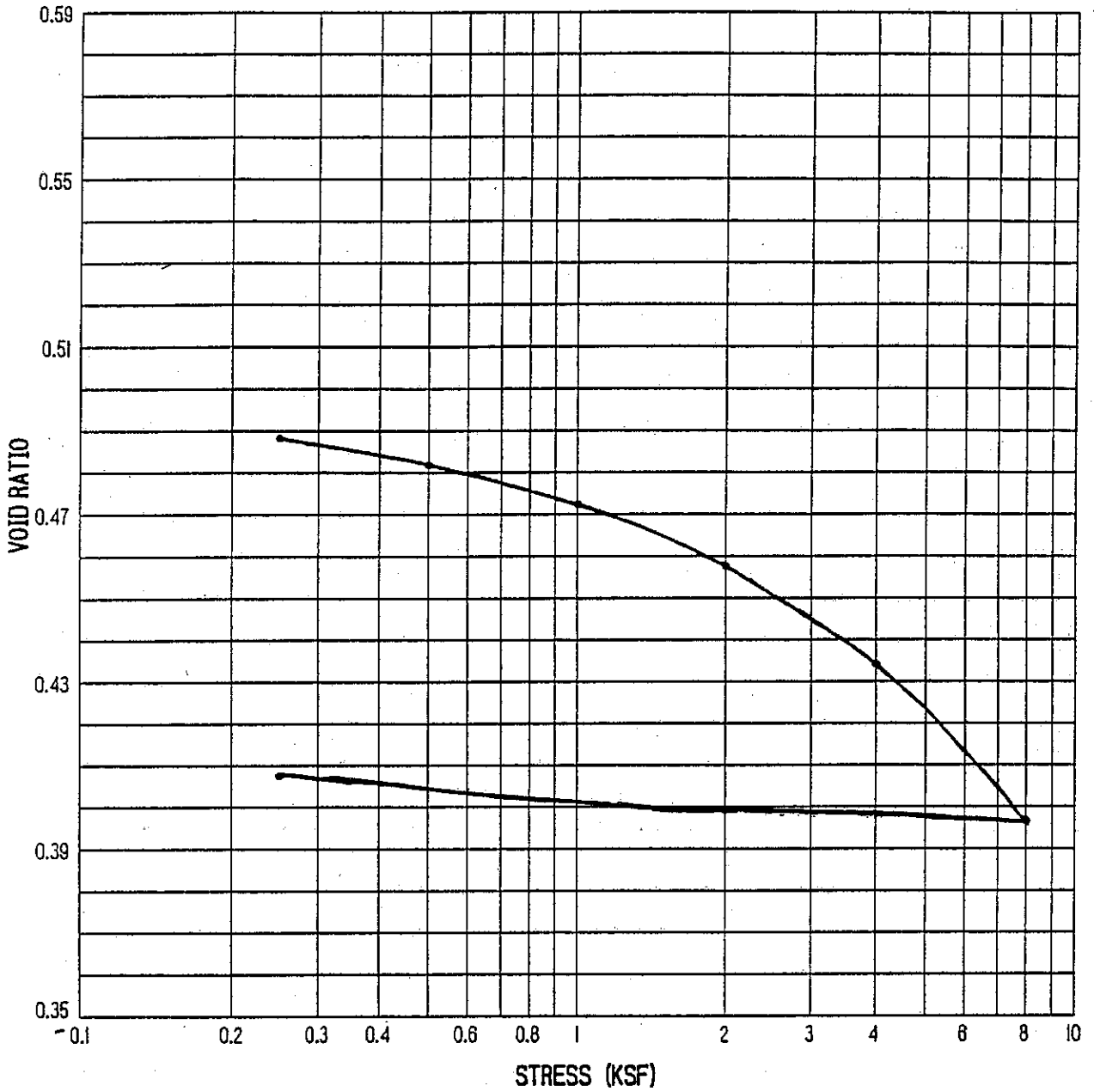
LINE SYMBOL	DRILL HOLE NO.	DEPTH (METERS)	CLASSIFICATION
———	B-19	3	GW-GM
— — —	B-19	7.5	GW-GM
- - - - - - -	B-19	13.5	GP-GM
.....			

GRAIN-SIZE DISTRIBUTION



LINE SYMBOL	DRILL HOLE NO.	DEPTH (METERS)	CLASSIFICATION
———	B-20	1.8	ML
— — —	B-20	4.95	CL
-------	B-20	9	SP-SM
.....			

CONSOLIDATION TEST



DRILL HOLE NO.: B-18	DEPTH (FEET): 11
INITIAL MOISTURE CONTENT (%): 15.8	FINAL MOISTURE CONTENT (%): 24.5
INITIAL VOID RATIO: .501	FINAL VOID RATIO: .408
INITIAL SATURATION (%): 85.2	FINAL SATURATION (%):
INITIAL DRY UNIT WEIGHT (PCF): 135.6	FINAL DRY UNIT WEIGHT (PCF): 124.2
DESCRIPTION: CLAY (CL) dark brown, firm, sandy	

Route 84 Arroyo Mocho

12/9/2009

Pile Design Spreadsheet

B19 abutment

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 126.2
Boring Surface El. (ft) 414.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 125.4
Bottom of Pile Cap El. (ft) 411.46
Bottom of Fill El. (ft) 411.46

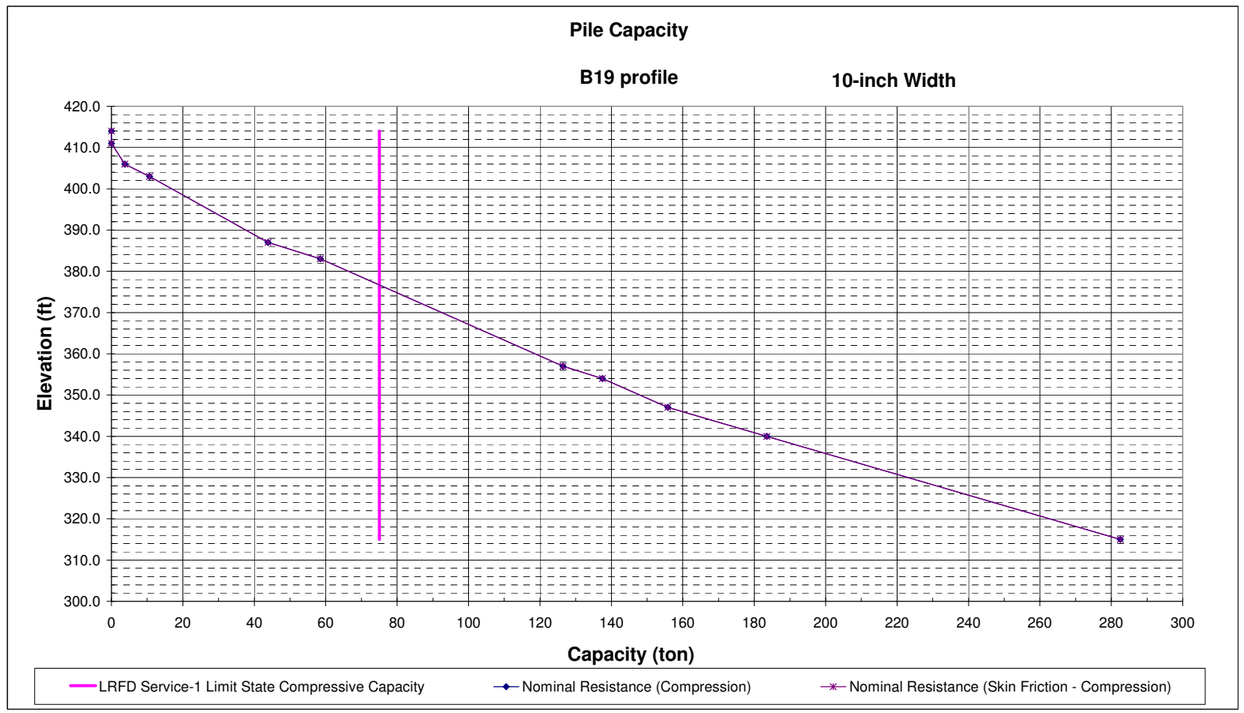
Nominal axial compress. Capacity (ult.)	75	ton
Nominal axial compress. Capacity (ult.)	668	kN
Pile Width	10	inch
Pile Width	254	mm
Pile Width	0.83	ft
Crit depth ratio	20	-
Crit depth	16.7	ft
Crit. Depth. Elev	397.3	ft
Crit. Depth. Elev	121.1	m
Crit. Eff. Vert. Str.	2160	psf

Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norlund

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction		Layer	Internal Depth to	Effective	Design Effective	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res. (Skin)		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?			Ratio		Angle		Thickness	Layer Top	Vert. Stress (Bot. Lay.)	Vert. Stress (Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	Type G= gran. C=cohes.	Capacity (B.C.)	B.C.?	to midlayer	(skin)		(Tot)							
						c	c	c_a/c	c_a	ϕ	δ																								
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			126.18	414.0										0	0					0.0	6.25	g	0	n	414.0	0	0	0	0	75	668	0	0	38	334
1	126.18	414.0	125.27	411.0	n	0	0	0.00	0	36	27	3.0	0.0	1755	405	0.0	0.0	0.0	62	1.8	8.32	g	1	n	412.5	0.0	0	0.0	0	75	668	0.0	0	38	334
2	125.27	411.0	123.74	406.0	y	0	0	0.00	0	36	27	5.0	3.0	2835	1080	0.0	3.7	2.0	62	6.6	9.00	g	4	n	408.5	3.7	33	3.7	33	75	668	2.0	18	38	334
3	123.74	406.0	122.83	403.0	Y	48	1000	0.96	960	0	0	3.0	8.0	3510	1485	7.0	0.0	0.0	0	11.4	9.00	c	1	n	404.5	10.7	95	10.7	95	75	668	9.0	80	38	334
4	122.83	403.0	117.95	387.0	Y	0	0	0.00	0	41	30.75	16.0	11.0	5493	2160	0.0	33.1	18.0	145	22.8	9.00	g	18	n	395.0	43.8	390	43.8	390	75	668	27.0	240	38	334
5	117.95	387.0	116.73	383.0	Y	96	2000	0.76	1520	0	0	4.0	27.0	6364	2160	14.7	0.0	0.0	0	34.8	9.00	c	1	n	385.0	58.5	521	58.5	521	75	668	41.7	371	38	334
6	116.73	383.0	108.81	357.0	Y	0	0	0.00	0	44	33	26.0	31.0	6800	2160	0.0	68.0	36.9	145	52.8	9.00	g	18	n	370.0	126.5	1126	126.5	1126	75	668	78.6	699	38	334
7	108.81	357.0	107.89	354.0	Y	96	2000	0.76	1520	0	0	3.0	57.0	6800	2160	11.0	0.0	0.0	0	70.2	9.00	c	1	n	355.5	137.5	1224	137.5	1224	75	668	89.6	797	38	334
8	107.89	354.0	105.76	347.0	Y	0	0	0.00	0	44	33	7.0	60.0	7526	2160	0.0	18.3	9.9	145	76.2	9.00	g	18	n	350.5	155.8	1386	155.8	1386	75	668	99.6	886	38	334
9	105.76	347.0	103.63	340.0	Y	192	4000	0.41	1640	0	0	7.0	67.0	8324	2160	27.7	0.0	0.0	0	84.6	9.00	c	2	n	343.5	183.5	1633	183.5	1633	75	668	127.3	1132	38	334
10	103.63	340.0	96.01	315.0	Y	192	4000	0.41	1640	0	0	25.0	74.0	8978	2160	99.0	0.0	0.0	0	103.8	9.00	c	2	n	327.5	282.5	2514	282.5	2514	75	668	226.3	2013	38	334
Bottom	96.01	315.0																																



Route 84 Arroyo Mocho

12/9/2009

Pile Design Spreadsheet

B20 abutment

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 126.2
Boring Surface El. (ft) 414.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 125.4
Bottom of Pile Cap El. (ft) 411.46
Bottom of Fill El. (ft) 411.46

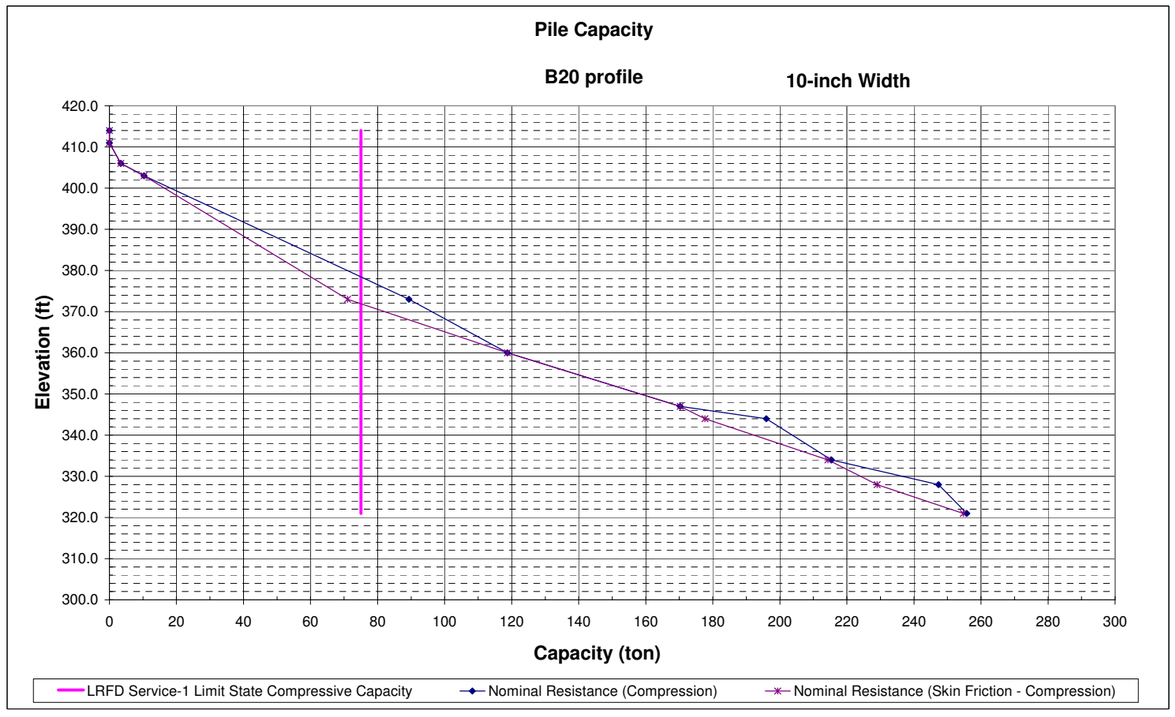
Nominal axial compress. Capacity (ult.)	75	ton
Nominal axial compress. Capacity (ult.)	668	kN
Pile Width	10	inch
Pile Width	254	mm
Pile Width	0.83	ft
Crit depth ratio	20	-
Crit depth	16.7	ft
Crit. Depth. Elev	397.3	ft
Crit. Depth. Elev	121.1	m
Crit. Eff. Vert. Str.	2160	psf

Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norlund

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction		Layer	Internal Depth to	Effective	Design Effective	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res. (Skin)		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?			Ratio		Angle		Thickness	Layer Top	Vert. Stress (Bot. Lay.)	Vert. Stress (Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	Type G= gran. C=cohes.	Capacity (B.C.)	B.C.?	to midlayer	(skin)		(Tot)							
						c	c	c_a/c	c_a	ϕ	δ																								
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			126.18	414.0										0	0					0.0	6.25	c	0	n	414.0	0	0	0	0	75	668	0	0	38	334
1	126.18	414.0	125.27	411.0	n	48	1000	0.96	0	0	0	3.0	0.0	1890	405	0.0	0.0	0.0	0	1.8	8.32	c	0	n	412.5	0.0	0	0.0	0	75	668	0.0	0	38	334
2	125.27	411.0	123.74	406.0	y	0	0	0.00	0	32	24	5.0	3.0	2835	1080	0.0	3.4	1.8	29	6.6	9.00	g	2	n	408.5	3.4	30	3.4	30	75	668	1.8	16	38	334
3	123.74	406.0	122.83	403.0	Y	48	1000	0.96	960	0	0	3.0	8.0	3510	1485	7.0	0.0	0.0	0	11.4	9.00	c	1	n	404.5	10.3	92	10.3	92	75	668	8.8	78	38	334
4	122.83	403.0	113.68	373.0	Y	0	0	0.00	0	40	30	30.0	11.0	5493	2160	0.0	60.7	33.0	145	31.2	9.00	g	18	y	388.0	71.0	632	89.4	795	75	668	41.8	372	38	334
5	113.68	373.0	109.72	360.0	Y	96	2000	0.76	1520	0	0	13.0	41.0	6364	2160	47.7	0.0	0.0	0	57.0	9.00	c	1	n	366.5	118.8	1057	118.8	1057	75	668	89.5	796	38	334
6	109.72	360.0	105.76	347.0	Y	192	4000	0.41	1640	0	0	13.0	54.0	6800	2160	51.5	0.0	0.0	0	72.6	9.00	c	2	n	353.5	170.3	1515	170.3	1515	75	668	141.0	1254	38	334
7	105.76	347.0	104.85	344.0	Y	0	0	0.00	0	41	30.75	3.0	67.0	6800	2160	0.0	7.4	4.0	145	82.2	9.00	g	18	y	345.5	177.6	1581	195.9	1744	75	668	145.0	1290	38	334
8	104.85	344.0	101.8	334.0	Y	96	2000	0.76	1520	0	0	10.0	70.0	7526	2160	36.7	0.0	0.0	0	90.0	9.00	c	1	y	339.0	214.3	1908	215.4	1917	75	668	181.7	1616	38	334
9	101.8	334.0	99.97	328.0	Y	0	0	0.00	0	41	30.75	6.0	80.0	8324	2160	0.0	14.7	8.0	145	99.6	9.00	g	18	y	331.0	229.0	2039	247.4	2202	75	668	189.7	1688	38	334
10	99.97	328.0	97.84	321.0	Y	96	2000	0.76	1520	0	0	7.0	86.0	8978	2160	25.7	0.0	0.0	0	107.4	9.00	c	1	y	324.5	254.7	2267	255.8	2277	75	668	215.4	1916	38	334
Bottom	97.84	321.0																																



Route 84 Arroyo Mocho

9/13/2010

Pile Design Spreadsheet

NB23 abut wider

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 126.2
Boring Surface El. (ft) 414.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 125.4
Bottom of Pile Cap El. (ft) 411.46
Bottom of Fill El. (ft) 411.46

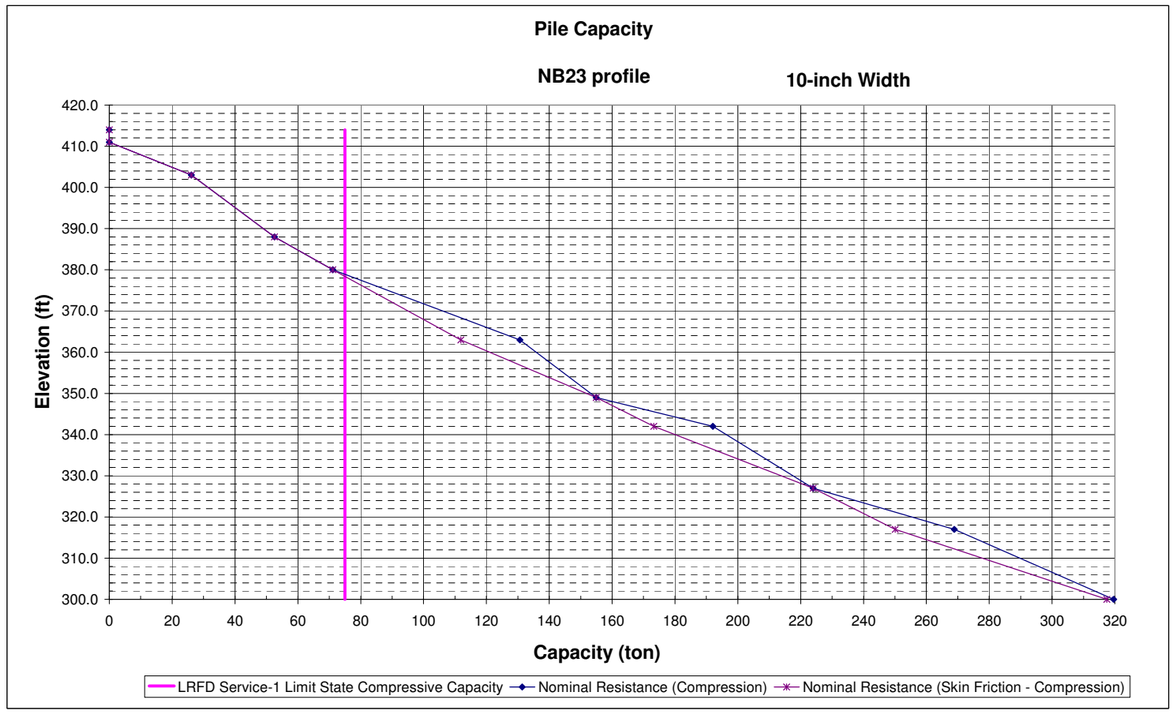
Nominal axial compress. Capacity (ult.)	75	ton
Nominal axial compress. Capacity (ult.)	668	kN
Pile Width	10	inch
Pile Width	254	mm
Pile Width	0.83	ft
Crit depth ratio	20	-
Crit depth	16.7	ft
Crit. Depth. Elev	397.3	ft
Crit. Depth. Elev	121.1	m
Crit. Eff. Vert. Str.	2160	psf

Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997)

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction		Layer	Internal		Design	delta			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression						Tension			
																										Cumulative				Nominal		Cumulative		Nominal	
No.	Top		Bot.		Resists?			Ratio		Angle		Thickness	Depth to	Effective	Effective	Lat. Res.			(granular)		(cohesive)	Type	Capacity	B.C.?	to	Axial Res.				Axial		Axial Res.		Axial	
						c	c	c_a/c	c_a	ϕ	δ		Layer Top	Vert. Stress (Bot. Lay.)	Vert. Stress (Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)				G= gran. C=cohes.	(B.C.)		midlayer	(skin)		(Tot)		Capacity		(Skin)		Capacity	
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			126.18	414.0										0	0					0.0	6.25	c	0	n	414.0	0	0	0	0	75	668	0	0	38	334
1	126.18	414.0	125.27	411.0	n	158	3300	0.41	0	0	0	3.0	0.0	405	405	0.0	0.0	0.0	0	1.8	8.32	c	2	n	412.5	0.0	0	0.0	0	75	668	0.0	0	38	334
2	125.27	411.0	122.83	403.0	y	158	3300	0.41	1353	0	0	8.0	3.0	810	810	26.1	0.0	0.0	0	8.4	9.00	c	2	n	407.0	26.1	233	26.1	233	75	668	26.1	233	38	334
3	122.83	403.0	118.26	388.0	Y	0	0	0.00	0	43	32.25	15.0	11.0	2835	2160	0.0	26.4	14.4	145	22.2	9.00	g	19	n	395.5	52.5	468	52.5	468	75	668	40.5	360	38	334
4	118.26	388.0	115.82	380.0	Y	48	1000	0.96	960	0	0	8.0	26.0	5493	2160	18.5	0.0	0.0	0	36.0	9.00	c	1	n	384.0	71.1	633	71.1	633	75	668	59.0	525	38	334
5	115.82	380.0	110.64	363.0	Y	0	0	0.00	0	40	30	17.0	34.0	6364	2160	0.0	40.8	22.2	145	51.0	9.00	g	19	y	371.5	111.9	996	130.7	1163	75	668	81.2	722	38	334
6	110.64	363.0	106.37	349.0	Y	67	1400	0.91	1274	0	0	14.0	51.0	6800	2160	43.1	0.0	0.0	0	69.6	9.00	c	1	n	356.0	155.0	1379	155.0	1379	75	668	124.3	1106	38	334
7	106.37	349.0	104.24	342.0	Y	0	0	0.00	0	44	33	7.0	65.0	6800	2160	0.0	18.3	9.9	145	82.2	9.00	g	19	y	345.5	173.3	1542	192.1	1709	75	668	134.2	1194	38	334
8	104.24	342.0	99.66	327.0	Y	134	2800	0.50	1400	0	0	15.0	72.0	7526	2160	50.7	0.0	0.0	0	95.4	9.00	c	2	n	334.5	224.0	1993	224.0	1993	75	668	184.9	1645	38	334
9	99.66	327.0	96.62	317.0	Y	0	0	0.00	0	44	33	10.0	87.0	8324	2160	0.0	26.1	14.2	145	110.4	9.00	g	19	y	322.0	250.1	2226	268.9	2393	75	668	199.1	1772	38	334
10	96.62	317.0	91.44	300.0	Y	192	4000	0.41	1640	0	0	17.0	97.0	8978	2160	67.3	0.0	0.0	0	126.6	9.00	c	2	y	308.5	317.4	2825	319.6	2844	75	668	266.5	2371	38	334
Bottom	91.44	300.0																																	



Route 84 Arroyo Mocho

9/13/2010

Pile Design Spreadsheet

NB24 abutment

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 126.2
Boring Surface El. (ft) 414.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 125.4
Bottom of Pile Cap El. (ft) 411.46
Bottom of Fill El. (ft) 411.46

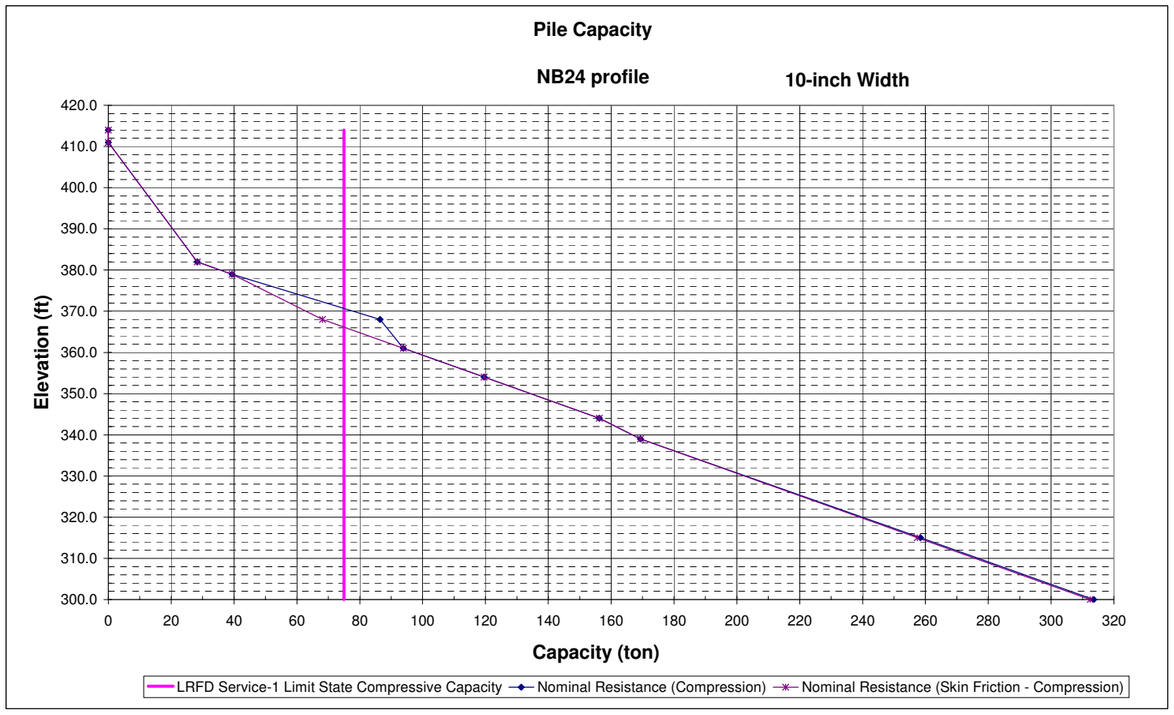
Nominal axial compress. Capacity (ult.)	75	ton
Nominal axial compress. Capacity (ult.)	668	kN
Pile Width	10	inch
Pile Width	254	mm
Pile Width	0.83	ft
Crit depth ratio	20	-
Crit depth	16.7	ft
Crit. Depth. Elev	397.3	ft
Crit. Depth. Elev	121.1	m
Crit. Eff. Vert. Str.	2160	psf

Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997), friction in sand based on Norlund's method

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction Angle		Layer	Internal Depth to	Effective Vert. Stress	Design Effective Vert. Stress	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res.		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?			Ratio				Thickness	Layer Top	(Bot. Lay.)	(Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	Type	Capacity	B.C.?	to	(skin)		(Tot)				(Skin)			
						c	c	c_a/c	c_a	ϕ	δ											G= gran. C=cohes.	(B.C.)		midlayer										
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			126.18	414.0										0	0					0.0	6.25	g	0	n	414.0	0	0	0	0	75	668	0	0	38	334
1	126.18	414.0	125.27	411.0	n	0	0	0.00	0	40	30	3.0	0.0	405	405	0.0	0.0	0.0	145	1.8	8.32	g	3	n	412.5	0.0	0	0.0	0	75	668	0.0	0	38	334
2	125.27	411.0	116.43	382.0	y	0	0	0.00	0	40	30	29.0	3.0	1350	1350	0.0	28.3	15.4	145	21.0	9.00	g	11	n	396.5	28.3	252	28.3	252	75	668	15.4	137	38	334
3	116.43	382.0	115.51	379.0	y	115	2400	0.64	1536	0	0	3.0	32.0	2430	2160	11.1	0.0	0.0	0	40.2	9.00	c	1	n	380.5	39.4	351	39.4	351	75	668	26.5	236	38	334
4	115.51	379.0	112.16	368.0	Y	0	0	0.00	0	44	33	11.0	35.0	4725	2160	0.0	28.8	15.6	145	48.6	9.00	g	18	y	373.5	68.1	607	86.5	770	75	668	42.1	375	38	334
5	112.16	368.0	110.03	361.0	Y	96	2000	0.76	1520	0	0	7.0	46.0	5929	2160	25.7	0.0	0.0	0	59.4	9.00	c	1	n	364.5	93.8	835	93.8	835	75	668	67.8	603	38	334
6	110.03	361.0	107.89	354.0	Y	96	2000	0.76	1520	0	0	7.0	53.0	6437	2160	25.7	0.0	0.0	0	67.8	9.00	c	1	n	357.5	119.5	1064	119.5	1064	75	668	93.5	832	38	334
7	107.89	354.0	104.85	344.0	Y	96	2000	0.76	1520	0	0	10.0	60.0	7526	2160	36.7	0.0	0.0	0	78.0	9.00	c	1	n	349.0	156.2	1391	156.2	1391	75	668	130.2	1158	38	334
8	104.85	344.0	103.32	339.0	Y	0	0	0.00	0	44	33	5.0	70.0	8324	2160	0.0	13.1	7.1	145	87.0	9.00	g	18	n	341.5	169.3	1507	169.3	1507	75	668	137.3	1222	38	334
9	103.32	339.0	96.01	315.0	Y	96	2000	0.76	1520	0	0	24.0	75.0	8397	2160	88.1	0.0	0.0	0	104.4	9.00	c	1	y	327.0	257.4	2291	258.5	2300	75	668	225.4	2005	38	334
10	96.01	315.0	91.44	300.0	Y	96	2000	0.76	1520	0	0	15.0	99.0	8978	2160	55.1	0.0	0.0	0	127.8	9.00	c	1	y	307.5	312.5	2781	313.5	2790	75	668	280.5	2495	38	334
Bottom	91.44	300.0																															



route 84 Arroyo Mocho

12/9/2009

Pile Design Spreadsheet

B19 pier

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 123.1
Boring Surface El. (ft) 404.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 117.6
Bottom of Pile Cap El. (ft) 385.86
Bottom of Fill El. (ft) 400

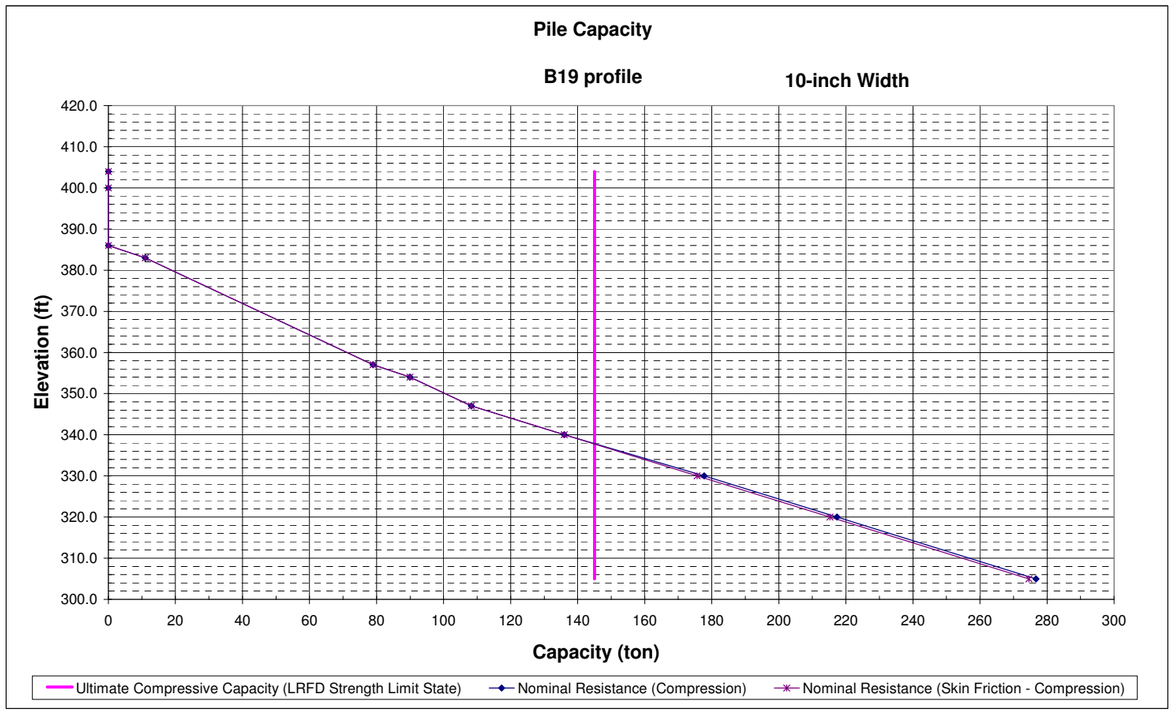
Nominal axial compress. Capacity (ult.)	145	ton
Nominal axial compress. Capacity (ult.)	1291	kN
Pile Width	10	inch
Pile Width	254	mm
Pile Width	0.83	ft
Crit depth ratio	20	-
Crit depth	16.7	ft
Crit. Depth. Elev	387.3	ft
Crit. Depth. Elev	118.1	m
Crit. Eff. Vert. Str.	2160	psf

Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norlund

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction Angle		Layer	Internal Depth to	Effective Vert. Stress	Design Effective Vert. Stress	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression				Tension	
																										Cumulative Axial Res.				Nominal Axial Capacity		Cumulative Axial Res. (Skin)		Nominal Axial Capacity	
No.	Top		Bot.		Resists?	c	c	Ratio		ϕ	δ	Thickness	Layer Top	(Bot. Lay.)	(Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	G= gran. C=cohes.	(B.C.)	B.C.?	to midlayer	(skin)		(Tot)					
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)	c_a/c	c_a (psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			123.13	404.0										0	0					0.0	6.25	g	0	n	404.0	0	0	0	0	145	1291	0	0	73	645
1	123.13	404.0	121.91	400.0	n	0	0	0.00	0	41	30.75	4.0	0.0	540	540	0.0	0.0	0.0	145	2.4	8.56	g	5	n	402.0	0.0	0	0.0	0	145	1291	0.0	0	73	645
2	121.91	400.0	117.65	386.0	n	0	0	0.00	0	41	30.75	14.0	4.0	2430	2160	0.0	0.0	0.0	145	13.2	9.00	g	18	n	393.0	0.0	0	0.0	0	145	1291	0.0	0	73	645
3	117.65	386.0	116.73	383.0	y	96	2000	0.76	1520	0	0	3.0	18.0	3510	2160	11.0	0.0	0.0	0	23.4	9.00	c	1	n	384.5	11.0	98	11.0	98	145	1291	11.0	98	73	645
4	116.73	383.0	108.81	357.0	Y	0	0	0.00	0	44	33	26.0	21.0	4869	2160	0.0	68.0	36.9	145	40.8	9.00	g	18	n	370.0	79.0	703	79.0	703	145	1291	47.9	427	73	645
5	108.81	357.0	107.89	354.0	Y	96	2000	0.76	1520	0	0	3.0	47.0	5740	2160	11.0	0.0	0.0	0	58.2	9.00	c	1	n	355.5	90.0	801	90.0	801	145	1291	59.0	524	73	645
6	107.89	354.0	105.76	347.0	Y	0	0	0.00	0	44	33	7.0	50.0	6176	2160	0.0	18.3	9.9	145	64.2	9.00	g	18	n	350.5	108.3	964	108.3	964	145	1291	68.9	613	73	645
7	105.76	347.0	103.63	340.0	Y	192	4000	0.41	1640	0	0	7.0	57.0	6176	2160	27.7	0.0	0.0	0	72.6	9.00	c	2	n	343.5	136.0	1210	136.0	1210	145	1291	96.6	860	73	645
8	103.63	340.0	100.58	330.0	Y	192	4000	0.41	1640	0	0	10.0	64.0	6902	2160	39.6	0.0	0.0	0	82.8	9.00	c	2	y	335.0	175.6	1563	177.7	1582	145	1291	136.2	1212	73	645
9	100.58	330.0	97.53	320.0	Y	192	4000	0.41	1640	0	0	10.0	74.0	7700	2160	39.6	0.0	0.0	0	94.8	9.00	c	2	y	325.0	215.2	1915	217.3	1934	145	1291	175.8	1564	73	645
10	97.53	320.0	92.96	305.0	Y	192	4000	0.41	1640	0	0	15.0	84.0	8354	2160	59.4	0.0	0.0	0	109.8	9.00	c	2	y	312.5	274.6	2444	276.7	2463	145	1291	235.2	2093	73	645
Bottom	92.96	305.0																																	



Route 84 Arroyo Mocho

12/9/2009

Pile Design Spreadsheet

B20 pier

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 123.1
Boring Surface El. (ft) 404.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 117.6
Bottom of Pile Cap El. (ft) 385.86
Bottom of Fill El. (ft) 400

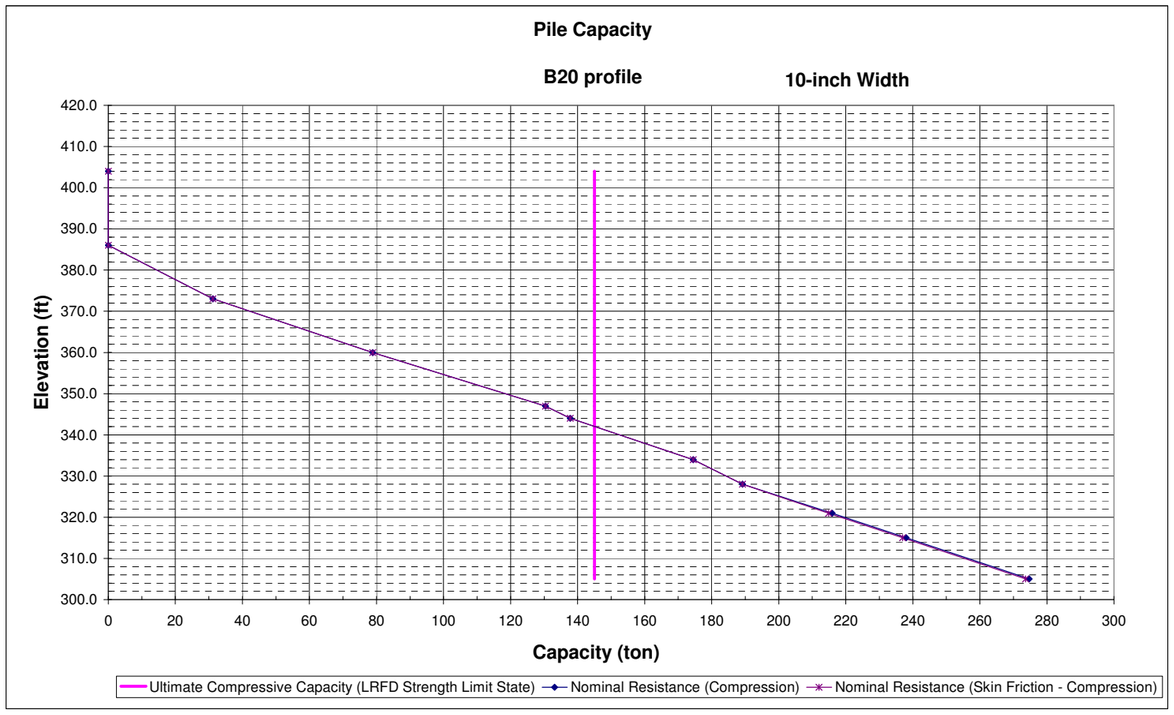
Nominal axial compress. Capacity (ult.)	145	ton
Nominal axial compress. Capacity (ult.)	1291	kN
Pile Width	10	inch
Pile Width	254	mm
Pile Width	0.83	ft
Crit depth ratio	20	-
Crit depth	16.7	ft
Crit. Depth. Elev	387.3	ft
Crit. Depth. Elev	118.1	m
Crit. Eff. Vert. Str.	2160	psf

Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norland.

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction		Layer	Internal Depth to	Effective	Design Effective	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression				Tension			
																										Cumulative		Nominal		Cumulative		Nominal	
No.	Top		Bot.		Resists?			Ratio		Angle		Thickness	Layer Top	Vert. Stress	Vert. Stress	Cohesive	Friction		(granular)		(cohesive)	Type	Capacity	B.C.?	to	Axial Res.				Axial		Axial Res.		Axial	
														(Bot. Lay.)	(Bot. Lay.)		(comp)	(tensile)				G= gran.	(B.C.)		midlayer	(skin)		(Tot)		Capacity		(Skin)		Capacity	
						c	c	c_a/c	c_a	ϕ	δ											C=cohes.											
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			123.13	404.0										0	0					0.0	6.25	c	0	n	404.0	0	0	0	0	145	1291	0	0	73	645
1	123.13	404.0	117.65	386.0	n	0	0	0.00	0	40	30	18.0	0.0	2430	2160	0.0	0.0	0.0	145	10.8	9.00	g	18	n	395.0	0.0	0	0.0	0	145	1291	0.0	0	73	645
2	117.65	386.0	113.68	373.0	y	0	0	0.00	0	40	30	13.0	18.0	2835	2160	0.0	31.2	17.0	145	29.4	9.00	g	18	n	379.5	31.2	278	31.2	278	145	1291	17.0	151	73	645
3	113.68	373.0	109.72	360.0	Y	96	2000	0.76	1520	0	0	13.0	31.0	3510	2160	47.7	0.0	0.0	0	45.0	9.00	c	1	n	366.5	78.9	702	78.9	702	145	1291	64.7	575	73	645
4	109.72	360.0	105.76	347.0	Y	192	4000	0.41	1640	0	0	13.0	44.0	4869	2160	51.5	0.0	0.0	0	60.6	9.00	c	2	n	353.5	130.4	1161	130.4	1161	145	1291	116.2	1033	73	645
5	105.76	347.0	104.85	344.0	Y	0	0	0.00	0	41	30.75	3.0	57.0	5740	2160	0.0	7.4	4.0	145	70.2	9.00	g	18	n	345.5	137.8	1226	137.8	1226	145	1291	120.2	1069	73	645
6	104.85	344.0	101.8	334.0	Y	96	2000	0.76	1520	0	0	10.0	60.0	6176	2160	36.7	0.0	0.0	0	78.0	9.00	c	1	n	339.0	174.5	1553	174.5	1553	145	1291	156.9	1396	73	645
7	101.8	334.0	99.97	328.0	Y	0	0	0.00	0	41	30.75	6.0	70.0	6176	2160	0.0	14.7	8.0	145	87.6	9.00	g	18	n	331.0	189.2	1684	189.2	1684	145	1291	164.9	1467	73	645
8	99.97	328.0	97.84	321.0	Y	96	2000	0.76	1520	0	0	7.0	76.0	6902	2160	25.7	0.0	0.0	0	95.4	9.00	c	1	y	324.5	214.9	1913	215.9	1922	145	1291	190.6	1695	73	645
9	97.84	321.0	96.01	315.0	Y	96	2000	0.76	1520	0	0	6.0	83.0	7700	2160	22.0	0.0	0.0	0	103.2	9.00	c	1	y	318.0	236.9	2109	238.0	2118	145	1291	212.6	1891	73	645
10	96.01	315.0	92.96	305.0	Y	96	2000	0.76	1520	0	0	10.0	89.0	8354	2160	36.7	0.0	0.0	0	112.8	9.00	c	1	y	310.0	273.6	2435	274.7	2445	145	1291	249.3	2218	73	645
Bottom	92.96	305.0																																	



Route 84 Arroyo Mocho

9/13/2010

Pile Design Spreadsheet

NB23 pier widen

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 123.1
Boring Surface El. (ft) 404.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 117.6
Bottom of Pile Cap El. (ft) 385.86
Bottom of Fill El. (ft) 400

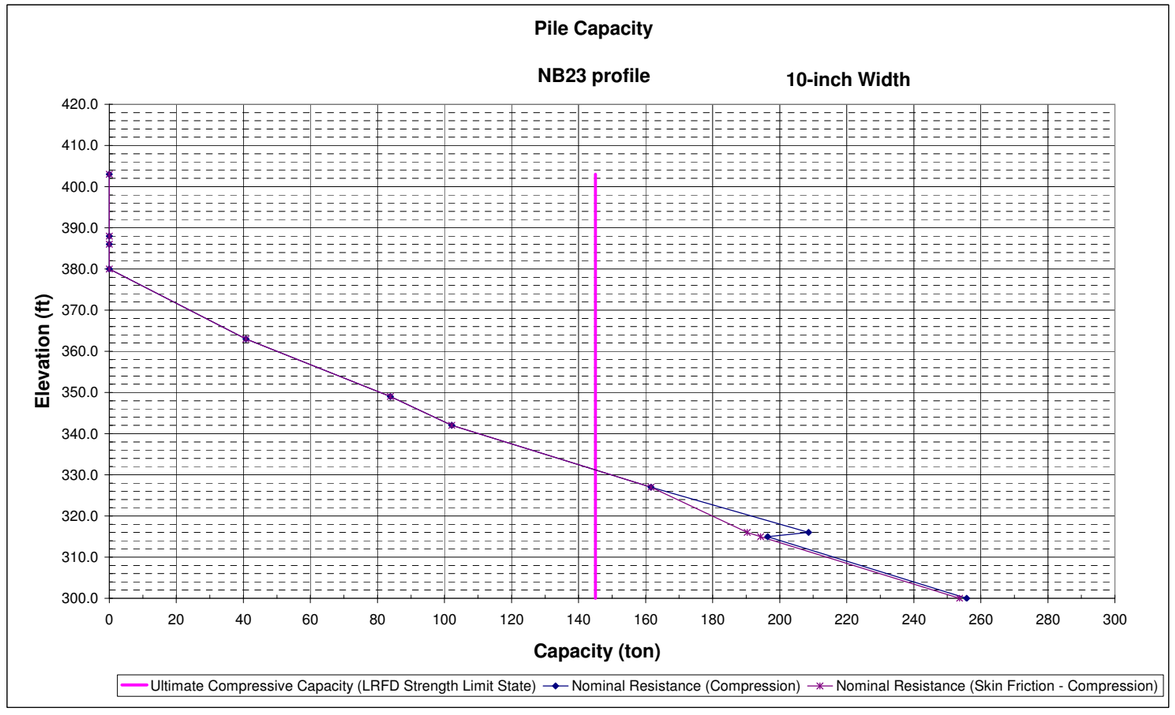
Nominal axial compress. Capacity (ult.) 145 ton
Nominal axial compress. Capacity (ult.) 1291 kN
Pile Width 10 inch
Pile Width 254 mm
Pile Width 0.83 ft
Crit depth ratio 20 -
Crit depth 16.7 ft
Crit. Depth. Elev 387.3 ft
Crit. Depth. Elev 118.1 m
Crit. Eff. Vert. Str. 2160 psf

Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norlund

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction		Layer	Internal Depth to	Effective	Design Effective	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res. (Skin)		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?	c	c	Ratio		Angle		Thickness	Layer Top	Vert. Stress (Bot. Lay.)	Vert. Stress (Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	Type	Capacity	B.C.?	to	(skin)		(Tot)							
																						G= gran. C=cohes.	(B.C.)		midlayer										
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)	c_a/c	c_a	ϕ (deg)	δ (deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			122.83	403.0										0	0					0.0	6.25	g	0	n	403.0	0	0	0	0	145	1291	0	0	73	645
1	122.83	403.0	118.26	388.0	n	0	0	0.00	0	43	32.25	15.0	1.0	405	405	0.0	0.0	0.0	145	10.2	9.00	g	3	n	395.5	0.0	0	0.0	0	145	1291	0.0	0	73	645
2	118.26	388.0	117.65	386.0	n	48	1000	0.96	0	0	0	2.0	16.0	1350	1350	0.0	0.0	0.0	0	20.4	9.00	g	0	n	387.0	0.0	0	0.0	0	145	1291	0.0	0	73	645
3	117.65	386.0	115.82	380.0	n	48	1000	0.96	0	0	0	6.0	18.0	2430	2160	0.0	0.0	0.0	0	25.2	9.00	c	1	n	383.0	0.0	0	0.0	0	145	1291	0.0	0	73	645
4	115.82	380.0	110.64	363.0	Y	0	0	0.00	0	40	30	17.0	24.0	4288	2160	0.0	40.8	22.2	145	39.0	9.00	g	18	n	371.5	40.8	363	40.8	363	145	1291	22.2	197	73	645
5	110.64	363.0	106.37	349.0	Y	67	1400	0.91	1274	0	0	14.0	41.0	5305	2160	43.1	0.0	0.0	0	57.6	9.00	c	1	n	356.0	83.9	746	83.9	746	145	1291	65.2	580	73	645
6	106.37	349.0	104.24	342.0	Y	0	0	0.00	0	44	33	7.0	55.0	5813	2160	0.0	18.3	9.9	145	70.2	9.00	g	18	n	345.5	102.2	909	102.2	909	145	1291	75.2	669	73	645
7	104.24	342.0	99.66	327.0	Y	192	4000	0.41	1640	0	0	15.0	62.0	6902	2160	59.4	0.0	0.0	0	83.4	9.00	c	2	n	334.5	161.6	1439	161.6	1439	145	1291	134.6	1197	73	645
8	99.66	327.0	96.31	316.0	Y	0	0	0.00	0	44	33	11.0	77.0	7700	2160	0.0	28.8	15.6	145	99.0	9.00	g	18	y	321.5	190.3	1694	208.6	1857	145	1291	150.2	1336	73	645
9	96.31	316.0	96.01	315.0	Y	192	4000	0.41	1640	0	0	1.0	88.0	7773	2160	4.0	0.0	0.0	0	106.2	9.00	c	2	y	315.5	194.3	1729	196.4	1748	145	1291	154.2	1372	73	645
10	96.01	315.0	91.44	300.0	Y	192	4000	0.41	1640	0	0	15.0	89.0	8354	2160	59.4	0.0	0.0	0	115.8	9.00	c	2	y	307.5	253.7	2258	255.8	2277	145	1291	213.6	1900	73	645
Bottom	91.44	300.0																																	



Route 84 Arroyo Mocho

9/13/2010

Pile Design Spreadsheet

NB24 pier

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 123.1
Boring Surface El. (ft) 404.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 117.6
Bottom of Pile Cap El. (ft) 385.9
Bottom of Fill El. (ft) 400

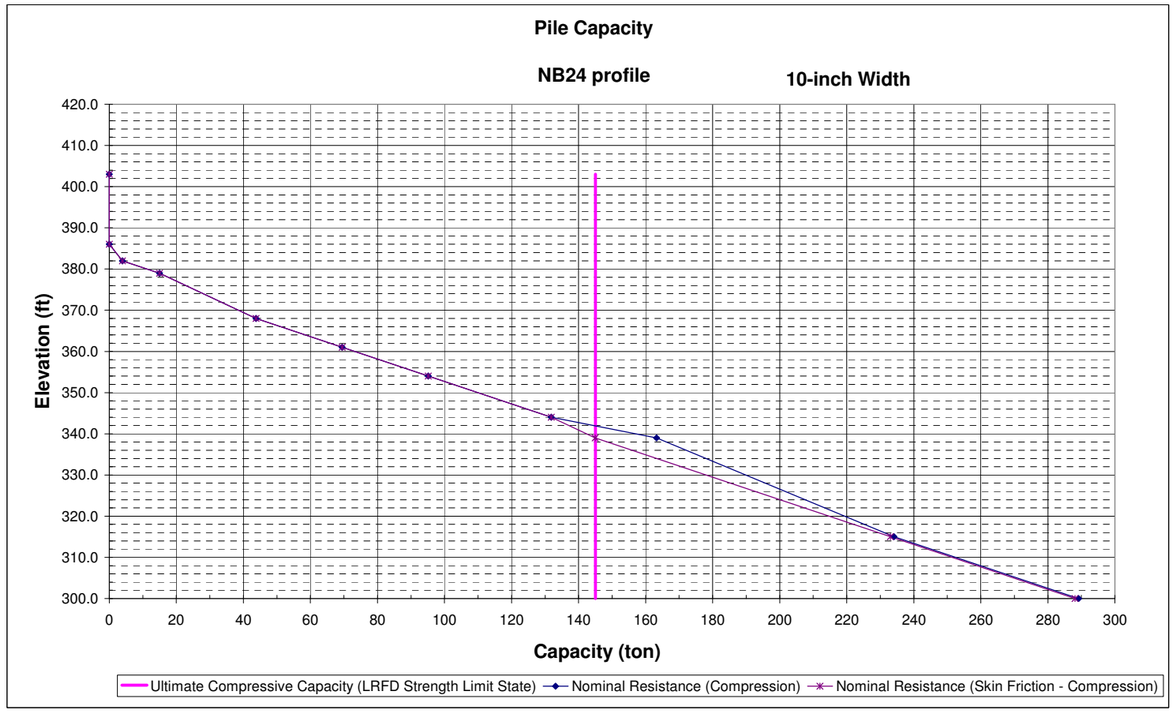
Nominal axial compress. Capacity (ult.)	145	ton
Nominal axial compress. Capacity (ult.)	1291	kN
Pile Width	10	inch
Pile Width	254	mm
Pile Width	0.83	ft
Crit depth ratio	20	-
Crit depth	16.7	ft
Crit. Depth. Elev	387.3	ft
Crit. Depth. Elev	118.1	m
Crit. Eff. Vert. Str.	2160	psf

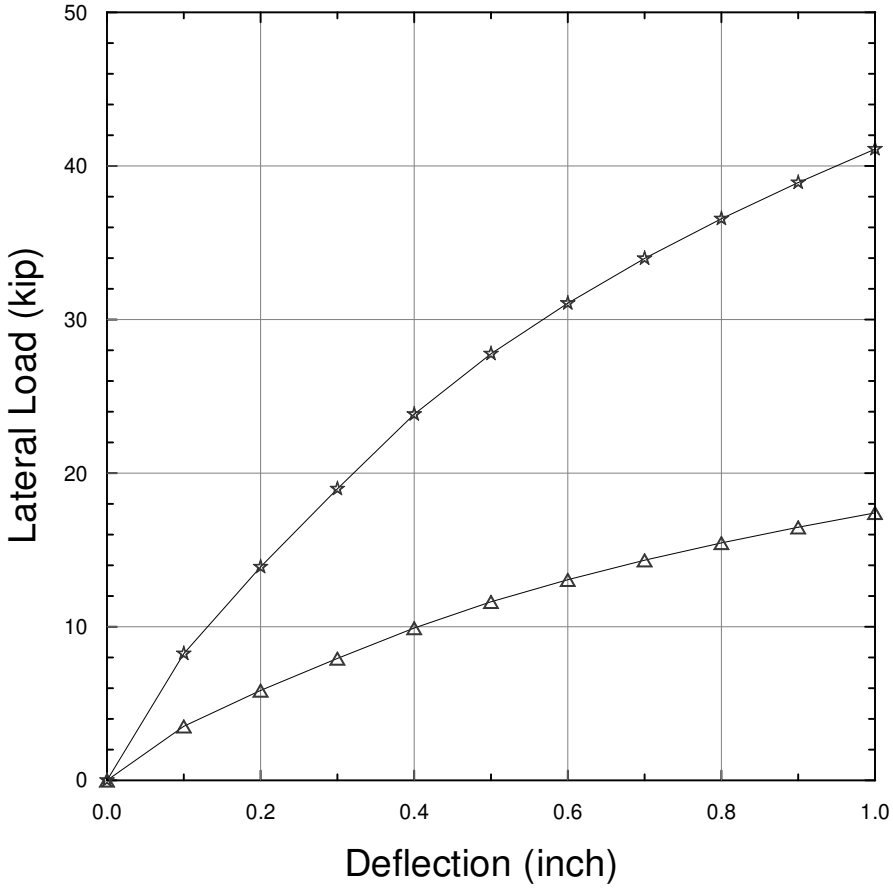
Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

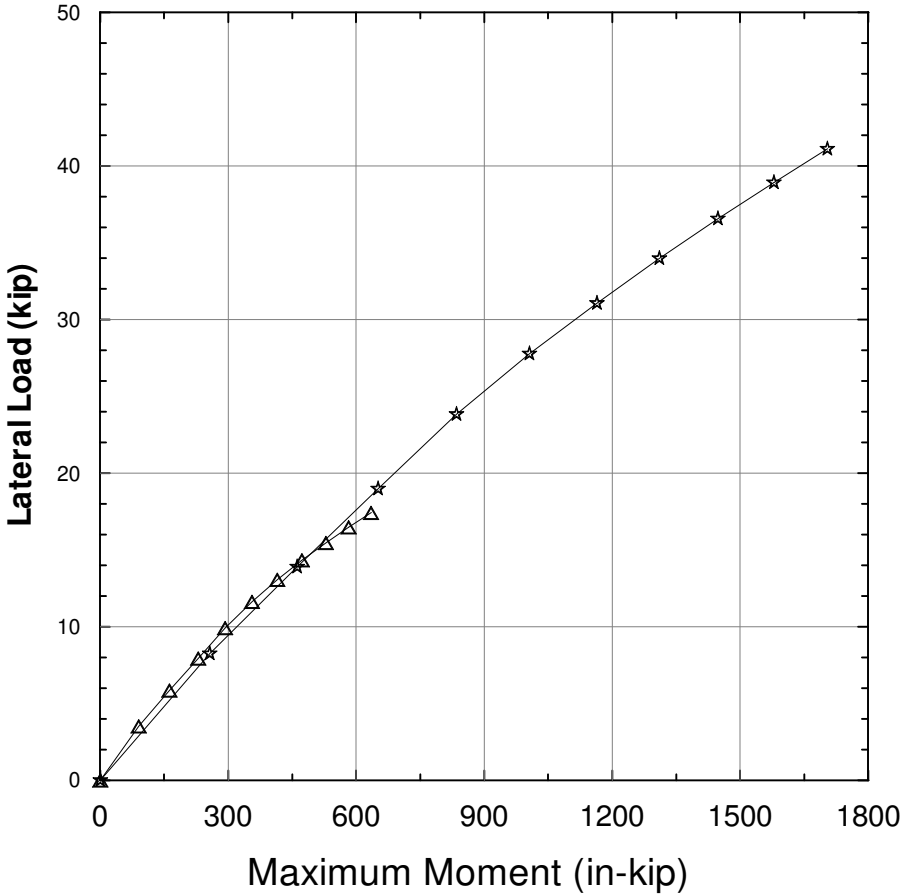
Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norlund method

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction Angle		Layer	Internal Depth to	Effective	Design Effective	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res. (Skin)		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?	c	c	Ratio	c_s	ϕ	δ	Thickness	Layer Top	Vert. Stress (Bot. Lay.)	Vert. Stress (Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	Type G= gran. C=cohes.	Capacity (B.C.)	B.C.?	to midlayer	(skin)		(Tot)							
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			122.83	403.0										0	0					0.0	6.25	g	0	n	403.0	0	0	0	0	145	1291	0	0	73	645
1	122.83	403.0	117.65	386.0	n	0	0	0.00	0	40	30	17.0	1.0	405	405	0.0	0.0	0.0	145	11.4	9.00	g	3	n	394.5	0.0	0	0.0	0	145	1291	0.0	0	73	645
2	117.65	386.0	116.43	382.0	y	0	0	0.00	0	40	30	4.0	18.0	1350	1350	0.0	3.9	2.1	145	24.0	9.00	g	11	n	384.0	3.9	35	3.9	35	145	1291	2.1	19	73	645
3	116.43	382.0	115.51	379.0	y	115	2400	0.64	1536	0	0	3.0	22.0	2430	2160	11.1	0.0	0.0	0	28.2	9.00	c	1	n	380.5	15.0	134	15.0	134	145	1291	13.2	118	73	645
4	115.51	379.0	112.16	368.0	Y	0	0	0.00	0	44	33	11.0	25.0	4288	2160	0.0	28.8	15.6	145	36.6	9.00	g	18	n	373.5	43.8	390	43.8	390	145	1291	28.9	257	73	645
5	112.16	368.0	110.03	361.0	Y	96	2000	0.76	1520	0	0	7.0	36.0	5305	2160	25.7	0.0	0.0	0	47.4	9.00	c	1	n	364.5	69.5	618	69.5	618	145	1291	54.6	485	73	645
6	110.03	361.0	107.89	354.0	Y	96	2000	0.76	1520	0	0	7.0	43.0	5813	2160	25.7	0.0	0.0	0	55.8	9.00	c	1	n	357.5	95.2	847	95.2	847	145	1291	80.3	714	73	645
7	107.89	354.0	104.85	344.0	Y	96	2000	0.76	1520	0	0	10.0	50.0	6902	2160	36.7	0.0	0.0	0	66.0	9.00	c	1	n	349.0	131.9	1174	131.9	1174	145	1291	117.0	1041	73	645
8	104.85	344.0	103.32	339.0	Y	0	0	0.00	0	44	33	5.0	60.0	7700	2160	0.0	13.1	7.1	145	75.0	9.00	g	18	y	341.5	144.9	1290	163.3	1453	145	1291	124.1	1104	73	645
9	103.32	339.0	96.01	315.0	Y	96	2000	0.76	1520	0	0	24.0	65.0	7773	2160	88.1	0.0	0.0	0	92.4	9.00	c	1	y	327.0	233.0	2074	234.1	2083	145	1291	212.2	1888	73	645
10	96.01	315.0	91.44	300.0	Y	96	2000	0.76	1520	0	0	15.0	89.0	8354	2160	55.1	0.0	0.0	0	115.8	9.00	c	1	y	307.5	288.1	2564	289.2	2574	145	1291	267.2	2377	73	645
Bottom	91.44	300.0																																







Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Mocho Bridge (Widen) Abutments 1 & 4 Pile Lateral Resistance HP 10x57 Pile**	Figure G-1
	URS		

X:/Route 84/geotech/Analysis/Pile Design/Lateral/Arroyo Mocho/Abutments_B20.grf

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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==========

This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Pier_B20_Fixed.lpd
Name of output file: ArroyoMocho_Pier_B20_Fixed.lpo
Name of plot output file: ArroyoMocho_Pier_B20_Fixed.lpp
Name of runtime file: ArroyoMocho_Pier_B20_Fixed.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 12: 1:14

Problem Title

SR84 Isabel Pier - Arroyo Mocho Bridge Widen - H pile

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 492.00 in
Depth of ground surface below top of pile = -216.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	492.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -216.000 in
Distance from top of pile to bottom of layer = -180.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -180.000 in
Distance from top of pile to bottom of layer = 108.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is stiff clay without free water
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 120.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 780.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 288.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-216.00	.07230
2	-180.00	.07230
3	-180.00	.07810
4	108.00	.07810
5	108.00	.04200
6	120.00	.04200
7	120.00	.04200
8	780.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-216.000	.00000	32.00	------	------
2	-180.000	.00000	32.00	------	------
3	-180.000	.00000	40.00	------	------
4	108.000	.00000	40.00	------	------
5	108.000	20.83300	.00	.00500	.0
6	120.000	20.83300	.00	.00500	.0
7	120.000	20.83300	.00	.00500	.0
8	780.000	20.83300	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .100 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .200 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .300 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .400 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .500 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .600 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

```
Deflection at pile head     =            .700 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .800 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .900 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           1.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs
```

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	276.000

Depth of ground surface below top of pile =   -216.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =            2
Depth below pile head       =       60.000 in
Depth below ground surface  =      276.000 in
Equivalent Depth (see note) =      276.000 in
Pile Diameter               =       10.000 in
Angle of Friction           =       40.000 deg.
Avg. Eff. Unit Weight       =       .07734 lbs/in**3
k                           =      225.000 pci
A (static)                  =        .8800
B (static)                  =        .5000
Pst                         =    28178.350 lbs/in
```

Psd	=	22232.297	lbs/in
Ps	=	22232.297	lbs/in
pu	=	19564.422	lbs/in
Cbar	=	33042.3027	
n	=	1.6447	
m	=	40551.7102	
yk	=	.2000	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	862.500
.0278	1725.000
.0417	2587.500
.0556	3450.000
.0694	4312.500
.0833	5175.000
.0972	6037.500
.1111	6900.000
.1250	7762.500
.1389	8625.000
.1528	9487.500
.1667	10350.000
.3750	19564.422
10.3750	19564.422
20.3750	19564.422
30.3750	19564.422

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	-1.207E+06	1.098E+05	0.0000	71642.3950	-4860.0000
4.920	.095014	-7.242E+05	86241.4338	-.001622	47757.9071	-4722.8450

9.840	.084042	-3.549E+05	64117.7790	-.002528	29473.7164	-4270.5107
14.760	.070137	-88339.3243	44653.9813	-.002900	16277.9958	-3641.6022
19.680	.055503	90210.1666	28455.3810	-.002899	16370.6117	-2943.1947
24.600	.041613	1.974E+05	15673.3687	-.002657	21675.3759	-2252.7453
29.520	.029355	2.497E+05	6142.3535	-.002282	24264.4433	-1621.6512
34.440	.019161	2.623E+05	-502.9322	-.001852	24889.7977	-1079.6845
39.360	.011134	2.484E+05	-4732.6076	-.001423	24199.8639	-639.6958
44.280	.005159	2.185E+05	-7049.5211	-.001031	22723.0369	-302.1390
49.200	9.91E-04	1.810E+05	-7938.2166	-6.952E-04	20866.2644	-59.1193
54.120	-.001682	1.418E+05	-7832.2274	-4.241E-04	18923.8347	102.2044
59.040	-.003182	1.048E+05	-7096.3539	-2.170E-04	17092.2787	196.9311
63.960	-.003817	72384.2003	-6020.4466	-6.819E-05	15488.1382	240.4296
68.880	-.003853	45680.8527	-4821.3972	3.097E-05	14166.1903	246.9889
73.800	-.003512	24880.7123	-3650.4341	9.023E-05	13136.4803	229.0124
78.720	-.002965	9583.0124	-2603.3162	1.192E-04	12379.1685	196.6453
83.640	-.002340	-970.4520	-1731.5570	1.264E-04	11952.8041	157.7283
88.560	-.001722	-7704.2772	-1053.3264	1.191E-04	12286.1618	117.9751
93.480	-.001167	-11569.6148	-563.1403	1.029E-04	12477.5151	81.2875
98.400	-7.09E-04	-13448.1515	-239.8370	8.192E-05	12570.5120	50.1366
103.320	-3.61E-04	-14090.8327	-52.6504	5.879E-05	12602.3279	25.9555
108.240	-1.30E-04	-14081.9344	411.7313	3.513E-05	12601.8874	162.8175
113.160	-1.56E-05	-10108.5341	1016.3522	1.481E-05	12405.1844	82.9633
118.080	1.55E-05	-4110.1822	957.7931	2.872E-06	12108.2363	-106.7678
123.000	1.27E-05	-689.5013	474.4877	-1.159E-06	11938.8956	-89.6978
127.920	4.13E-06	561.0590	114.7538	-1.267E-06	11932.5371	-56.5355
132.840	2.12E-07	442.1700	-53.2937	-4.247E-07	11926.6515	-11.7764
137.760	-5.04E-08	37.4849	-45.4818	-2.189E-08	11906.6176	14.9520
142.680	-3.16E-09	-5.3280	-3.8477	5.120E-09	11905.0257	1.9724
147.600	1.53E-11	-.3862	.5417	3.213E-10	11904.7810	-.1882
152.520	1.99E-13	.001797	.039247	-1.550E-12	11904.7620	-.016100
157.440	-5.86E-17	2.415E-05	-1.827E-04	-2.027E-14	11904.7619	7.226E-05
162.360	-4.25E-20	-7.076E-09	-2.454E-06	5.951E-18	11904.7619	9.983E-07
167.280	5.85E-24	-5.144E-12	7.191E-10	4.319E-21	11904.7619	-2.919E-10
172.200	0.000	7.073E-16	5.228E-13	-5.949E-25	11904.7619	-2.126E-13
177.120	0.000	5.160E-19	-7.188E-17	0.0000	11904.7619	2.918E-17
182.040	0.000	-7.071E-23	-5.244E-20	0.0000	11904.7619	2.132E-20
186.960	0.000	0.0000	7.186E-24	0.0000	11904.7619	-2.917E-24
191.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
196.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000	in
Computed slope at pile head	=	0.000	
Maximum bending moment	=	-1206700.188	lbs-in
Maximum shear force	=	109815.232	lbs
Depth of maximum bending moment	=	0.000	in
Depth of maximum shear force	=	0.000	in
Number of iterations	=	5	

Number of zero deflection points = 39

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .200000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	-2.413E+06	2.196E+05	0.0000	1.314E+05	-9720.0000
4.920	.190028	-1.448E+06	1.725E+05	-.003243	83609.4035	-9445.6985
9.840	.168085	-7.098E+05	1.282E+05	-.005056	47041.4704	-8541.0530
14.760	.140276	-1.767E+05	89305.8221	-.005801	20650.5174	-7283.2705
19.680	.111007	1.804E+05	56908.1926	-.005797	20836.6053	-5886.4976
24.600	.083230	3.947E+05	31343.5244	-.005314	31445.4352	-4505.6439
29.520	.058714	4.993E+05	12280.6364	-.004563	36622.6885	-3243.4975
34.440	.038325	5.245E+05	-1010.9687	-.003704	37872.2843	-2159.5940
39.360	.022271	4.966E+05	-9471.4426	-.002846	36491.0382	-1279.6230
44.280	.010322	4.369E+05	-14106.3299	-.002062	33535.7349	-604.4775
49.200	.001983	3.619E+05	-15884.4840	-.001391	29820.3108	-118.3494
54.120	-.003364	2.834E+05	-15672.6370	-8.489E-04	25933.4520	204.4661
59.040	-.006370	2.093E+05	-14199.9398	-4.351E-04	22268.4247	394.1913
63.960	-.007645	1.445E+05	-12045.5197	-1.379E-04	19058.6413	481.5892
68.880	-.007727	91089.4285	-9642.4691	5.999E-05	16414.1396	495.2606
73.800	-.007055	49508.4091	-7292.4648	1.781E-04	14355.6732	460.0257
78.720	-.005974	18981.1237	-5186.2189	2.356E-04	12844.4215	396.1719
83.640	-.004737	-1987.6400	-3426.0360	2.499E-04	12003.1599	319.3496
88.560	-.003516	-15222.8145	-2047.7901	2.354E-04	12658.3666	240.9130
93.480	-.002420	-22601.1920	-1040.5530	2.036E-04	13023.6328	168.5330
98.400	-.001512	-25862.6342	-362.8863	1.629E-04	13185.0903	106.9412
103.320	-8.17E-04	-26492.6665	44.5773	1.190E-04	13216.2800	58.6944
108.240	-3.41E-04	-25658.1301	706.3953	7.517E-05	13174.9664	210.3373
113.160	-7.72E-05	-19689.6746	1567.3681	3.709E-05	12879.4983	139.6516
118.080	2.39E-05	-10308.2116	1620.1985	1.189E-05	12415.0694	-118.1758
123.000	3.98E-05	-3770.3215	1032.6759	6.633E-08	12091.4115	-120.6545
127.920	2.45E-05	-146.8111	493.5960	-3.224E-06	11912.0298	-98.4836
132.840	8.04E-06	1093.0074	96.3037	-2.429E-06	11958.8712	-63.0173
137.760	6.03E-07	805.5969	-99.9248	-8.343E-07	11944.6429	-16.7503
142.680	-1.73E-07	111.3894	-83.3165	-6.414E-08	11910.2762	23.5017
147.600	-2.79E-08	-14.1115	-11.6645	1.756E-08	11905.4605	5.6252
152.520	2.27E-10	-3.4237	1.4370	2.833E-09	11904.9314	-.2994
157.440	1.68E-11	.023438	.3481	-2.311E-11	11904.7631	-.1433
162.360	-1.26E-14	.002041	-.002382	-1.712E-12	11904.7620	7.996E-04
167.280	-9.85E-17	-1.505E-06	-2.075E-04	1.284E-15	11904.7619	8.446E-05
172.200	4.42E-21	-1.192E-08	1.530E-07	1.001E-17	11904.7619	-6.120E-08
177.120	9.88E-24	5.320E-13	1.211E-09	-4.488E-22	11904.7619	-4.925E-10
182.040	0.000	1.195E-15	-5.406E-14	-1.004E-24	11904.7619	2.188E-14

186.960	0.000	-5.286E-20	-1.215E-16	0.0000	11904.7619	4.939E-17
191.880	0.000	-1.199E-22	5.372E-21	0.0000	11904.7619	-2.174E-21
196.800	0.000	0.0000	1.218E-23	0.0000	11904.7619	-4.952E-24
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-2413358.280 lbs-in
Maximum shear force	=	219628.685 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	39

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .300000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	-3.560E+06	3.140E+05	0.0000	1.881E+05	-12895.9432
4.920	.285290	-2.168E+06	2.510E+05	-.004811	1.192E+05	-12717.0650
9.840	.252665	-1.080E+06	1.904E+05	-.007538	65375.5550	-11923.5240
14.760	.211113	-2.792E+05	1.346E+05	-.008680	25728.1609	-10780.2836
19.680	.167253	2.612E+05	86233.8858	-.008695	24833.1968	-8869.0914
24.600	.125552	5.864E+05	47695.9530	-.007983	40935.5043	-6796.7349
29.520	.088697	7.462E+05	18922.5341	-.006864	48845.0511	-4899.7769
34.440	.058008	7.861E+05	-1171.9610	-.005577	50821.9580	-3268.7171
39.360	.033817	7.456E+05	-13992.7787	-.004291	48817.5162	-1942.9975
44.280	.015788	6.569E+05	-21047.0626	-.003113	44423.6970	-924.5976
49.200	.003188	5.447E+05	-23789.4993	-.002104	38868.1487	-190.2140
54.120	-.004911	4.269E+05	-23523.1353	-.001288	33040.0929	298.4921
59.040	-.009482	3.157E+05	-21345.3632	-6.638E-04	27534.7969	586.7812
63.960	-.011443	2.182E+05	-18128.6446	-2.154E-04	22706.8277	720.8280
68.880	-.011601	1.378E+05	-14526.0796	8.357E-05	18724.7986	743.6293
73.800	-.010621	75100.6343	-10993.0986	2.624E-04	15622.6151	692.5419
78.720	-.009020	29076.3402	-7818.0543	3.498E-04	13344.1847	598.1265

83.640	-.007178	-2517.5235	-5156.1075	3.722E-04	12029.3918	483.9657
88.560	-.005358	-22392.1596	-3062.3540	3.512E-04	13013.2847	367.1536
93.480	-.003722	-33342.3164	-1521.5316	3.044E-04	13555.3716	259.1969
98.400	-.002362	-37963.1380	-472.8122	2.445E-04	13784.1252	167.1118
103.320	-.001316	-38476.0362	170.8932	1.803E-04	13809.5162	94.5571
108.240	-5.88E-04	-36636.4516	1000.6342	1.173E-04	13718.4476	242.7360
113.160	-1.62E-04	-28860.5469	2023.6683	6.224E-05	13333.5018	173.1315
118.080	2.46E-05	-16846.0488	2164.2842	2.385E-05	12738.7247	-115.9706
123.000	7.24E-05	-7610.9358	1535.2142	3.314E-06	12281.5409	-139.7490
127.920	5.72E-05	-1746.0625	883.5217	-4.545E-06	11991.2006	-125.1666
132.840	2.77E-05	1091.8630	341.4695	-5.095E-06	11958.8145	-95.1798
137.760	7.12E-06	1624.0235	-26.7554	-2.814E-06	11985.1591	-54.5051
142.680	-1.58E-08	834.1276	-159.4239	-7.491E-07	11946.0553	.5748
147.600	-2.55E-07	56.7661	-87.2987	-8.421E-10	11907.5721	28.7444
152.520	-2.41E-08	-24.8903	-6.0755	2.593E-08	11905.9941	4.2732
157.440	6.41E-10	-3.0674	2.5375	2.449E-09	11904.9138	-.7719
162.360	1.32E-11	.074345	.3119	-6.514E-11	11904.7656	-.1328
167.280	-6.77E-14	.001612	-.007557	-1.340E-12	11904.7620	.002938
172.200	-5.54E-17	-8.180E-06	-1.638E-04	6.882E-15	11904.7619	6.728E-05
177.120	3.90E-20	-6.718E-09	8.313E-07	5.634E-18	11904.7619	-3.374E-07
182.040	5.57E-24	4.716E-12	6.827E-10	-3.962E-21	11904.7619	-2.779E-10
186.960	0.000	6.754E-16	-4.793E-13	-5.665E-25	11904.7619	1.948E-13
191.880	0.000	-4.726E-19	-6.864E-17	0.0000	11904.7619	2.794E-17
196.800	0.000	-6.791E-23	4.803E-20	0.0000	11904.7619	-1.952E-20
201.720	0.000	0.0000	6.901E-24	0.0000	11904.7619	-2.809E-24
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	.30000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-3559796.555 lbs-in
Maximum shear force	=	314046.564 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	38

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

Specified deflection at pile head	=	.400000 in
Specified slope at pile head	=	0.000E+00 in/in
Specified axial load at pile head	=	200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	-4.630E+06	3.971E+05	0.0000	2.411E+05	-15269.6852
4.920	.380870	-2.857E+06	3.212E+05	-.006288	1.533E+05	-15621.8532
9.840	.338131	-1.457E+06	2.464E+05	-.009911	84038.4470	-14753.2929
14.760	.283350	-4.123E+05	1.776E+05	-.011481	32314.7948	-13224.7812
19.680	.225162	3.131E+05	1.168E+05	-.011564	27404.3767	-11498.5067
24.600	.169562	7.596E+05	65915.0319	-.010663	49509.3237	-9179.2144
29.520	.120239	9.827E+05	26994.2802	-.009200	60552.3260	-6642.2294
34.440	.079037	1.043E+06	-301.6285	-.007498	63555.2931	-4453.6685
39.360	.046458	9.945E+05	-17824.1458	-.005787	61135.8941	-2669.3061
44.280	.022098	8.793E+05	-27574.1845	-.004213	55436.3947	-1294.1243
49.200	.005005	7.314E+05	-31492.3917	-.002860	48114.1463	-298.6428
54.120	-.006043	5.751E+05	-31323.5030	-.001763	40374.1736	367.2968
59.040	-.012339	4.267E+05	-28541.5440	-9.212E-04	33027.2896	763.5809
63.960	-.015108	2.960E+05	-24321.9925	-3.142E-04	26560.5195	951.6839
68.880	-.015431	1.880E+05	-19547.6801	9.228E-05	21209.9630	989.0934
73.800	-.014200	1.035E+05	-14836.7301	3.371E-04	17029.2931	925.9269
78.720	-.012114	41308.2539	-10582.8171	4.587E-04	13949.7250	803.3061
83.640	-.009686	-1522.1506	-7000.1801	4.921E-04	11980.1159	653.0504
88.560	-.007271	-28542.0399	-4167.9022	4.669E-04	13317.7342	498.2821
93.480	-.005092	-43453.1372	-2069.8316	4.064E-04	14055.9073	354.5921
98.400	-.003272	-49709.0129	-628.0911	3.282E-04	14365.6041	231.4813
103.320	-.001863	-50279.3974	270.6404	2.442E-04	14393.8410	133.8567
108.240	-8.69E-04	-47526.4870	1264.1252	1.620E-04	14257.5583	269.9989
113.160	-2.69E-04	-38159.3192	2422.3462	9.008E-05	13793.8371	200.8226
118.080	1.70E-05	-23867.8861	2671.9133	3.799E-05	13086.3404	-99.3726
123.000	1.05E-04	-11942.4548	2043.2502	7.913E-06	12495.9725	-156.1815
127.920	9.49E-05	-3777.8762	1291.3243	-5.290E-06	12091.7855	-149.4794
132.840	5.32E-05	774.5879	616.3873	-7.813E-06	11943.1078	-124.8852
137.760	1.80E-05	2302.7503	93.6394	-5.228E-06	12018.7594	-87.6139
142.680	1.80E-06	1706.2886	-205.7565	-1.861E-06	11989.2316	-34.0917
147.600	-3.04E-07	281.7688	-175.1828	-1.913E-07	11918.7109	46.5200
152.520	-8.15E-08	-17.1339	-29.6286	3.093E-08	11905.6101	12.6484
157.440	-8.45E-11	-9.8373	1.7417	8.281E-09	11905.2489	.1038
162.360	6.30E-12	-.011751	.9998	8.590E-12	11904.7625	-.4054
167.280	1.31E-15	7.617E-04	.001194	-6.400E-13	11904.7619	-5.483E-04
172.200	-6.31E-19	1.585E-07	-7.741E-05	-1.330E-16	11904.7619	3.146E-05
177.120	-1.31E-22	-7.631E-11	-1.611E-08	6.411E-20	11904.7619	6.555E-09
182.040	0.000	-1.592E-14	7.755E-12	1.336E-23	11904.7619	-3.151E-12
186.960	0.000	7.644E-18	1.618E-15	0.0000	11904.7619	-6.585E-16
191.880	0.000	1.600E-21	-7.768E-19	0.0000	11904.7619	3.157E-19
196.800	0.000	-7.657E-25	-1.626E-22	0.0000	11904.7619	6.614E-23
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = 0.000
Maximum bending moment = -4629594.545 lbs-in
Maximum shear force = 397143.620 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 6
Number of zero deflection points = 38

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	-5.564E+06	4.513E+05	0.0000	2.874E+05	-15269.6852
4.920	.477008	-3.524E+06	3.753E+05	-.007633	1.864E+05	-15621.8533
9.840	.424892	-1.856E+06	2.976E+05	-.012152	1.038E+05	-15974.0211
14.760	.357435	-5.722E+05	2.196E+05	-.014191	40231.1397	-15731.8109
19.680	.285250	3.321E+05	1.475E+05	-.014393	28343.1729	-13575.7168
24.600	.215808	9.071E+05	85992.1555	-.013352	56812.5122	-11411.1092
29.520	.153863	1.204E+06	37011.4994	-.011579	71533.2743	-8499.7266
34.440	.101873	1.294E+06	1980.6467	-.009480	75969.9439	-5740.4574
39.360	.060578	1.243E+06	-20703.1025	-.007350	73421.7212	-3480.5788
44.280	.029553	1.105E+06	-33522.8391	-.005378	66600.9134	-1730.6962
49.200	.007658	9.234E+05	-38904.5003	-.003675	57615.7427	-456.9709
54.120	-.006605	7.293E+05	-39041.1115	-.002287	48007.4124	401.4380
59.040	-.014841	5.437E+05	-35794.1845	-.001217	38820.4666	918.4511
63.960	-.018585	3.795E+05	-30654.9701	-4.421E-04	30689.6460	1170.6604
68.880	-.019192	2.429E+05	-24748.9811	8.063E-05	23930.6216	1230.1481
73.800	-.017791	1.358E+05	-18869.0346	3.987E-04	18625.8514	1160.0740
78.720	-.015269	56466.4629	-13524.5132	5.601E-04	14700.1314	1012.4956
83.640	-.012279	1582.4593	-8997.2123	6.089E-04	11983.1015	827.8706
88.560	-.009277	-33264.3935	-5396.7517	5.823E-04	13551.5141	635.7313
93.480	-.006550	-52667.4984	-2710.8767	5.101E-04	14512.0638	456.0878
98.400	-.004258	-60943.3064	-847.9571	4.147E-04	14921.7573	301.1966
103.320	-.002469	-61827.4970	329.4328	3.116E-04	14965.5291	177.4171
108.240	-.001192	-58314.8639	1485.0665	2.107E-04	14791.6364	292.3526
113.160	-3.96E-04	-47629.0384	2749.7541	1.217E-04	14262.6351	221.7480
118.080	5.50E-06	-31496.7662	3126.3472	5.523E-05	13464.0078	-68.6614
123.000	1.47E-04	-16974.4795	2539.3053	1.452E-05	12745.0827	-169.9735
127.920	1.48E-04	-6538.5830	1707.5720	-5.225E-06	12228.4541	-168.1294
132.840	9.57E-05	-161.6869	932.5027	-1.085E-05	11912.7662	-146.9394
137.760	4.16E-05	2658.6019	291.7032	-8.756E-06	12036.3759	-113.5482
142.680	9.52E-06	2725.9040	-159.4627	-4.233E-06	12039.7076	-69.8526
147.600	-4.91E-08	1097.8201	-265.0589	-1.022E-06	11959.1094	26.9273
152.520	-5.41E-07	119.7352	-117.1583	6.386E-10	11910.6894	33.1949

157.440	-4.28E-08	-55.0191	-12.6934	5.499E-08	11907.4856	9.2705
162.360	4.03E-10	-5.2765	5.5970	4.351E-09	11905.0231	-1.8354
167.280	7.64E-12	.046856	.5363	-4.091E-11	11904.7642	-.2218
172.200	-1.07E-15	9.250E-04	-.004762	-7.766E-13	11904.7620	.001859
177.120	-7.67E-19	-1.296E-07	-9.400E-05	1.090E-16	11904.7619	3.822E-05
182.040	1.07E-22	-9.279E-11	1.317E-08	7.791E-20	11904.7619	-5.347E-09
186.960	0.000	1.296E-14	9.430E-12	-1.090E-23	11904.7619	-3.834E-12
191.880	0.000	9.308E-18	-1.317E-15	0.0000	11904.7619	5.345E-16
196.800	0.000	-1.295E-21	-9.459E-19	0.0000	11904.7619	3.846E-19
201.720	0.000	-9.337E-25	1.316E-22	0.0000	11904.7619	-5.344E-23
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-5564067.895 lbs-in
Maximum shear force	=	451271.648 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	38

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .600000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	-6.371E+06	4.914E+05	0.0000	3.273E+05	-15269.6852
4.920	.573675	-4.133E+06	4.154E+05	-.008821	2.165E+05	-15621.8534
9.840	.513197	-2.266E+06	3.376E+05	-.014196	1.241E+05	-15974.0215
14.760	.433991	-7.823E+05	2.582E+05	-.016756	50632.1999	-16326.1892
19.680	.348320	3.075E+05	1.793E+05	-.017154	27128.2636	-15756.0561
24.600	.265191	1.015E+06	1.081E+05	-.016043	62172.9815	-13154.3119
29.520	.190454	1.403E+06	49902.5840	-.014012	81371.3184	-10521.0336
34.440	.127313	1.534E+06	6372.9352	-.011545	87847.0954	-7173.9456
39.360	.076850	1.489E+06	-22137.0595	-.009006	85600.5473	-4415.4832
44.280	.038690	1.334E+06	-38572.9825	-.006636	77940.9537	-2265.7863
49.200	.011554	1.122E+06	-45842.7719	-.004573	67457.0356	-689.4126

54.120	-.006308	8.918E+05	-46595.5675	-.002881	56055.1480	383.3981
59.040	-.016800	6.693E+05	-43094.8944	-.001570	45039.7252	1039.6397
63.960	-.021760	4.709E+05	-37165.5323	-6.126E-04	35215.3727	1370.6701
68.880	-.022828	3.048E+05	-30194.1005	3.884E-05	26995.0148	1463.2452
73.800	-.021378	1.737E+05	-23165.4666	4.407E-04	20503.1749	1393.9230
78.720	-.018491	76007.5500	-16719.9566	6.504E-04	15667.5119	1226.2030
83.640	-.014977	7883.4868	-11219.5283	7.209E-04	12295.0335	1009.7435
88.560	-.011398	-35811.3524	-6814.2041	6.975E-04	13677.6011	781.0387
93.480	-.008114	-60540.8648	-3502.9058	6.165E-04	14901.8344	565.0176
98.400	-.005331	-71493.2696	-1185.2465	5.056E-04	15444.0327	377.1204
103.320	-.003139	-73198.7782	297.2291	3.841E-04	15528.4638	225.5120
108.240	-.001551	-69324.4648	1620.9664	2.644E-04	15336.6661	312.5926
113.160	-5.37E-04	-57768.8251	2979.2868	1.577E-04	14764.6047	239.5702
118.080	3.98E-09	-40318.5688	3565.9312	7.528E-05	13900.7307	-1.0969
123.000	2.04E-04	-22828.2220	3103.6077	2.225E-05	13034.8719	-186.8395
127.920	2.19E-04	-9822.8550	2178.8063	-5.174E-06	12391.0419	-189.0960
132.840	1.53E-04	-1378.5856	1292.8769	-1.458E-05	11973.0087	-171.0379
137.760	7.54E-05	2927.7509	526.8616	-1.328E-05	12049.7001	-140.3504
142.680	2.22E-05	3831.8690	-59.1373	-7.603E-06	12094.4584	-97.8605
147.600	6.32E-07	2360.8029	-349.7147	-2.402E-06	12021.6333	-20.2604
152.520	-1.43E-06	395.4045	-251.9281	-8.743E-08	11924.3364	60.0110
157.440	-2.28E-07	-117.9975	-42.9695	1.456E-07	11910.6034	24.9315
162.360	4.36E-10	-27.7023	12.0004	2.319E-08	11906.1333	-2.5860
167.280	4.88E-11	.040938	2.8159	-4.429E-11	11904.7639	-1.1476
172.200	-3.41E-16	.005900	-.004161	-4.955E-12	11904.7622	.001204
177.120	-4.89E-18	-4.004E-08	-5.996E-04	3.462E-17	11904.7619	2.437E-04
182.040	3.22E-23	-5.915E-10	4.069E-09	4.968E-19	11904.7619	-1.605E-09
186.960	4.90E-25	3.777E-15	6.012E-11	-3.272E-24	11904.7619	-2.444E-11
191.880	0.000	5.931E-17	-3.838E-16	0.0000	11904.7619	1.511E-16
196.800	0.000	-3.549E-22	-6.027E-18	0.0000	11904.7619	2.450E-18
201.720	0.000	-5.946E-24	3.607E-23	0.0000	11904.7619	-1.417E-23
206.640	0.000	0.0000	6.043E-25	0.0000	11904.7619	-2.457E-25
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-6370611.181 lbs-in
Maximum shear force	=	491363.318 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	37

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .700000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	-7.090E+06	5.240E+05	0.0000	3.629E+05	-15269.6852
4.920	.670705	-4.691E+06	4.480E+05	-.009894	2.441E+05	-15621.8542
9.840	.602645	-2.662E+06	3.703E+05	-.016069	1.437E+05	-15974.0241
14.760	.512586	-1.016E+06	2.908E+05	-.019158	62184.2544	-16326.1948
19.680	.414134	2.371E+05	2.096E+05	-.019812	23644.3485	-16678.3659
24.600	.317641	1.086E+06	1.317E+05	-.018700	65657.7265	-15005.7656
29.520	.230121	1.569E+06	64822.6690	-.016470	89600.2988	-12162.7807
34.440	.155573	1.756E+06	13336.9821	-.013677	98839.3442	-8766.3603
39.360	.095537	1.728E+06	-21731.5973	-.010751	97429.6466	-5489.1598
44.280	.049778	1.563E+06	-42406.2685	-.007987	89300.7255	-2915.1781
49.200	.016941	1.326E+06	-52064.3119	-.005561	77550.5137	-1010.8559
54.120	-.004938	1.062E+06	-53812.7294	-.003555	64480.4518	300.1171
59.040	-.018040	8.035E+05	-50328.1652	-.001988	51683.1299	1116.3724
63.960	-.024501	5.707E+05	-43785.2842	-8.339E-04	40157.8493	1543.3353
68.880	-.026245	3.743E+05	-35850.2730	-4.020E-05	30435.3050	1682.2790
73.800	-.024896	2.180E+05	-27718.3679	4.573E-04	22698.0685	1623.3735
78.720	-.021746	1.007E+05	-20177.5553	7.250E-04	16888.3399	1441.9975
83.640	-.017763	18050.9338	-13684.2546	8.247E-04	12798.3725	1197.5556
88.560	-.013631	-35607.7335	-8440.4477	8.099E-04	13667.5210	934.0732
93.480	-.009793	-66596.9961	-4465.0701	7.241E-04	15201.6429	681.9340
98.400	-.006506	-80969.0159	-1655.3412	6.001E-04	15913.1290	460.2323
103.320	-.003888	-84066.6378	163.9809	4.615E-04	16066.4766	279.3296
108.240	-.001964	-80263.7439	1666.9749	3.235E-04	15878.2146	331.6436
113.160	-7.04E-04	-68300.2867	3113.7438	1.987E-04	15285.9642	256.4738
118.080	-8.85E-06	-50015.6290	3958.1677	9.937E-05	14380.7831	86.7879
123.000	2.73E-04	-29547.4779	3676.0914	3.255E-05	13367.5083	-201.4531
127.920	3.11E-04	-13906.9434	2670.6983	-3.949E-06	12593.2244	-207.2433
132.840	2.35E-04	-3260.0356	1689.4883	-1.837E-05	12066.1498	-191.6226
137.760	1.31E-04	2753.7675	816.5412	-1.879E-05	12041.0870	-163.2340
142.680	4.96E-05	4811.7127	109.6495	-1.244E-05	12142.9655	-124.1204
147.600	8.30E-06	3857.1963	-369.7816	-5.157E-06	12095.7122	-70.7703
152.520	-1.14E-06	1183.2114	-386.9803	-9.239E-07	11963.3367	63.7789
157.440	-7.93E-07	51.1288	-129.3073	1.128E-07	11907.2930	40.9662
162.360	-2.70E-08	-89.3949	-5.5248	8.068E-08	11909.1874	9.3519
167.280	5.13E-10	-3.3944	9.0917	2.747E-09	11904.9299	-3.4102
172.200	9.47E-13	.061880	.3450	-5.216E-11	11904.7650	-.1453
177.120	-7.12E-17	1.146E-04	-.006289	-9.622E-14	11904.7619	.002547
182.040	-9.50E-20	-8.589E-09	-1.164E-05	7.233E-18	11904.7619	4.734E-06
186.960	7.10E-24	-1.149E-11	8.729E-10	9.650E-21	11904.7619	-3.539E-10
191.880	0.000	8.566E-16	1.168E-12	-7.213E-25	11904.7619	-4.748E-13
196.800	0.000	1.152E-18	-8.705E-17	0.0000	11904.7619	3.529E-17
201.720	0.000	-8.541E-23	-1.171E-19	0.0000	11904.7619	4.762E-20
206.640	0.000	-1.156E-25	8.680E-24	0.0000	11904.7619	-3.519E-24
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-7089504.385 lbs-in
Maximum shear force	=	523969.062 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	37

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .800000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	-7.765E+06	5.531E+05	0.0000	3.963E+05	-15269.6852
4.920	.767912	-5.223E+06	4.771E+05	-.010908	2.704E+05	-15621.8540
9.840	.692662	-3.049E+06	3.994E+05	-.017856	1.629E+05	-15974.0236
14.760	.592211	-1.258E+06	3.199E+05	-.021473	74164.1822	-16326.1937
19.680	.481367	1.409E+05	2.387E+05	-.022411	18880.3878	-16678.3642
24.600	.371687	1.135E+06	1.561E+05	-.021339	68117.6093	-16913.5892
29.520	.271392	1.719E+06	80901.0894	-.018942	96993.7442	-13649.7342
34.440	.185301	1.969E+06	21636.5872	-.015845	1.094E+05	-10441.5269
39.360	.115482	1.963E+06	-20371.9423	-.012542	1.091E+05	-6635.1112
44.280	.061884	1.793E+06	-45609.6666	-.009388	1.007E+05	-3624.1264
49.200	.023105	1.533E+06	-57916.6273	-.006595	87774.0485	-1378.7032
54.120	-.003008	1.236E+06	-60858.5621	-.004269	73100.0927	182.7947
59.040	-.018905	9.421E+05	-57530.9315	-.002440	58544.0381	1169.9006
63.960	-.027016	6.748E+05	-50466.6580	-.001082	45312.8292	1701.7553
68.880	-.029550	4.477E+05	-41620.8966	-1.391E-04	34065.6766	1894.0827
73.800	-.028384	2.656E+05	-32408.5081	4.600E-04	25051.6434	1850.7906
78.720	-.025024	1.278E+05	-23773.4892	7.904E-04	18233.7501	1659.3797
83.640	-.020607	30080.4142	-16273.7465	9.230E-04	13393.8913	1389.2962
88.560	-.015941	-34104.5928	-10168.7776	9.196E-04	13593.1081	1092.3984
93.480	-.011558	-71790.1956	-5501.6756	8.307E-04	15458.7320	804.7975
98.400	-.007767	-89875.8883	-2170.1991	6.949E-04	16354.0633	549.4613
103.320	-.004720	-94512.5475	15.6591	5.401E-04	16583.6009	339.0990
108.240	-.002453	-90784.6239	1713.0076	3.844E-04	16399.0502	350.8801
113.160	-9.37E-04	-78413.1004	3255.3409	2.423E-04	15786.5986	276.0847
118.080	-6.88E-05	-59228.9535	4298.5996	1.267E-04	14836.8883	148.0042
123.000	3.10E-04	-36364.2595	4153.9471	4.643E-05	13704.9728	-206.8060

127.920	3.88E-04	-18445.4893	3107.6745	3.970E-07	12817.9049	-218.5080
132.840	3.14E-04	-5785.5241	2063.1048	-1.995E-05	12191.1740	-206.1138
137.760	1.92E-04	1894.7316	1112.2838	-2.322E-05	11998.5605	-180.3988
142.680	8.53E-05	5205.0493	313.0054	-1.726E-05	12162.4376	-144.5111
147.600	2.19E-05	5008.6706	-285.3027	-8.681E-06	12152.7159	-98.7036
152.520	-1.19E-07	2414.7544	-462.5924	-2.446E-06	12024.3042	26.6346
157.440	-2.17E-06	461.5748	-261.9250	-3.015E-08	11927.6121	54.9375
162.360	-4.16E-07	-162.5280	-51.9773	2.210E-07	11912.8078	30.4071
167.280	2.53E-10	-50.3166	16.5243	4.224E-08	11907.2528	-2.5609
172.200	1.79E-10	-.012543	5.1157	-2.575E-11	11904.7625	-2.0767
177.120	4.87E-16	.021601	.001271	-1.814E-11	11904.7630	-.002301
182.040	-1.79E-17	6.320E-08	-.002195	-4.944E-17	11904.7619	8.924E-04
186.960	-5.60E-23	-2.166E-09	-6.422E-09	1.819E-18	11904.7619	2.790E-09
191.880	1.79E-24	-7.204E-15	2.201E-10	5.686E-24	11904.7619	-8.947E-11
196.800	0.000	2.171E-16	7.321E-16	-1.824E-25	11904.7619	-3.156E-16
201.720	0.000	8.093E-22	-2.207E-17	0.0000	11904.7619	8.970E-18
206.640	0.000	-2.177E-23	-8.225E-23	0.0000	11904.7619	3.523E-23
211.560	0.000	0.0000	2.212E-24	0.0000	11904.7619	-8.993E-25
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-7765426.485 lbs-in
Maximum shear force	=	553091.863 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	37

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .900000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	-8.362E+06	5.766E+05	0.0000	4.259E+05	-15269.6852
4.920	.865447	-5.703E+06	5.006E+05	-.011813	2.942E+05	-15621.8546
9.840	.783764	-3.412E+06	4.229E+05	-.019468	1.808E+05	-15974.0257
14.760	.673879	-1.503E+06	3.434E+05	-.023597	86316.5823	-16326.1987
19.680	.551572	13489.4189	2.623E+05	-.024848	12572.5549	-16678.3738

24.600	.429376	1.126E+06	1.793E+05	-.023891	67664.7582	-17030.5516
29.520	.316489	1.825E+06	99858.4528	-.021412	1.023E+05	-15274.5920
34.440	.218686	2.151E+06	32790.4164	-.018072	1.184E+05	-11988.8374
39.360	.138660	2.183E+06	-16300.5133	-.014432	1.200E+05	-7966.8251
44.280	.076677	2.019E+06	-46945.4160	-.010902	1.119E+05	-4490.4524
49.200	.031382	1.743E+06	-62598.3848	-.007743	98184.0056	-1872.5431
54.120	4.90E-04	1.418E+06	-67278.0300	-.005088	82121.1645	-29.7517
59.040	-.018681	1.091E+06	-64507.3802	-.002980	65906.6116	1156.0321
63.960	-.028836	7.895E+05	-57195.2264	-.001401	50988.1159	1816.3881
68.880	-.032466	5.308E+05	-47607.6184	-2.921E-04	38181.6646	2081.0135
73.800	-.031710	3.216E+05	-37401.9237	4.238E-04	27825.5355	2067.6429
78.720	-.028296	1.619E+05	-27699.6956	8.299E-04	19920.8235	1876.3523
83.640	-.023544	47401.3550	-19179.1542	.001006	14251.3636	1587.2824
88.560	-.018400	-28777.6905	-12172.7575	.001021	13329.4001	1260.8464
93.480	-.013493	-74388.6187	-6759.7030	9.347E-04	15587.3668	939.5823
98.400	-.009202	-97132.6865	-2847.0052	7.907E-04	16713.3107	650.9452
103.320	-.005713	-1.040E+05	-235.8951	6.218E-04	17051.2552	410.4817
108.240	-.003084	-1.007E+05	1689.1468	4.499E-04	16888.7980	372.0557
113.160	-.001286	-88223.3555	3341.9038	2.912E-04	16272.2548	299.7968
118.080	-2.18E-04	-68366.3597	4563.9538	1.597E-04	15289.2352	196.9715
123.000	2.85E-04	-43628.3911	4555.4635	6.566E-05	14064.5832	-200.4229
127.920	4.28E-04	-23669.8261	3512.8851	9.142E-06	13076.5355	-223.3895
132.840	3.75E-04	-9079.5934	2432.2560	-1.836E-05	12354.2467	-215.8906
137.760	2.47E-04	299.7118	1425.0088	-2.574E-05	11919.5991	-193.5594
142.680	1.22E-04	4993.1443	554.3327	-2.129E-05	12151.9473	-160.3739
147.600	3.80E-05	5796.2489	-125.6203	-1.223E-05	12191.7049	-116.0298
152.520	1.76E-06	3781.1102	-500.0899	-4.187E-06	12091.9456	-36.1937
157.440	-3.22E-06	883.6034	-402.0718	-2.688E-07	11948.5046	76.0384
162.360	-8.86E-07	-174.7472	-100.5897	3.266E-07	11913.4128	46.5152
167.280	-1.39E-09	-106.8424	17.7510	9.009E-08	11910.0511	1.5908
172.200	3.57E-10	-.2545	10.8624	1.412E-10	11904.7745	-4.3910
177.120	1.36E-14	.043179	.025856	-3.627E-11	11904.7640	-.014078
182.040	-3.58E-17	1.658E-06	-.004388	-1.385E-15	11904.7619	.001784
186.960	-1.38E-21	-4.328E-09	-1.685E-07	3.636E-18	11904.7619	6.884E-08
191.880	3.59E-24	-1.679E-13	4.399E-10	1.403E-22	11904.7619	-1.788E-10
196.800	0.000	4.339E-16	1.707E-14	-3.644E-25	11904.7619	-6.973E-15
201.720	0.000	1.701E-20	-4.409E-17	0.0000	11904.7619	1.792E-17
206.640	0.000	-4.349E-23	-1.729E-21	0.0000	11904.7619	7.063E-22
211.560	0.000	0.0000	4.420E-24	0.0000	11904.7619	-1.797E-24
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-8361874.866 lbs-in
Maximum shear force	=	576621.916 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	37

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	-8.944E+06	5.993E+05	0.0000	4.547E+05	-15269.6852
4.920	.963042	-6.173E+06	5.233E+05	-.012696	3.175E+05	-15621.8537
9.840	.875067	-3.770E+06	4.456E+05	-.021047	1.985E+05	-15974.0227
14.760	.755936	-1.747E+06	3.661E+05	-.025681	98406.2124	-16326.1922
19.680	.622364	-1.170E+05	2.849E+05	-.027247	17697.6299	-16678.3624
24.600	.487825	1.110E+06	2.020E+05	-.026413	66843.7586	-17030.5338
29.520	.362458	1.922E+06	1.184E+05	-.023867	1.071E+05	-16930.8174
34.440	.252979	2.322E+06	44193.7744	-.020302	1.269E+05	-13249.4294
39.360	.162691	2.397E+06	-11394.8483	-.016338	1.306E+05	-9347.5717
44.280	.092215	2.242E+06	-47674.8488	-.012441	1.229E+05	-5400.3960
49.200	.040270	1.953E+06	-66870.9327	-.008918	1.086E+05	-2402.8901
54.120	.004462	1.602E+06	-73449.1083	-.005933	91198.1798	-271.1650
59.040	-.018109	1.242E+06	-71359.3454	-.003545	73369.5939	1120.6621
63.960	-.030419	9.065E+05	-63888.8826	-.001741	56782.3447	1916.1113
68.880	-.035237	6.163E+05	-53619.0955	-4.616E-04	42417.0647	2258.5989
73.800	-.034961	3.798E+05	-42455.0884	3.751E-04	30707.9133	2279.6154
78.720	-.031546	1.979E+05	-31701.2416	8.603E-04	21699.4293	2091.8670
83.640	-.026496	66190.4497	-22160.9032	.001082	15181.5168	1786.3193
88.560	-.020899	-22340.4281	-14243.5785	.001119	13010.7237	1432.1054
93.480	-.015486	-76168.2639	-8067.8436	.001036	15675.4680	1078.3559
98.400	-.010703	-1.038E+05	-3552.4915	8.850E-04	17041.7464	757.1531
103.320	-.006778	-1.129E+05	-491.9372	7.030E-04	17492.2098	486.9747
108.240	-.003785	-1.100E+05	1669.3629	5.159E-04	17349.8782	391.6026
113.160	-.001702	-97455.1576	3423.2460	3.416E-04	16729.2747	321.3580
118.080	-4.24E-04	-76978.9657	4779.0608	1.951E-04	15715.6018	229.7863
123.000	2.18E-04	-50813.2387	4887.1388	8.781E-05	14420.2688	-185.8521
127.920	4.41E-04	-29062.3345	3876.4701	2.073E-05	13343.4913	-224.9888
132.840	4.22E-04	-12709.5629	2774.9128	-1.436E-05	12533.9482	-222.7987
137.760	2.99E-04	-1728.9392	1725.3414	-2.648E-05	11990.3530	-203.8563
142.680	1.62E-04	4319.9148	796.7024	-2.431E-05	12118.6191	-173.6392
147.600	6.01E-05	6158.4486	41.8132	-1.551E-05	12209.6356	-133.2263
152.520	9.24E-06	4761.8734	-474.4804	-6.335E-06	12140.4982	-76.6491
157.440	-2.25E-06	1502.0282	-479.7104	-1.074E-06	11979.1197	74.5231
162.360	-1.33E-06	43.6366	-167.8483	2.243E-07	11906.9221	52.2501
167.280	-4.35E-08	-150.0408	-4.9516	1.349E-07	11912.1897	13.9681
172.200	3.46E-10	-5.3526	15.2532	4.425E-09	11905.0269	-5.7548
177.120	4.00E-13	.041778	.5440	-3.517E-11	11904.7640	-.2246
182.040	-3.45E-17	4.843E-05	-.004246	-4.067E-14	11904.7619	.001722
186.960	-4.01E-20	-4.169E-09	-4.922E-06	3.510E-18	11904.7619	2.001E-06
191.880	3.45E-24	-4.857E-12	4.237E-10	4.079E-21	11904.7619	-1.718E-10
196.800	0.000	4.161E-16	4.936E-13	-3.503E-25	11904.7619	-2.007E-13

201.720	0.000	4.872E-19	-4.228E-17	0.0000	11904.7619	1.715E-17
206.640	0.000	-4.152E-23	-4.951E-20	0.0000	11904.7619	2.013E-20
211.560	0.000	0.0000	4.219E-24	0.0000	11904.7619	-1.711E-24
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-8944030.266 lbs-in
Maximum shear force	=	599274.765 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	37

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .100000	S= 0.000	2.000E+05	.100000	-1.207E+06	1.098E+05
5	y= .200000	S= 0.000	2.000E+05	.2000	-2.413E+06	2.196E+05
5	y= .300000	S= 0.000	2.000E+05	.3000	-3.560E+06	3.140E+05
5	y= .400000	S= 0.000	2.000E+05	.4000	-4.630E+06	3.971E+05
5	y= .500000	S= 0.000	2.000E+05	.5000	-5.564E+06	4.513E+05
5	y= .600000	S= 0.000	2.000E+05	.6000	-6.371E+06	4.914E+05
5	y= .700000	S= 0.000	2.000E+05	.7000	-7.090E+06	5.240E+05
5	y= .800000	S= 0.000	2.000E+05	.8000	-7.765E+06	5.531E+05
5	y= .900000	S= 0.000	2.000E+05	.9000	-8.362E+06	5.766E+05
5	y= 1.000	S= 0.000	2.000E+05	1.0000	-8.944E+06	5.993E+05

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = .10000 in
Slope = .00000
Axial Load = 200000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
492.000	.10000000	-1206700.188	109815.232
467.400	.10000000	-1209599.154	109951.115
442.800	.10000000	-1212398.785	110082.594
418.200	.10000000	-1215058.746	110207.951
393.600	.10000000	-1217543.774	110325.459
369.000	.10000000	-1219890.852	110436.750
344.400	.10000000	-1222098.990	110541.641
319.800	.10000000	-1224167.674	110640.090
295.200	.10000000	-1226068.587	110730.887
270.600	.10000000	-1227833.848	110815.283

The analysis ended normally.

Route 84 Arroyo Mocho

12/9/2009

Pile Design Spreadsheet

NB24 pier

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 123.1
Boring Surface El. (ft) 404.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 117.6
Bottom of Pile Cap El. (ft) 385.9
Bottom of Fill El. (ft) 400

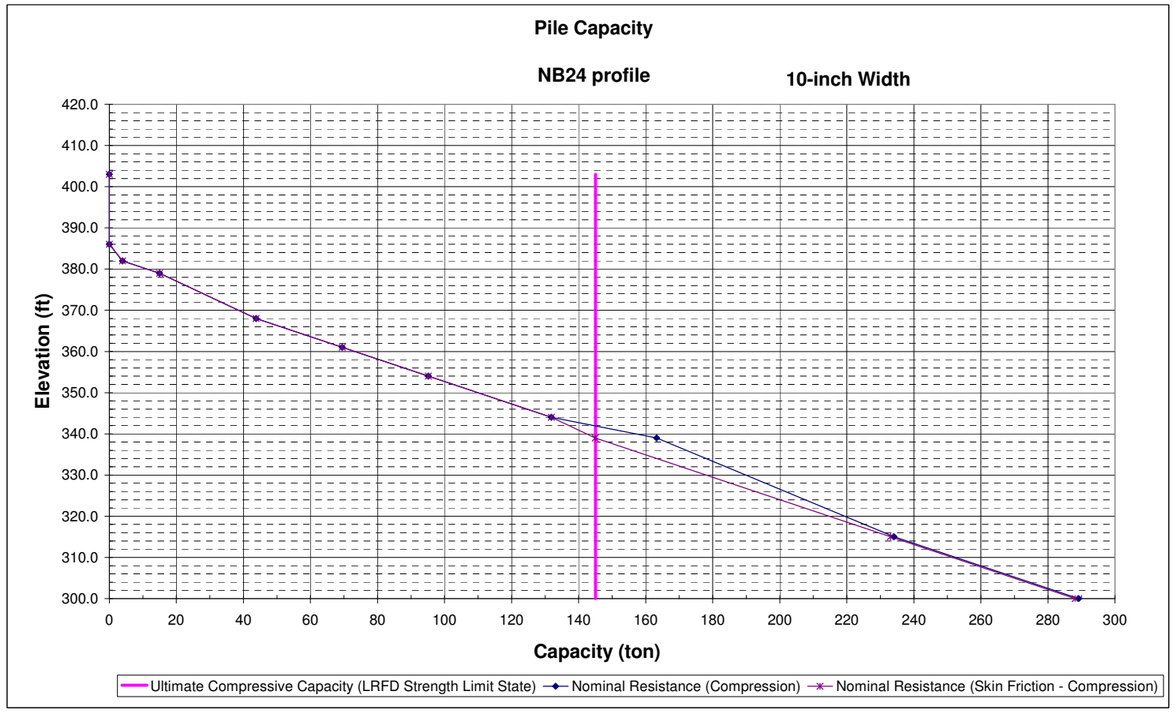
Nominal axial compress. Capacity (ult.) 145 ton
Nominal axial compress. Capacity (ult.) 1291 kN
Pile Width 10 inch
Pile Width 254 mm
Pile Width 0.83 ft
Crit depth ratio 20 -
Crit depth 16.7 ft
Crit. Depth. Elev 387.3 ft
Crit. Depth. Elev 118.1 m
Crit. Eff. Vert. Str. 2160 psf

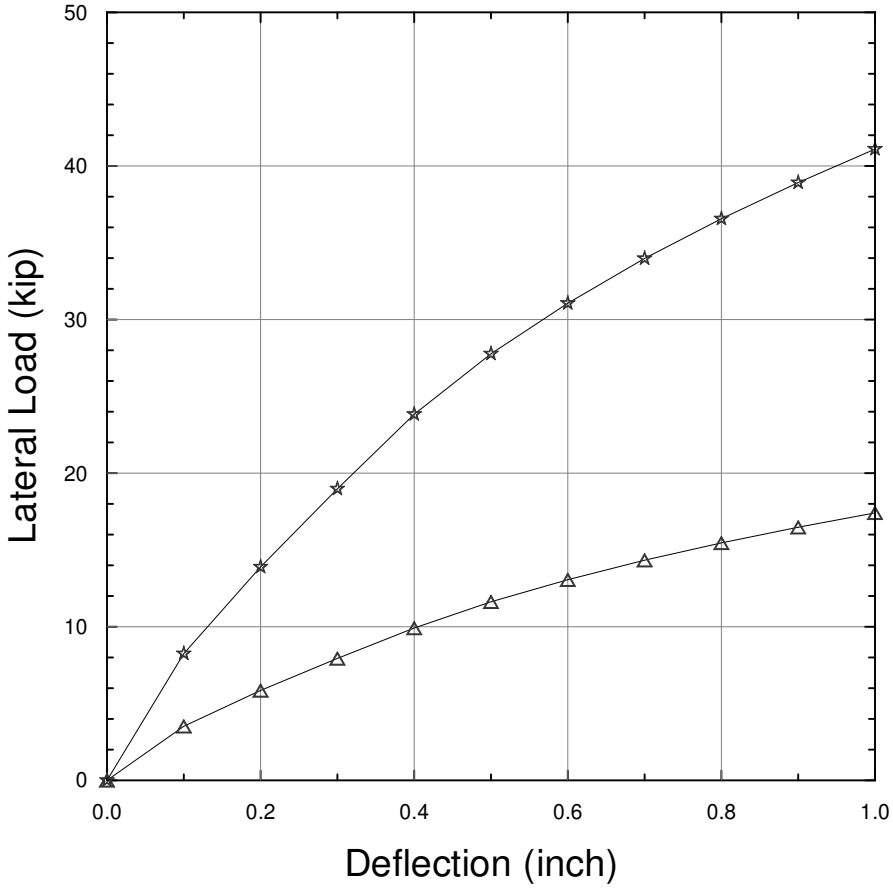
Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

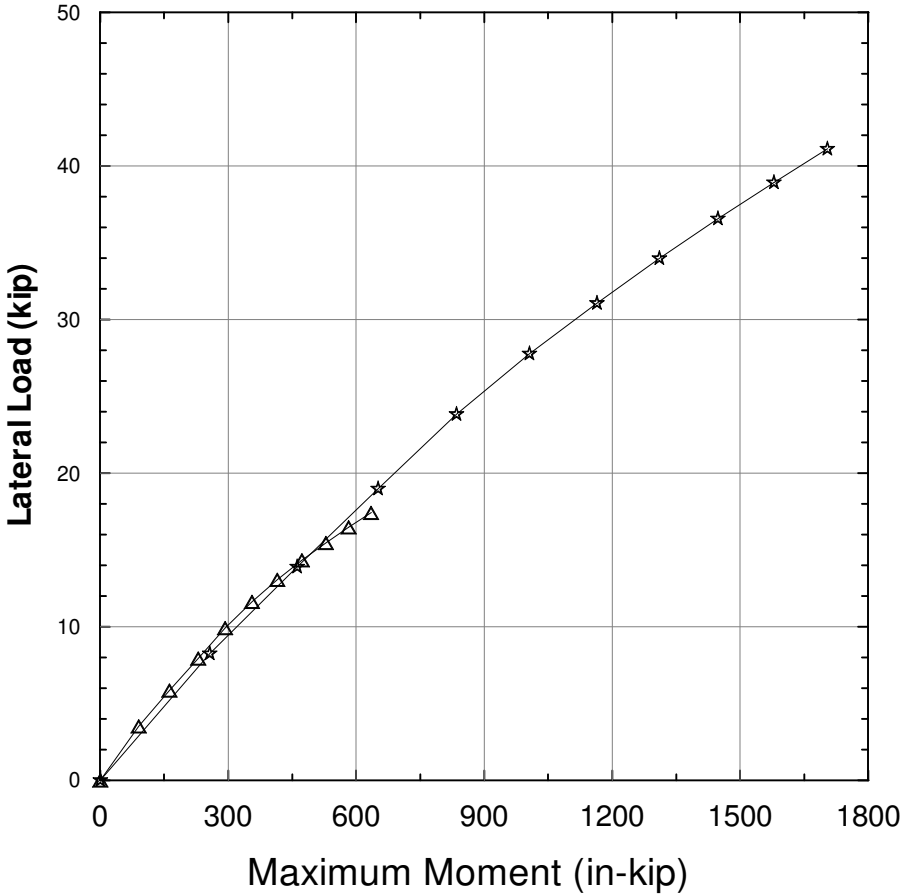
Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norlund method

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction Angle		Layer	Internal Depth to	Effective	Design Effective	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res. (Skin)		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?			Ratio				Thickness	Layer Top	Vert. Stress (Bot. Lay.)	Vert. Stress (Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	Type G= gran. C=cohes.	Capacity (B.C.)	B.C.?	to midlayer	(skin)		(Tot)							
						c	c	c_a/c	c_a	ϕ	δ																								
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			122.83	403.0										0	0					0.0	6.25	g	0	n	403.0	0	0	0	0	145	1291	0	0	73	645
1	122.83	403.0	117.65	386.0	n	0	0	0.00	0	40	30	17.0	1.0	405	405	0.0	0.0	0.0	145	11.4	9.00	g	3	n	394.5	0.0	0	0.0	0	145	1291	0.0	0	73	645
2	117.65	386.0	116.43	382.0	y	0	0	0.00	0	40	30	4.0	18.0	1350	1350	0.0	3.9	2.1	145	24.0	9.00	g	11	n	384.0	3.9	35	3.9	35	145	1291	2.1	19	73	645
3	116.43	382.0	115.51	379.0	y	115	2400	0.64	1536	0	0	3.0	22.0	2430	2160	11.1	0.0	0.0	0	28.2	9.00	c	1	n	380.5	15.0	134	15.0	134	145	1291	13.2	118	73	645
4	115.51	379.0	112.16	368.0	Y	0	0	0.00	0	44	33	11.0	25.0	4288	2160	0.0	28.8	15.6	145	36.6	9.00	g	18	n	373.5	43.8	390	43.8	390	145	1291	28.9	257	73	645
5	112.16	368.0	110.03	361.0	Y	96	2000	0.76	1520	0	0	7.0	36.0	5305	2160	25.7	0.0	0.0	0	47.4	9.00	c	1	n	364.5	69.5	618	69.5	618	145	1291	54.6	485	73	645
6	110.03	361.0	107.89	354.0	Y	96	2000	0.76	1520	0	0	7.0	43.0	5813	2160	25.7	0.0	0.0	0	55.8	9.00	c	1	n	357.5	95.2	847	95.2	847	145	1291	80.3	714	73	645
7	107.89	354.0	104.85	344.0	Y	96	2000	0.76	1520	0	0	10.0	50.0	6902	2160	36.7	0.0	0.0	0	66.0	9.00	c	1	n	349.0	131.9	1174	131.9	1174	145	1291	117.0	1041	73	645
8	104.85	344.0	103.32	339.0	Y	0	0	0.00	0	44	33	5.0	60.0	7700	2160	0.0	13.1	7.1	145	75.0	9.00	g	18	y	341.5	144.9	1290	163.3	1453	145	1291	124.1	1104	73	645
9	103.32	339.0	96.01	315.0	Y	96	2000	0.76	1520	0	0	24.0	65.0	7773	2160	88.1	0.0	0.0	0	92.4	9.00	c	1	y	327.0	233.0	2074	234.1	2083	145	1291	212.2	1888	73	645
10	96.01	315.0	91.44	300.0	Y	96	2000	0.76	1520	0	0	15.0	89.0	8354	2160	55.1	0.0	0.0	0	115.8	9.00	c	1	y	307.5	288.1	2564	289.2	2574	145	1291	267.2	2377	73	645
Bottom	91.44	300.0																																







Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Mocho Bridge (Widen) Abutments 1 & 4 Pile Lateral Resistance HP 10x57 Pile**	Figure G-1
	URS		

X:/Route 84/geotech/Analysis/Pile Design/Lateral/Arroyo Mocho/Abutments_B20.grf

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Pier_B19_Fixed.lpd
Name of output file: ArroyoMocho_Pier_B19_Fixed.lpo
Name of plot output file: ArroyoMocho_Pier_B19_Fixed.lpp
Name of runtime file: ArroyoMocho_Pier_B19_Fixed.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:54:51

Problem Title

SR84 Isabel Pier - Arroyo Mocho Bridge Widen - H pile

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 492.00 in
Depth of ground surface below top of pile = -216.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	492.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -216.000 in
Distance from top of pile to bottom of layer = -180.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -180.000 in
Distance from top of pile to bottom of layer = 108.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 780.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 288.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-216.00	.07230
2	-180.00	.07230
3	-180.00	.07810
4	108.00	.07810
5	108.00	.04200
6	420.00	.04200
7	420.00	.04200
8	780.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-216.000	.00000	35.00	------	------
2	-180.000	.00000	35.00	------	------
3	-180.000	.00000	40.00	------	------
4	108.000	.00000	40.00	------	------
5	108.000	.00000	40.00	------	------
6	420.000	.00000	40.00	------	------
7	420.000	27.77800	.00	.00500	.0
8	780.000	27.77800	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .100 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .200 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .300 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .400 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .500 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .600 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

```
Deflection at pile head     =            .700 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .800 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .900 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           1.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs
```

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	276.000

Depth of ground surface below top of pile =   -216.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =            2
Depth below pile head       =       60.000 in
Depth below ground surface  =      276.000 in
Equivalent Depth (see note) =      276.000 in
Pile Diameter               =       10.000 in
Angle of Friction           =       40.000 deg.
Avg. Eff. Unit Weight       =       .07734 lbs/in**3
k                           =      225.000 pci
A (static)                  =        .8800
B (static)                  =        .5000
Pst                         =    28178.350 lbs/in
```

Psd	=	22232.297	lbs/in
Ps	=	22232.297	lbs/in
pu	=	19564.422	lbs/in
Cbar	=	33042.3027	
n	=	1.6447	
m	=	40551.7102	
yk	=	.2000	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	862.500
.0278	1725.000
.0417	2587.500
.0556	3450.000
.0694	4312.500
.0833	5175.000
.0972	6037.500
.1111	6900.000
.1250	7762.500
.1389	8625.000
.1528	9487.500
.1667	10350.000
.3750	19564.422
10.3750	19564.422
20.3750	19564.422
30.3750	19564.422

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	-1.207E+06	1.098E+05	0.0000	71638.7917	-4860.0000
4.920	.095014	-7.242E+05	86237.7679	-.001622	47755.1907	-4722.8599

9.840	.084043	-3.549E+05	64113.9444	-.002528	29471.9094	-4270.5643
14.760	.070139	-88322.5485	44649.7453	-.002900	16277.1653	-3641.7118
19.680	.055506	90204.5356	28450.4441	-.002899	16370.3330	-2943.3700
24.600	.041618	1.973E+05	15667.4076	-.002657	21673.7783	-2252.9864
29.520	.029361	2.496E+05	6135.0744	-.002282	24261.2406	-1621.9459
34.440	.019166	2.622E+05	-511.7238	-.001852	24884.6420	-1080.0046
39.360	.011139	2.482E+05	-4742.9172	-.001423	24192.3802	-639.9927
44.280	.005163	2.183E+05	-7061.0514	-.001031	22712.8817	-302.3383
49.200	9.91E-04	1.808E+05	-7950.2292	-6.961E-04	20853.2157	-59.1161
54.120	-.001687	1.415E+05	-7843.3810	-4.255E-04	18907.9180	102.5503
59.040	-.003196	1.044E+05	-7104.5274	-2.190E-04	17073.9347	197.7966
63.960	-.003842	71986.1848	-6022.5639	-7.084E-05	15468.4344	242.0259
68.880	-.003893	45294.6702	-4813.2821	2.766E-05	14147.0723	249.5521
73.800	-.003570	24569.0465	-3626.7380	8.634E-05	13121.0513	232.7829
78.720	-.003044	9437.6497	-2557.5816	1.149E-04	12371.9723	201.8335
83.640	-.002439	-823.6839	-1656.4986	1.221E-04	11945.5383	164.4604
88.560	-.001842	-7102.6626	-941.4354	1.155E-04	12256.3789	126.2157
93.480	-.001303	-10314.6725	-407.7350	1.009E-04	12415.3893	90.7356
98.400	-8.49E-04	-11313.2503	-36.6970	8.269E-05	12464.8238	60.0928
103.320	-4.89E-04	-10838.4983	197.6329	6.408E-05	12441.3212	35.1632
108.240	-2.19E-04	-9494.6560	305.9618	4.700E-05	12374.7944	8.8729
113.160	-2.69E-05	-7920.3389	330.5113	3.238E-05	12296.8579	1.1065
118.080	9.97E-05	-6306.1451	322.9934	2.043E-05	12216.9473	-4.1626
123.000	1.74E-04	-4782.2889	294.6014	1.112E-05	12141.5089	-7.3789
127.920	2.09E-04	-3429.1453	254.3393	4.220E-06	12074.5216	-8.9878
132.840	2.16E-04	-2287.8954	209.0959	-5.815E-07	12018.0241	-9.4038
137.760	2.03E-04	-1370.4968	163.8425	-3.654E-06	11972.6083	-8.9919
142.680	1.80E-04	-668.4943	121.9022	-5.367E-06	11937.8557	-8.0570
147.600	1.51E-04	-160.4175	85.2509	-6.063E-06	11912.7034	-6.8419
152.520	1.20E-04	182.3066	54.8164	-6.044E-06	11913.7870	-5.5299
157.440	9.11E-05	390.8710	30.7562	-5.563E-06	11924.1120	-4.2507
162.360	6.53E-05	495.8959	12.7016	-4.818E-06	11929.3112	-3.0886
167.280	4.36E-05	525.3373	-.040648	-3.961E-06	11930.7687	-2.0912
172.200	2.63E-05	503.2903	-8.3284	-3.097E-06	11929.6773	-1.2778
177.120	1.32E-05	449.4799	-13.0648	-2.296E-06	11927.0134	-.6475
182.040	3.74E-06	379.2518	-15.1151	-1.600E-06	11923.5367	-.1859
186.960	-2.57E-06	303.8964	-15.2540	-1.027E-06	11919.8063	.1295
191.880	-6.37E-06	231.1724	-14.1372	-5.772E-07	11916.2061	.3245
196.800	-8.25E-06	165.9220	-12.2917	-2.437E-07	11912.9759	.4257
201.720	-8.76E-06	110.7019	-10.1188	-1.138E-08	11910.2422	.4576
206.640	-8.36E-06	66.3751	-7.9065	1.373E-07	11908.0478	.4418
211.560	-7.41E-06	32.6319	-5.8453	2.205E-07	11906.3773	.3961
216.480	-6.19E-06	8.4236	-4.0473	2.550E-07	11905.1789	.3347
221.400	-4.90E-06	-7.6955	-2.5644	2.556E-07	11905.1429	.2681
226.320	-3.68E-06	-17.3131	-1.4048	2.346E-07	11905.6190	.2033
231.240	-2.59E-06	-21.9807	-.5479	2.016E-07	11905.8501	.1450
236.160	-1.69E-06	-23.1009	.044411	1.637E-07	11905.9055	.095720
241.080	-9.83E-07	-21.8659	.4181	1.260E-07	11905.8444	.056192
246.000	-4.54E-07	-19.2346	.6209	9.144E-08	11905.7141	.026227
250.920	-8.38E-08	-15.9365	.6974	6.190E-08	11905.5508	.004889
255.840	1.55E-07	-12.4938	.6870	3.802E-08	11905.3804	-.009136
260.760	2.90E-07	-9.2516	.6219	1.975E-08	11905.2199	-.017302
265.680	3.49E-07	-6.4129	.5276	6.598E-09	11905.0794	-.021031
270.600	3.55E-07	-4.0727	.4227	-2.208E-09	11904.9635	-.021609
275.520	3.28E-07	-2.2489	.3201	-7.518E-09	11904.8732	-.020126
280.440	2.81E-07	-.9085	.2276	-1.017E-08	11904.8069	-.017455
285.360	2.27E-07	.010916	.1496	-1.092E-08	11904.7624	-.014257

290.280	1.74E-07	.5852	.087478	-1.042E-08	11904.7909	-.010999
295.200	1.25E-07	.8922	.040781	-9.182E-09	11904.8061	-.007984
300.120	8.35E-08	1.0045	.007897	-7.589E-09	11904.8116	-.005384
305.040	5.03E-08	.9849	-.013401	-5.918E-09	11904.8107	-.003274
309.960	2.52E-08	.8843	-.025533	-4.348E-09	11904.8057	-.001658
314.880	7.48E-09	.7422	-.030833	-2.982E-09	11904.7986	-4.964E-04
319.800	-4.12E-09	.5868	-.031375	-1.866E-09	11904.7910	2.762E-04
324.720	-1.09E-08	.4371	-.028887	-1.006E-09	11904.7835	7.353E-04
329.640	-1.40E-08	.3045	-.024725	-3.831E-10	11904.7770	9.564E-04
334.560	-1.46E-08	.1946	-.019892	3.609E-11	11904.7715	.001008
339.480	-1.37E-08	.1087	-.015078	2.908E-10	11904.7673	9.490E-04
344.400	-1.18E-08	.045625	-.010712	4.204E-10	11904.7642	8.257E-04
349.320	-9.53E-09	.002463	-.007024	4.608E-10	11904.7620	6.735E-04
354.240	-7.25E-09	-.024401	-.004096	4.424E-10	11904.7631	5.170E-04
359.160	-5.18E-09	-.038710	-.001908	3.894E-10	11904.7638	3.722E-04
364.080	-3.42E-09	-.043945	-3.823E-04	3.199E-10	11904.7641	2.481E-04
369.000	-2.03E-09	-.043102	5.930E-04	2.468E-10	11904.7640	1.484E-04
373.920	-9.93E-10	-.038595	.001138	1.782E-10	11904.7638	7.320E-05
378.840	-2.75E-10	-.032253	.001369	1.187E-10	11904.7635	2.048E-05
383.760	1.75E-10	-.025362	.001387	7.033E-11	11904.7632	-1.315E-05
388.680	4.17E-10	-.018748	.001277	3.328E-11	11904.7628	-3.149E-05
393.600	5.03E-10	-.012865	.001105	6.730E-12	11904.7625	-3.832E-05
398.520	4.83E-10	-.007888	9.195E-04	-1.070E-11	11904.7623	-3.709E-05
403.440	3.98E-10	-.003796	7.525E-04	-2.051E-11	11904.7621	-3.079E-05
408.360	2.81E-10	-4.432E-04	6.228E-04	-2.407E-11	11904.7619	-2.193E-05
413.280	1.61E-10	.002379	5.377E-04	-2.245E-11	11904.7620	-1.265E-05
418.200	6.02E-11	.004892	4.949E-04	-1.634E-11	11904.7621	-4.770E-06
423.120	6.00E-18	.007281	-4.984E-04	-6.115E-12	11904.7623	-3.990E-04
428.040	-4.52E-18	1.821E-09	-7.399E-04	-6.099E-19	11904.7619	3.008E-04
432.960	-1.81E-24	-5.475E-10	-1.850E-10	4.598E-19	11904.7619	1.204E-10
437.880	3.40E-25	-3.015E-16	5.564E-11	1.841E-25	11904.7619	-2.262E-11
442.800	0.000	4.117E-17	3.064E-17	0.0000	11904.7619	-1.586E-17
447.720	0.000	3.505E-23	-4.184E-18	0.0000	11904.7619	1.701E-18
452.640	0.000	-3.095E-24	-3.561E-24	0.0000	11904.7619	1.703E-24
457.560	0.000	0.0000	3.146E-25	0.0000	11904.7619	-1.279E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1206627.403 lbs-in
Maximum shear force	=	109811.603 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5

Number of zero deflection points = 14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .200000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	-2.413E+06	2.196E+05	0.0000	1.314E+05	-9720.0000
4.920	.190028	-1.448E+06	1.725E+05	-.003243	83605.6196	-9445.7198
9.840	.168086	-7.097E+05	1.282E+05	-.005056	47039.0569	-8541.1286
14.760	.140279	-1.766E+05	89299.4905	-.005800	20649.5687	-7283.4236
19.680	.111012	1.804E+05	56900.8882	-.005797	20835.9040	-5886.7399
24.600	.083236	3.947E+05	31334.8152	-.005314	31442.7948	-4505.9727
29.520	.058721	4.992E+05	12270.1487	-.004563	36617.7194	-3243.8917
34.440	.038333	5.244E+05	-1023.4476	-.003704	37864.5222	-2160.0092
39.360	.022278	4.964E+05	-9485.8343	-.002846	36479.9985	-1279.9854
44.280	.010325	4.366E+05	-14122.1028	-.002063	33521.0016	-604.6766
49.200	.001981	3.615E+05	-15900.4585	-.001392	29801.6695	-118.2322
54.120	-.003375	2.829E+05	-15686.7619	-8.510E-04	25911.0740	205.1007
59.040	-.006392	2.088E+05	-14209.0548	-4.380E-04	22243.1075	395.5933
63.960	-.007684	1.440E+05	-12045.1278	-1.417E-04	19032.1069	484.0518
68.880	-.007787	90589.3404	-9626.5641	5.533E-05	16389.3827	499.1042
73.800	-.007140	49138.0931	-7253.4759	1.727E-04	14337.3408	465.5658
78.720	-.006087	18875.2994	-5115.1631	2.298E-04	12839.1827	403.6670
83.640	-.004879	-1647.3678	-3312.9973	2.443E-04	11986.3148	328.9207
88.560	-.003684	-14205.3251	-1882.8708	2.310E-04	12607.9958	252.4315
93.480	-.002606	-20629.3449	-815.4699	2.017E-04	12926.0166	181.4713
98.400	-.001699	-22626.5005	-73.3940	1.654E-04	13024.8857	120.1856
103.320	-9.79E-04	-21676.9966	395.2657	1.282E-04	12977.8805	70.3265
108.240	-4.38E-04	-18989.3121	611.9237	9.401E-05	12844.8269	17.7458
113.160	-5.38E-05	-15840.6777	661.0226	6.476E-05	12688.9539	2.2131
118.080	1.99E-04	-12612.2903	645.9869	4.086E-05	12529.1327	-8.3251
123.000	3.48E-04	-9564.5779	589.2027	2.223E-05	12378.2559	-14.7578
127.920	4.18E-04	-6858.2906	508.6786	8.440E-06	12244.2812	-17.9755
132.840	4.31E-04	-4575.7907	418.1919	-1.163E-06	12131.2862	-18.8077
137.760	4.07E-04	-2740.9936	327.6849	-7.308E-06	12040.4547	-17.9838
142.680	3.59E-04	-1336.9886	243.8044	-1.073E-05	11970.9495	-16.1140
147.600	3.01E-04	-320.8350	170.5019	-1.213E-05	11920.6448	-13.6838
152.520	2.40E-04	364.6132	109.6328	-1.209E-05	11922.8121	-11.0598
157.440	1.82E-04	781.7421	61.5125	-1.113E-05	11943.4620	-8.5013
162.360	1.31E-04	991.7918	25.4033	-9.636E-06	11953.8605	-6.1772
167.280	8.73E-05	1050.6747	-.081295	-7.921E-06	11956.7755	-4.1824
172.200	5.27E-05	1006.5806	-16.6568	-6.193E-06	11954.5926	-2.5556
177.120	2.64E-05	898.9598	-26.1296	-4.593E-06	11949.2649	-1.2951
182.040	7.47E-06	758.5035	-30.2303	-3.201E-06	11942.3116	-.3718

186.960	-5.14E-06	607.7929	-30.5081	-2.053E-06	11934.8507	.2589
191.880	-1.27E-05	462.3448	-28.2745	-1.154E-06	11927.6503	.6491
196.800	-1.65E-05	331.8440	-24.5834	-4.874E-07	11921.1898	.8514
201.720	-1.75E-05	221.4038	-20.2377	-2.276E-08	11915.7225	.9152
206.640	-1.67E-05	132.7502	-15.8129	2.747E-07	11911.3337	.8835
211.560	-1.48E-05	65.2639	-11.6906	4.410E-07	11907.9928	.7923
216.480	-1.24E-05	16.8473	-8.0946	5.100E-07	11905.5959	.6695
221.400	-9.81E-06	-15.3911	-5.1288	5.112E-07	11905.5238	.5361
226.320	-7.35E-06	-34.6263	-2.8097	4.692E-07	11906.4761	.4066
231.240	-5.19E-06	-43.9615	-1.0957	4.032E-07	11906.9382	.2901
236.160	-3.39E-06	-46.2019	.088823	3.274E-07	11907.0491	.1914
241.080	-1.97E-06	-43.7319	.8362	2.519E-07	11906.9268	.1124
246.000	-9.08E-07	-38.4691	1.2417	1.829E-07	11906.6663	.052455
250.920	-1.68E-07	-31.8731	1.3948	1.238E-07	11906.3398	.009779
255.840	3.10E-07	-24.9877	1.3739	7.604E-08	11905.9989	-.018273
260.760	5.81E-07	-18.5032	1.2439	3.951E-08	11905.6779	-.034604
265.680	6.99E-07	-12.8259	1.0553	1.320E-08	11905.3968	-.042062
270.600	7.11E-07	-8.1455	.8455	-4.416E-09	11905.1651	-.043217
275.520	6.55E-07	-4.4978	.6401	-1.504E-08	11904.9846	-.040251
280.440	5.63E-07	-1.8169	.4552	-2.034E-08	11904.8519	-.034910
285.360	4.55E-07	.021833	.2992	-2.185E-08	11904.7630	-.028515
290.280	3.48E-07	1.1703	.1750	-2.085E-08	11904.8198	-.021998
295.200	2.50E-07	1.7844	.081562	-1.836E-08	11904.8502	-.015967
300.120	1.67E-07	2.0090	.015794	-1.518E-08	11904.8614	-.010768
305.040	1.01E-07	1.9697	-.026802	-1.184E-08	11904.8594	-.006548
309.960	5.04E-08	1.7686	-.051066	-8.696E-09	11904.8495	-.003316
314.880	1.50E-08	1.4843	-.061666	-5.964E-09	11904.8354	-9.929E-04
319.800	-8.25E-09	1.1736	-.062750	-3.732E-09	11904.8200	5.524E-04
324.720	-2.18E-08	.8742	-.057773	-2.012E-09	11904.8052	.001471
329.640	-2.80E-08	.6090	-.049450	-7.661E-10	11904.7921	.001913
334.560	-2.93E-08	.3891	-.039785	7.218E-11	11904.7812	.002016
339.480	-2.73E-08	.2174	-.030156	5.816E-10	11904.7727	.001898
344.400	-2.36E-08	.091250	-.021424	8.408E-10	11904.7664	.001651
349.320	-1.91E-08	.004926	-.014049	9.216E-10	11904.7621	.001347
354.240	-1.45E-08	-.048802	-.008192	8.847E-10	11904.7643	.001034
359.160	-1.04E-08	-.077420	-.003817	7.787E-10	11904.7657	7.445E-04
364.080	-6.84E-09	-.087890	-7.646E-04	6.399E-10	11904.7663	4.962E-04
369.000	-4.06E-09	-.086203	.001186	4.937E-10	11904.7662	2.968E-04
373.920	-1.99E-09	-.077191	.002276	3.564E-10	11904.7657	1.464E-04
378.840	-5.51E-10	-.064507	.002737	2.374E-10	11904.7651	4.095E-05
383.760	3.51E-10	-.050725	.002773	1.407E-10	11904.7644	-2.631E-05
388.680	8.33E-10	-.037496	.002553	6.656E-11	11904.7638	-6.299E-05
393.600	1.01E-09	-.025729	.002210	1.346E-11	11904.7632	-7.665E-05
398.520	9.66E-10	-.015776	.001839	-2.140E-11	11904.7627	-7.419E-05
403.440	7.95E-10	-.007592	.001505	-4.102E-11	11904.7623	-6.158E-05
408.360	5.62E-10	-8.863E-04	.001246	-4.815E-11	11904.7619	-4.387E-05
413.280	3.22E-10	.004759	.001075	-4.489E-11	11904.7621	-2.529E-05
418.200	1.20E-10	.009784	9.897E-04	-3.268E-11	11904.7624	-9.541E-06
423.120	1.20E-17	.014562	-9.968E-04	-1.223E-11	11904.7626	-7.980E-04
428.040	-9.05E-18	3.642E-09	-.001480	-1.220E-18	11904.7619	6.016E-04
432.960	-3.62E-24	-1.095E-09	-3.700E-10	9.196E-19	11904.7619	2.409E-10
437.880	6.80E-25	-6.031E-16	1.113E-10	3.682E-25	11904.7619	-4.523E-11
442.800	0.000	8.233E-17	6.127E-17	0.0000	11904.7619	-3.171E-17
447.720	0.000	7.010E-23	-8.367E-18	0.0000	11904.7619	3.401E-18
452.640	0.000	-6.191E-24	-7.123E-24	0.0000	11904.7619	3.407E-24
457.560	0.000	0.0000	6.291E-25	0.0000	11904.7619	-2.557E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-2413254.805 lbs-in
Maximum shear force	=	219623.207 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .300000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	-3.560E+06	3.140E+05	0.0000	1.881E+05	-12895.9432
4.920	.285291	-2.168E+06	2.510E+05	-.004810	1.192E+05	-12717.0821
9.840	.252666	-1.080E+06	1.904E+05	-.007538	65372.8700	-11923.5843
14.760	.211116	-2.792E+05	1.346E+05	-.008680	25727.3527	-10780.4047
19.680	.167258	2.611E+05	86224.9536	-.008695	24831.9815	-8869.3760
24.600	.125559	5.863E+05	47685.3861	-.007983	40931.9266	-6797.1148
29.520	.088705	7.461E+05	18909.9355	-.006864	48838.6616	-4900.2228
34.440	.058016	7.859E+05	-1186.7739	-.005577	50812.2329	-3269.1712
39.360	.033824	7.454E+05	-14009.6168	-.004291	48803.9272	-1943.3665
44.280	.015791	6.565E+05	-21065.1716	-.003114	44405.8244	-924.7452
49.200	.003183	5.442E+05	-23807.3298	-.002105	38845.8452	-189.9533
54.120	-.004926	4.264E+05	-23538.0847	-.001290	33013.7078	299.4025
59.040	-.009512	3.151E+05	-21353.5062	-6.674E-04	27505.4648	588.6375
63.960	-.011493	2.176E+05	-18124.4870	-2.200E-04	22676.8217	723.9719
68.880	-.011676	1.372E+05	-14502.3884	7.805E-05	18697.9357	748.4259
73.800	-.010725	74738.5001	-10940.8872	2.561E-04	15604.6877	699.3388
78.720	-.009157	29059.8306	-7726.8328	3.433E-04	13343.3674	607.1874

83.640	-.007348	-1969.0512	-5014.5385	3.660E-04	12002.2397	495.3713
88.560	-.005555	-21003.5229	-2859.4880	3.467E-04	12944.5403	380.6655
93.480	-.003936	-30788.7366	-1248.8192	3.032E-04	13428.9568	274.0779
98.400	-.002571	-33888.6211	-127.0999	2.489E-04	13582.4164	181.9056
103.320	-.001487	-32529.2124	583.2001	1.931E-04	13515.1190	106.8342
108.240	-6.71E-04	-28529.9647	912.9439	1.418E-04	13317.1364	27.2080
113.160	-9.14E-05	-23824.9539	989.1289	9.785E-05	13084.2151	3.7616
118.080	2.92E-04	-18989.5092	968.4305	6.189E-05	12844.8366	-12.1756
123.000	5.18E-04	-14417.4041	884.5219	3.384E-05	12618.4948	-21.9336
127.920	6.25E-04	-10352.4022	764.5207	1.303E-05	12417.2571	-26.8474
132.840	6.46E-04	-6920.1669	629.1980	-1.475E-06	12247.3444	-28.1619
137.760	6.10E-04	-4158.1917	493.5643	-1.078E-05	12110.6130	-26.9737
142.680	5.40E-04	-2042.2802	367.6753	-1.599E-05	12005.8649	-24.2007
147.600	4.53E-04	-508.8047	257.5291	-1.813E-05	11929.9503	-20.5742
152.520	3.61E-04	527.4850	165.9654	-1.811E-05	11930.8750	-16.6468
157.440	2.74E-04	1159.9430	93.4999	-1.670E-05	11962.1848	-12.8107
162.360	1.97E-04	1480.3831	39.0560	-1.448E-05	11978.0482	-9.3210
167.280	1.32E-04	1572.7489	.5736	-1.191E-05	11982.6208	-6.3223
172.200	7.98E-05	1509.4754	-24.5098	-9.326E-06	11979.4884	-3.8742
177.120	4.02E-05	1349.9262	-38.8990	-6.925E-06	11971.5899	-1.9750
182.040	1.17E-05	1140.3372	-45.1897	-4.833E-06	11961.2142	-.5822
186.960	-7.37E-06	914.7707	-45.7092	-3.107E-06	11950.0476	.3710
191.880	-1.89E-05	696.6732	-42.4295	-1.754E-06	11939.2507	.9622
196.800	-2.46E-05	500.7161	-36.9370	-7.480E-07	11929.5498	1.2705
201.720	-2.62E-05	334.6854	-30.4420	-4.637E-08	11921.3305	1.3698
206.640	-2.51E-05	201.2583	-23.8132	4.038E-07	11914.7252	1.3249
211.560	-2.23E-05	99.5692	-17.6273	6.564E-07	11909.6911	1.1897
216.480	-1.86E-05	26.5137	-12.2246	7.623E-07	11906.0745	1.0065
221.400	-1.48E-05	-22.2208	-7.7634	7.659E-07	11905.8619	.8069
226.320	-1.11E-05	-51.3853	-4.2709	7.041E-07	11907.3057	.6128
231.240	-7.83E-06	-65.6323	-1.6866	6.058E-07	11908.0110	.4378
236.160	-5.12E-06	-69.1738	.1024	4.926E-07	11908.1864	.2895
241.080	-2.98E-06	-65.5943	1.2338	3.794E-07	11908.0091	.1705
246.000	-1.39E-06	-57.7800	1.8503	2.758E-07	11907.6223	.080157
250.920	-2.70E-07	-47.9298	2.0863	1.870E-07	11907.1347	.015753
255.840	4.52E-07	-37.6191	2.0594	1.151E-07	11906.6242	-.026664
260.760	8.63E-07	-27.8917	1.8673	6.013E-08	11906.1427	-.051441
265.680	1.04E-06	-19.3633	1.5861	2.044E-08	11905.7205	-.062845
270.600	1.06E-06	-12.3242	1.2723	-6.173E-09	11905.3720	-.064737
275.520	9.83E-07	-6.8318	.9645	-2.226E-08	11905.1001	-.060396
280.440	8.45E-07	-2.7900	.6869	-3.034E-08	11904.9000	-.052452
285.360	6.84E-07	-.013361	.4523	-3.270E-08	11904.7626	-.042893
290.280	5.24E-07	1.7251	.2653	-3.126E-08	11904.8473	-.033130
295.200	3.77E-07	2.6587	.1246	-2.758E-08	11904.8935	-.024080
300.120	2.52E-07	3.0050	.025306	-2.282E-08	11904.9107	-.016267
305.040	1.52E-07	2.9526	-.039106	-1.782E-08	11904.9081	-.009917
309.960	7.68E-08	2.6552	-.075925	-1.311E-08	11904.8934	-.005050
314.880	2.33E-08	2.2313	-.092149	-9.004E-09	11904.8724	-.001545
319.800	-1.18E-08	1.7662	-.094008	-5.647E-09	11904.8493	7.897E-04
324.720	-3.23E-08	1.3173	-.086699	-3.057E-09	11904.8271	.002181
329.640	-4.19E-08	.9191	-.074308	-1.178E-09	11904.8074	.002856
334.560	-4.39E-08	.5885	-.059856	8.779E-11	11904.7910	.003019
339.480	-4.10E-08	.3299	-.045425	8.592E-10	11904.7782	.002847
344.400	-3.54E-08	.1398	-.032318	1.254E-09	11904.7688	.002481
349.320	-2.87E-08	.009465	-.021232	1.379E-09	11904.7624	.002026
354.240	-2.18E-08	-.071841	-.012418	1.327E-09	11904.7655	.001557
359.160	-1.56E-08	-.1153	-.005825	1.169E-09	11904.7676	.001123

364.080	-1.03E-08	-.1315	-.001220	9.622E-10	11904.7684	7.496E-04
369.000	-6.15E-09	-.1292	.001730	7.432E-10	11904.7683	4.495E-04
373.920	-3.02E-09	-.1159	.003385	5.373E-10	11904.7676	2.230E-04
378.840	-8.60E-10	-.096982	.004091	3.585E-10	11904.7667	6.394E-05
383.760	5.03E-10	-.076354	.004155	2.130E-10	11904.7657	-3.773E-05
388.680	1.24E-09	-.056514	.003833	1.014E-10	11904.7647	-9.339E-05
393.600	1.50E-09	-.038841	.003322	2.128E-11	11904.7638	-1.144E-04
398.520	1.44E-09	-.023871	.002767	-3.139E-11	11904.7631	-1.110E-04
403.440	1.19E-09	-.011549	.002267	-6.114E-11	11904.7625	-9.228E-05
408.360	8.43E-10	-.001441	.001878	-7.205E-11	11904.7620	-6.581E-05
413.280	4.83E-10	.007076	.001623	-6.732E-11	11904.7623	-3.797E-05
418.200	1.81E-10	.014662	.001494	-4.906E-11	11904.7626	-1.433E-05
423.120	1.81E-17	.021877	-.001494	-1.837E-11	11904.7630	-.001200
428.040	-1.36E-17	5.475E-09	-.002223	-1.835E-18	11904.7619	9.038E-04
432.960	-5.44E-24	-1.645E-09	-5.561E-10	1.382E-18	11904.7619	3.620E-10
437.880	1.02E-24	-9.062E-16	1.672E-10	5.533E-25	11904.7619	-6.796E-11
442.800	0.000	1.237E-16	9.207E-17	-1.039E-25	11904.7619	-4.765E-17
447.720	0.000	1.053E-22	-1.257E-17	0.0000	11904.7619	5.110E-18
452.640	0.000	-9.300E-24	-1.070E-23	0.0000	11904.7619	5.119E-24
457.560	0.000	0.0000	9.452E-25	0.0000	11904.7619	-3.842E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =      .30000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =   -3559670.151 lbs-in
Maximum shear force              =     314039.309 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              5
Number of zero deflection points =             14
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .400000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =      200000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	-4.629E+06	3.971E+05	0.0000	2.411E+05	-15269.6852
4.920	.380870	-2.857E+06	3.211E+05	-.006287	1.533E+05	-15621.8535
9.840	.338133	-1.457E+06	2.464E+05	-.009910	84035.4387	-14753.3629
14.760	.283354	-4.123E+05	1.776E+05	-.011480	32314.0745	-13224.9204
19.680	.225168	3.131E+05	1.168E+05	-.011563	27402.6410	-11498.7225
24.600	.169570	7.595E+05	65902.9039	-.010663	49504.8762	-9179.6487
29.520	.120248	9.825E+05	26979.8474	-.009200	60544.6538	-6642.7320
34.440	.079046	1.043E+06	-318.5309	-.007498	63543.8063	-4454.1697
39.360	.046465	9.941E+05	-17843.2388	-.005787	61120.0111	-2669.6953
44.280	.022100	8.789E+05	-27594.5232	-.004214	55415.6755	-1294.2415
49.200	.004999	7.309E+05	-31512.1041	-.002862	48088.4846	-298.2710
54.120	-.006062	5.745E+05	-31339.4981	-.001766	40344.0573	368.4361
59.040	-.012375	4.260E+05	-28549.2117	-9.254E-04	32994.1338	765.8267
63.960	-.015168	2.954E+05	-24314.9360	-3.195E-04	26527.0703	955.4236
68.880	-.015519	1.874E+05	-19517.5432	8.596E-05	21180.7570	994.7360
73.800	-.014322	1.031E+05	-14773.2123	3.300E-04	17011.1402	933.8538
78.720	-.012272	41357.3289	-10474.0024	4.513E-04	13952.1544	813.7925
83.640	-.009881	-803.5559	-6833.3440	4.854E-04	11944.5419	666.1500
88.560	-.007496	-26838.0201	-3930.9921	4.622E-04	13233.3768	513.6679
93.480	-.005333	-40394.0743	-1753.8470	4.057E-04	13904.4686	371.3505
98.400	-.003504	-44894.3044	-230.5906	3.341E-04	14127.2522	247.8595
103.320	-.002046	-43320.5438	740.7040	2.600E-04	14049.3433	146.9757
108.240	-9.46E-04	-38117.4265	1196.5404	1.916E-04	13791.7632	38.3236
113.160	-1.60E-04	-31923.6291	1307.0581	1.328E-04	13485.1396	6.6023
118.080	3.61E-04	-25517.2484	1286.2344	8.452E-05	13167.9920	-15.0672
123.000	6.71E-04	-19433.4135	1179.2027	4.676E-05	12866.8121	-28.4416
127.920	8.21E-04	-14005.9266	1022.4146	1.868E-05	12598.1246	-35.2934
132.840	8.55E-04	-9409.6152	843.8790	-9.866E-07	12370.5844	-37.2821
137.760	8.11E-04	-5700.2154	663.9154	-1.368E-05	12186.9508	-35.8739
142.680	7.20E-04	-2849.7708	496.2084	-2.086E-05	12045.8397	-32.2997
147.600	6.06E-04	-776.4759	348.9943	-2.390E-05	11943.2013	-27.5434
152.520	4.85E-04	631.3750	226.2544	-2.403E-05	11936.0181	-22.3508
157.440	3.70E-04	1497.1492	128.8285	-2.224E-05	11978.8782	-17.2532
162.360	2.66E-04	1942.8109	55.3931	-1.935E-05	12000.9407	-12.5986
167.280	1.79E-04	2080.2955	3.2785	-1.597E-05	12007.7468	-8.5862
172.200	1.09E-04	2006.5002	-30.8838	-1.254E-05	12004.0936	-5.3009
177.120	5.58E-05	1801.0722	-50.6753	-9.339E-06	11993.9239	-2.7444
182.040	1.73E-05	1526.2350	-59.5491	-6.545E-06	11980.3181	-.8628
186.960	-8.55E-06	1227.9893	-60.6119	-4.232E-06	11965.5535	.4308
191.880	-2.43E-05	938.1419	-56.5046	-2.412E-06	11951.2046	1.2388
196.800	-3.23E-05	676.7316	-49.3583	-1.056E-06	11938.2635	1.6662
201.720	-3.47E-05	454.5349	-40.8036	-1.059E-07	11927.2636	1.8113
206.640	-3.33E-05	275.4325	-32.0158	5.071E-07	11918.3972	1.7610
211.560	-2.97E-05	138.5015	-23.7791	8.548E-07	11911.6184	1.5873
216.480	-2.49E-05	39.7640	-16.5601	1.005E-06	11906.7304	1.3473
221.400	-1.98E-05	-26.4269	-10.5807	1.016E-06	11906.0702	1.0834
226.320	-1.49E-05	-66.3492	-5.8853	9.378E-07	11908.0465	.8253
231.240	-1.06E-05	-86.1842	-2.3991	8.097E-07	11909.0285	.5919
236.160	-6.96E-06	-91.5497	.024567	6.604E-07	11909.2941	.3934
241.080	-4.09E-06	-87.2422	1.5669	5.102E-07	11909.0808	.2336
246.000	-1.94E-06	-77.1358	2.4170	3.722E-07	11908.5805	.1120
250.920	-4.26E-07	-64.1917	2.7536	2.535E-07	11907.9397	.024878
255.840	5.56E-07	-50.5394	2.7342	1.571E-07	11907.2639	-.032775

260.760	1.12E-06	-37.5968	2.4893	8.311E-08	11906.6231	-.066744
265.680	1.37E-06	-26.2078	2.1217	2.952E-08	11906.0593	-.082699
270.600	1.41E-06	-16.7773	1.7072	-6.579E-09	11905.5925	-.085792
275.520	1.31E-06	-9.3958	1.2984	-2.856E-08	11905.2270	-.080411
280.440	1.13E-06	-3.9451	.9281	-3.977E-08	11904.9572	-.070086
285.360	9.17E-07	-.1845	.6143	-4.323E-08	11904.7710	-.057498
290.280	7.04E-07	2.1845	.3632	-4.155E-08	11904.8701	-.044552
295.200	5.09E-07	3.4716	.1737	-3.680E-08	11904.9338	-.032498
300.120	3.42E-07	3.9662	.039506	-3.056E-08	11904.9583	-.022054
305.040	2.08E-07	3.9204	-.048054	-2.393E-08	11904.9560	-.013540
309.960	1.06E-07	3.5405	-.098558	-1.767E-08	11904.9372	-.006991
314.880	3.40E-08	2.9854	-.1213	-1.219E-08	11904.9097	-.002259
319.800	-1.36E-08	2.3707	-.1246	-7.688E-09	11904.8793	9.099E-04
324.720	-4.16E-08	1.7742	-.1155	-4.207E-09	11904.8497	.002813
329.640	-5.50E-08	1.2428	-.099328	-1.673E-09	11904.8234	.003750
334.560	-5.81E-08	.8001	-.080271	4.271E-11	11904.8015	.003997
339.480	-5.46E-08	.4528	-.061119	1.095E-09	11904.7843	.003788
344.400	-4.73E-08	.1965	-.043648	1.640E-09	11904.7716	.003314
349.320	-3.84E-08	.020097	-.028818	1.822E-09	11904.7629	.002715
354.240	-2.94E-08	-.090638	-.016989	1.763E-09	11904.7664	.002094
359.160	-2.11E-08	-.1505	-.008112	1.560E-09	11904.7694	.001515
364.080	-1.40E-08	-.1735	-.001885	1.288E-09	11904.7705	.001016
369.000	-8.39E-09	-.1716	.002125	9.984E-10	11904.7704	6.139E-04
373.920	-4.19E-09	-.1546	.004395	7.244E-10	11904.7696	3.091E-04
378.840	-1.27E-09	-.1298	.005387	4.855E-10	11904.7683	9.417E-05
383.760	5.86E-10	-.1025	.005511	2.904E-10	11904.7670	-4.393E-05
388.680	1.59E-09	-.076154	.005107	1.403E-10	11904.7657	-1.203E-04
393.600	1.97E-09	-.052558	.004442	3.223E-11	11904.7645	-1.499E-04
398.520	1.91E-09	-.032504	.003713	-3.921E-11	11904.7635	-1.466E-04
403.440	1.58E-09	-.015944	.003051	-7.990E-11	11904.7627	-1.224E-04
408.360	1.12E-09	-.002321	.002535	-9.524E-11	11904.7620	-8.756E-05
413.280	6.44E-10	.009186	.002195	-8.948E-11	11904.7624	-5.064E-05
418.200	2.42E-10	.019453	.002023	-6.543E-11	11904.7629	-1.915E-05
423.120	2.42E-17	.029223	-.001982	-2.454E-11	11904.7634	-.001609
428.040	-1.82E-17	7.323E-09	-.002970	-2.459E-18	11904.7619	.001207
432.960	-7.28E-24	-2.197E-09	-7.438E-10	1.846E-18	11904.7619	4.839E-10
437.880	1.37E-24	-1.211E-15	2.233E-10	7.398E-25	11904.7619	-9.078E-11
442.800	0.000	1.652E-16	1.231E-16	-1.388E-25	11904.7619	-6.368E-17
447.720	0.000	1.408E-22	-1.679E-17	0.0000	11904.7619	6.826E-18
452.640	0.000	-1.242E-23	-1.430E-23	0.0000	11904.7619	6.840E-24
457.560	0.000	0.0000	1.263E-24	0.0000	11904.7619	-5.132E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = 0.000
Maximum bending moment = -4629445.113 lbs-in
Maximum shear force = 397134.653 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 5
Number of zero deflection points = 14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	-5.564E+06	4.513E+05	0.0000	2.873E+05	-15269.6852
4.920	.477009	-3.524E+06	3.753E+05	-.007633	1.864E+05	-15621.8557
9.840	.424895	-1.856E+06	2.975E+05	-.012151	1.038E+05	-15974.0294
14.760	.357440	-5.722E+05	2.195E+05	-.014191	40230.3870	-15731.9753
19.680	.285257	3.320E+05	1.474E+05	-.014393	28341.0819	-13575.9713
24.600	.215817	9.070E+05	85978.4984	-.013352	56807.2760	-11411.4458
29.520	.153874	1.204E+06	36995.5963	-.011579	71524.4982	-8500.3031
34.440	.101883	1.294E+06	1961.9160	-.009480	75956.9516	-5741.0304
39.360	.060586	1.242E+06	-20724.3353	-.007350	73403.8476	-3481.0230
44.280	.029555	1.104E+06	-33545.4976	-.005380	66577.6558	-1730.8316
49.200	.007651	9.228E+05	-38926.4655	-.003677	57586.9773	-456.5537
54.120	-.006626	7.286E+05	-39058.8961	-.002290	47973.6867	402.7202
59.040	-.014882	5.429E+05	-35802.5989	-.001222	38783.3729	920.9779
63.960	-.018651	3.787E+05	-30646.8236	-4.480E-04	30652.2736	1174.8657
68.880	-.019291	2.423E+05	-24714.8909	7.354E-05	23898.0714	1236.4891
73.800	-.017928	1.354E+05	-18797.4462	3.907E-04	18605.7760	1168.9762
78.720	-.015446	56529.0898	-13402.0738	5.519E-04	14703.2317	1024.2646
83.640	-.012497	2398.0171	-8809.6803	6.014E-04	12023.4756	842.5620
88.560	-.009529	-31341.6255	-5130.6643	5.770E-04	13456.3275	652.9729
93.480	-.006819	-49223.3405	-2356.2256	5.094E-04	14341.5609	474.8477
98.400	-.004517	-55529.3423	-402.1287	4.214E-04	14653.7392	319.5006
103.320	-.002673	-54009.6007	856.2294	3.294E-04	14578.5045	192.0271
108.240	-.001275	-47752.3041	1455.7634	2.439E-04	14268.7374	51.6860
113.160	-2.72E-04	-40164.9478	1610.4849	1.701E-04	13893.1257	11.2090
118.080	3.98E-04	-32239.8753	1597.1251	1.093E-04	13500.7953	-16.6398
123.000	8.03E-04	-24664.3032	1472.4943	6.149E-05	13125.7670	-34.0232
127.920	.001004	-17871.5423	1282.6701	2.576E-05	12789.4917	-43.1411
132.840	.001056	-12093.5335	1063.2217	5.973E-07	12503.4517	-46.0655
137.760	.001009	-7410.6158	840.0976	-1.578E-05	12271.6241	-44.6354
142.680	9.01E-04	-3795.9111	630.9068	-2.520E-05	12092.6783	-40.4015
147.600	7.61E-04	-1152.9072	446.3819	-2.935E-05	11961.8365	-34.6086
152.520	6.12E-04	654.2517	291.8601	-2.977E-05	11937.1506	-28.2051

157.440	4.69E-04	1777.5855	168.6742	-2.773E-05	11992.7612	-21.8705
162.360	3.39E-04	2368.5759	75.3805	-2.425E-05	12022.0181	-16.0538
167.280	2.30E-04	2567.0468	8.7884	-2.010E-05	12031.8434	-11.0162
172.200	1.42E-04	2494.6128	-35.2198	-1.585E-05	12028.2576	-6.8733
177.120	7.40E-05	2251.6768	-61.0703	-1.186E-05	12016.2311	-3.6350
182.040	2.49E-05	1917.0290	-73.0610	-8.362E-06	11999.6643	-1.2393
186.960	-8.31E-06	1549.2139	-75.0795	-5.451E-06	11981.4557	.4188
191.880	-2.87E-05	1188.9747	-70.4458	-3.151E-06	11963.6220	1.4649
196.800	-3.93E-05	862.2297	-61.8506	-1.429E-06	11947.4465	2.0291
201.720	-4.28E-05	583.1763	-51.3628	-2.147E-07	11933.6320	2.2342
206.640	-4.14E-05	357.2421	-40.4815	5.752E-07	11922.4472	2.1891
211.560	-3.71E-05	183.7067	-30.2148	1.029E-06	11913.8563	1.9844
216.480	-3.13E-05	57.9029	-21.1698	1.232E-06	11907.6284	1.6924
221.400	-2.50E-05	-27.0300	-13.6437	1.258E-06	11906.1000	1.3670
226.320	-1.89E-05	-78.8271	-7.7069	1.169E-06	11908.6642	1.0463
231.240	-1.35E-05	-105.1669	-3.2770	1.015E-06	11909.9682	.7545
236.160	-8.94E-06	-113.0696	-.1783	8.316E-07	11910.3594	.5051
241.080	-5.31E-06	-108.5581	1.8110	6.455E-07	11910.1361	.3035
246.000	-2.59E-06	-96.5194	2.9251	4.732E-07	11909.5401	.1493
250.920	-6.56E-07	-80.7064	3.3867	3.244E-07	11908.7573	.038306
255.840	6.06E-07	-63.8329	3.3930	2.030E-07	11907.9219	-.035749
260.760	1.34E-06	-47.7191	3.1084	1.093E-07	11907.1242	-.079919
265.680	1.68E-06	-33.4611	2.6628	4.111E-08	11906.4184	-.1012
270.600	1.75E-06	-21.5985	2.1525	-5.133E-09	11905.8311	-.1062
275.520	1.63E-06	-12.2703	1.6448	-3.358E-08	11905.3693	-.1002
280.440	1.42E-06	-5.3476	1.1822	-4.838E-08	11905.0266	-.087816
285.360	1.16E-06	-.5418	.7882	-5.332E-08	11904.7887	-.072386
290.280	8.90E-07	2.5127	.4715	-5.167E-08	11904.8863	-.056352
295.200	6.47E-07	4.1990	.2312	-4.603E-08	11904.9698	-.041319
300.120	4.38E-07	4.8782	.060104	-3.841E-08	11905.0034	-.028226
305.040	2.69E-07	4.8660	-.052385	-3.022E-08	11905.0028	-.017501
309.960	1.40E-07	4.4222	-.1181	-2.242E-08	11904.9808	-.009212
314.880	4.81E-08	3.7480	-.1486	-1.556E-08	11904.9475	-.003191
319.800	-1.30E-08	2.9904	-.1543	-9.900E-09	11904.9099	8.693E-04
324.720	-4.93E-08	2.2490	-.1440	-5.499E-09	11904.8732	.003334
329.640	-6.71E-08	1.5845	-.1245	-2.280E-09	11904.8403	.004576
334.560	-7.18E-08	1.0281	-.1011	-8.548E-11	11904.8128	.004939
339.480	-6.79E-08	.5896	-.077366	1.273E-09	11904.7911	.004717
344.400	-5.92E-08	.2643	-.055555	1.990E-09	11904.7750	.004149
349.320	-4.83E-08	.039061	-.036943	2.245E-09	11904.7638	.003416
354.240	-3.71E-08	-.1036	-.022026	2.191E-09	11904.7670	.002647
359.160	-2.68E-08	-.1820	-.010776	1.951E-09	11904.7709	.001926
364.080	-1.79E-08	-.2135	-.002839	1.619E-09	11904.7725	.001301
369.000	-1.09E-08	-.2131	.002314	1.261E-09	11904.7725	7.937E-04
373.920	-5.53E-09	-.1932	.005270	9.196E-10	11904.7715	4.079E-04
378.840	-1.81E-09	-.1631	.006604	6.204E-10	11904.7700	1.342E-04
383.760	5.73E-10	-.1294	.006828	3.748E-10	11904.7683	-4.297E-05
388.680	1.88E-09	-.096611	.006372	1.849E-10	11904.7667	-1.423E-04
393.600	2.39E-09	-.067083	.005574	4.746E-11	11904.7652	-1.823E-04
398.520	2.35E-09	-.041858	.004681	-4.404E-11	11904.7640	-1.805E-04
403.440	1.96E-09	-.020932	.003864	-9.678E-11	11904.7629	-1.517E-04
408.360	1.40E-09	-.003644	.003223	-1.174E-10	11904.7621	-1.090E-04
413.280	8.04E-10	.011010	.002799	-1.112E-10	11904.7624	-6.326E-05
418.200	3.02E-10	.024115	.002584	-8.173E-11	11904.7631	-2.398E-05
423.120	3.05E-17	.036599	-.002457	-3.074E-11	11904.7637	-.002025
428.040	-2.27E-17	9.190E-09	-.003719	-3.096E-18	11904.7619	.001512
432.960	-9.13E-24	-2.752E-09	-9.335E-10	2.311E-18	11904.7619	6.068E-10

437.880	1.71E-24	-1.518E-15	2.797E-10	9.277E-25	11904.7619	-1.137E-10
442.800	0.000	2.069E-16	1.543E-16	-1.738E-25	11904.7619	-7.981E-17
447.720	0.000	1.764E-22	-2.103E-17	0.0000	11904.7619	8.548E-18
452.640	0.000	-1.556E-23	-1.792E-23	0.0000	11904.7619	8.571E-24
457.560	0.000	0.0000	1.581E-24	0.0000	11904.7619	-6.428E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-5563893.268 lbs-in
Maximum shear force	=	451260.933 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .600000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	-6.370E+06	4.914E+05	0.0000	3.273E+05	-15269.6852
4.920	.573676	-4.133E+06	4.154E+05	-.008821	2.165E+05	-15621.8640
9.840	.513200	-2.266E+06	3.376E+05	-.014195	1.241E+05	-15974.0572
14.760	.433997	-7.823E+05	2.582E+05	-.016755	50631.1193	-16326.2611
19.680	.348329	3.075E+05	1.793E+05	-.017154	27126.2340	-15756.3737
24.600	.265202	1.015E+06	1.081E+05	-.016043	62167.4646	-13154.7371
29.520	.190466	1.403E+06	49884.5641	-.014012	81361.8137	-10521.7301
34.440	.127325	1.534E+06	6351.4490	-.011545	87832.7840	-7174.6581
39.360	.076860	1.488E+06	-22161.7532	-.009007	85580.5990	-4416.0746
44.280	.038694	1.333E+06	-38599.7950	-.006637	77914.6928	-2266.0562
49.200	.011548	1.121E+06	-45869.4474	-.004576	67424.1821	-689.0870

54.120	-.006329	8.910E+05	-46618.3010	-.002885	56016.1464	384.6750
59.040	-.016843	6.684E+05	-43107.9301	-.001575	44996.1700	1042.3051
63.960	-.021832	4.700E+05	-37160.7915	-6.194E-04	35170.5299	1375.2309
68.880	-.022937	3.040E+05	-30160.9177	3.067E-05	26954.4239	1470.2463
73.800	-.021530	1.731E+05	-23090.5484	4.314E-04	20475.2926	1403.8876
78.720	-.018692	75943.1794	-16587.7255	6.406E-04	15664.3252	1239.5363
83.640	-.015227	8640.8258	-11013.0590	7.116E-04	12332.5256	1026.5883
88.560	-.011690	-33825.8041	-6517.0098	6.905E-04	13579.3067	801.0740
93.480	-.008433	-56845.4057	-3101.8681	6.143E-04	14718.8909	587.1949
98.400	-.005645	-65557.1731	-674.9990	5.115E-04	15150.1665	399.3372
103.320	-.003399	-64494.0665	908.1855	4.023E-04	15097.5375	244.2338
108.240	-.001687	-57412.3391	1677.1593	2.999E-04	14746.9569	68.3572
113.160	-4.48E-04	-48581.0345	1890.6918	2.109E-04	14309.7636	18.4446
118.080	3.89E-04	-39222.9529	1896.1529	1.371E-04	13846.4922	-16.2247
123.000	9.01E-04	-30192.7816	1762.2995	7.884E-05	13399.4541	-38.1873
127.920	.001164	-22037.0812	1545.2278	3.497E-05	12995.7065	-50.0533
132.840	.001245	-15056.5668	1288.5148	3.819E-06	12650.1365	-54.3015
137.760	.001202	-9365.6106	1024.1915	-1.669E-05	12368.4060	-53.1470
142.680	.001081	-4945.6710	774.2169	-2.871E-05	12149.5971	-48.4687
147.600	9.19E-04	-1690.8095	552.1950	-3.429E-05	11988.4653	-41.7841
152.520	7.44E-04	555.4034	365.1338	-3.524E-05	11932.2571	-34.2570
157.440	5.73E-04	1971.4600	215.1108	-3.312E-05	12002.3589	-26.7280
162.360	4.18E-04	2737.2692	100.7523	-2.916E-05	12040.2703	-19.7592
167.280	2.86E-04	3020.2556	18.4827	-2.433E-05	12054.2795	-13.6838
172.200	1.78E-04	2967.0152	-36.4756	-1.930E-05	12051.6438	-8.6570
177.120	9.57E-05	2699.3164	-69.3418	-1.454E-05	12038.3914	-4.7033
182.040	3.53E-05	2313.3064	-85.2361	-1.033E-05	12019.2820	-1.7578
186.960	-5.94E-06	1880.9226	-88.8249	-6.807E-06	11997.8769	.2990
191.880	-3.17E-05	1452.6665	-84.1192	-4.008E-06	11976.6761	1.6139
196.800	-4.54E-05	1061.0766	-74.3899	-1.896E-06	11957.2905	2.3411
201.720	-5.03E-05	724.4015	-62.1681	-3.967E-07	11940.6234	2.6272
206.640	-4.93E-05	450.1234	-49.3016	5.897E-07	11927.0452	2.6031
211.560	-4.45E-05	238.1128	-37.0459	1.168E-06	11916.5497	2.3789
216.480	-3.78E-05	83.2937	-26.1692	1.438E-06	11908.8854	2.0425
221.400	-3.04E-05	-22.2215	-17.0606	1.489E-06	11905.8620	1.6602
226.320	-2.31E-05	-87.5132	-9.8306	1.397E-06	11909.0942	1.2789
231.240	-1.66E-05	-121.7033	-4.3989	1.221E-06	11910.7868	.9291
236.160	-1.11E-05	-133.2018	-.5680	1.007E-06	11911.3561	.6282
241.080	-6.71E-06	-129.2740	1.9205	7.866E-07	11911.1616	.3834
246.000	-3.37E-06	-115.8522	3.3430	5.807E-07	11910.4972	.1949
250.920	-9.96E-07	-97.5218	3.9654	4.015E-07	11909.5897	.058128
255.840	5.76E-07	-77.6232	4.0247	2.544E-07	11908.6046	-.034002
260.760	1.51E-06	-58.4193	3.7201	1.401E-07	11907.6539	-.089835
265.680	1.96E-06	-41.2934	3.2094	5.640E-08	11906.8061	-.1177
270.600	2.06E-06	-26.9494	2.6112	-9.137E-10	11906.0960	-.1254
275.520	1.95E-06	-15.5975	2.0084	-3.665E-08	11905.5341	-.1196
280.440	1.70E-06	-7.1148	1.4544	-5.572E-08	11905.1141	-.1056
285.360	1.40E-06	-1.1767	.9790	-6.269E-08	11904.8202	-.087628
290.280	1.08E-06	2.6422	.5946	-6.146E-08	11904.8927	-.068662
295.200	7.94E-07	4.7947	.3009	-5.521E-08	11904.9993	-.050705
300.120	5.42E-07	5.7118	.090209	-4.639E-08	11905.0447	-.034947
305.040	3.37E-07	5.7736	-.049766	-3.674E-08	11905.0477	-.021953
309.960	1.80E-07	5.2945	-.1329	-2.744E-08	11905.0240	-.011845
314.880	6.70E-08	4.5198	-.1730	-1.920E-08	11904.9857	-.004448
319.800	-8.77E-09	3.6300	-.1825	-1.236E-08	11904.9416	5.875E-04
324.720	-5.46E-08	2.7485	-.1720	-6.999E-09	11904.8980	.003688
329.640	-7.76E-08	1.9516	-.1499	-3.052E-09	11904.8585	.005296

334.560	-8.46E-08	1.2798	-.1225	-3.378E-10	11904.8253	.005822
339.480	-8.10E-08	.7467	-.094366	1.364E-09	11904.7989	.005622
344.400	-7.12E-08	.3485	-.068271	2.284E-09	11904.7792	.004986
349.320	-5.85E-08	.070442	-.045838	2.636E-09	11904.7654	.004133
354.240	-4.52E-08	-.1077	-.027738	2.605E-09	11904.7672	.003224
359.160	-3.29E-08	-.2076	-.013993	2.340E-09	11904.7722	.002363
364.080	-2.22E-08	-.2500	-.004219	1.955E-09	11904.7743	.001610
369.000	-1.36E-08	-.2530	.002193	1.533E-09	11904.7744	9.961E-04
373.920	-7.13E-09	-.2314	.005936	1.126E-09	11904.7734	5.254E-04
378.840	-2.54E-09	-.1968	.007693	7.665E-10	11904.7716	1.889E-04
383.760	4.17E-10	-.1572	.008081	4.691E-10	11904.7697	-3.126E-05
388.680	2.08E-09	-.1182	.007618	2.378E-10	11904.7678	-1.569E-04
393.600	2.76E-09	-.082750	.006716	6.903E-11	11904.7660	-2.101E-04
398.520	2.75E-09	-.052250	.005678	-4.435E-11	11904.7645	-2.116E-04
403.440	2.32E-09	-.026787	.004716	-1.107E-10	11904.7632	-1.797E-04
408.360	1.67E-09	-.005628	.003954	-1.380E-10	11904.7622	-1.300E-04
413.280	9.63E-10	.012394	.003448	-1.323E-10	11904.7625	-7.576E-05
418.200	3.64E-10	.028562	.003191	-9.787E-11	11904.7633	-2.882E-05
423.120	3.69E-17	.043985	-.002910	-3.694E-11	11904.7641	-.002451
428.040	-2.73E-17	1.108E-08	-.004470	-3.747E-18	11904.7619	.001817
432.960	-1.10E-23	-3.307E-09	-1.125E-09	2.778E-18	11904.7619	7.306E-10
437.880	2.06E-24	-1.827E-15	3.361E-10	1.117E-24	11904.7619	-1.366E-10
442.800	0.000	2.487E-16	1.856E-16	-2.089E-25	11904.7619	-9.601E-17
447.720	0.000	2.122E-22	-2.527E-17	0.0000	11904.7619	1.027E-17
452.640	0.000	-1.870E-23	-2.156E-23	0.0000	11904.7619	1.031E-23
457.560	0.000	0.0000	1.900E-24	0.0000	11904.7619	-7.725E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000	in
Computed slope at pile head	=	0.000	
Maximum bending moment	=	-6370408.703	lbs-in
Maximum shear force	=	491351.247	lbs
Depth of maximum bending moment	=	0.000	in
Depth of maximum shear force	=	0.000	in
Number of iterations	=	5	
Number of zero deflection points	=	14	

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .700000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	-7.089E+06	5.240E+05	0.0000	3.629E+05	-15269.6852
4.920	.670706	-4.690E+06	4.480E+05	-.009893	2.441E+05	-15621.8612
9.840	.602649	-2.662E+06	3.702E+05	-.016068	1.437E+05	-15974.0489
14.760	.512593	-1.016E+06	2.908E+05	-.019157	62182.5973	-16326.2471
19.680	.414144	2.371E+05	2.096E+05	-.019811	23642.2405	-16678.4550
24.600	.317655	1.086E+06	1.316E+05	-.018700	65651.7503	-15006.2964
29.520	.230138	1.569E+06	64802.7395	-.016470	89589.8283	-12163.4205
34.440	.155590	1.756E+06	13313.0938	-.013677	98823.6299	-8767.3298
39.360	.095552	1.727E+06	-21760.0217	-.010752	97407.5527	-5490.0342
44.280	.049788	1.563E+06	-42438.2183	-.007989	89271.2408	-2915.7368
49.200	.016940	1.325E+06	-52097.4811	-.005563	77513.0173	-1010.7928
54.120	-.004956	1.061E+06	-53843.0648	-.003559	64435.0812	301.2060
59.040	-.018082	8.025E+05	-50349.3750	-.001994	51631.2651	1118.9931
63.960	-.024576	5.696E+05	-43788.3573	-8.416E-04	40102.7164	1548.0873
68.880	-.026363	3.733E+05	-35823.0917	-4.969E-05	30382.6896	1689.8256
73.800	-.025065	2.172E+05	-27645.5438	4.462E-04	22657.1009	1634.3809
78.720	-.021972	1.003E+05	-20040.6670	7.129E-04	16872.2784	1457.0325
83.640	-.018050	18594.0724	-13462.7265	8.128E-04	12825.2605	1216.9271
88.560	-.013974	-33728.9978	-8113.3708	8.001E-04	13574.5143	957.6077
93.480	-.010177	-62816.0820	-4014.3161	7.190E-04	15014.4689	708.6747
98.400	-.006899	-74644.8766	-1070.3524	6.036E-04	15600.0528	488.0586
103.320	-.004238	-74536.1517	879.3590	4.783E-04	15594.6704	304.5071
108.240	-.002193	-66933.2078	1847.1177	3.594E-04	15218.2870	88.8908
113.160	-7.01E-04	-57067.9064	2136.7731	2.553E-04	14729.9058	28.8553
118.080	3.19E-04	-46409.7945	2174.9906	1.684E-04	14202.2765	-13.3198
123.000	9.56E-04	-35997.3965	2042.6015	9.918E-05	13686.8112	-40.4969
127.920	.001295	-26505.7841	1806.0361	4.669E-05	13216.9294	-55.6679
132.840	.001415	-18317.8800	1517.3007	9.040E-06	12811.5876	-61.7042
137.760	.001384	-11593.3361	1214.9708	-1.608E-05	12478.6894	-61.1941
142.680	.001257	-6330.9186	925.8127	-3.114E-05	12218.1737	-56.3498
147.600	.001077	-2422.0635	666.7226	-3.849E-05	12024.6660	-48.9713
152.520	8.78E-04	305.3753	446.7458	-4.027E-05	11919.8795	-40.4501
157.440	6.81E-04	2053.1570	269.0066	-3.828E-05	12006.4033	-31.8016
162.360	5.01E-04	3027.7440	132.4400	-3.402E-05	12054.6502	-23.7133
167.280	3.47E-04	3423.3117	33.2624	-2.860E-05	12074.2328	-16.6027
172.200	2.20E-04	3411.3291	-33.8395	-2.286E-05	12073.6396	-10.6745
177.120	1.22E-04	3135.3174	-74.7995	-1.736E-05	12059.9756	-5.9759
182.040	4.92E-05	2709.4674	-95.5166	-1.245E-05	12038.8940	-2.4456
186.960	-9.11E-07	2219.9388	-101.4199	-8.311E-06	12014.6599	.045893
191.880	-3.26E-05	1727.8519	-97.2145	-4.996E-06	11990.2991	1.6636
196.800	-5.01E-05	1273.1791	-86.7666	-2.475E-06	11967.7906	2.5835
201.720	-5.70E-05	878.9395	-73.0915	-6.676E-07	11948.2738	2.9755
206.640	-5.66E-05	555.2722	-58.4112	5.369E-07	11932.2506	2.9922
211.560	-5.17E-05	303.1166	-44.2531	1.258E-06	11919.7677	2.7632
216.480	-4.43E-05	117.3464	-31.5697	1.611E-06	11910.5711	2.3927
221.400	-3.58E-05	-10.6994	-20.8620	1.701E-06	11905.2916	1.9600
226.320	-2.75E-05	-91.2821	-12.2964	1.615E-06	11909.2808	1.5219

231.240	-2.00E-05	-134.8739	-5.8077	1.425E-06	11911.4388	1.1157
236.160	-1.35E-05	-151.2346	-1.1854	1.185E-06	11912.2488	.7633
241.080	-8.30E-06	-148.8699	1.8588	9.327E-07	11912.1317	.4742
246.000	-4.33E-06	-134.7794	3.6401	6.944E-07	11911.4342	.2499
250.920	-1.47E-06	-114.4176	4.4655	4.851E-07	11910.4261	.085634
255.840	4.47E-07	-91.7938	4.6113	3.119E-07	11909.3062	-.026352
260.760	1.60E-06	-69.6562	4.3116	1.763E-07	11908.2102	-.095483
265.680	2.18E-06	-49.7147	3.7535	7.608E-08	11907.2230	-.1314
270.600	2.35E-06	-32.8711	3.0786	6.715E-09	11906.3892	-.1430
275.520	2.25E-06	-19.4344	2.3871	-3.721E-08	11905.7240	-.1381
280.440	1.98E-06	-9.3089	1.7444	-6.136E-08	11905.2227	-.1232
285.360	1.64E-06	-2.1492	1.1879	-7.098E-08	11904.8683	-.1030
290.280	1.29E-06	2.5198	.7342	-7.067E-08	11904.8866	-.081395
295.200	9.49E-07	5.2143	.3848	-6.417E-08	11905.0200	-.060634
300.120	6.55E-07	6.4324	.1317	-5.439E-08	11905.0803	-.042239
305.040	4.14E-07	6.6175	-.038461	-4.343E-08	11905.0895	-.026943
309.960	2.27E-07	6.1394	-.1415	-3.272E-08	11905.0658	-.014947
314.880	9.18E-08	5.2894	-.1933	-2.312E-08	11905.0238	-.006089
319.800	-1.17E-10	4.2832	-.2082	-1.508E-08	11904.9739	7.808E-06
324.720	-5.66E-08	3.2702	-.1988	-8.733E-09	11904.9238	.003825
329.640	-8.61E-08	2.3443	-.1749	-4.018E-09	11904.8780	.005869
334.560	-9.61E-08	1.5566	-.1442	-7.416E-10	11904.8390	.006616
339.480	-9.34E-08	.9265	-.1120	1.344E-09	11904.8078	.006482
344.400	-8.29E-08	.4518	-.081779	2.501E-09	11904.7843	.005808
349.320	-6.87E-08	.1169	-.055543	2.979E-09	11904.7677	.004857
354.240	-5.36E-08	-.1006	-.034196	2.993E-09	11904.7669	.003820
359.160	-3.93E-08	-.2255	-.017849	2.719E-09	11904.7731	.002825
364.080	-2.68E-08	-.2816	-.006112	2.293E-09	11904.7758	.001946
369.000	-1.67E-08	-.2902	.001685	1.813E-09	11904.7763	.001223
373.920	-9.01E-09	-.2686	.006329	1.343E-09	11904.7752	6.643E-04
378.840	-3.51E-09	-.2305	.008605	9.240E-10	11904.7733	2.610E-04
383.760	8.33E-11	-.1858	.009232	5.744E-10	11904.7711	-6.246E-06
388.680	2.14E-09	-.1408	.008818	3.001E-10	11904.7689	-1.619E-04
393.600	3.04E-09	-.099574	.007851	9.821E-11	11904.7668	-2.314E-04
398.520	3.11E-09	-.063763	.006694	-3.898E-11	11904.7651	-2.387E-04
403.440	2.65E-09	-.033626	.005602	-1.208E-10	11904.7636	-2.054E-04
408.360	1.92E-09	-.008405	.004728	-1.561E-10	11904.7623	-1.498E-04
413.280	1.12E-09	.013202	.004143	-1.520E-10	11904.7626	-8.787E-05
418.200	4.24E-10	.032661	.003844	-1.135E-10	11904.7635	-3.358E-05
423.120	4.34E-17	.051254	-.003328	-4.305E-11	11904.7644	-.002882
428.040	-3.18E-17	1.295E-08	-.005209	-4.406E-18	11904.7619	.002117
432.960	-1.28E-23	-3.854E-09	-1.316E-09	3.237E-18	11904.7619	8.533E-10
437.880	2.39E-24	-2.133E-15	3.917E-10	1.304E-24	11904.7619	-1.592E-10
442.800	0.000	2.898E-16	2.167E-16	-2.434E-25	11904.7619	-1.120E-16
447.720	0.000	2.475E-22	-2.945E-17	0.0000	11904.7619	1.197E-17
452.640	0.000	-2.179E-23	-2.515E-23	0.0000	11904.7619	1.202E-23
457.560	0.000	0.0000	2.214E-24	0.0000	11904.7619	-9.001E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-7089248.740 lbs-in
Maximum shear force	=	523954.169 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .800000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	-7.765E+06	5.531E+05	0.0000	3.963E+05	-15269.6852
4.920	.767913	-5.222E+06	4.771E+05	-.010908	2.704E+05	-15621.8598
9.840	.692666	-3.049E+06	3.994E+05	-.017855	1.629E+05	-15974.0439
14.760	.592219	-1.258E+06	3.199E+05	-.021472	74162.0463	-16326.2365
19.680	.481379	1.409E+05	2.387E+05	-.022410	18878.4567	-16678.4364
24.600	.371703	1.135E+06	1.561E+05	-.021338	68111.5279	-16914.1818
29.520	.271411	1.719E+06	80879.5254	-.018941	96982.8125	-13650.4531
34.440	.185321	1.969E+06	21610.4677	-.015845	1.094E+05	-10442.6597
39.360	.115500	1.962E+06	-20403.4515	-.012543	1.091E+05	-6636.1692
44.280	.061897	1.792E+06	-45645.6194	-.009390	1.006E+05	-3624.8747
49.200	.023107	1.532E+06	-57954.6872	-.006598	87733.0500	-1378.8114
54.120	-.003024	1.235E+06	-60894.4972	-.004274	73049.9356	183.7667
59.040	-.018947	9.409E+05	-57558.0552	-.002446	58485.9701	1172.5105
63.960	-.027094	6.736E+05	-50475.2671	-.001090	45250.0738	1706.6716
68.880	-.029674	4.464E+05	-41597.7959	-1.495E-04	34004.2290	1902.0565
73.800	-.028565	2.645E+05	-32336.7574	4.476E-04	25001.1603	1862.5933
78.720	-.025270	1.273E+05	-23632.5670	7.767E-04	18208.4588	1675.6954
83.640	-.020922	30474.1901	-16040.3939	9.093E-04	13413.3852	1410.5538
88.560	-.016323	-32292.2374	-9818.8526	9.077E-04	13503.3875	1118.5281
93.480	-.011990	-67929.7521	-5013.4138	8.236E-04	15267.6209	834.9024
98.400	-.008219	-83245.0068	-1529.3162	6.966E-04	16025.8018	581.3975
103.320	-.005136	-84349.1278	808.5917	5.558E-04	16080.4613	368.9716
108.240	-.002749	-76382.3560	1990.3812	4.208E-04	15686.0667	111.4306
113.160	-9.94E-04	-65591.9990	2365.1514	3.016E-04	15151.8906	40.9150
118.080	2.18E-04	-53702.8221	2443.3619	2.014E-04	14563.3175	-9.1221
123.000	9.87E-04	-41945.6935	2317.9854	1.211E-04	13981.2814	-41.8440

127.920	.001410	-31132.1263	2065.9507	5.970E-05	13445.9563	-60.6091
132.840	.001575	-21734.2300	1747.9125	1.530E-05	12980.7139	-68.6747
137.760	.001560	-13962.7769	1409.2315	-1.468E-05	12595.9885	-69.0005
142.680	.001430	-7838.4996	1081.7185	-3.299E-05	12292.8064	-64.1348
147.600	.001236	-3253.7392	785.7810	-4.231E-05	12065.8381	-56.1650
152.520	.001014	-23.1533	532.6912	-4.506E-05	11905.9081	-46.7170
157.440	7.92E-04	2076.6203	326.7781	-4.334E-05	12007.5649	-36.9875
162.360	5.88E-04	3277.6268	167.4084	-3.884E-05	12067.0207	-27.7969
167.280	4.10E-04	3800.3530	50.6833	-3.289E-05	12092.8982	-19.6523
172.200	2.64E-04	3841.0852	-29.1827	-2.648E-05	12094.9146	-12.8135
177.120	1.50E-04	3565.3003	-78.7966	-2.026E-05	12081.2619	-7.3548
182.040	6.47E-05	3105.5898	-104.8140	-1.465E-05	12058.5040	-3.2214
186.960	5.49E-06	2562.7676	-113.4185	-9.892E-06	12031.6316	-.2764
191.880	-3.26E-05	2009.0195	-110.0105	-6.052E-06	12004.2183	1.6617
196.800	-5.41E-05	1492.1750	-99.0595	-3.112E-06	11978.6320	2.7899
201.720	-6.32E-05	1040.3975	-84.0769	-9.847E-07	11956.2667	3.3006
206.640	-6.38E-05	666.7958	-67.6715	4.492E-07	11937.7716	3.3683
211.560	-5.88E-05	373.6258	-51.6559	1.323E-06	11923.2582	3.1421
216.480	-5.07E-05	155.8979	-37.1787	1.768E-06	11912.4796	2.7429
221.400	-4.14E-05	4.3089	-24.8631	1.902E-06	11904.9752	2.2634
226.320	-3.20E-05	-92.4984	-14.9399	1.828E-06	11909.3410	1.7704
231.240	-2.34E-05	-146.2978	-7.3655	1.628E-06	11912.0044	1.3086
236.160	-1.60E-05	-168.1786	-1.9211	1.364E-06	11913.0876	.9046
241.080	-9.99E-06	-167.8853	1.7083	1.081E-06	11913.0731	.5708
246.000	-5.36E-06	-153.4971	3.8746	8.114E-07	11912.3608	.3098
250.920	-2.01E-06	-131.3561	4.9248	5.721E-07	11911.2647	.1171
255.840	2.65E-07	-106.1628	5.1745	3.726E-07	11910.0175	-.015638
260.760	1.66E-06	-81.1724	4.8927	2.153E-07	11908.7803	-.098915
265.680	2.38E-06	-58.4423	4.2963	9.803E-08	11907.6551	-.1435
270.600	2.62E-06	-39.0895	3.5506	1.612E-08	11906.6970	-.1596
275.520	2.54E-06	-23.5362	2.7737	-3.648E-08	11905.9271	-.1562
280.440	2.27E-06	-11.7248	2.0436	-6.610E-08	11905.3423	-.1406
285.360	1.89E-06	-3.2970	1.4061	-7.871E-08	11904.9251	-.1186
290.280	1.49E-06	2.2666	.8824	-7.958E-08	11904.8741	-.094349
295.200	1.11E-06	5.5425	.4760	-7.302E-08	11905.0363	-.070845
300.120	7.72E-07	7.0943	.1792	-6.241E-08	11905.1131	-.049827
305.040	4.95E-07	7.4283	-.022646	-5.021E-08	11905.1296	-.032213
309.960	2.78E-07	6.9703	-.1469	-3.812E-08	11905.1070	-.018294
314.880	1.20E-07	6.0579	-.2114	-2.718E-08	11905.0618	-.007931
319.800	1.08E-08	4.9435	-.2327	-1.794E-08	11905.0066	-7.266E-04
324.720	-5.70E-08	3.8034	-.2250	-1.059E-08	11904.9502	.003850
329.640	-9.33E-08	2.7502	-.1999	-5.085E-09	11904.8981	.006367
334.560	-1.07E-07	1.8465	-.1661	-1.224E-09	11904.8533	.007364
339.480	-1.05E-07	1.1181	-.1300	1.266E-09	11904.8173	.007318
344.400	-9.45E-08	.5649	-.095699	2.679E-09	11904.7899	.006623
349.320	-7.90E-08	.1711	-.065669	3.297E-09	11904.7704	.005585
354.240	-6.21E-08	-.087778	-.041042	3.367E-09	11904.7663	.004426
359.160	-4.59E-08	-.2394	-.022036	3.093E-09	11904.7738	.003300
364.080	-3.17E-08	-.3107	-.008271	2.631E-09	11904.7773	.002296
369.000	-2.00E-08	-.3259	9.769E-04	2.096E-09	11904.7780	.001463
373.920	-1.10E-08	-.3052	.006580	1.566E-09	11904.7770	8.144E-04
378.840	-4.60E-09	-.2643	.009424	1.088E-09	11904.7750	3.421E-04
383.760	-3.42E-10	-.2146	.010329	6.853E-10	11904.7725	2.567E-05
388.680	2.14E-09	-.1640	.009994	3.673E-10	11904.7700	-1.619E-04
393.600	3.27E-09	-.1170	.008982	1.313E-10	11904.7677	-2.493E-04
398.520	3.43E-09	-.075859	.007720	-3.066E-11	11904.7657	-2.638E-04
403.440	2.97E-09	-.040977	.006505	-1.288E-10	11904.7639	-2.300E-04

408.360	2.17E-09	-.011595	.005523	-1.729E-10	11904.7625	-1.692E-04
413.280	1.27E-09	.013711	.004862	-1.712E-10	11904.7626	-9.979E-05
418.200	4.83E-10	.036580	.004522	-1.289E-10	11904.7637	-3.830E-05
423.120	4.99E-17	.058461	-.003727	-4.910E-11	11904.7648	-.003315
428.040	-3.63E-17	1.483E-08	-.005941	-5.068E-18	11904.7619	.002415
432.960	-1.47E-23	-4.396E-09	-1.506E-09	3.692E-18	11904.7619	9.754E-10
437.880	2.73E-24	-2.436E-15	4.467E-10	1.491E-24	11904.7619	-1.816E-10
442.800	0.000	3.305E-16	2.475E-16	-2.776E-25	11904.7619	-1.279E-16
447.720	0.000	2.826E-22	-3.359E-17	0.0000	11904.7619	1.365E-17
452.640	0.000	-2.485E-23	-2.871E-23	0.0000	11904.7619	1.372E-23
457.560	0.000	0.0000	2.526E-24	0.0000	11904.7619	-1.027E-24
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-7765142.076 lbs-in
Maximum shear force	=	553075.677 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .900000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	-8.362E+06	5.766E+05	0.0000	4.258E+05	-15269.6852
4.920	.865449	-5.703E+06	5.006E+05	-.011812	2.942E+05	-15621.8598
9.840	.783769	-3.412E+06	4.229E+05	-.019467	1.808E+05	-15974.0447
14.760	.673889	-1.503E+06	3.434E+05	-.023596	86314.0001	-16326.2398
19.680	.551587	13444.2265	2.622E+05	-.024847	12570.3177	-16678.4455

24.600	.429396	1.126E+06	1.793E+05	-.023890	67657.6193	-17030.6626
29.520	.316512	1.825E+06	99835.8694	-.021411	1.022E+05	-15275.4472
34.440	.218710	2.151E+06	32763.4170	-.018072	1.184E+05	-11989.7774
39.360	.138682	2.183E+06	-16333.0297	-.014432	1.200E+05	-7968.1278
44.280	.076694	2.018E+06	-46983.5703	-.010904	1.118E+05	-4491.4415
49.200	.031387	1.742E+06	-62639.7708	-.007746	98140.2770	-1872.8676
54.120	4.76E-04	1.417E+06	-67318.2241	-.005092	82067.3469	-28.9426
59.040	-.018722	1.090E+06	-64539.3350	-.002987	65843.7636	1158.5723
63.960	-.028915	7.881E+05	-57208.6479	-.001410	50919.3854	1821.3818
68.880	-.032595	5.294E+05	-47588.4183	-3.034E-04	38113.1492	2089.2807
73.800	-.031900	3.204E+05	-37331.8909	4.104E-04	27767.2553	2080.0394
78.720	-.028557	1.613E+05	-27556.5933	8.149E-04	19887.7301	1893.6588
83.640	-.023881	47661.6741	-18937.5235	9.904E-04	14264.2507	1610.0281
88.560	-.018811	-27038.4037	-11805.7837	.001008	13243.2967	1289.0531
93.480	-.013965	-70490.4554	-6242.5759	9.258E-04	15394.3884	972.4135
98.400	-.009701	-90287.3652	-2162.2527	7.908E-04	16374.4334	686.2545
103.320	-.006183	-93323.2907	618.8266	6.366E-04	16524.7268	444.2656
108.240	-.003437	-85450.8938	2054.4188	4.864E-04	16135.0042	139.3085
113.160	-.001397	-74065.1002	2538.5218	3.525E-04	15571.3510	57.4814
118.080	3.10E-05	-61165.4693	2676.7434	2.389E-04	14932.7554	-1.2937
123.000	9.54E-04	-48196.0555	2574.1648	1.470E-04	14290.7052	-40.4049
127.920	.001478	-36125.0363	2318.4915	7.621E-05	13693.1300	-63.5274
132.840	.001703	-25532.0758	1979.4944	2.442E-05	13168.7261	-74.2763
137.760	.001718	-16694.8761	1609.8833	-1.104E-05	12731.2409	-75.9721
142.680	.001595	-9669.0927	1247.1023	-3.318E-05	12383.4299	-71.4999
147.600	.001392	-4358.0822	915.6320	-4.497E-05	12120.5085	-63.2441
152.520	.001152	-570.7809	629.4764	-4.911E-05	11933.0184	-53.0793
157.440	9.08E-04	1932.6055	394.5974	-4.796E-05	12000.4354	-42.4000
162.360	6.80E-04	3406.4466	211.1405	-4.348E-05	12073.3979	-32.1760
167.280	4.80E-04	4095.7924	75.3575	-3.718E-05	12107.5239	-23.0204
172.200	3.15E-04	4221.1284	-18.8157	-3.019E-05	12113.7287	-15.2615
177.120	1.83E-04	3970.0625	-78.5300	-2.331E-05	12101.2997	-9.0126
182.040	8.51E-05	3494.2708	-111.1194	-1.704E-05	12077.7456	-4.2351
186.960	1.57E-05	2910.1879	-123.4839	-1.166E-05	12048.8306	-.7912
191.880	-2.97E-05	2302.1439	-121.7109	-7.286E-06	12018.7294	1.5119
196.800	-5.60E-05	1726.8919	-110.8847	-3.902E-06	11990.2516	2.8890
201.720	-6.81E-05	1218.7176	-95.0367	-1.428E-06	11965.0945	3.5533
206.640	-7.00E-05	794.5411	-77.1929	2.627E-07	11944.0956	3.7003
211.560	-6.55E-05	458.6227	-59.4829	1.315E-06	11927.4660	3.4989
216.480	-5.71E-05	206.6409	-43.2820	1.874E-06	11914.9917	3.0869
221.400	-4.70E-05	29.0395	-29.3632	2.072E-06	11906.1995	2.5712
226.320	-3.67E-05	-86.3700	-18.0444	2.024E-06	11909.0376	2.0299
231.240	-2.71E-05	-152.5000	-9.3219	1.823E-06	11912.3114	1.5158
236.160	-1.88E-05	-181.6854	-2.9826	1.542E-06	11913.7562	1.0612
241.080	-1.19E-05	-184.8838	1.3056	1.235E-06	11913.9146	.6820
246.000	-6.63E-06	-171.2674	3.9249	9.354E-07	11913.2405	.3827
250.920	-2.73E-06	-148.1037	5.2587	6.672E-07	11912.0938	.1595
255.840	-6.22E-08	-120.8344	5.6601	4.413E-07	11910.7438	.003668
260.760	1.61E-06	-93.2767	5.4331	2.615E-07	11909.3796	-.095927
265.680	2.51E-06	-67.8868	4.8253	1.261E-07	11908.1226	-.1512
270.600	2.85E-06	-46.0439	4.0269	3.042E-08	11907.0413	-.1734
275.520	2.81E-06	-28.3219	3.1757	-3.204E-08	11906.1640	-.1726
280.440	2.54E-06	-14.7321	2.3640	-6.820E-08	11905.4912	-.1573
285.360	2.14E-06	-4.9264	1.6472	-8.471E-08	11905.0058	-.1340
290.280	1.70E-06	1.6429	1.0525	-8.747E-08	11904.8432	-.1077
295.200	1.28E-06	5.6025	.5867	-8.138E-08	11905.0393	-.081677
300.120	9.01E-07	7.5757	.2427	-7.031E-08	11905.1369	-.058125

305.040	5.86E-07	8.1294	.005813	-5.712E-08	11905.1643	-.038187
309.960	3.39E-07	7.7453	-.1429	-4.379E-08	11905.1453	-.022278
314.880	1.55E-07	6.8091	-.2231	-3.157E-08	11905.0990	-.010313
319.800	2.82E-08	5.6121	-.2531	-2.113E-08	11905.0397	-.001891
324.720	-5.26E-08	4.3599	-.2490	-1.276E-08	11904.9777	.003552
329.640	-9.73E-08	3.1866	-.2240	-6.421E-09	11904.9197	.006637
334.560	-1.16E-07	2.1686	-.1881	-1.923E-09	11904.8693	.007965
339.480	-1.16E-07	1.3399	-.1486	1.023E-09	11904.8282	.008071
344.400	-1.06E-07	.7043	-.1105	2.740E-09	11904.7968	.007402
349.320	-8.93E-08	.2468	-.076816	3.539E-09	11904.7741	.006309
354.240	-7.08E-08	-.058508	-.048875	3.697E-09	11904.7648	.005050
359.160	-5.29E-08	-.2414	-.027098	3.445E-09	11904.7739	.003803
364.080	-3.69E-08	-.3319	-.011153	2.964E-09	11904.7783	.002679
369.000	-2.37E-08	-.3570	-2.947E-04	2.385E-09	11904.7796	.001735
373.920	-1.35E-08	-.3395	.006418	1.800E-09	11904.7787	9.935E-04
378.840	-6.02E-09	-.2974	.009963	1.265E-09	11904.7766	4.476E-04
383.760	-1.02E-09	-.2440	.011254	8.104E-10	11904.7740	7.681E-05
388.680	1.95E-09	-.1883	.011079	4.473E-10	11904.7712	-1.477E-04
393.600	3.38E-09	-.1358	.010083	1.751E-10	11904.7686	-2.574E-04
398.520	3.68E-09	-.089401	.008755	-1.403E-11	11904.7663	-2.825E-04
403.440	3.24E-09	-.049661	.007443	-1.308E-10	11904.7644	-2.508E-04
408.360	2.39E-09	-.015909	.006367	-1.859E-10	11904.7627	-1.866E-04
413.280	1.41E-09	.013353	.005635	-1.880E-10	11904.7626	-1.109E-04
418.200	5.40E-10	.039908	.005257	-1.433E-10	11904.7639	-4.282E-05
423.120	5.64E-17	.065360	-.004067	-5.489E-11	11904.7651	-.003747
428.040	-4.06E-17	1.665E-08	-.006642	-5.728E-18	11904.7619	.002700
432.960	-1.64E-23	-4.915E-09	-1.691E-09	4.128E-18	11904.7619	1.094E-09
437.880	3.05E-24	-2.729E-15	4.994E-10	1.672E-24	11904.7619	-2.030E-10
442.800	0.000	3.695E-16	2.773E-16	-3.104E-25	11904.7619	-1.433E-16
447.720	0.000	3.163E-22	-3.755E-17	0.0000	11904.7619	1.527E-17
452.640	0.000	-2.779E-23	-3.214E-23	0.0000	11904.7619	1.536E-23
457.560	0.000	0.0000	2.824E-24	0.0000	11904.7619	-1.148E-24
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-8361535.825 lbs-in
Maximum shear force	=	576602.657 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	-8.944E+06	5.993E+05	0.0000	4.547E+05	-15269.6852
4.920	.963043	-6.173E+06	5.233E+05	-.012696	3.175E+05	-15621.8585
9.840	.875072	-3.770E+06	4.455E+05	-.021046	1.985E+05	-15974.0400
14.760	.755946	-1.747E+06	3.661E+05	-.025680	98403.4682	-16326.2292
19.680	.622379	-1.171E+05	2.849E+05	-.027246	17699.8683	-16678.4266
24.600	.487845	1.110E+06	2.020E+05	-.026412	66836.4644	-17030.6323
29.520	.362482	1.922E+06	1.184E+05	-.023866	1.071E+05	-16931.7052
34.440	.253004	2.322E+06	44165.9627	-.020302	1.268E+05	-13250.4058
39.360	.162715	2.397E+06	-11428.4415	-.016339	1.306E+05	-9348.9455
44.280	.092233	2.241E+06	-47714.4266	-.012443	1.229E+05	-5401.4549
49.200	.040276	1.952E+06	-66914.0569	-.008921	1.085E+05	-2403.2729
54.120	.004449	1.601E+06	-73491.2630	-.005938	91142.5256	-270.3881
59.040	-.018150	1.240E+06	-71393.3063	-.003552	73304.4199	1123.2161
63.960	-.030499	9.051E+05	-63904.0653	-.001750	56710.8190	1921.1908
68.880	-.035369	6.149E+05	-53600.9772	-4.732E-04	42345.3926	2267.0564
73.800	-.035156	3.786E+05	-42384.8505	3.612E-04	30646.3481	2292.3448
78.720	-.031815	1.971E+05	-31555.8454	8.447E-04	21663.3268	2109.6898
83.640	-.026844	66408.1563	-21913.8890	.001066	15192.2944	1809.8047
88.560	-.021325	-20607.6072	-13866.9559	.001104	12924.9405	1461.3063
93.480	-.015976	-72216.3440	-7535.5219	.001027	15479.8284	1112.4474
98.400	-.011224	-96777.3699	-2845.7472	8.846E-04	16695.7208	793.9651
103.320	-.007271	-1.020E+05	392.5732	7.177E-04	16952.2568	522.4253
108.240	-.004162	-94326.8632	2092.6707	5.528E-04	16574.4086	168.6713
113.160	-.001831	-82455.4939	2692.9780	4.044E-04	15986.7170	75.3561
118.080	-1.83E-04	-68623.7360	2897.1286	2.775E-04	15301.9766	7.6319
123.000	8.99E-04	-54493.8098	2822.2069	1.741E-04	14602.4753	-38.0879
127.920	.001530	-41195.7827	2566.6989	9.370E-05	13944.1571	-65.7772
132.840	.001821	-29421.8922	2209.5701	3.439E-05	13361.2912	-79.3972
137.760	.001868	-19521.2904	1811.0016	-6.717E-06	12871.1624	-82.6225
142.680	.001755	-11588.4167	1414.2140	-3.285E-05	12478.4459	-78.6732
147.600	.001545	-5540.7838	1047.9093	-4.723E-05	12179.0581	-70.2312
152.520	.001290	-1184.0366	728.9621	-5.288E-05	11963.3776	-59.4221
157.440	.001025	1736.2720	465.0917	-5.242E-05	11990.7160	-47.8423
162.360	7.74E-04	3495.6212	257.3266	-4.802E-05	12077.8125	-36.6151
167.280	5.52E-04	4362.8735	102.1531	-4.142E-05	12120.7457	-26.4636
172.200	3.67E-04	4582.3269	-6.7078	-3.391E-05	12131.6098	-17.7888
177.120	2.19E-04	4363.6024	-76.9049	-2.640E-05	12120.7818	-10.7466
182.040	1.07E-04	3877.5294	-116.4205	-1.947E-05	12096.7188	-5.3167
186.960	2.71E-05	3256.3496	-132.8534	-1.348E-05	12065.9673	-1.3634
191.880	-2.58E-05	2596.7857	-132.9698	-8.567E-06	12033.3157	1.3160
196.800	-5.72E-05	1964.7856	-122.4679	-4.736E-06	12002.0285	2.9531

201.720	-7.24E-05	1401.0209	-105.9024	-1.909E-06	11974.1194	3.7809
206.640	-7.60E-05	926.4619	-86.7229	4.610E-08	11950.6264	4.0157
211.560	-7.20E-05	547.5766	-67.3839	1.284E-06	11931.8697	3.8457
216.480	-6.34E-05	260.8767	-49.4954	1.963E-06	11917.6766	3.4261
221.400	-5.26E-05	56.6788	-33.9872	2.230E-06	11907.5678	2.8780
226.320	-4.14E-05	-77.9457	-21.2716	2.212E-06	11908.6206	2.2909
231.240	-3.09E-05	-156.9871	-11.3901	2.015E-06	11912.5335	1.7260
236.160	-2.16E-05	-193.9894	-4.1396	1.720E-06	11914.3653	1.2214
241.080	-1.39E-05	-201.1054	.8257	1.388E-06	11914.7176	.7970
246.000	-7.95E-06	-188.5959	3.9161	1.061E-06	11914.0983	.4592
250.920	-3.51E-06	-164.6589	5.5500	7.640E-07	11912.9133	.2050
255.840	-4.33E-07	-135.4877	6.1171	5.120E-07	11911.4692	.025565
260.760	1.53E-06	-105.4738	5.9564	3.096E-07	11909.9834	-.090914
265.680	2.61E-06	-77.4862	5.3457	1.559E-07	11908.5979	-.1573
270.600	3.06E-06	-53.1786	4.5009	4.618E-08	11907.3945	-.1861
275.520	3.07E-06	-33.2883	3.5795	-2.644E-08	11906.4098	-.1885
280.440	2.80E-06	-17.9046	2.6885	-6.944E-08	11905.6483	-.1737
285.360	2.38E-06	-6.6967	1.8936	-9.010E-08	11905.0934	-.1494
290.280	1.91E-06	.9058	1.2283	-9.497E-08	11904.8067	-.1211
295.200	1.45E-06	5.5764	.7026	-8.952E-08	11905.0380	-.092622
300.120	1.03E-06	7.9956	.3110	-7.812E-08	11905.1577	-.066585
305.040	6.81E-07	8.7899	.038083	-6.402E-08	11905.1970	-.044338
309.960	4.02E-07	8.4964	-.1360	-4.951E-08	11905.1825	-.026435
314.880	1.94E-07	7.5489	-.2327	-3.603E-08	11905.1356	-.012849
319.800	4.75E-08	6.2779	-.2721	-2.442E-08	11905.0727	-.003184
324.720	-4.66E-08	4.9195	-.2722	-1.501E-08	11905.0054	.003153
329.640	-1.00E-07	3.6293	-.2476	-7.833E-09	11904.9416	.006833
334.560	-1.24E-07	2.4985	-.2099	-2.686E-09	11904.8856	.008515
339.480	-1.27E-07	1.5697	-.1673	7.304E-10	11904.8396	.008792
344.400	-1.17E-07	.8511	-.1256	2.764E-09	11904.8040	.008163
349.320	-9.94E-08	.3286	-.088201	3.754E-09	11904.7782	.007026
354.240	-7.96E-08	-.024231	-.056961	4.010E-09	11904.7631	.005674
359.160	-6.00E-08	-.2397	-.032398	3.788E-09	11904.7738	.004311
364.080	-4.23E-08	-.3505	-.014244	3.293E-09	11904.7793	.003069
369.000	-2.76E-08	-.3864	-.001736	2.674E-09	11904.7810	.002016
373.920	-1.60E-08	-.3728	.006127	2.036E-09	11904.7804	.001181
378.840	-7.53E-09	-.3301	.010409	1.446E-09	11904.7782	5.601E-04
383.760	-1.78E-09	-.2732	.012115	9.390E-10	11904.7754	1.337E-04
388.680	1.71E-09	-.2127	.012127	5.308E-10	11904.7724	-1.291E-04
393.600	3.44E-09	-.1550	.011164	2.220E-10	11904.7696	-2.622E-04
398.520	3.89E-09	-.1033	.009784	5.123E-12	11904.7670	-2.990E-04
403.440	3.49E-09	-.058701	.008384	-1.309E-10	11904.7648	-2.703E-04
408.360	2.60E-09	-.020547	.007219	-1.975E-10	11904.7629	-2.032E-04
413.280	1.55E-09	.012720	.006419	-2.041E-10	11904.7625	-1.217E-04
418.200	5.96E-10	.043021	.006004	-1.573E-10	11904.7640	-4.724E-05
423.120	6.28E-17	.072107	-.004384	-6.056E-11	11904.7655	-.004175
428.040	-4.48E-17	1.844E-08	-.007328	-6.383E-18	11904.7619	.002979
432.960	-1.82E-23	-5.422E-09	-1.873E-09	4.554E-18	11904.7619	1.210E-09
437.880	3.37E-24	-3.017E-15	5.510E-10	1.849E-24	11904.7619	-2.240E-10
442.800	0.000	4.077E-16	3.065E-16	-3.424E-25	11904.7619	-1.583E-16
447.720	0.000	3.494E-22	-4.143E-17	0.0000	11904.7619	1.684E-17
452.640	0.000	-3.065E-23	-3.550E-23	0.0000	11904.7619	1.697E-23
457.560	0.000	0.0000	3.115E-24	0.0000	11904.7619	-1.266E-24
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-8943677.734 lbs-in
Maximum shear force	=	599254.814 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	14

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .100000	S= 0.000	2.000E+05	.100000	-1.207E+06	1.098E+05
5	y= .200000	S= 0.000	2.000E+05	.2000	-2.413E+06	2.196E+05
5	y= .300000	S= 0.000	2.000E+05	.3000	-3.560E+06	3.140E+05
5	y= .400000	S= 0.000	2.000E+05	.4000	-4.629E+06	3.971E+05
5	y= .500000	S= 0.000	2.000E+05	.5000	-5.564E+06	4.513E+05
5	y= .600000	S= 0.000	2.000E+05	.6000	-6.370E+06	4.914E+05
5	y= .700000	S= 0.000	2.000E+05	.7000	-7.089E+06	5.240E+05
5	y= .800000	S= 0.000	2.000E+05	.8000	-7.765E+06	5.531E+05
5	y= .900000	S= 0.000	2.000E+05	.9000	-8.362E+06	5.766E+05
5	y= 1.000	S= 0.000	2.000E+05	1.0000	-8.944E+06	5.993E+05

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = .10000 in
Slope = .00000
Axial Load = 200000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
492.000	.10000000	-1206627.403	109811.603
467.400	.10000000	-1209563.587	109949.020
442.800	.10000000	-1212352.060	110080.057
418.200	.10000000	-1214994.877	110204.654
393.600	.10000000	-1217495.040	110322.789
369.000	.10000000	-1219847.469	110434.270
344.400	.10000000	-1222051.706	110539.012
319.800	.10000000	-1224106.646	110636.915
295.200	.10000000	-1226014.097	110727.946
270.600	.10000000	-1227770.250	110811.961

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Pier_B19_Free.lpd
Name of output file: ArroyoMocho_Pier_B19_Free.lpo
Name of plot output file: ArroyoMocho_Pier_B19_Free.lpp
Name of runtime file: ArroyoMocho_Pier_B19_Free.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:58: 8

Problem Title

SR84 Isabel Pier - Arroyo Mocho Bridge Widen - H pile

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 492.00 in
Depth of ground surface below top of pile = -216.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	492.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -216.000 in
Distance from top of pile to bottom of layer = -180.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -180.000 in
Distance from top of pile to bottom of layer = 108.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 780.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 288.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-216.00	.07230
2	-180.00	.07230
3	-180.00	.07810
4	108.00	.07810
5	108.00	.04200
6	420.00	.04200
7	420.00	.04200
8	780.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-216.000	.00000	35.00	------	------
2	-180.000	.00000	35.00	------	------
3	-180.000	.00000	40.00	------	------
4	108.000	.00000	40.00	------	------
5	108.000	.00000	40.00	------	------
6	420.000	.00000	40.00	------	------
7	420.000	27.77800	.00	.00500	.0
8	780.000	27.77800	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .100 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .200 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .300 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .400 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .500 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .600 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Deflection at pile head = .700 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .800 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .900 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	276.000

Depth of ground surface below top of pile = -216.00 in

p-y Curve in Sand Computed Using Reese Criteria

Soil Layer Number = 2
Depth below pile head = 60.000 in
Depth below ground surface = 276.000 in
Equivalent Depth (see note) = 276.000 in
Pile Diameter = 10.000 in
Angle of Friction = 40.000 deg.
Avg. Eff. Unit Weight = .07734 lbs/in**3
k = 225.000 pci
A (static) = .8800
B (static) = .5000
Pst = 28178.350 lbs/in

Psd = 22232.297 lbs/in
Ps = 22232.297 lbs/in
pu = 19564.422 lbs/in
Cbar = 33042.3027
n = 1.6447
m = 40551.7102
yk = .2000 in
ym = .1667 in
yu = .3750 in
p-multiplier = 1.00000
y-multiplier = 1.00000

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	862.500
.0278	1725.000
.0417	2587.500
.0556	3450.000
.0694	4312.500
.0833	5175.000
.0972	6037.500
.1111	6900.000
.1250	7762.500
.1389	8625.000
.1528	9487.500
.1667	10350.000
.3750	19564.422
10.3750	19564.422
20.3750	19564.422
30.3750	19564.422

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .100000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	0.0000	55122.4809	-.004532	11904.7619	-4860.0000
4.920	.077701	2.168E+05	33665.7102	-.004350	22639.4615	-3862.2645

9.840	.057193	3.398E+05	17015.2388	-.003883	28728.1248	-2906.2198
14.760	.039494	3.919E+05	4821.4812	-.003268	31306.3515	-2050.5922
19.680	.025035	3.937E+05	-3488.7059	-.002608	31395.2100	-1327.5326
24.600	.013828	3.627E+05	-8595.9933	-.001973	29861.0222	-748.6005
29.520	.005620	3.130E+05	-11201.2648	-.001406	27400.0795	-310.4530
34.440	-1.86E-06	2.553E+05	-11964.7217	-9.282E-04	24541.4977	.1046
39.360	-.003514	1.971E+05	-11467.7892	-5.483E-04	21662.1544	201.9004
44.280	-.005397	1.435E+05	-10193.5611	-2.623E-04	19008.6280	316.0785
49.200	-.006095	97310.7980	-8521.3995	-6.000E-05	16722.1281	363.6620
54.120	-.005988	59765.6057	-6731.5687	7.192E-05	14863.4553	363.9115
59.040	-.005387	30930.6162	-5016.2850	1.481E-04	13435.9805	333.3583
63.960	-.004530	10113.9061	-3494.2063	1.826E-04	12405.4503	285.3729
68.880	-.003590	-3811.6710	-2226.0603	1.879E-04	12093.4585	230.1336
73.800	-.002682	-12160.2409	-1229.7582	1.744E-04	12506.7540	174.8672
78.720	-.001874	-16255.8058	-493.9214	1.506E-04	12709.5048	124.2534
83.640	-.001200	-17316.7738	10.7757	1.224E-04	12762.0279	80.9080
88.560	-6.69E-04	-16390.6274	322.6693	9.408E-05	12716.1791	45.8780
93.480	-2.74E-04	-14326.8486	482.5289	6.828E-05	12614.0118	19.1056
98.400	2.34E-06	-11776.9106	529.1211	4.635E-05	12487.7773	-.1657
103.320	1.82E-04	-9211.5183	496.5935	2.872E-05	12360.7777	-13.0569
108.240	2.85E-04	-6946.9614	436.0584	1.515E-05	12248.6709	-11.5508
113.160	3.31E-04	-4950.5260	374.1564	5.161E-06	12149.8374	-13.6126
118.080	3.36E-04	-3275.4195	306.1749	-1.748E-06	12066.9114	-14.0222
123.000	3.14E-04	-1934.3262	238.9848	-6.123E-06	12000.5206	-13.2908
127.920	2.76E-04	-911.7591	177.1506	-8.513E-06	11949.8985	-11.8450
132.840	2.30E-04	-174.4098	123.3535	-9.426E-06	11913.3961	-10.0237
137.760	1.83E-04	320.5896	78.8121	-9.303E-06	11920.6327	-8.0825
142.680	1.38E-04	619.4100	43.6716	-8.513E-06	11935.4258	-6.2022
147.600	9.90E-05	767.0730	17.3444	-7.349E-06	11942.7358	-4.4999
152.520	6.60E-05	804.5419	-1.2067	-6.029E-06	11944.5907	-3.0412
157.440	3.97E-05	767.0638	-13.2450	-4.709E-06	11942.7354	-1.8524
162.360	1.97E-05	683.4790	-20.0918	-3.491E-06	11938.5975	-.9309
167.280	5.33E-06	576.2306	-23.0103	-2.433E-06	11933.2882	-.2555
172.200	-4.26E-06	461.8454	-23.1308	-1.561E-06	11927.6255	.2065
177.120	-1.00E-05	351.6956	-21.4107	-8.777E-07	11922.1726	.4927
182.040	-1.29E-05	252.8918	-18.6206	-3.699E-07	11917.2813	.6414
186.960	-1.37E-05	169.1968	-15.3492	-1.538E-08	11913.1380	.6884
191.880	-1.30E-05	101.8857	-12.0198	2.123E-07	11909.8058	.6650
196.800	-1.16E-05	50.5038	-8.9143	3.403E-07	11907.2621	.5974
201.720	-9.69E-06	13.4995	-6.1993	3.940E-07	11905.4302	.5062
206.640	-7.70E-06	-11.2732	-3.9533	3.959E-07	11905.3200	.4068
211.560	-5.80E-06	-26.1799	-2.1901	3.645E-07	11906.0579	.3099
216.480	-4.11E-06	-33.5408	-.8805	3.143E-07	11906.4223	.2224
221.400	-2.71E-06	-35.4623	.030699	2.563E-07	11906.5175	.1480
226.320	-1.59E-06	-33.7431	.6112	1.982E-07	11906.4324	.088016
231.240	-7.56E-07	-29.8377	.9318	1.448E-07	11906.2390	.042270
236.160	-1.67E-07	-24.8597	1.0589	9.888E-08	11905.9926	.009434
241.080	2.17E-07	-19.6123	1.0517	6.152E-08	11905.7328	-.012388
246.000	4.38E-07	-14.6323	.9589	3.276E-08	11905.4863	-.025322
250.920	5.39E-07	-10.2411	.8192	1.187E-08	11905.2689	-.031471
255.840	5.55E-07	-6.5948	.6612	-2.268E-09	11905.0884	-.032752
260.760	5.17E-07	-3.7304	.5049	-1.094E-08	11904.9466	-.030805
265.680	4.48E-07	-1.6054	.3628	-1.542E-08	11904.8414	-.026954
270.600	3.65E-07	-.1303	.2418	-1.688E-08	11904.7684	-.022211
275.520	2.82E-07	.8073	.1446	-1.631E-08	11904.8019	-.017300
280.440	2.05E-07	1.3249	.070828	-1.452E-08	11904.8275	-.012701
285.360	1.39E-07	1.5329	.018200	-1.212E-08	11904.8378	-.008693

290.280	8.54E-08	1.5278	-.016482	-9.549E-09	11904.8375	-.005406
295.200	4.48E-08	1.3895	-.036814	-7.098E-09	11904.8307	-.002860
300.120	1.56E-08	1.1796	-.046319	-4.941E-09	11904.8203	-.001004
305.040	-3.87E-09	.9434	-.048171	-3.158E-09	11904.8086	2.518E-04
309.960	-1.55E-08	.7118	-.045044	-1.767E-09	11904.7971	.001019
314.880	-2.13E-08	.5036	-.039066	-7.467E-10	11904.7868	.001411
319.800	-2.29E-08	.3288	-.031831	-4.752E-11	11904.7782	.001530
324.720	-2.17E-08	.1905	-.024454	3.887E-10	11904.7713	.001468
329.640	-1.90E-08	.087441	-.017649	6.221E-10	11904.7662	.001298
334.560	-1.56E-08	.015629	-.011815	7.087E-10	11904.7627	.001074
339.480	-1.21E-08	-.030215	-.007115	6.964E-10	11904.7634	8.369E-04
344.400	-8.75E-09	-.055751	-.003548	6.242E-10	11904.7647	6.130E-04
349.320	-5.91E-09	-.066357	-.001013	5.217E-10	11904.7652	4.176E-04
354.240	-3.62E-09	-.066743	6.490E-04	4.099E-10	11904.7652	2.579E-04
359.160	-1.88E-09	-.060778	.001615	3.028E-10	11904.7649	1.349E-04
364.080	-6.38E-10	-.051446	.002061	2.085E-10	11904.7645	4.625E-05
369.000	1.76E-10	-.040909	.002143	1.310E-10	11904.7639	-1.284E-05
373.920	6.51E-10	-.030616	.001993	7.091E-11	11904.7634	-4.800E-05
378.840	8.73E-10	-.021434	.001716	2.719E-11	11904.7630	-6.493E-05
383.760	9.19E-10	-.013788	.001386	-2.390E-12	11904.7626	-6.886E-05
388.680	8.50E-10	-.007787	.001059	-2.051E-11	11904.7623	-6.423E-05
393.600	7.17E-10	-.003327	7.667E-04	-2.985E-11	11904.7621	-5.461E-05
398.520	5.56E-10	-1.840E-04	5.273E-04	-3.279E-11	11904.7619	-4.272E-05
403.440	3.94E-10	.001926	3.471E-04	-3.133E-11	11904.7620	-3.051E-05
408.360	2.48E-10	.003293	2.245E-04	-2.695E-11	11904.7621	-1.934E-05
413.280	1.29E-10	.004188	1.520E-04	-2.066E-11	11904.7621	-1.013E-05
418.200	4.45E-11	.004830	1.184E-04	-1.309E-11	11904.7621	-3.524E-06
423.120	3.68E-18	.005379	-4.917E-04	-4.517E-12	11904.7622	-2.445E-04
428.040	-3.34E-18	1.254E-09	-5.466E-04	-3.738E-19	11904.7619	2.222E-04
432.960	-1.28E-24	-4.044E-10	-1.274E-10	3.397E-19	11904.7619	8.519E-11
437.880	2.51E-25	-2.159E-16	4.110E-11	1.302E-25	11904.7619	-1.671E-11
442.800	0.000	3.041E-17	2.193E-17	0.0000	11904.7619	-1.143E-17
447.720	0.000	2.537E-23	-3.090E-18	0.0000	11904.7619	1.256E-18
452.640	0.000	-2.287E-24	-2.578E-24	0.0000	11904.7619	1.237E-24
457.560	0.000	0.0000	2.324E-25	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	-.00453240
Maximum bending moment	=	393707.052 lbs-in
Maximum shear force	=	55122.481 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5

Number of zero deflection points = 14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .200000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	0.0000	1.102E+05	-.009065	11904.7619	-9720.0000
4.920	.155401	4.337E+05	67331.4205	-.008701	33374.1610	-7724.5290
9.840	.114387	6.797E+05	34030.4776	-.007765	45551.4877	-5812.4396
14.760	.078989	7.838E+05	9642.9624	-.006536	50707.9412	-4101.1844
19.680	.050069	7.874E+05	-6977.4118	-.005217	50885.6581	-2655.0652
24.600	.027657	7.254E+05	-17191.9866	-.003946	47817.2825	-1497.2009
29.520	.011240	6.260E+05	-22402.5296	-.002811	42895.3971	-620.9060
34.440	-3.71E-06	5.105E+05	-23929.4434	-.001856	37178.2336	.2093
39.360	-.007028	3.942E+05	-22935.5785	-.001097	31419.5469	403.8009
44.280	-.010794	2.870E+05	-20387.1221	-5.245E-04	26112.4940	632.1570
49.200	-.012189	1.946E+05	-17042.7990	-1.200E-04	21539.4944	727.3239
54.120	-.011975	1.195E+05	-13463.1375	1.438E-04	17822.1486	727.8231
59.040	-.010774	61861.2324	-10032.5700	2.962E-04	14967.1992	666.7166
63.960	-.009061	20227.8122	-6988.4127	3.651E-04	12906.1387	570.7458
68.880	-.007181	-7623.3420	-4452.1206	3.757E-04	12282.1551	460.2673
73.800	-.005364	-24320.4818	-2459.5164	3.489E-04	13108.7461	349.7344
78.720	-.003748	-32511.6117	-987.8429	3.012E-04	13514.2476	248.5069
83.640	-.002400	-34633.5476	21.5514	2.448E-04	13619.2940	161.8160
88.560	-.001339	-32781.2549	645.3385	1.882E-04	13527.5963	91.7560
93.480	-5.49E-04	-28653.6971	965.0579	1.366E-04	13323.2618	38.2113
98.400	4.69E-06	-23553.8213	1058.2423	9.270E-05	13070.7927	-.3314
103.320	3.63E-04	-18423.0365	993.1869	5.745E-05	12816.7934	-26.1138
108.240	5.70E-04	-13893.9229	872.1168	3.031E-05	12592.5799	-23.1016
113.160	6.62E-04	-9901.0519	748.3128	1.032E-05	12394.9130	-27.2252
118.080	6.72E-04	-6550.8390	612.3497	-3.495E-06	12229.0609	-28.0444
123.000	6.27E-04	-3868.6525	477.9695	-1.225E-05	12096.2794	-26.5817
127.920	5.51E-04	-1823.5181	354.3012	-1.703E-05	11995.0351	-23.6900
132.840	4.60E-04	-348.8196	246.7071	-1.885E-05	11922.0302	-20.0474
137.760	3.66E-04	641.1792	157.6243	-1.861E-05	11936.5035	-16.1651
142.680	2.77E-04	1238.8199	87.3433	-1.703E-05	11966.0896	-12.4044
147.600	1.98E-04	1534.1460	34.6888	-1.470E-05	11980.7097	-8.9998
152.520	1.32E-04	1609.0837	-2.4135	-1.206E-05	11984.4195	-6.0825
157.440	7.94E-05	1534.1276	-26.4899	-9.418E-06	11980.7088	-3.7047
162.360	3.94E-05	1366.9580	-40.1836	-6.982E-06	11972.4331	-1.8618
167.280	1.07E-05	1152.4612	-46.0206	-4.866E-06	11961.8144	-.5110
172.200	-8.51E-06	923.6908	-46.2616	-3.122E-06	11950.4892	.4130
177.120	-2.01E-05	703.3913	-42.8213	-1.755E-06	11939.5833	.9855
182.040	-2.58E-05	505.7836	-37.2412	-7.398E-07	11929.8007	1.2829

186.960	-2.73E-05	338.3936	-30.6984	-3.077E-08	11921.5141	1.3768
191.880	-2.61E-05	203.7715	-24.0397	4.246E-07	11914.8496	1.3300
196.800	-2.32E-05	101.0075	-17.8286	6.806E-07	11909.7623	1.1948
201.720	-1.94E-05	26.9991	-12.3987	7.881E-07	11906.0985	1.0124
206.640	-1.54E-05	-22.5465	-7.9066	7.918E-07	11905.8781	.8136
211.560	-1.16E-05	-52.3597	-4.3801	7.289E-07	11907.3540	.6199
216.480	-8.23E-06	-67.0815	-1.7610	6.286E-07	11908.0828	.4448
221.400	-5.41E-06	-70.9246	.061398	5.127E-07	11908.2730	.2960
226.320	-3.18E-06	-67.4863	1.2225	3.964E-07	11908.1028	.1760
231.240	-1.51E-06	-59.6754	1.8635	2.896E-07	11907.7161	.084540
236.160	-3.34E-07	-49.7194	2.1179	1.978E-07	11907.2233	.018868
241.080	4.34E-07	-39.2246	2.1034	1.230E-07	11906.7037	-.024777
246.000	8.77E-07	-29.2646	1.9178	6.553E-08	11906.2106	-.050645
250.920	1.08E-06	-20.4822	1.6384	2.374E-08	11905.7759	-.062942
255.840	1.11E-06	-13.1895	1.3224	-4.535E-09	11905.4149	-.065504
260.760	1.03E-06	-7.4607	1.0097	-2.188E-08	11905.1312	-.061609
265.680	8.95E-07	-3.2109	.7255	-3.084E-08	11904.9209	-.053908
270.600	7.30E-07	-.2607	.4837	-3.376E-08	11904.7748	-.044422
275.520	5.63E-07	1.6147	.2893	-3.262E-08	11904.8418	-.034600
280.440	4.09E-07	2.6498	.1417	-2.904E-08	11904.8931	-.025401
285.360	2.77E-07	3.0657	.036399	-2.424E-08	11904.9137	-.017386
290.280	1.71E-07	3.0557	-.032964	-1.910E-08	11904.9132	-.010811
295.200	8.95E-08	2.7789	-.073629	-1.420E-08	11904.8995	-.005719
300.120	3.11E-08	2.3591	-.092639	-9.881E-09	11904.8787	-.002009
305.040	-7.73E-09	1.8868	-.096342	-6.315E-09	11904.8553	5.036E-04
309.960	-3.10E-08	1.4236	-.090088	-3.535E-09	11904.8324	.002039
314.880	-4.25E-08	1.0073	-.078133	-1.493E-09	11904.8118	.002821
319.800	-4.57E-08	.6577	-.063662	-9.503E-11	11904.7945	.003061
324.720	-4.35E-08	.3810	-.048908	7.774E-10	11904.7808	.002937
329.640	-3.81E-08	.1749	-.035298	1.244E-09	11904.7706	.002595
334.560	-3.12E-08	.031258	-.023630	1.417E-09	11904.7635	.002148
339.480	-2.41E-08	-.060430	-.014230	1.393E-09	11904.7649	.001674
344.400	-1.75E-08	-.1115	-.007096	1.248E-09	11904.7674	.001226
349.320	-1.18E-08	-.1327	-.002025	1.043E-09	11904.7685	8.353E-04
354.240	-7.23E-09	-.1335	.001298	8.198E-10	11904.7685	5.157E-04
359.160	-3.75E-09	-.1216	.003230	6.056E-10	11904.7679	2.698E-04
364.080	-1.28E-09	-.1029	.004122	4.171E-10	11904.7670	9.251E-05
369.000	3.51E-10	-.081819	.004286	2.620E-10	11904.7660	-2.568E-05
373.920	1.30E-09	-.061232	.003987	1.418E-10	11904.7649	-9.600E-05
378.840	1.75E-09	-.042868	.003431	5.438E-11	11904.7640	-1.299E-04
383.760	1.84E-09	-.027577	.002773	-4.781E-12	11904.7633	-1.377E-04
388.680	1.70E-09	-.015574	.002118	-4.102E-11	11904.7627	-1.285E-04
393.600	1.43E-09	-.006654	.001533	-5.969E-11	11904.7622	-1.092E-04
398.520	1.11E-09	-3.679E-04	.001055	-6.559E-11	11904.7619	-8.543E-05
403.440	7.88E-10	.003851	6.943E-04	-6.266E-11	11904.7621	-6.101E-05
408.360	4.96E-10	.006587	4.490E-04	-5.390E-11	11904.7622	-3.868E-05
413.280	2.58E-10	.008375	3.040E-04	-4.133E-11	11904.7623	-2.027E-05
418.200	8.89E-11	.009660	2.368E-04	-2.618E-11	11904.7624	-7.048E-06
423.120	7.36E-18	.010757	-9.835E-04	-9.035E-12	11904.7624	-4.890E-04
428.040	-6.68E-18	2.508E-09	-.001093	-7.475E-19	11904.7619	4.444E-04
432.960	-2.56E-24	-8.089E-10	-2.547E-10	6.793E-19	11904.7619	1.704E-10
437.880	5.03E-25	-4.317E-16	8.220E-11	2.605E-25	11904.7619	-3.342E-11
442.800	0.000	6.082E-17	4.387E-17	0.0000	11904.7619	-2.286E-17
447.720	0.000	5.075E-23	-6.181E-18	0.0000	11904.7619	2.513E-18
452.640	0.000	-4.573E-24	-5.157E-24	0.0000	11904.7619	2.474E-24
457.560	0.000	0.0000	4.648E-25	0.0000	11904.7619	-1.889E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	-.00906479
Maximum bending moment	=	787414.104 lbs-in
Maximum shear force	=	110244.962 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .300000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	0.0000	1.591E+05	-.013557	11904.7619	-12895.9432
4.920	.233297	6.399E+05	1.002E+05	-.013020	43582.7369	-11033.5451
9.840	.171883	1.012E+06	51577.6404	-.011633	61986.4507	-8734.0681
14.760	.118830	1.170E+06	14914.2566	-.009800	69841.0318	-6169.7465
19.680	.075448	1.178E+06	-10105.4029	-.007828	70206.4181	-4000.8468
24.600	.041799	1.086E+06	-25513.9536	-.005927	65681.0776	-2262.7917
29.520	.017128	9.383E+05	-33408.0010	-.004226	58355.2652	-946.1707
34.440	2.11E-04	7.659E+05	-35764.8172	-.002795	49818.8448	-11.8846
39.360	-.010377	5.919E+05	-34327.4183	-.001655	41205.5153	596.1931
44.280	-.016072	4.313E+05	-30545.3052	-7.954E-04	33258.1952	941.2512
49.200	-.018204	2.929E+05	-25557.7478	-1.872E-04	26403.5163	1086.2111
54.120	-.017914	1.802E+05	-20207.2628	2.102E-04	20826.5194	1088.7828
59.040	-.016136	93621.7933	-15072.4392	4.401E-04	16539.5041	998.5438
63.960	-.013583	31040.4922	-10511.1738	5.448E-04	13441.4199	855.6291
68.880	-.010774	-10880.4153	-6707.4005	5.618E-04	12443.3963	690.6202
73.800	-.008055	-36065.9090	-3716.3456	5.223E-04	13690.2029	525.2557
78.720	-.005635	-48477.2405	-1505.0709	4.513E-04	14304.6253	373.6365

83.640	-.003614	-51764.0515	13.4972	3.672E-04	14467.3387	243.6677
88.560	-.002022	-49066.9858	953.7312	2.825E-04	14333.8206	138.5413
93.480	-8.35E-04	-42935.2329	1437.5324	2.052E-04	14030.2685	58.1259
98.400	-2.59E-06	-35325.4954	1580.9732	1.395E-04	13653.5488	.1834
103.320	5.38E-04	-27652.9296	1486.4040	8.657E-05	13273.7188	-38.6262
108.240	8.49E-04	-20869.6575	1306.7059	4.582E-05	12937.9133	-34.4218
113.160	9.88E-04	-14885.1184	1121.9764	1.579E-05	12641.6490	-40.6715
118.080	.001005	-9860.4869	918.7145	-4.992E-06	12392.9048	-41.9553
123.000	9.39E-04	-5835.1430	717.5824	-1.817E-05	12193.6304	-39.8057
127.920	8.26E-04	-2763.7081	532.3236	-2.540E-05	12041.5791	-35.5027
132.840	6.89E-04	-547.0987	371.0290	-2.818E-05	11931.8460	-30.0642
137.760	5.49E-04	942.6700	237.3968	-2.785E-05	11951.4287	-24.2579
142.680	4.15E-04	1843.6845	131.8984	-2.550E-05	11996.0334	-18.6276
147.600	2.98E-04	2290.7441	52.8002	-2.203E-05	12018.1651	-13.5261
152.520	1.99E-04	2406.5982	-2.9875	-1.809E-05	12023.9004	-9.1518
157.440	1.20E-04	2296.9427	-39.2379	-1.414E-05	12018.4719	-5.5842
162.360	5.96E-05	2048.3185	-59.9050	-1.049E-05	12006.1638	-2.8171
167.280	1.64E-05	1728.1170	-68.7715	-7.316E-06	11990.3122	-.7872
172.200	-1.24E-05	1386.0042	-69.2252	-4.700E-06	11973.3760	.6028
177.120	-2.98E-05	1056.1912	-64.1377	-2.649E-06	11957.0486	1.4653
182.040	-3.85E-05	760.1024	-55.8222	-1.124E-06	11942.3907	1.9150
186.960	-4.09E-05	509.1117	-46.0466	-5.757E-08	11929.9655	2.0589
191.880	-3.91E-05	307.1173	-36.0834	6.280E-07	11919.9657	1.9912
196.800	-3.47E-05	152.8148	-26.7810	1.014E-06	11912.3270	1.7903
201.720	-2.91E-05	41.5964	-18.6423	1.178E-06	11906.8211	1.5181
206.640	-2.31E-05	-32.9428	-11.9045	1.185E-06	11906.3927	1.2208
211.560	-1.74E-05	-77.8754	-6.6115	1.092E-06	11908.6171	.9308
216.480	-1.24E-05	-100.1483	-2.6772	9.422E-07	11909.7197	.6685
221.400	-8.14E-06	-106.0733	.062788	7.690E-07	11910.0131	.4453
226.320	-4.80E-06	-101.0439	1.8110	5.951E-07	11909.7641	.2653
231.240	-2.29E-06	-89.4244	2.7785	4.351E-07	11909.1889	.1280
236.160	-5.18E-07	-74.5593	3.1654	2.974E-07	11908.4530	.029277
241.080	6.37E-07	-58.8623	3.1479	1.853E-07	11907.6759	-.036390
246.000	1.31E-06	-43.9489	2.8729	9.895E-08	11906.9376	-.075385
250.920	1.61E-06	-30.7876	2.4562	3.618E-08	11906.2860	-.094003
255.840	1.66E-06	-19.8509	1.9839	-6.348E-09	11905.7446	-.097989
260.760	1.55E-06	-11.2534	1.5159	-3.247E-08	11905.3190	-.092262
265.680	1.34E-06	-4.8706	1.0902	-4.601E-08	11905.0030	-.080795
270.600	1.10E-06	-.4356	.7275	-5.047E-08	11904.7835	-.066626
275.520	8.45E-07	2.3875	.4359	-4.883E-08	11904.8801	-.051932
280.440	6.15E-07	3.9495	.2143	-4.351E-08	11904.9574	-.038156
285.360	4.17E-07	4.5814	.056083	-3.634E-08	11904.9887	-.026141
290.280	2.57E-07	4.5729	-.048273	-2.866E-08	11904.9883	-.016280
295.200	1.35E-07	4.1628	-.1096	-2.132E-08	11904.9680	-.008636
300.120	4.75E-08	3.5367	-.1383	-1.485E-08	11904.9370	-.003063
305.040	-1.10E-08	2.8307	-.1441	-9.504E-09	11904.9020	7.156E-04
309.960	-4.61E-08	2.1373	-.1349	-5.332E-09	11904.8677	.003028
314.880	-6.35E-08	1.5136	-.1171	-2.265E-09	11904.8368	.004211
319.800	-6.83E-08	.9894	-.095488	-1.631E-10	11904.8109	.004577
324.720	-6.51E-08	.5743	-.073412	1.150E-09	11904.7903	.004397
329.640	-5.70E-08	.2648	-.053028	1.855E-09	11904.7750	.003889
334.560	-4.68E-08	.048907	-.035537	2.119E-09	11904.7643	.003221
339.480	-3.62E-08	-.089076	-.021434	2.085E-09	11904.7663	.002512
344.400	-2.63E-08	-.1661	-.010725	1.870E-09	11904.7701	.001841
349.320	-1.78E-08	-.1983	-.003106	1.564E-09	11904.7717	.001256
354.240	-1.09E-08	-.1998	.001893	1.230E-09	11904.7718	7.765E-04
359.160	-5.67E-09	-.1821	.004806	9.094E-10	11904.7709	4.074E-04

364.080	-1.95E-09	-.1543	.006155	6.269E-10	11904.7695	1.410E-04
369.000	5.02E-10	-.1228	.006412	3.943E-10	11904.7680	-3.669E-05
373.920	1.93E-09	-.091938	.005971	2.139E-10	11904.7665	-1.426E-04
378.840	2.61E-09	-.064424	.005143	8.261E-11	11904.7651	-1.938E-04
383.760	2.75E-09	-.041496	.004159	-6.350E-12	11904.7640	-2.060E-04
388.680	2.54E-09	-.023484	.003180	-6.093E-11	11904.7631	-1.923E-04
393.600	2.15E-09	-.010089	.002304	-8.912E-11	11904.7624	-1.636E-04
398.520	1.67E-09	-6.389E-04	.001586	-9.813E-11	11904.7619	-1.281E-04
403.440	1.18E-09	.005712	.001046	-9.387E-11	11904.7622	-9.152E-05
408.360	7.44E-10	.009838	6.780E-04	-8.081E-11	11904.7624	-5.805E-05
413.280	3.87E-10	.012543	4.604E-04	-6.201E-11	11904.7625	-3.043E-05
418.200	1.34E-10	.014490	3.595E-04	-3.931E-11	11904.7626	-1.059E-05
423.120	1.11E-17	.016157	-.001475	-1.357E-11	11904.7627	-7.353E-04
428.040	-1.00E-17	3.768E-09	-.001642	-1.124E-18	11904.7619	6.675E-04
432.960	-3.85E-24	-1.215E-09	-3.827E-10	1.020E-18	11904.7619	2.560E-10
437.880	7.55E-25	-6.486E-16	1.235E-10	3.913E-25	11904.7619	-5.019E-11
442.800	0.000	9.135E-17	6.590E-17	0.0000	11904.7619	-3.434E-17
447.720	0.000	7.623E-23	-9.284E-18	0.0000	11904.7619	3.774E-18
452.640	0.000	-6.869E-24	-7.746E-24	0.0000	11904.7619	3.716E-24
457.560	0.000	0.0000	6.981E-25	0.0000	11904.7619	-2.838E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      .30000000 in
Computed slope at pile head       =     -.01355744
Maximum bending moment            =    1177693.456 lbs-in
Maximum shear force               =     159072.510 lbs
Depth of maximum bending moment   =         19.680 in
Depth of maximum shear force      =          0.000 in
Number of iterations              =              5
Number of zero deflection points  =             14
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head     =         .400000 in
Specified bending moment at pile head =            .000 in-lbs
Specified axial load at pile head     =      200000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	0.0000	2.014E+05	-.017937	11904.7619	-15269.6852
4.920	.311750	8.238E+05	1.305E+05	-.017245	52688.1673	-13573.8287
9.840	.230308	1.318E+06	69562.4750	-.015446	77138.1465	-11183.3140
14.760	.159757	1.539E+06	21646.4623	-.013047	88078.9280	-8294.7400
19.680	.101922	1.556E+06	-12054.2123	-.010448	88953.9122	-5404.7212
24.600	.056950	1.441E+06	-32933.9445	-.007931	83224.8681	-3082.9748
29.520	.023884	1.248E+06	-43763.7466	-.005673	73683.4988	-1319.3837
34.440	.001131	1.021E+06	-47166.2143	-.003767	62458.9510	-63.7333
39.360	-.013182	7.912E+05	-45459.8219	-.002245	51074.4694	757.3887
44.280	-.020956	5.783E+05	-40577.5974	-.001094	40532.8516	1227.2554
49.200	-.023951	3.941E+05	-34042.8168	-2.777E-04	31414.5803	1429.1595
54.120	-.023689	2.439E+05	-26985.3126	2.581E-04	23976.6757	1439.7446
59.040	-.021412	1.281E+05	-20183.9544	5.704E-04	18244.1165	1325.0351
63.960	-.018076	44119.9368	-14123.3619	7.150E-04	14088.9172	1138.6204
68.880	-.014376	-12326.1136	-9055.5921	7.417E-04	12514.9656	921.4487
73.800	-.010777	-46446.8347	-5060.1201	6.924E-04	14204.1102	702.7269
78.720	-.007563	-63480.2967	-2097.7409	6.001E-04	15047.3509	501.4923
83.640	-.004873	-68269.5097	-55.9340	4.894E-04	15284.4406	328.5105
88.560	-.002747	-64993.8261	1215.2618	3.775E-04	15122.2780	188.2358
93.480	-.001158	-57054.2045	1876.7381	2.750E-04	14729.2275	80.6570
98.400	-4.12E-05	-47067.8628	2082.3285	1.875E-04	14234.8541	2.9163
103.320	6.87E-04	-36933.1308	1968.1013	1.170E-04	13733.1347	-49.3501
108.240	.001110	-27931.9420	1736.0534	6.249E-05	13287.5313	-44.9782
113.160	.001302	-19973.3464	1493.6445	2.226E-05	12893.5414	-53.5620
118.080	.001329	-13278.2795	1225.3801	-5.671E-06	12562.1025	-55.4886
123.000	.001246	-7904.4454	958.9940	-2.346E-05	12296.0711	-52.7984
127.920	.001098	-3795.6055	713.0028	-3.329E-05	12092.6632	-47.1980
132.840	9.18E-04	-822.9857	498.3785	-3.717E-05	11945.5038	-40.0476
137.760	7.32E-04	1181.5853	320.2169	-3.687E-05	11963.2562	-32.3758
142.680	5.56E-04	2400.5026	179.2876	-3.386E-05	12023.5987	-24.9126
147.600	3.99E-04	3012.4076	73.3929	-2.931E-05	12053.8910	-18.1340
152.520	2.67E-04	3180.3743	-1.4983	-2.411E-05	12062.2062	-12.3095
157.440	1.62E-04	3045.1144	-50.3526	-1.888E-05	12055.5101	-7.5499
162.360	8.14E-05	2722.0644	-78.3985	-1.404E-05	12039.5176	-3.8508
167.280	2.36E-05	2301.3006	-90.6530	-9.819E-06	12018.6877	-1.1307
172.200	-1.52E-05	1849.3631	-91.6199	-6.333E-06	11996.3145	.7377
177.120	-3.87E-05	1412.2247	-85.1247	-3.594E-06	11974.6740	1.9027
182.040	-5.06E-05	1018.8093	-74.2549	-1.552E-06	11955.1980	2.5159
186.960	-5.40E-05	684.6117	-61.3753	-1.216E-07	11938.6536	2.7197
191.880	-5.18E-05	415.1158	-48.1926	8.021E-07	11925.3122	2.6391
196.800	-4.61E-05	208.8177	-35.8484	1.326E-06	11915.0994	2.3788
201.720	-3.87E-05	59.7574	-25.0237	1.552E-06	11907.7202	2.0215
206.640	-3.08E-05	-40.4694	-16.0438	1.568E-06	11906.7653	1.6289
211.560	-2.33E-05	-101.1992	-8.9751	1.449E-06	11909.7718	1.2445
216.480	-1.66E-05	-131.6357	-3.7091	1.253E-06	11911.2785	.8961
221.400	-1.10E-05	-140.1631	-.031370	1.025E-06	11911.7007	.5989
226.320	-6.49E-06	-133.9617	2.3246	7.948E-07	11911.3937	.3588
231.240	-3.13E-06	-118.8531	3.6382	5.825E-07	11910.6457	.1751
236.160	-7.58E-07	-99.3086	4.1744	3.992E-07	11909.6782	.042851
241.080	7.96E-07	-78.5626	4.1680	2.499E-07	11908.6511	-.045467
246.000	1.70E-06	-58.7873	3.8146	1.345E-07	11907.6722	-.098201
250.920	2.12E-06	-41.2920	3.2687	5.045E-08	11906.8061	-.1237
255.840	2.20E-06	-26.7226	2.6457	-6.675E-09	11906.0848	-.1296

260.760	2.05E-06	-15.2455	2.0259	-4.192E-08	11905.5166	-.1224
265.680	1.78E-06	-6.7057	1.4605	-6.036E-08	11905.0939	-.1074
270.600	1.46E-06	-.7554	.9778	-6.663E-08	11904.7993	-.088784
275.520	1.13E-06	3.0470	.5888	-6.470E-08	11904.9127	-.069350
280.440	8.23E-07	5.1656	.2925	-5.780E-08	11905.0176	-.051072
285.360	5.60E-07	6.0394	.080584	-4.839E-08	11905.0609	-.035093
290.280	3.47E-07	6.0538	-.059737	-3.824E-08	11905.0616	-.021949
295.200	1.84E-07	5.5269	-.1426	-2.851E-08	11905.0355	-.011740
300.120	6.63E-08	4.7066	-.1820	-1.991E-08	11904.9949	-.004277
305.040	-1.22E-08	3.7751	-.1906	-1.279E-08	11904.9488	7.975E-04
309.960	-5.96E-08	2.8566	-.1790	-7.221E-09	11904.9033	.003917
314.880	-8.33E-08	2.0282	-.1557	-3.119E-09	11904.8623	.005528
319.800	-9.03E-08	1.3303	-.1273	-2.980E-10	11904.8278	.006046
324.720	-8.62E-08	.7765	-.098053	1.471E-09	11904.8003	.005829
329.640	-7.58E-08	.3626	-.070999	2.428E-09	11904.7799	.005169
334.560	-6.23E-08	.073127	-.047728	2.794E-09	11904.7655	.004290
339.480	-4.83E-08	-.1126	-.028925	2.761E-09	11904.7675	.003353
344.400	-3.52E-08	-.2169	-.014614	2.484E-09	11904.7726	.002464
349.320	-2.38E-08	-.2613	-.004407	2.083E-09	11904.7748	.001685
354.240	-1.47E-08	-.2644	.002313	1.641E-09	11904.7750	.001047
359.160	-7.70E-09	-.2417	.006250	1.216E-09	11904.7739	5.536E-04
364.080	-2.72E-09	-.2053	.008096	8.406E-10	11904.7721	1.970E-04
369.000	5.71E-10	-.1637	.008478	5.307E-10	11904.7700	-4.176E-05
373.920	2.51E-09	-.1229	.007921	2.899E-10	11904.7680	-1.848E-04
378.840	3.42E-09	-.086357	.006840	1.142E-10	11904.7662	-2.546E-04
383.760	3.63E-09	-.055827	.005544	-5.240E-12	11904.7647	-2.721E-04
388.680	3.37E-09	-.031790	.004248	-7.883E-11	11904.7635	-2.549E-04
393.600	2.85E-09	-.013872	.003086	-1.172E-10	11904.7626	-2.174E-04
398.520	2.22E-09	-.001193	.002132	-1.298E-10	11904.7620	-1.705E-04
403.440	1.58E-09	.007360	.001412	-1.247E-10	11904.7623	-1.220E-04
408.360	9.93E-10	.012948	9.214E-04	-1.076E-10	11904.7625	-7.749E-05
413.280	5.17E-10	.016639	6.308E-04	-8.274E-11	11904.7627	-4.067E-05
418.200	1.79E-10	.019318	4.959E-04	-5.254E-11	11904.7629	-1.417E-05
423.120	1.48E-17	.021622	-.001967	-1.816E-11	11904.7630	-9.869E-04
428.040	-1.34E-17	5.048E-09	-.002197	-1.509E-18	11904.7619	8.932E-04
432.960	-5.16E-24	-1.626E-09	-5.127E-10	1.365E-18	11904.7619	3.428E-10
437.880	1.01E-24	-8.684E-16	1.652E-10	5.240E-25	11904.7619	-6.716E-11
442.800	0.000	1.222E-16	8.823E-17	-1.027E-25	11904.7619	-4.597E-17
447.720	0.000	1.020E-22	-1.242E-17	0.0000	11904.7619	5.050E-18
452.640	0.000	-9.192E-24	-1.037E-23	0.0000	11904.7619	4.975E-24
457.560	0.000	0.0000	9.341E-25	0.0000	11904.7619	-3.797E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = -.01793699
Maximum bending moment = 1556392.836 lbs-in
Maximum shear force = 201420.090 lbs
Depth of maximum bending moment = 19.680 in
Depth of maximum shear force = 0.000 in
Number of iterations = 5
Number of zero deflection points = 14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .500000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	0.0000	2.345E+05	-.022221	11904.7619	-15269.6852
4.920	.390672	9.906E+05	1.585E+05	-.021389	60941.9570	-15621.8575
9.840	.289531	1.601E+06	87693.1817	-.019212	91177.8555	-13144.1619
14.760	.201623	1.891E+06	29628.9647	-.016279	1.055E+05	-10459.1783
19.680	.129346	1.925E+06	-12973.6751	-.013074	1.072E+05	-6858.9679
24.600	.072977	1.789E+06	-39565.2317	-.009954	1.005E+05	-3950.6080
29.520	.031395	1.555E+06	-53550.2285	-.007145	88893.4111	-1734.3501
34.440	.002667	1.276E+06	-58186.3658	-.004767	75095.7614	-150.2585
39.360	-.015513	9.920E+05	-56363.3375	-.002862	61013.6043	891.3269
44.280	-.025495	7.275E+05	-50497.7763	-.001418	47918.3860	1493.0475
49.200	-.029464	4.979E+05	-42499.8972	-3.886E-04	36552.8152	1758.1228
54.120	-.029319	3.100E+05	-33791.4327	2.899E-04	27253.3271	1781.9034
59.040	-.026611	1.648E+05	-25356.8305	6.888E-04	20063.7898	1646.7967
63.960	-.022541	59174.3144	-17812.7646	8.769E-04	14834.1834	1419.8968
68.880	-.017982	-12190.9531	-11484.3243	9.163E-04	12508.2744	1152.6399
73.800	-.013524	-55634.8069	-6479.4560	8.594E-04	14658.9603	881.8594
78.720	-.009526	-77640.0623	-2756.1045	7.474E-04	15748.3293	631.6981
83.640	-.006170	-84225.8501	-178.9047	6.115E-04	16074.3584	415.9440
88.560	-.003509	-80603.9157	1435.8432	4.731E-04	15895.0548	240.4576
93.480	-.001515	-71028.1401	2286.8158	3.457E-04	15421.0065	105.4662
98.400	-1.07E-04	-58782.0061	2564.9192	2.367E-04	14814.7622	7.5839
103.320	8.14E-04	-46255.1327	2439.6381	1.485E-04	14194.6200	-58.5112
108.240	.001354	-35068.1512	2160.7304	8.017E-05	13640.8090	-54.8659
113.160	.001603	-25151.3123	1863.4878	2.959E-05	13149.8764	-65.9644
118.080	.001645	-16789.6627	1532.2388	-5.636E-06	12735.9333	-68.6896
123.000	.001548	-10062.9899	1201.9203	-2.819E-05	12402.9297	-65.5862
127.920	.001367	-4907.2900	895.9595	-4.076E-05	12147.6971	-58.7881
132.840	.001147	-1166.5278	628.3411	-4.586E-05	11962.5108	-49.9999
137.760	9.16E-04	1365.8458	405.6777	-4.570E-05	11972.3780	-40.5137
142.680	6.97E-04	2915.2713	229.1388	-4.210E-05	12049.0823	-31.2501
147.600	5.02E-04	3703.4255	96.1460	-3.654E-05	12088.0998	-22.8120
152.520	3.37E-04	3933.2626	1.7909	-3.013E-05	12099.4779	-15.5438

157.440	2.05E-04	3780.3397	-60.0397	-2.365E-05	12091.9074	-9.5906
162.360	1.05E-04	3389.0138	-95.8165	-1.763E-05	12072.5349	-4.9528
167.280	3.20E-05	2872.1978	-111.7711	-1.237E-05	12046.9499	-1.5329
172.200	-1.70E-05	2313.5294	-113.5132	-8.014E-06	12019.2931	.8247
177.120	-4.69E-05	1770.9992	-105.8195	-4.584E-06	11992.4351	2.3029
182.040	-6.21E-05	1281.2864	-92.5539	-2.020E-06	11968.1919	3.0896
186.960	-6.67E-05	864.2446	-76.6835	-2.180E-07	11947.5463	3.3617
191.880	-6.42E-05	527.1496	-60.3562	9.506E-07	11930.8584	3.2754
196.800	-5.74E-05	268.4688	-45.0142	1.619E-06	11918.0524	2.9612
201.720	-4.83E-05	81.0237	-31.5240	1.912E-06	11908.7730	2.5227
206.640	-3.86E-05	-45.4904	-20.3056	1.942E-06	11907.0139	2.0376
211.560	-2.92E-05	-122.6052	-11.4536	1.801E-06	11910.8315	1.5607
216.480	-2.08E-05	-161.7379	-4.8416	1.562E-06	11912.7687	1.1271
221.400	-1.38E-05	-173.3214	-.2089	1.281E-06	11913.3422	.7562
226.320	-8.25E-06	-166.3138	2.7728	9.955E-07	11912.9953	.4559
231.240	-4.03E-06	-147.9958	4.4492	7.315E-07	11912.0884	.2256
236.160	-1.05E-06	-123.9732	5.1497	5.031E-07	11910.8992	.059186
241.080	9.16E-07	-98.3130	5.1666	3.164E-07	11909.6289	-.052328
246.000	2.07E-06	-73.7570	4.7443	1.719E-07	11908.4132	-.1193
250.920	2.61E-06	-51.9677	4.0763	6.631E-08	11907.3346	-.1522
255.840	2.72E-06	-33.7762	3.3075	-5.707E-09	11906.4340	-.1604
260.760	2.55E-06	-19.4106	2.5390	-5.038E-08	11905.7228	-.1520
265.680	2.22E-06	-8.6932	1.8357	-7.398E-08	11905.1923	-.1339
270.600	1.82E-06	-1.2016	1.2336	-8.229E-08	11904.8214	-.1109
275.520	1.41E-06	3.6075	.7472	-8.027E-08	11904.9405	-.086839
280.440	1.03E-06	6.3085	.3758	-7.194E-08	11905.0742	-.064126
285.360	7.05E-07	7.4469	.1093	-6.039E-08	11905.1306	-.044213
290.280	4.39E-07	7.5027	-.067846	-4.783E-08	11905.1333	-.027791
295.200	2.35E-07	6.8734	-.1731	-3.576E-08	11905.1022	-.015004
300.120	8.73E-08	5.8696	-.2239	-2.506E-08	11905.0525	-.005630
305.040	-1.18E-08	4.7198	-.2358	-1.616E-08	11904.9956	7.660E-04
309.960	-7.18E-08	3.5807	-.2224	-9.192E-09	11904.9392	.004719
314.880	-1.02E-07	2.5499	-.1941	-4.043E-09	11904.8881	.006783
319.800	-1.12E-07	1.6791	-.1590	-4.913E-10	11904.8450	.007472
324.720	-1.07E-07	.9864	-.1228	1.747E-09	11904.8107	.007235
329.640	-9.44E-08	.4672	-.089177	2.968E-09	11904.7850	.006437
334.560	-7.78E-08	.1031	-.060166	3.447E-09	11904.7670	.005357
339.480	-6.04E-08	-.1316	-.036663	3.423E-09	11904.7684	.004197
344.400	-4.42E-08	-.2644	-.018729	3.091E-09	11904.7750	.003093
349.320	-3.00E-08	-.3220	-.005900	2.598E-09	11904.7778	.002123
354.240	-1.86E-08	-.3276	.002580	2.053E-09	11904.7781	.001325
359.160	-9.84E-09	-.3006	.007579	1.525E-09	11904.7768	7.073E-04
364.080	-3.58E-09	-.2560	.009957	1.058E-09	11904.7746	2.593E-04
369.000	5.69E-10	-.2047	.010492	6.707E-10	11904.7720	-4.164E-05
373.920	3.02E-09	-.1541	.009841	3.693E-10	11904.7695	-2.229E-04
378.840	4.20E-09	-.1086	.008524	1.487E-10	11904.7673	-3.125E-04
383.760	4.49E-09	-.070513	.006928	-1.793E-12	11904.7654	-3.363E-04
388.680	4.19E-09	-.040439	.005322	-9.498E-11	11904.7639	-3.164E-04
393.600	3.55E-09	-.017957	.003878	-1.440E-10	11904.7628	-2.706E-04
398.520	2.77E-09	-.001995	.002689	-1.608E-10	11904.7620	-2.127E-04
403.440	1.97E-09	.008823	.001791	-1.550E-10	11904.7623	-1.525E-04
408.360	1.24E-09	.015935	.001177	-1.343E-10	11904.7627	-9.700E-05
413.280	6.48E-10	.020673	8.134E-04	-1.035E-10	11904.7629	-5.098E-05
418.200	2.24E-10	.024142	6.442E-04	-6.587E-11	11904.7631	-1.778E-05
423.120	1.87E-17	.027142	-.002458	-2.280E-11	11904.7632	-.001243
428.040	-1.69E-17	6.345E-09	-.002758	-1.901E-18	11904.7619	.001121
432.960	-6.48E-24	-2.041E-09	-6.444E-10	1.714E-18	11904.7619	4.306E-10

437.880	1.27E-24	-1.091E-15	2.074E-10	6.582E-25	11904.7619	-8.431E-11
442.800	0.000	1.535E-16	1.108E-16	-1.289E-25	11904.7619	-5.772E-17
447.720	0.000	1.281E-22	-1.559E-17	0.0000	11904.7619	6.339E-18
452.640	0.000	-1.154E-23	-1.302E-23	0.0000	11904.7619	6.246E-24
457.560	0.000	0.0000	1.173E-24	0.0000	11904.7619	-4.767E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	-.02222107
Maximum bending moment	=	1924902.463 lbs-in
Maximum shear force	=	234450.785 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .600000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	0.0000	2.578E+05	-.026253	11904.7619	-15269.6852
4.920	.470835	1.109E+06	1.818E+05	-.025321	66818.1776	-15621.8619
9.840	.350838	1.839E+06	1.060E+05	-.022846	1.029E+05	-15174.0183
14.760	.246034	2.197E+06	39264.5742	-.019456	1.207E+05	-11962.0382
19.680	.159392	2.263E+06	-10954.5101	-.015710	1.239E+05	-8452.2238
24.600	.091453	2.121E+06	-43925.9292	-.012028	1.169E+05	-4950.7921
29.520	.041039	1.855E+06	-61681.8682	-.008689	1.037E+05	-2267.0693
34.440	.005952	1.531E+06	-68083.9536	-.005846	87682.7457	-335.4045
39.360	-.016484	1.196E+06	-66579.1851	-.003556	71121.0979	947.0990
44.280	-.029034	8.826E+05	-60066.4734	-.001810	55596.5161	1700.3448
49.200	-.034291	6.087E+05	-50850.0995	-5.572E-04	42037.3027	2046.1486

54.120	-.034517	3.833E+05	-40655.8352	2.759E-04	30880.2588	2097.8613
59.040	-.031576	2.081E+05	-30688.1586	7.726E-04	22205.7946	1954.0398
63.960	-.026915	79813.0208	-21710.5795	.001014	15855.9015	1695.3826
68.880	-.021594	-7547.6304	-14134.9878	.001075	12278.4070	1384.1262
73.800	-.016336	-61391.0938	-8109.7515	.001017	14943.9250	1065.1569
78.720	-.011584	-89349.4725	-3599.7196	8.906E-04	16328.0031	768.1895
83.640	-.007572	-98565.0659	-454.1761	7.328E-04	16784.2206	510.4868
88.560	-.004374	-95260.6966	1538.9326	5.700E-04	16620.6380	299.7200
93.480	-.001963	-84543.7302	2612.5084	4.190E-04	16090.0951	136.6929
98.400	-2.51E-04	-70378.1797	2992.4493	2.889E-04	15388.8302	17.7546
103.320	8.79E-04	-55666.5277	2880.6889	1.830E-04	14660.5306	-63.1857
108.240	.001550	-42392.3636	2570.7283	1.007E-04	14003.3938	-62.8146
113.160	.001870	-30568.6448	2226.9430	3.937E-05	13418.0612	-76.9355
118.080	.001937	-20556.7323	1838.6669	-3.565E-06	12922.4219	-80.9003
123.000	.001835	-12469.1463	1448.3900	-3.130E-05	12522.0464	-77.7489
127.920	.001629	-6242.9704	1084.8263	-4.702E-05	12213.8198	-70.0413
132.840	.001372	-1701.9229	765.3401	-5.369E-05	11989.0155	-59.8311
137.760	.001101	1393.6417	498.3961	-5.395E-05	11973.7541	-48.6827
142.680	8.41E-04	3308.4692	285.8524	-5.000E-05	12068.5475	-37.7171
147.600	6.09E-04	4304.8320	124.9880	-4.361E-05	12117.8724	-27.6749
152.520	4.12E-04	4624.1703	10.2031	-3.611E-05	12133.6812	-18.9857
157.440	2.54E-04	4476.2903	-65.6242	-2.846E-05	12126.3604	-11.8384
162.360	1.32E-04	4034.4464	-110.1112	-2.132E-05	12104.4870	-6.2457
167.280	4.39E-05	3434.7473	-130.6441	-1.504E-05	12074.7989	-2.1010
172.200	-1.60E-05	2778.5138	-133.9065	-9.825E-06	12042.3121	.7748
177.120	-5.28E-05	2136.4432	-125.6147	-5.697E-06	12010.5264	2.5958
182.040	-7.20E-05	1553.6768	-110.4132	-2.598E-06	11981.6766	3.5837
186.960	-7.84E-05	1055.0896	-91.8845	-4.067E-07	11956.9941	3.9483
191.880	-7.60E-05	650.3337	-72.6359	1.026E-06	11936.9566	3.8763
196.800	-6.83E-05	338.3339	-54.4312	1.856E-06	11921.5111	3.5240
201.720	-5.78E-05	111.0784	-38.3423	2.233E-06	11910.2608	3.0162
206.640	-4.63E-05	-43.3493	-24.9029	2.290E-06	11906.9079	2.4470
211.560	-3.52E-05	-138.4732	-14.2517	2.138E-06	11911.6170	1.8828
216.480	-2.53E-05	-187.7931	-6.2577	1.864E-06	11914.0586	1.3668
221.400	-1.69E-05	-203.7166	-.6235	1.535E-06	11914.8469	.9235
226.320	-1.02E-05	-196.9490	3.0331	1.198E-06	11914.5119	.5629
231.240	-5.10E-06	-176.2295	5.1192	8.848E-07	11913.4861	.2851
236.160	-1.47E-06	-148.3176	6.0255	6.123E-07	11912.1044	.083337
241.080	9.25E-07	-118.1432	6.1005	3.885E-07	11910.6106	-.052848
246.000	2.35E-06	-89.0528	5.6370	2.144E-07	11909.1705	-.1356
250.920	3.04E-06	-63.0976	4.8676	8.666E-08	11907.8855	-.1771
255.840	3.20E-06	-41.3260	3.9674	-1.045E-09	11906.8077	-.1888
260.760	3.02E-06	-24.0558	3.0596	-5.596E-08	11905.9528	-.1803
265.680	2.65E-06	-11.1094	2.2236	-8.549E-08	11905.3119	-.1596
270.600	2.18E-06	-2.0070	1.5044	-9.651E-08	11904.8613	-.1328
275.520	1.70E-06	3.8837	.9206	-9.493E-08	11904.9542	-.1045
280.440	1.25E-06	7.2390	.4729	-8.559E-08	11905.1203	-.077533
285.360	8.58E-07	8.7055	.1499	-7.220E-08	11905.1929	-.053785
290.280	5.39E-07	8.8558	-.066356	-5.745E-08	11905.2003	-.034109
295.200	2.93E-07	8.1657	-.1963	-4.315E-08	11905.1661	-.018718
300.120	1.14E-07	7.0090	-.2605	-3.041E-08	11905.1089	-.007377
305.040	-6.31E-09	5.6622	-.2776	-1.977E-08	11905.0422	4.109E-04
309.960	-8.02E-08	4.3159	-.2637	-1.139E-08	11904.9756	.005271
314.880	-1.18E-07	3.0901	-.2314	-5.167E-09	11904.9149	.007854
319.800	-1.31E-07	2.0494	-.1905	-8.502E-10	11904.8634	.008774
324.720	-1.27E-07	1.2176	-.1478	1.894E-09	11904.8222	.008565
329.640	-1.12E-07	.5911	-.1079	3.413E-09	11904.7912	.007665

334.560	-9.31E-08	.1493	-.073265	4.035E-09	11904.7693	.006410
339.480	-7.27E-08	-.1377	-.045082	4.044E-09	11904.7687	.005046
344.400	-5.33E-08	-.3023	-.023475	3.675E-09	11904.7769	.003737
349.320	-3.65E-08	-.3759	-.007935	3.105E-09	11904.7805	.002580
354.240	-2.28E-08	-.3865	.002410	2.465E-09	11904.7810	.001625
359.160	-1.23E-08	-.3571	.008576	1.840E-09	11904.7796	8.817E-04
364.080	-4.69E-09	-.3057	.011581	1.283E-09	11904.7770	3.398E-04
369.000	3.65E-10	-.2457	.012351	8.204E-10	11904.7741	-2.672E-05
373.920	3.39E-09	-.1858	.011671	4.580E-10	11904.7711	-2.497E-04
378.840	4.87E-09	-.1317	.010165	1.913E-10	11904.7684	-3.623E-04
383.760	5.27E-09	-.086168	.008302	8.310E-12	11904.7662	-3.950E-04
388.680	4.95E-09	-.050039	.006409	-1.061E-10	11904.7644	-3.744E-04
393.600	4.23E-09	-.022891	.004696	-1.673E-10	11904.7630	-3.220E-04
398.520	3.31E-09	-.003498	.003279	-1.895E-10	11904.7621	-2.540E-04
403.440	2.36E-09	.009751	.002205	-1.843E-10	11904.7624	-1.828E-04
408.360	1.49E-09	.018559	.001468	-1.605E-10	11904.7628	-1.166E-04
413.280	7.81E-10	.024514	.001030	-1.243E-10	11904.7631	-6.146E-05
418.200	2.71E-10	.028941	8.262E-04	-7.940E-11	11904.7633	-2.149E-05
423.120	2.27E-17	.032800	-.002947	-2.755E-11	11904.7635	-.001512
428.040	-2.04E-17	7.685E-09	-.003333	-2.312E-18	11904.7619	.001355
432.960	-7.84E-24	-2.466E-09	-7.806E-10	2.071E-18	11904.7619	5.211E-10
437.880	1.53E-24	-1.319E-15	2.506E-10	7.966E-25	11904.7619	-1.019E-10
442.800	0.000	1.854E-16	1.340E-16	-1.558E-25	11904.7619	-6.981E-17
447.720	0.000	1.550E-22	-1.885E-17	0.0000	11904.7619	7.661E-18
452.640	0.000	-1.394E-23	-1.575E-23	0.0000	11904.7619	7.553E-24
457.560	0.000	0.0000	1.417E-24	0.0000	11904.7619	-5.761E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	-.02625300
Maximum bending moment	=	2263172.111 lbs-in
Maximum shear force	=	257770.344 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .700000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	0.0000	2.773E+05	-.030137	11904.7619	-15269.6852
4.920	.551726	1.209E+06	2.013E+05	-.029122	71752.2292	-15621.9021
9.840	.413443	2.038E+06	1.235E+05	-.026395	1.128E+05	-15974.1393
14.760	.292000	2.476E+06	50982.1630	-.022604	1.345E+05	-13517.5281
19.680	.191023	2.584E+06	-7189.6712	-.018354	1.398E+05	-10129.5590
24.600	.111400	2.442E+06	-46943.7337	-.014133	1.328E+05	-6030.6290
29.520	.051957	2.150E+06	-68839.7530	-.010276	1.183E+05	-2870.1918
34.440	.010280	1.785E+06	-77325.3875	-.006972	1.003E+05	-579.2531
39.360	-.016648	1.403E+06	-76397.2454	-.004295	81338.6232	956.5466
44.280	-.031985	1.041E+06	-69436.2120	-.002243	63455.9586	1873.1417
49.200	-.038716	7.237E+05	-59145.2583	-7.602E-04	47732.7406	2310.1728
54.120	-.039465	4.608E+05	-47561.7030	2.347E-04	34718.6679	2398.5895
59.040	-.036406	2.553E+05	-36118.8510	8.361E-04	24541.2043	2252.9764
63.960	-.031238	1.038E+05	-25735.9654	.001138	17042.6783	1967.7088
68.880	-.025212	-224.7114	-16919.9933	.001225	11915.8862	1616.0196
73.800	-.019187	-65116.9455	-9866.8559	.001170	15128.3731	1251.1094
78.720	-.013701	-99616.6938	-4554.1006	.001031	16836.2814	908.5472
83.640	-.009038	-1.120E+05	-820.0918	8.537E-04	17447.2932	609.3426
88.560	-.005300	-1.094E+05	1572.4108	6.678E-04	17318.9463	363.2195
93.480	-.002467	-97800.9114	2888.4574	4.938E-04	16746.3912	171.7588
98.400	-4.41E-04	-81915.9833	3387.7378	3.429E-04	15960.0086	31.2007
103.320	9.08E-04	-65140.4018	3304.0929	2.194E-04	15129.5343	-65.2027
108.240	.001718	-49835.4729	2972.4274	1.228E-04	14371.8645	-69.6207
113.160	.002116	-36133.4389	2586.9723	5.062E-05	13693.5460	-87.0684
118.080	.002216	-24479.2921	2145.1466	-2.840E-07	13116.6080	-92.5356
123.000	.002113	-15024.6373	1697.2092	-3.346E-05	12648.5558	-89.5528
127.920	.001887	-7712.8991	1277.3892	-5.256E-05	12286.5886	-81.1058
132.840	.001596	-2351.6916	906.6518	-6.101E-05	12021.1823	-69.6005
137.760	.001286	1328.6265	595.5138	-6.187E-05	11970.5355	-56.8784
142.680	9.87E-04	3629.9268	346.6948	-5.771E-05	12084.4612	-44.2675
147.600	7.18E-04	4853.6702	157.4718	-5.058E-05	12145.0426	-32.6524
152.520	4.90E-04	5278.9944	21.6634	-4.207E-05	12166.0983	-22.5543
157.440	3.04E-04	5149.6348	-68.7800	-3.331E-05	12159.6943	-14.2113
162.360	1.62E-04	4667.7590	-122.5670	-2.507E-05	12135.8391	-7.6534
167.280	5.78E-05	3992.9079	-148.2039	-1.779E-05	12102.4306	-2.7682
172.200	-1.33E-05	3244.4498	-153.4301	-1.171E-05	12065.3782	.6437
177.120	-5.75E-05	2506.2111	-144.8961	-6.885E-06	12028.8318	2.8254
182.040	-8.10E-05	1832.2223	-128.0296	-3.241E-06	11995.4660	4.0309
186.960	-8.94E-05	1252.7788	-107.0371	-6.503E-07	11966.7807	4.5026
191.880	-8.74E-05	780.2574	-84.9968	1.057E-06	11943.3885	4.4568
196.800	-7.90E-05	414.3296	-64.0065	2.060E-06	11925.2733	4.0758
201.720	-6.71E-05	146.3779	-45.3561	2.531E-06	11912.0083	3.5057
206.640	-5.41E-05	-36.9563	-29.7039	2.623E-06	11906.5914	2.8570
211.560	-4.13E-05	-151.0712	-17.2424	2.465E-06	11912.2407	2.2086
216.480	-2.98E-05	-211.4731	-7.8434	2.161E-06	11915.2309	1.6121
221.400	-2.01E-05	-232.5029	-1.1793	1.788E-06	11916.2719	1.0969
226.320	-1.22E-05	-226.5963	3.1820	1.402E-06	11915.9795	.6760

231.240	-6.26E-06	-203.9522	5.7061	1.041E-06	11914.8585	.3501
236.160	-1.98E-06	-172.4964	6.8433	7.247E-07	11913.3013	.1122
241.080	8.68E-07	-138.0407	6.9971	4.638E-07	11911.5956	-.049605
246.000	2.58E-06	-104.5576	6.5086	2.601E-07	11909.9380	-.1490
250.920	3.43E-06	-74.5082	5.6500	1.097E-07	11908.4504	-.2000
255.840	3.66E-06	-49.1779	4.6269	5.812E-09	11907.1965	-.2158
260.760	3.48E-06	-28.9906	3.5851	-5.984E-08	11906.1971	-.2077
265.680	3.07E-06	-13.7823	2.6195	-9.576E-08	11905.4442	-.1849
270.600	2.54E-06	-3.0263	1.7843	-1.099E-07	11904.9117	-.1546
275.520	1.99E-06	3.9915	1.1033	-1.091E-07	11904.9595	-.1222
280.440	1.47E-06	8.0444	.5783	-9.896E-08	11905.1601	-.091163
285.360	1.02E-06	9.8772	.1975	-8.391E-08	11905.2509	-.063636
290.280	6.43E-07	10.1533	-.059170	-6.709E-08	11905.2645	-.040717
295.200	3.55E-07	9.4270	-.2152	-5.064E-08	11905.2286	-.022702
300.120	1.45E-07	8.1356	-.2940	-3.589E-08	11905.1647	-.009359
305.040	2.09E-09	6.6042	-.3174	-2.351E-08	11905.0888	-1.364E-04
309.960	-8.63E-08	5.0585	-.3038	-1.372E-08	11905.0123	.005674
314.880	-1.33E-07	3.6419	-.2681	-6.410E-09	11904.9422	.008818
319.800	-1.49E-07	2.4327	-.2218	-1.308E-09	11904.8823	.010004
324.720	-1.46E-07	1.4616	-.1730	1.963E-09	11904.8343	.009851
329.640	-1.30E-07	.7266	-.1269	3.801E-09	11904.7979	.008870
334.560	-1.08E-07	.2051	-.086769	4.583E-09	11904.7721	.007457
339.480	-8.50E-08	-.1362	-.053914	4.641E-09	11904.7686	.005899
344.400	-6.27E-08	-.3345	-.028601	4.246E-09	11904.7785	.004391
349.320	-4.32E-08	-.4260	-.010294	3.607E-09	11904.7830	.003051
354.240	-2.72E-08	-.4429	.001980	2.877E-09	11904.7838	.001938
359.160	-1.49E-08	-.4122	.009377	2.159E-09	11904.7823	.001069
364.080	-5.95E-09	-.3549	.013066	1.515E-09	11904.7795	4.311E-04
369.000	4.10E-11	-.2866	.014119	9.760E-10	11904.7761	-3.000E-06
373.920	3.66E-09	-.2179	.013448	5.523E-10	11904.7727	-2.698E-04
378.840	5.48E-09	-.1554	.011783	2.389E-10	11904.7696	-4.072E-04
383.760	6.01E-09	-.1024	.009673	2.237E-11	11904.7670	-4.505E-04
388.680	5.70E-09	-.060213	.007506	-1.142E-10	11904.7649	-4.305E-04
393.600	4.89E-09	-.028334	.005531	-1.886E-10	11904.7633	-3.723E-04
398.520	3.84E-09	-.005420	.003889	-2.169E-10	11904.7622	-2.950E-04
403.440	2.75E-09	.010362	.002639	-2.128E-10	11904.7624	-2.130E-04
408.360	1.75E-09	.020971	.001780	-1.865E-10	11904.7629	-1.363E-04
413.280	9.16E-10	.028246	.001268	-1.451E-10	11904.7633	-7.204E-05
418.200	3.19E-10	.033730	.001028	-9.308E-11	11904.7636	-2.525E-05
423.120	2.69E-17	.038547	-.003434	-3.237E-11	11904.7638	-.001789
428.040	-2.40E-17	9.053E-09	-.003917	-2.735E-18	11904.7619	.001592
432.960	-9.22E-24	-2.898E-09	-9.195E-10	2.434E-18	11904.7619	6.133E-10
437.880	1.80E-24	-1.552E-15	2.946E-10	9.375E-25	11904.7619	-1.197E-10
442.800	0.000	2.179E-16	1.577E-16	-1.830E-25	11904.7619	-8.211E-17
447.720	0.000	1.822E-22	-2.215E-17	0.0000	11904.7619	9.003E-18
452.640	0.000	-1.639E-23	-1.852E-23	0.0000	11904.7619	8.881E-24
457.560	0.000	0.0000	1.665E-24	0.0000	11904.7619	-6.770E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	-.03013703
Maximum bending moment	=	2583837.917 lbs-in
Maximum shear force	=	277251.232 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .800000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	0.0000	2.935E+05	-.033865	11904.7619	-15269.6852
4.920	.633382	1.293E+06	2.175E+05	-.032780	75901.6966	-15621.8655
9.840	.477447	2.205E+06	1.398E+05	-.029842	1.211E+05	-15974.0514
14.760	.339738	2.727E+06	63299.6305	-.025699	1.469E+05	-15132.9293
19.680	.224567	2.879E+06	-2163.1742	-.020991	1.544E+05	-11477.9670
24.600	.133187	2.747E+06	-48135.7962	-.016266	1.479E+05	-7210.0908
29.520	.064512	2.437E+06	-74639.5419	-.011912	1.325E+05	-3563.7896
34.440	.015978	2.036E+06	-85621.2619	-.008154	1.127E+05	-900.3242
39.360	-.015728	1.611E+06	-85613.0426	-.005092	91633.6869	903.6653
44.280	-.034124	1.204E+06	-78474.0174	-.002728	71504.9835	1998.3774
49.200	-.042569	8.437E+05	-67309.3169	-.001008	53672.4972	2540.1187
54.120	-.044043	5.436E+05	-54475.7530	1.571E-04	38814.8911	2676.7772
59.040	-.041023	3.074E+05	-41645.7039	8.718E-04	27120.4860	2538.6899
63.960	-.035464	1.321E+05	-29905.1003	.001241	18443.1363	2233.9131
68.880	-.028813	10649.3910	-19866.3895	.001361	12431.9595	1846.8636
73.800	-.022074	-66088.0642	-11782.3033	.001314	15176.4483	1439.3503
78.720	-.015882	-1.079E+05	-5650.7888	.001168	17245.0983	1053.1352
83.640	-.010580	-1.240E+05	-1305.3217	9.733E-04	18042.9108	713.3148
88.560	-.006304	-1.226E+05	1512.0953	7.662E-04	17975.7865	431.9766
93.480	-.003041	-1.106E+05	3095.6466	5.703E-04	17380.9741	211.7434
98.400	-6.92E-04	-93295.8882	3736.9688	3.990E-04	16523.3702	48.9566
103.320	8.86E-04	-74633.0200	3700.8628	2.580E-04	15599.4659	-63.6339
108.240	.001847	-57387.1397	3360.2064	1.471E-04	14745.7094	-74.8443
113.160	.002333	-41858.1171	2939.9179	6.376E-05	13976.9459	-96.0046
118.080	.002474	-28583.8348	2449.5856	4.601E-06	13319.8032	-103.3175
123.000	.002379	-17763.2507	1947.4732	-3.432E-05	12784.1308	-100.7932

127.920	.002136	-9353.1477	1473.5941	-5.710E-05	12367.7890	-91.8406
132.840	.001817	-3150.7144	1052.7868	-6.760E-05	12060.7379	-79.2193
137.760	.001471	1139.3128	697.8757	-6.929E-05	11961.1635	-65.0535
142.680	.001135	3852.7456	412.6676	-6.510E-05	12095.4919	-50.8848
147.600	8.31E-04	5328.0730	194.6268	-5.739E-05	12168.5279	-37.7497
152.520	5.70E-04	5880.8100	37.1418	-4.797E-05	12195.8911	-26.2686
157.440	3.59E-04	5787.9584	-68.6496	-3.817E-05	12191.2945	-16.7360
162.360	1.95E-04	5280.4206	-132.4655	-2.888E-05	12166.1689	-9.2054
167.280	7.44E-05	4541.3261	-163.8778	-2.063E-05	12129.5800	-3.5639
172.200	-8.33E-06	3708.4566	-171.6504	-1.370E-05	12088.3489	.4043
177.120	-6.04E-05	2879.2446	-163.3540	-8.165E-06	12047.2988	2.9682
182.040	-8.87E-05	2117.1231	-145.1981	-3.969E-06	12009.5700	4.4122
186.960	-9.95E-05	1458.3060	-122.0203	-9.661E-07	11976.9553	5.0097
191.880	-9.82E-05	918.3450	-97.3818	1.030E-06	11950.2245	5.0059
196.800	-8.93E-05	498.0421	-73.7290	2.220E-06	11929.4175	4.6090
201.720	-7.63E-05	188.4838	-52.5845	2.796E-06	11914.0928	3.9863
206.640	-6.18E-05	-24.8926	-34.7457	2.934E-06	11905.9942	3.2653
211.560	-4.75E-05	-159.1872	-20.4711	2.779E-06	11912.6425	2.5374
216.480	-3.45E-05	-231.7976	-9.6462	2.451E-06	11916.2370	1.8630
221.400	-2.34E-05	-258.9284	-1.9209	2.038E-06	11917.5801	1.2773
226.320	-1.44E-05	-254.7114	3.1803	1.607E-06	11917.3714	.7963
231.240	-7.55E-06	-230.7971	6.1774	1.199E-06	11916.1875	.4220
236.160	-2.60E-06	-196.2862	7.5772	8.406E-07	11914.4790	.1470
241.080	7.23E-07	-157.8916	7.8373	5.432E-07	11912.5783	-.041328
246.000	2.74E-06	-120.2365	7.3459	3.096E-07	11910.7142	-.1584
250.920	3.77E-06	-86.2175	6.4149	1.362E-07	11909.0301	-.2200
255.840	4.08E-06	-57.3817	5.2812	1.557E-08	11907.6026	-.2408
260.760	3.92E-06	-34.2807	4.1137	-6.141E-08	11906.4590	-.2338
265.680	3.48E-06	-16.7820	3.0233	-1.043E-07	11905.5927	-.2095
270.600	2.90E-06	-4.3261	2.0746	-1.220E-07	11904.9761	-.1762
275.520	2.28E-06	3.8723	1.2969	-1.224E-07	11904.9536	-.1400
280.440	1.69E-06	8.6760	.6942	-1.119E-07	11905.1914	-.1050
285.360	1.18E-06	10.9237	.2544	-9.541E-08	11905.3027	-.073792
290.280	7.53E-07	11.3672	-.044376	-7.669E-08	11905.3246	-.047666
295.200	4.23E-07	10.6380	-.2281	-5.820E-08	11905.2885	-.027022
300.120	1.80E-07	9.2371	-.3232	-4.151E-08	11905.2192	-.011643
305.040	1.44E-08	7.5391	-.3542	-2.742E-08	11905.1351	-9.385E-04
309.960	-8.93E-08	5.8060	-.3420	-1.621E-08	11905.0493	.005874
314.880	-1.45E-07	4.2054	-.3039	-7.805E-09	11904.9701	.009631
319.800	-1.66E-07	2.8310	-.2528	-1.895E-09	11904.9021	.011128
324.720	-1.64E-07	1.7213	-.1982	1.928E-09	11904.8471	.011069
329.640	-1.47E-07	.8767	-.1463	4.110E-09	11904.8053	.010038
334.560	-1.23E-07	.2736	-.1007	5.076E-09	11904.7754	.008488
339.480	-9.72E-08	-.1245	-.063240	5.202E-09	11904.7681	.006751
344.400	-7.21E-08	-.3589	-.034201	4.796E-09	11904.7797	.005054
349.320	-5.00E-08	-.4704	-.013072	4.099E-09	11904.7852	.003536
354.240	-3.18E-08	-.4956	.001204	3.288E-09	11904.7864	.002267
359.160	-1.77E-08	-.4651	.009909	2.481E-09	11904.7849	.001271
364.080	-7.40E-09	-.4030	.014355	1.752E-09	11904.7819	5.364E-04
369.000	-4.43E-10	-.3273	.015754	1.139E-09	11904.7781	3.238E-05
373.920	3.81E-09	-.2502	.015143	6.536E-10	11904.7743	-2.807E-04
378.840	5.99E-09	-.1795	.013357	2.927E-10	11904.7708	-4.453E-04
383.760	6.69E-09	-.1193	.011029	4.166E-11	11904.7678	-5.013E-04
388.680	6.40E-09	-.071088	.008606	-1.183E-10	11904.7654	-4.836E-04
393.600	5.52E-09	-.034424	.006381	-2.069E-10	11904.7636	-4.208E-04
398.520	4.36E-09	-.007891	.004521	-2.424E-10	11904.7623	-3.351E-04
403.440	3.14E-09	.010544	.003100	-2.402E-10	11904.7624	-2.429E-04

408.360	2.00E-09	.023081	.002118	-2.120E-10	11904.7630	-1.560E-04
413.280	1.05E-09	.031804	.001531	-1.659E-10	11904.7635	-8.270E-05
418.200	3.67E-10	.038472	.001256	-1.068E-10	11904.7638	-2.907E-05
423.120	3.12E-17	.044373	-.003917	-3.727E-11	11904.7641	-.002074
428.040	-2.76E-17	1.045E-08	-.004509	-3.170E-18	11904.7619	.001833
432.960	-1.06E-23	-3.337E-09	-1.061E-09	2.802E-18	11904.7619	7.071E-10
437.880	2.07E-24	-1.789E-15	3.391E-10	1.081E-24	11904.7619	-1.378E-10
442.800	0.000	2.509E-16	1.817E-16	-2.107E-25	11904.7619	-9.460E-17
447.720	0.000	2.099E-22	-2.550E-17	0.0000	11904.7619	1.036E-17
452.640	0.000	-1.886E-23	-2.133E-23	0.0000	11904.7619	1.023E-23
457.560	0.000	0.0000	1.917E-24	0.0000	11904.7619	-7.793E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	-.03386548
Maximum bending moment	=	2878634.687 lbs-in
Maximum shear force	=	293541.973 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .900000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	0.0000	3.084E+05	-.037501	11904.7619	-15269.6852
4.920	.715494	1.370E+06	2.324E+05	-.036351	79704.8203	-15621.9074
9.840	.542307	2.359E+06	1.547E+05	-.033220	1.287E+05	-15974.1552
14.760	.388613	2.957E+06	75250.1961	-.028755	1.583E+05	-16326.4358
19.680	.259359	3.156E+06	3892.4511	-.023621	1.681E+05	-12680.7776

24.600	.156186	3.042E+06	-48101.8325	-.018415	1.625E+05	-8455.1101
29.520	.078153	2.719E+06	-79522.0389	-.013577	1.465E+05	-4317.3316
34.440	.022589	2.286E+06	-93273.8880	-.009373	1.251E+05	-1272.8510
39.360	-.014081	1.819E+06	-94414.8884	-.005925	1.020E+05	809.0297
44.280	-.035715	1.369E+06	-87279.4053	-.003247	79672.4998	2091.5731
49.200	-.046036	9.669E+05	-75376.6232	-.001286	59769.7389	2746.9562
54.120	-.048366	6.297E+05	-61387.8324	5.527E-05	43079.6412	2939.5442
59.040	-.045492	3.627E+05	-47231.1002	8.888E-04	29860.5786	2815.2250
63.960	-.039620	1.632E+05	-34166.1668	.001331	19985.4246	2495.7235
68.880	-.032400	23893.9585	-22917.8707	.001488	13087.6311	2076.7546
73.800	-.024982	-65210.2114	-13801.9035	.001453	15132.9902	1628.9231
78.720	-.018102	-1.148E+05	-6841.7562	.001302	17586.7536	1200.4051
83.640	-.012172	-1.351E+05	-1870.0662	.001092	18592.6360	820.6071
88.560	-.007358	-1.353E+05	1388.9262	8.648E-04	18604.1005	504.1866
93.480	-.003662	-1.231E+05	3256.4870	6.478E-04	18000.3067	254.9845
98.400	-9.84E-04	-1.046E+05	4054.9268	4.565E-04	17080.8804	69.5846
103.320	8.30E-04	-84127.9706	4079.3379	2.981E-04	16069.5129	-59.6614
108.240	.001949	-65003.4814	3738.2291	1.728E-04	15122.7560	-79.0007
113.160	.002531	-47683.8722	3287.7309	7.816E-05	14265.3496	-104.1286
118.080	.002718	-32806.0267	2752.3270	1.056E-05	13528.8226	-113.5152
123.000	.002635	-20621.7512	2198.4364	-3.432E-05	12925.6407	-111.6436
127.920	.002381	-11105.8803	1672.0304	-6.096E-05	12454.5580	-102.3425
132.840	.002035	-4048.9973	1201.9998	-7.369E-05	12105.2073	-88.7268
137.760	.001655	866.8219	803.6453	-7.636E-05	11947.6739	-73.2060
142.680	.001283	4009.1556	482.0107	-7.227E-05	12103.2350	-57.5398
147.600	9.44E-04	5752.0314	234.8752	-6.407E-05	12189.5159	-42.9218
152.520	6.53E-04	6446.4175	55.2990	-5.382E-05	12223.8915	-30.0767
157.440	4.15E-04	6402.1008	-66.3150	-4.303E-05	12221.6976	-19.3599
162.360	2.29E-04	5878.5683	-140.6378	-3.272E-05	12195.7801	-10.8526
167.280	9.28E-05	5082.6172	-178.2697	-2.351E-05	12156.3766	-4.4450
172.200	-1.91E-06	4170.6688	-188.9767	-1.574E-05	12111.2307	.092514
177.120	-6.21E-05	3254.0662	-181.2395	-9.506E-06	12065.8543	3.0527
182.040	-9.54E-05	2405.9796	-162.0477	-4.752E-06	12023.8698	4.7489
186.960	-1.09E-04	1668.8692	-136.8736	-1.330E-06	11987.3792	5.4845
191.880	-1.09E-04	1061.7601	-109.7695	9.636E-07	11957.3243	5.5334
196.800	-9.94E-05	586.8407	-83.5395	2.348E-06	11933.8134	5.1292
201.720	-8.54E-05	235.1101	-59.9490	3.039E-06	11916.4010	4.4604
206.640	-6.95E-05	-9.0378	-39.9435	3.228E-06	11905.2093	3.6719
211.560	-5.37E-05	-164.2878	-23.8561	3.083E-06	11912.8950	2.8677
216.480	-3.92E-05	-249.8492	-11.5926	2.735E-06	11917.1307	2.1175
221.400	-2.67E-05	-283.7416	-2.7865	2.287E-06	11918.8085	1.4623
226.320	-1.67E-05	-281.7685	3.0776	1.812E-06	11918.7108	.9215
231.240	-8.92E-06	-257.0241	6.5706	1.359E-06	11917.4859	.4985
236.160	-3.29E-06	-219.7892	8.2542	9.589E-07	11915.6426	.1860
241.080	5.20E-07	-177.6898	8.6386	6.251E-07	11913.5584	-.029683
246.000	2.86E-06	-136.0151	8.1592	3.616E-07	11911.4953	-.1652
250.920	4.08E-06	-98.1146	7.1674	1.650E-07	11909.6191	-.2380
255.840	4.48E-06	-65.8126	5.9314	2.727E-08	11908.0200	-.2644
260.760	4.35E-06	-39.8033	4.6437	-6.143E-08	11906.7324	-.2590
265.680	3.88E-06	-19.9976	3.4320	-1.117E-07	11905.7519	-.2336
270.600	3.25E-06	-5.8126	2.3716	-1.333E-07	11905.0497	-.1975
275.520	2.57E-06	3.6009	1.4977	-1.352E-07	11904.9402	-.1577
280.440	1.92E-06	9.1905	.8170	-1.244E-07	11905.2169	-.1190
285.360	1.34E-06	11.8853	.3174	-1.067E-07	11905.3503	-.084142
290.280	8.67E-07	12.5237	-.024496	-8.625E-08	11905.3819	-.054839
295.200	4.94E-07	11.8140	-.2370	-6.581E-08	11905.3468	-.031563
300.120	2.19E-07	10.3207	-.3494	-4.722E-08	11905.2728	-.014128

305.040	2.93E-08	8.4684	-.3889	-3.144E-08	11905.1811	-.001911
309.960	-9.03E-08	6.5558	-.3790	-1.882E-08	11905.0864	.005939
314.880	-1.56E-07	4.7761	-.3389	-9.300E-09	11904.9983	.010341
319.800	-1.82E-07	3.2389	-.2835	-2.568E-09	11904.9222	.012179
324.720	-1.81E-07	1.9911	-.2235	1.824E-09	11904.8605	.012241
329.640	-1.64E-07	1.0364	-.1659	4.367E-09	11904.8132	.011179
334.560	-1.38E-07	.3505	-.1150	5.532E-09	11904.7793	.009506
339.480	-1.09E-07	-.1058	-.072888	5.737E-09	11904.7671	.007601
344.400	-8.17E-08	-.3780	-.040114	5.331E-09	11904.7806	.005722
349.320	-5.70E-08	-.5110	-.016128	4.584E-09	11904.7872	.004029
354.240	-3.66E-08	-.5457	1.961E-04	3.697E-09	11904.7889	.002607
359.160	-2.06E-08	-.5164	.010259	2.804E-09	11904.7875	.001484
364.080	-8.98E-09	-.4503	.015511	1.993E-09	11904.7842	6.508E-04
369.000	-1.03E-09	-.3677	.017298	1.306E-09	11904.7801	7.555E-05
373.920	3.87E-09	-.2826	.016782	7.594E-10	11904.7759	-2.854E-04
378.840	6.44E-09	-.2041	.014902	3.506E-10	11904.7720	-4.788E-04
383.760	7.32E-09	-.1367	.012374	6.442E-11	11904.7687	-5.489E-04
388.680	7.07E-09	-.082421	.009708	-1.196E-10	11904.7660	-5.346E-04
393.600	6.14E-09	-.040941	.007241	-2.232E-10	11904.7639	-4.682E-04
398.520	4.88E-09	-.010727	.005168	-2.666E-10	11904.7624	-3.746E-04
403.440	3.52E-09	.010437	.003576	-2.669E-10	11904.7624	-2.726E-04
408.360	2.25E-09	.024986	.002473	-2.371E-10	11904.7631	-1.757E-04
413.280	1.19E-09	.035241	.001811	-1.865E-10	11904.7636	-9.340E-05
418.200	4.15E-10	.043178	.001501	-1.207E-10	11904.7640	-3.292E-05
423.120	3.56E-17	.050246	-.004396	-4.220E-11	11904.7644	-.002364
428.040	-3.12E-17	1.186E-08	-.005106	-3.614E-18	11904.7619	.002076
432.960	-1.21E-23	-3.778E-09	-1.205E-09	3.173E-18	11904.7619	8.018E-10
437.880	2.35E-24	-2.028E-15	3.840E-10	1.226E-24	11904.7619	-1.561E-10
442.800	0.000	2.841E-16	2.060E-16	-2.386E-25	11904.7619	-1.072E-16
447.720	0.000	2.379E-22	-2.887E-17	0.0000	11904.7619	1.174E-17
452.640	0.000	-2.136E-23	-2.417E-23	0.0000	11904.7619	1.159E-23
457.560	0.000	0.0000	2.171E-24	0.0000	11904.7619	-8.824E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	-.03750119
Maximum bending moment	=	3155759.999 lbs-in
Maximum shear force	=	308429.281 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = 1.000000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	0.0000	3.203E+05	-.040956	11904.7619	-15269.6852
4.920	.798497	1.431E+06	2.443E+05	-.039754	82768.8183	-15621.9109
9.840	.608824	2.482E+06	1.666E+05	-.036467	1.348E+05	-15974.1631
14.760	.439666	3.143E+06	87138.9884	-.031742	1.675E+05	-16326.4484
19.680	.296480	3.402E+06	12624.4162	-.026245	1.803E+05	-13964.0281
24.600	.181411	3.318E+06	-45886.0107	-.020601	1.762E+05	-9820.6983
29.520	.093768	2.991E+06	-82787.5088	-.015301	1.600E+05	-5179.9107
34.440	.030846	2.534E+06	-99805.8497	-.010661	1.373E+05	-1738.1140
39.360	-.011135	2.030E+06	-1.025E+05	-.006828	1.124E+05	639.7940
44.280	-.036338	1.539E+06	-95698.8326	-.003830	88076.5066	2128.0451
49.200	-.048824	1.096E+06	-83297.0728	-.001617	66166.3647	2913.3207
54.120	-.052252	7.222E+05	-68318.0965	-9.012E-05	47657.6739	3175.6941
59.040	-.049711	4.240E+05	-52938.2046	8.726E-04	32895.4383	3076.2945
63.960	-.043666	1.996E+05	-38604.2004	.001396	21784.9442	2750.5365
68.880	-.035971	41398.4060	-26165.9300	.001599	13954.1879	2305.6710
73.800	-.027934	-61039.3023	-16013.1849	.001582	14926.5095	1821.4611
78.720	-.020402	-1.193E+05	-8204.2335	.001431	17809.9650	1352.9094
83.640	-.013856	-1.446E+05	-2578.0817	.001209	19062.4191	934.1442
88.560	-.008504	-1.470E+05	1153.5210	9.642E-04	19183.6232	582.7674
93.480	-.004368	-1.351E+05	3335.3529	7.272E-04	18594.4447	304.1561
98.400	-.001348	-1.156E+05	4318.2316	5.166E-04	17629.7275	95.3881
103.320	7.15E-04	-93656.8693	4426.4447	3.408E-04	16541.2406	-51.3990
108.240	.002005	-72758.8161	4100.0765	2.010E-04	15506.6835	-81.2710
113.160	.002694	-53707.7792	3627.5016	9.483E-05	14563.5629	-110.8326
118.080	.002938	-37250.8289	3052.9979	1.844E-05	13748.8623	-122.7055
123.000	.002875	-23702.5651	2451.4313	-3.276E-05	13078.1562	-121.8338
127.920	.002616	-13064.2821	1875.0604	-6.364E-05	12551.5085	-112.4632
132.840	.002249	-5126.7359	1357.1585	-7.891E-05	12158.5607	-98.0660
137.760	.001840	445.4592	915.8106	-8.285E-05	11926.8143	-81.3437
142.680	.001434	4047.8796	557.5692	-7.907E-05	12105.1520	-64.2829
147.600	.001061	6087.5530	280.7547	-7.056E-05	12206.1259	-48.2434
152.520	7.39E-04	6949.3663	78.2800	-5.961E-05	12248.7899	-34.0635
157.440	4.75E-04	6975.1393	-60.0505	-4.791E-05	12250.0658	-22.1685
162.360	2.68E-04	6452.7648	-145.7639	-3.664E-05	12224.2057	-12.6744
167.280	1.14E-04	5612.9242	-190.4253	-2.650E-05	12182.6294	-5.4807
172.200	7.19E-06	4631.1377	-204.7667	-1.790E-05	12134.0261	-.3491
177.120	-6.17E-05	3633.2461	-198.1628	-1.096E-05	12084.6256	3.0336
182.040	-1.01E-04	2702.7820	-178.3825	-5.637E-06	12038.5630	5.0071
186.960	-1.17E-04	1889.0552	-151.5426	-1.780E-06	11998.2795	5.9034
191.880	-1.18E-04	1215.1059	-122.2011	8.268E-07	11964.9157	6.0241
196.800	-1.09E-04	684.9691	-93.5377	2.423E-06	11938.6713	5.6277

201.720	-9.43E-05	289.9269	-67.5789	3.241E-06	11919.1147	4.9246
206.640	-7.72E-05	13.6131	-45.4354	3.496E-06	11905.4358	4.0768
211.560	-5.99E-05	-164.0384	-27.5299	3.370E-06	11912.8826	3.2019
216.480	-4.40E-05	-263.9129	-13.8009	3.011E-06	11917.8269	2.3790
221.400	-3.03E-05	-305.7639	-3.8751	2.532E-06	11919.8987	1.6558
226.320	-1.91E-05	-307.0276	2.7947	2.018E-06	11919.9613	1.0555
231.240	-1.04E-05	-282.2341	6.8260	1.523E-06	11918.7339	.5832
236.160	-4.11E-06	-242.8559	8.8320	1.082E-06	11916.7845	.2322
241.080	2.10E-07	-197.4563	9.3736	7.118E-07	11914.5370	-.012008
246.000	2.90E-06	-152.0210	8.9326	4.183E-07	11912.2877	-.1673
250.920	4.33E-06	-110.3831	7.9000	1.979E-07	11910.2264	-.2525
255.840	4.84E-06	-74.6744	6.5762	4.246E-08	11908.4587	-.2857
260.760	4.74E-06	-45.7571	5.1780	-5.869E-08	11907.0271	-.2827
265.680	4.27E-06	-23.6074	3.8507	-1.169E-07	11905.9306	-.2568
270.600	3.59E-06	-7.6361	2.6813	-1.432E-07	11905.1399	-.2185
275.520	2.86E-06	3.0579	1.7119	-1.470E-07	11904.9133	-.1755
280.440	2.15E-06	9.4979	.9524	-1.365E-07	11905.2321	-.1332
285.360	1.51E-06	12.6986	.3915	-1.178E-07	11905.3905	-.094870
290.280	9.86E-07	13.5818	.004499	-9.578E-08	11905.4343	-.062429
295.200	5.71E-07	12.9313	-.2389	-7.351E-08	11905.4021	-.036511
300.120	2.63E-07	11.3757	-.3705	-5.309E-08	11905.3251	-.016978
305.040	4.90E-08	9.3903	-.4201	-3.565E-08	11905.2268	-.003188
309.960	-8.76E-08	7.3123	-.4138	-2.162E-08	11905.1239	.005762
314.880	-1.64E-07	5.3616	-.3728	-1.098E-08	11905.0273	.010871
319.800	-1.96E-07	3.6652	-.3139	-3.397E-09	11904.9433	.013106
324.720	-1.97E-07	2.2800	-.2488	1.596E-09	11904.8748	.013332
329.640	-1.80E-07	1.2137	-.1858	4.530E-09	11904.8220	.012275
334.560	-1.53E-07	.4426	-.1298	5.921E-09	11904.7838	.010507
339.480	-1.22E-07	-.074940	-.083137	6.230E-09	11904.7656	.008451
344.400	-9.14E-08	-.3878	-.046601	5.841E-09	11904.7811	.006401
349.320	-6.42E-08	-.5450	-.019688	5.058E-09	11904.7889	.004539
354.240	-4.16E-08	-.5914	-.001226	4.103E-09	11904.7912	.002966
359.160	-2.39E-08	-.5651	.010289	3.132E-09	11904.7899	.001715
364.080	-1.08E-08	-.4964	.016433	2.240E-09	11904.7865	7.821E-04
369.000	-1.81E-09	-.4078	.018684	1.481E-09	11904.7821	1.327E-04
373.920	3.79E-09	-.3154	.018323	8.736E-10	11904.7775	-2.792E-04
378.840	6.78E-09	-.2293	.016396	4.161E-10	11904.7733	-5.042E-04
383.760	7.88E-09	-.1549	.013702	9.346E-11	11904.7696	-5.909E-04
388.680	7.70E-09	-.094606	.010817	-1.161E-10	11904.7666	-5.821E-04
393.600	6.74E-09	-.048239	.008122	-2.361E-10	11904.7643	-5.135E-04
398.520	5.38E-09	-.014223	.005842	-2.885E-10	11904.7626	-4.131E-04
403.440	3.90E-09	.009818	.004083	-2.922E-10	11904.7624	-3.020E-04
408.360	2.50E-09	.026532	.002860	-2.617E-10	11904.7632	-1.953E-04
413.280	1.32E-09	.038476	.002123	-2.071E-10	11904.7638	-1.042E-04
418.200	4.65E-10	.047833	.001776	-1.346E-10	11904.7643	-3.683E-05
423.120	4.01E-17	.056220	-.004871	-4.722E-11	11904.7647	-.002665
428.040	-3.49E-17	1.331E-08	-.005713	-4.074E-18	11904.7619	.002323
432.960	-1.35E-23	-4.227E-09	-1.351E-09	3.550E-18	11904.7619	8.987E-10
437.880	2.63E-24	-2.271E-15	4.296E-10	1.374E-24	11904.7619	-1.746E-10
442.800	0.000	3.179E-16	2.308E-16	-2.670E-25	11904.7619	-1.201E-16
447.720	0.000	2.664E-22	-3.230E-17	0.0000	11904.7619	1.313E-17
452.640	0.000	-2.390E-23	-2.706E-23	0.0000	11904.7619	1.298E-23
457.560	0.000	0.0000	2.429E-24	0.0000	11904.7619	-9.874E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.04095593
Maximum bending moment	=	3402308.091 lbs-in
Maximum shear force	=	320318.161 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	14

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .100000	M= 0.000	2.000E+05	.100000	3.937E+05	55122.4809
4	y= .200000	M= 0.000	2.000E+05	.2000	7.874E+05	1.102E+05
4	y= .300000	M= 0.000	2.000E+05	.3000	1.178E+06	1.591E+05
4	y= .400000	M= 0.000	2.000E+05	.4000	1.556E+06	2.014E+05
4	y= .500000	M= 0.000	2.000E+05	.5000	1.925E+06	2.345E+05
4	y= .600000	M= 0.000	2.000E+05	.6000	2.263E+06	2.578E+05
4	y= .700000	M= 0.000	2.000E+05	.7000	2.584E+06	2.773E+05
4	y= .800000	M= 0.000	2.000E+05	.8000	2.879E+06	2.935E+05
4	y= .900000	M= 0.000	2.000E+05	.9000	3.156E+06	3.084E+05
4	y= 1.000	M= 0.000	2.000E+05	1.0000	3.402E+06	3.203E+05

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = .10000 in
Moment   = 0. in-lbs
Axial Load = 200000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
492.000	.10000000	393707.052	55122.481
467.400	.10000000	396722.144	55061.756
442.800	.10000000	398289.040	55004.095
418.200	.10000000	398271.135	54949.609
393.600	.10000000	396526.252	54898.380
369.000	.10000000	398029.158	54850.291
344.400	.10000000	399150.946	54805.328
319.800	.10000000	397690.287	54763.482
295.200	.10000000	399380.900	54724.819
270.600	.10000000	398516.666	54689.245

The analysis ended normally.

Route 84 Arroyo Mocho

12/9/2009

Pile Design Spreadsheet

NB24 pier

NAVFAC Design Method For a Single Pile

Project Name: Isabel Road Rt 84
Project Number:
Bridge Name: Arryo Mocho
Boring Surface El. (m) 123.1
Boring Surface El. (ft) 404.0
Design GWS El. (ft) 376.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 117.6
Bottom of Pile Cap El. (ft) 385.9
Bottom of Fill El. (ft) 400

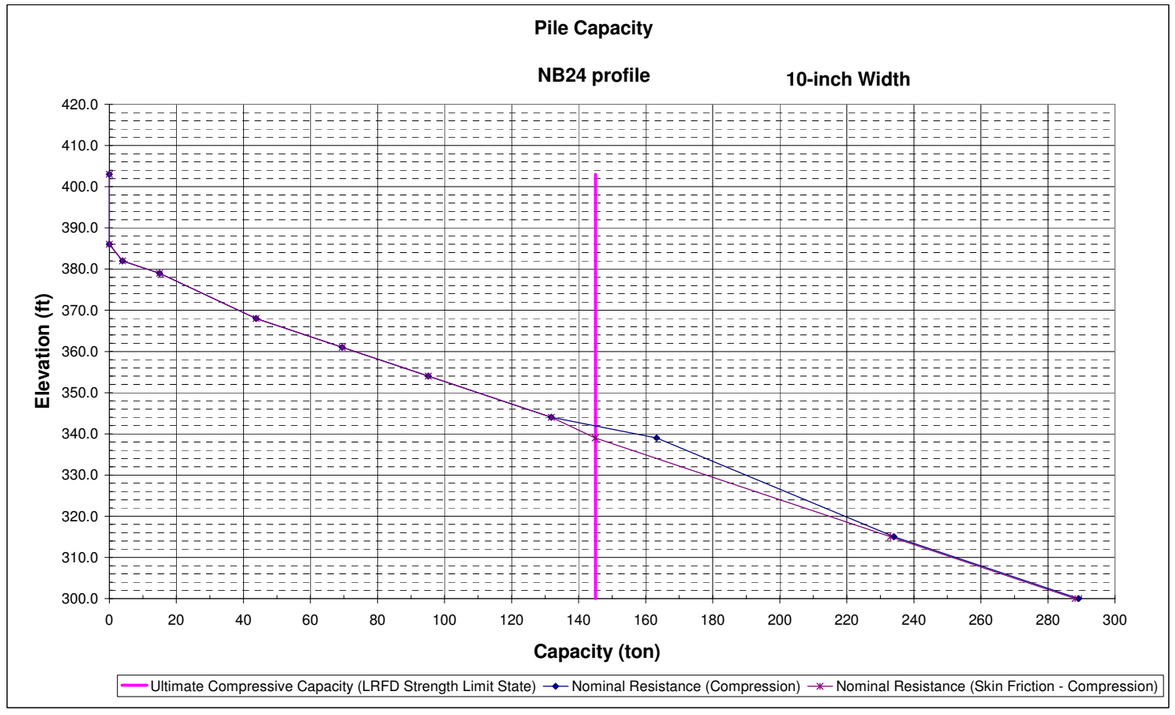
Nominal axial compress. Capacity (ult.) 145 ton
Nominal axial compress. Capacity (ult.) 1291 kN
Pile Width 10 inch
Pile Width 254 mm
Pile Width 0.83 ft
Crit depth ratio 20 -
Crit depth 16.7 ft
Crit. Depth. Elev 387.3 ft
Crit. Depth. Elev 118.1 m
Crit. Eff. Vert. Str. 2160 psf

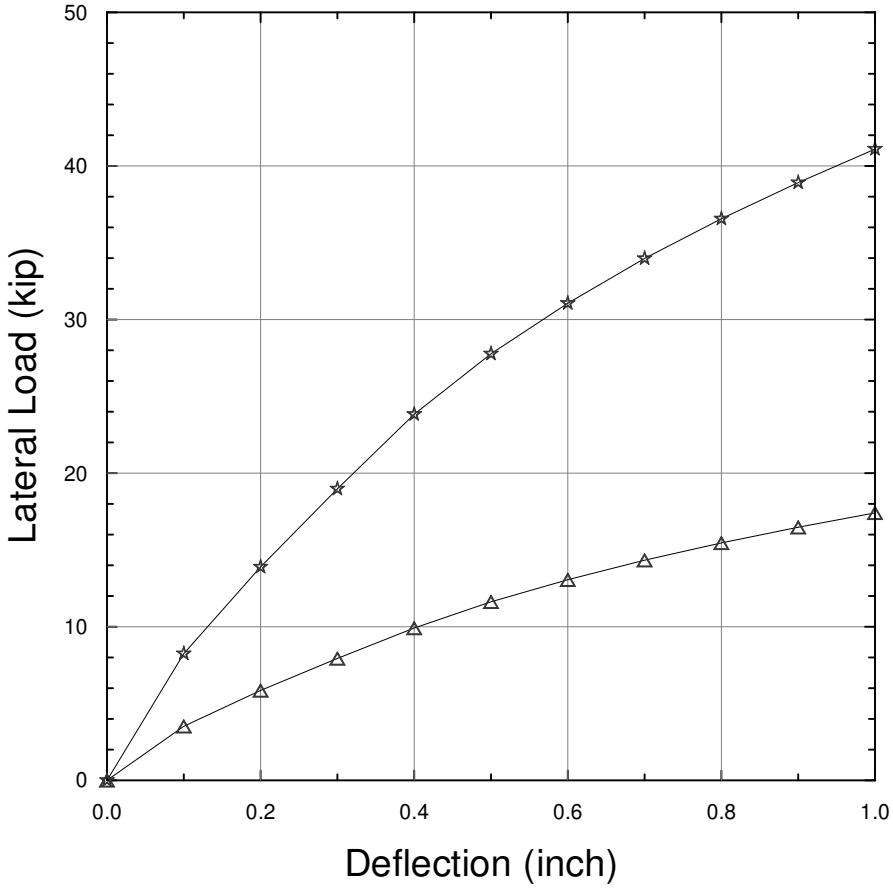
Skin Resistance (Friction) of Pile in Granular Material:
Type (Steel=S,Concrete=C,Timber=T) s
Earth Press. Coefficient * (Comp.) 0.92
Earth Press. Coefficient * (Tens) 0.5
Minimum Adhesion 500 psf

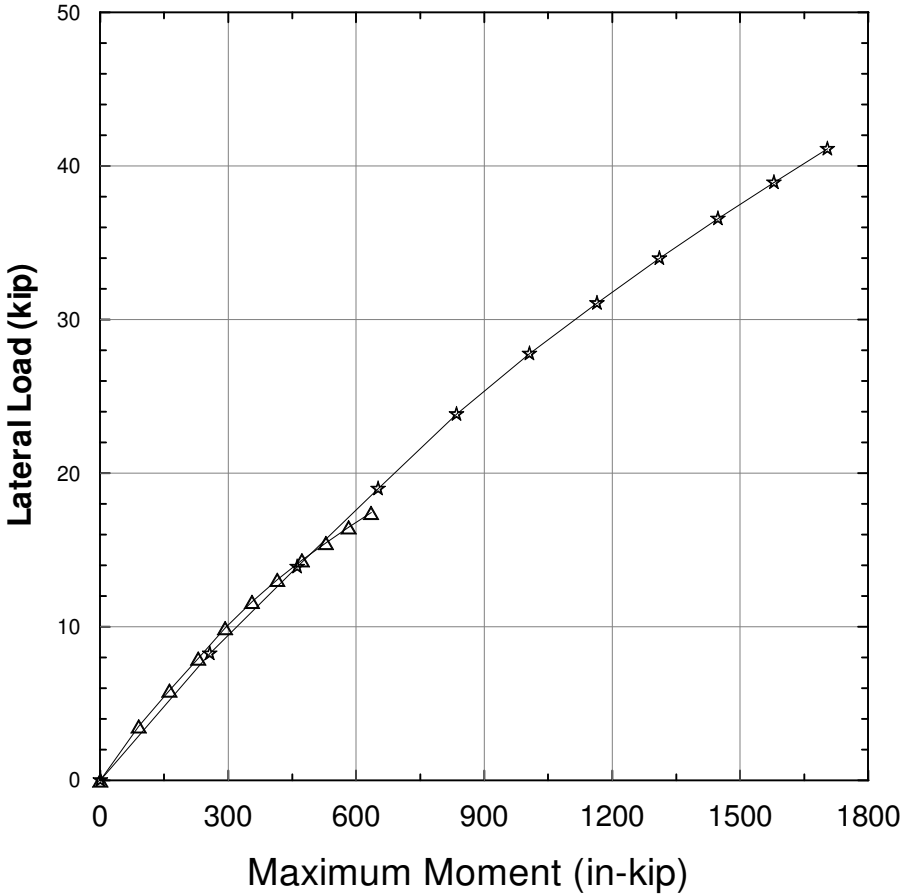
Pile Shape Square (Square, Circular or Octogonal)
Pile Surface Area 1.47 sq. m/m Pile Tip Area 0.01 sq. m
Pile Surface Area 4.83 sq. ft/ft Pile Tip Area 0.12 sq. ft.

* Note: adhesion values based on FHWA correlations for steel piles (1997); side friction in sand based on Norlund method

Layer	Layer Elevation				Lateral	Cohesion		Adhesion	Adhesion	Friction Angle		Layer	Internal Depth to	Effective	Design Effective	delta Lat. Res.			Nq	z/B	Nc	Soil	Bearing	Include	Elevation	Compression Cumulative Axial Res.				Compression Nominal Axial Capacity		Tension Cumulative Axial Res. (Skin)		Tension Nominal Axial Capacity	
No.	Top		Bot.		Resists?			Ratio				Thickness	Layer Top	Vert. Stress (Bot. Lay.)	Vert. Stress (Bot. Lay.)	Cohesive	Friction (comp)	Friction (tensile)	(granular)		(cohesive)	Type G= gran. C=cohes.	Capacity (B.C.)	B.C.?	to midlayer	(skin)		(Tot)							
						c	c	c_a/c	c_a	ϕ	δ																								
(-)	(m)	(feet)	(m)	(feet)		(kPa)	(psf)		(psf)	(deg)	(deg)	(feet)	(feet)	(psf)	(psf)	(ton)	(ton)	(ton)	(-)	(-)	(-)		(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			122.83	403.0										0	0					0.0	6.25	g	0	n	403.0	0	0	0	0	145	1291	0	0	73	645
1	122.83	403.0	117.65	386.0	n	0	0	0.00	0	40	30	17.0	1.0	405	405	0.0	0.0	0.0	145	11.4	9.00	g	3	n	394.5	0.0	0	0.0	0	145	1291	0.0	0	73	645
2	117.65	386.0	116.43	382.0	y	0	0	0.00	0	40	30	4.0	18.0	1350	1350	0.0	3.9	2.1	145	24.0	9.00	g	11	n	384.0	3.9	35	3.9	35	145	1291	2.1	19	73	645
3	116.43	382.0	115.51	379.0	y	115	2400	0.64	1536	0	0	3.0	22.0	2430	2160	11.1	0.0	0.0	0	28.2	9.00	c	1	n	380.5	15.0	134	15.0	134	145	1291	13.2	118	73	645
4	115.51	379.0	112.16	368.0	Y	0	0	0.00	0	44	33	11.0	25.0	4288	2160	0.0	28.8	15.6	145	36.6	9.00	g	18	n	373.5	43.8	390	43.8	390	145	1291	28.9	257	73	645
5	112.16	368.0	110.03	361.0	Y	96	2000	0.76	1520	0	0	7.0	36.0	5305	2160	25.7	0.0	0.0	0	47.4	9.00	c	1	n	364.5	69.5	618	69.5	618	145	1291	54.6	485	73	645
6	110.03	361.0	107.89	354.0	Y	96	2000	0.76	1520	0	0	7.0	43.0	5813	2160	25.7	0.0	0.0	0	55.8	9.00	c	1	n	357.5	95.2	847	95.2	847	145	1291	80.3	714	73	645
7	107.89	354.0	104.85	344.0	Y	96	2000	0.76	1520	0	0	10.0	50.0	6902	2160	36.7	0.0	0.0	0	66.0	9.00	c	1	n	349.0	131.9	1174	131.9	1174	145	1291	117.0	1041	73	645
8	104.85	344.0	103.32	339.0	Y	0	0	0.00	0	44	33	5.0	60.0	7700	2160	0.0	13.1	7.1	145	75.0	9.00	g	18	y	341.5	144.9	1290	163.3	1453	145	1291	124.1	1104	73	645
9	103.32	339.0	96.01	315.0	Y	96	2000	0.76	1520	0	0	24.0	65.0	7773	2160	88.1	0.0	0.0	0	92.4	9.00	c	1	y	327.0	233.0	2074	234.1	2083	145	1291	212.2	1888	73	645
10	96.01	315.0	91.44	300.0	Y	96	2000	0.76	1520	0	0	15.0	89.0	8354	2160	55.1	0.0	0.0	0	115.8	9.00	c	1	y	307.5	288.1	2564	289.2	2574	145	1291	267.2	2377	73	645
Bottom	91.44	300.0																																







Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Mocho Bridge (Widen) Abutments 1 & 4 Pile Lateral Resistance HP 10x57 Pile**	Figure G-1
	URS		

X:/Route 84/geotech/Analysis/Pile Design/Lateral/Arroyo Mocho/Abutments_B20.grf

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Pier_B19_Fixed.lpd
Name of output file: ArroyoMocho_Pier_B19_Fixed.lpo
Name of plot output file: ArroyoMocho_Pier_B19_Fixed.lpp
Name of runtime file: ArroyoMocho_Pier_B19_Fixed.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:54:51

Problem Title

SR84 Isabel Pier - Arroyo Mocho Bridge Widen - H pile

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 492.00 in
Depth of ground surface below top of pile = -216.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	492.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -216.000 in
Distance from top of pile to bottom of layer = -180.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -180.000 in
Distance from top of pile to bottom of layer = 108.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 780.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 288.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-216.00	.07230
2	-180.00	.07230
3	-180.00	.07810
4	108.00	.07810
5	108.00	.04200
6	420.00	.04200
7	420.00	.04200
8	780.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-216.000	.00000	35.00	------	------
2	-180.000	.00000	35.00	------	------
3	-180.000	.00000	40.00	------	------
4	108.000	.00000	40.00	------	------
5	108.000	.00000	40.00	------	------
6	420.000	.00000	40.00	------	------
7	420.000	27.77800	.00	.00500	.0
8	780.000	27.77800	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .100 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .200 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .300 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .400 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .500 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .600 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   200000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

```
Deflection at pile head     =            .700 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .800 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .900 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           1.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      200000.000 lbs
```

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	276.000

Depth of ground surface below top of pile =   -216.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =            2
Depth below pile head       =       60.000 in
Depth below ground surface  =      276.000 in
Equivalent Depth (see note) =      276.000 in
Pile Diameter               =       10.000 in
Angle of Friction           =       40.000 deg.
Avg. Eff. Unit Weight       =       .07734 lbs/in**3
k                           =      225.000 pci
A (static)                  =        .8800
B (static)                  =        .5000
Pst                         =    28178.350 lbs/in
```

Psd	=	22232.297	lbs/in
Ps	=	22232.297	lbs/in
pu	=	19564.422	lbs/in
Cbar	=	33042.3027	
n	=	1.6447	
m	=	40551.7102	
yk	=	.2000	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	862.500
.0278	1725.000
.0417	2587.500
.0556	3450.000
.0694	4312.500
.0833	5175.000
.0972	6037.500
.1111	6900.000
.1250	7762.500
.1389	8625.000
.1528	9487.500
.1667	10350.000
.3750	19564.422
10.3750	19564.422
20.3750	19564.422
30.3750	19564.422

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	-1.207E+06	1.098E+05	0.0000	71638.7917	-4860.0000
4.920	.095014	-7.242E+05	86237.7679	-.001622	47755.1907	-4722.8599

9.840	.084043	-3.549E+05	64113.9444	-.002528	29471.9094	-4270.5643
14.760	.070139	-88322.5485	44649.7453	-.002900	16277.1653	-3641.7118
19.680	.055506	90204.5356	28450.4441	-.002899	16370.3330	-2943.3700
24.600	.041618	1.973E+05	15667.4076	-.002657	21673.7783	-2252.9864
29.520	.029361	2.496E+05	6135.0744	-.002282	24261.2406	-1621.9459
34.440	.019166	2.622E+05	-511.7238	-.001852	24884.6420	-1080.0046
39.360	.011139	2.482E+05	-4742.9172	-.001423	24192.3802	-639.9927
44.280	.005163	2.183E+05	-7061.0514	-.001031	22712.8817	-302.3383
49.200	9.91E-04	1.808E+05	-7950.2292	-6.961E-04	20853.2157	-59.1161
54.120	-.001687	1.415E+05	-7843.3810	-4.255E-04	18907.9180	102.5503
59.040	-.003196	1.044E+05	-7104.5274	-2.190E-04	17073.9347	197.7966
63.960	-.003842	71986.1848	-6022.5639	-7.084E-05	15468.4344	242.0259
68.880	-.003893	45294.6702	-4813.2821	2.766E-05	14147.0723	249.5521
73.800	-.003570	24569.0465	-3626.7380	8.634E-05	13121.0513	232.7829
78.720	-.003044	9437.6497	-2557.5816	1.149E-04	12371.9723	201.8335
83.640	-.002439	-823.6839	-1656.4986	1.221E-04	11945.5383	164.4604
88.560	-.001842	-7102.6626	-941.4354	1.155E-04	12256.3789	126.2157
93.480	-.001303	-10314.6725	-407.7350	1.009E-04	12415.3893	90.7356
98.400	-8.49E-04	-11313.2503	-36.6970	8.269E-05	12464.8238	60.0928
103.320	-4.89E-04	-10838.4983	197.6329	6.408E-05	12441.3212	35.1632
108.240	-2.19E-04	-9494.6560	305.9618	4.700E-05	12374.7944	8.8729
113.160	-2.69E-05	-7920.3389	330.5113	3.238E-05	12296.8579	1.1065
118.080	9.97E-05	-6306.1451	322.9934	2.043E-05	12216.9473	-4.1626
123.000	1.74E-04	-4782.2889	294.6014	1.112E-05	12141.5089	-7.3789
127.920	2.09E-04	-3429.1453	254.3393	4.220E-06	12074.5216	-8.9878
132.840	2.16E-04	-2287.8954	209.0959	-5.815E-07	12018.0241	-9.4038
137.760	2.03E-04	-1370.4968	163.8425	-3.654E-06	11972.6083	-8.9919
142.680	1.80E-04	-668.4943	121.9022	-5.367E-06	11937.8557	-8.0570
147.600	1.51E-04	-160.4175	85.2509	-6.063E-06	11912.7034	-6.8419
152.520	1.20E-04	182.3066	54.8164	-6.044E-06	11913.7870	-5.5299
157.440	9.11E-05	390.8710	30.7562	-5.563E-06	11924.1120	-4.2507
162.360	6.53E-05	495.8959	12.7016	-4.818E-06	11929.3112	-3.0886
167.280	4.36E-05	525.3373	-.040648	-3.961E-06	11930.7687	-2.0912
172.200	2.63E-05	503.2903	-8.3284	-3.097E-06	11929.6773	-1.2778
177.120	1.32E-05	449.4799	-13.0648	-2.296E-06	11927.0134	-.6475
182.040	3.74E-06	379.2518	-15.1151	-1.600E-06	11923.5367	-.1859
186.960	-2.57E-06	303.8964	-15.2540	-1.027E-06	11919.8063	.1295
191.880	-6.37E-06	231.1724	-14.1372	-5.772E-07	11916.2061	.3245
196.800	-8.25E-06	165.9220	-12.2917	-2.437E-07	11912.9759	.4257
201.720	-8.76E-06	110.7019	-10.1188	-1.138E-08	11910.2422	.4576
206.640	-8.36E-06	66.3751	-7.9065	1.373E-07	11908.0478	.4418
211.560	-7.41E-06	32.6319	-5.8453	2.205E-07	11906.3773	.3961
216.480	-6.19E-06	8.4236	-4.0473	2.550E-07	11905.1789	.3347
221.400	-4.90E-06	-7.6955	-2.5644	2.556E-07	11905.1429	.2681
226.320	-3.68E-06	-17.3131	-1.4048	2.346E-07	11905.6190	.2033
231.240	-2.59E-06	-21.9807	-.5479	2.016E-07	11905.8501	.1450
236.160	-1.69E-06	-23.1009	.044411	1.637E-07	11905.9055	.095720
241.080	-9.83E-07	-21.8659	.4181	1.260E-07	11905.8444	.056192
246.000	-4.54E-07	-19.2346	.6209	9.144E-08	11905.7141	.026227
250.920	-8.38E-08	-15.9365	.6974	6.190E-08	11905.5508	.004889
255.840	1.55E-07	-12.4938	.6870	3.802E-08	11905.3804	-.009136
260.760	2.90E-07	-9.2516	.6219	1.975E-08	11905.2199	-.017302
265.680	3.49E-07	-6.4129	.5276	6.598E-09	11905.0794	-.021031
270.600	3.55E-07	-4.0727	.4227	-2.208E-09	11904.9635	-.021609
275.520	3.28E-07	-2.2489	.3201	-7.518E-09	11904.8732	-.020126
280.440	2.81E-07	-.9085	.2276	-1.017E-08	11904.8069	-.017455
285.360	2.27E-07	.010916	.1496	-1.092E-08	11904.7624	-.014257

290.280	1.74E-07	.5852	.087478	-1.042E-08	11904.7909	-.010999
295.200	1.25E-07	.8922	.040781	-9.182E-09	11904.8061	-.007984
300.120	8.35E-08	1.0045	.007897	-7.589E-09	11904.8116	-.005384
305.040	5.03E-08	.9849	-.013401	-5.918E-09	11904.8107	-.003274
309.960	2.52E-08	.8843	-.025533	-4.348E-09	11904.8057	-.001658
314.880	7.48E-09	.7422	-.030833	-2.982E-09	11904.7986	-4.964E-04
319.800	-4.12E-09	.5868	-.031375	-1.866E-09	11904.7910	2.762E-04
324.720	-1.09E-08	.4371	-.028887	-1.006E-09	11904.7835	7.353E-04
329.640	-1.40E-08	.3045	-.024725	-3.831E-10	11904.7770	9.564E-04
334.560	-1.46E-08	.1946	-.019892	3.609E-11	11904.7715	.001008
339.480	-1.37E-08	.1087	-.015078	2.908E-10	11904.7673	9.490E-04
344.400	-1.18E-08	.045625	-.010712	4.204E-10	11904.7642	8.257E-04
349.320	-9.53E-09	.002463	-.007024	4.608E-10	11904.7620	6.735E-04
354.240	-7.25E-09	-.024401	-.004096	4.424E-10	11904.7631	5.170E-04
359.160	-5.18E-09	-.038710	-.001908	3.894E-10	11904.7638	3.722E-04
364.080	-3.42E-09	-.043945	-3.823E-04	3.199E-10	11904.7641	2.481E-04
369.000	-2.03E-09	-.043102	5.930E-04	2.468E-10	11904.7640	1.484E-04
373.920	-9.93E-10	-.038595	.001138	1.782E-10	11904.7638	7.320E-05
378.840	-2.75E-10	-.032253	.001369	1.187E-10	11904.7635	2.048E-05
383.760	1.75E-10	-.025362	.001387	7.033E-11	11904.7632	-1.315E-05
388.680	4.17E-10	-.018748	.001277	3.328E-11	11904.7628	-3.149E-05
393.600	5.03E-10	-.012865	.001105	6.730E-12	11904.7625	-3.832E-05
398.520	4.83E-10	-.007888	9.195E-04	-1.070E-11	11904.7623	-3.709E-05
403.440	3.98E-10	-.003796	7.525E-04	-2.051E-11	11904.7621	-3.079E-05
408.360	2.81E-10	-4.432E-04	6.228E-04	-2.407E-11	11904.7619	-2.193E-05
413.280	1.61E-10	.002379	5.377E-04	-2.245E-11	11904.7620	-1.265E-05
418.200	6.02E-11	.004892	4.949E-04	-1.634E-11	11904.7621	-4.770E-06
423.120	6.00E-18	.007281	-4.984E-04	-6.115E-12	11904.7623	-3.990E-04
428.040	-4.52E-18	1.821E-09	-7.399E-04	-6.099E-19	11904.7619	3.008E-04
432.960	-1.81E-24	-5.475E-10	-1.850E-10	4.598E-19	11904.7619	1.204E-10
437.880	3.40E-25	-3.015E-16	5.564E-11	1.841E-25	11904.7619	-2.262E-11
442.800	0.000	4.117E-17	3.064E-17	0.0000	11904.7619	-1.586E-17
447.720	0.000	3.505E-23	-4.184E-18	0.0000	11904.7619	1.701E-18
452.640	0.000	-3.095E-24	-3.561E-24	0.0000	11904.7619	1.703E-24
457.560	0.000	0.0000	3.146E-25	0.0000	11904.7619	-1.279E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1206627.403 lbs-in
Maximum shear force	=	109811.603 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5

Number of zero deflection points = 14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .200000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	-2.413E+06	2.196E+05	0.0000	1.314E+05	-9720.0000
4.920	.190028	-1.448E+06	1.725E+05	-.003243	83605.6196	-9445.7198
9.840	.168086	-7.097E+05	1.282E+05	-.005056	47039.0569	-8541.1286
14.760	.140279	-1.766E+05	89299.4905	-.005800	20649.5687	-7283.4236
19.680	.111012	1.804E+05	56900.8882	-.005797	20835.9040	-5886.7399
24.600	.083236	3.947E+05	31334.8152	-.005314	31442.7948	-4505.9727
29.520	.058721	4.992E+05	12270.1487	-.004563	36617.7194	-3243.8917
34.440	.038333	5.244E+05	-1023.4476	-.003704	37864.5222	-2160.0092
39.360	.022278	4.964E+05	-9485.8343	-.002846	36479.9985	-1279.9854
44.280	.010325	4.366E+05	-14122.1028	-.002063	33521.0016	-604.6766
49.200	.001981	3.615E+05	-15900.4585	-.001392	29801.6695	-118.2322
54.120	-.003375	2.829E+05	-15686.7619	-8.510E-04	25911.0740	205.1007
59.040	-.006392	2.088E+05	-14209.0548	-4.380E-04	22243.1075	395.5933
63.960	-.007684	1.440E+05	-12045.1278	-1.417E-04	19032.1069	484.0518
68.880	-.007787	90589.3404	-9626.5641	5.533E-05	16389.3827	499.1042
73.800	-.007140	49138.0931	-7253.4759	1.727E-04	14337.3408	465.5658
78.720	-.006087	18875.2994	-5115.1631	2.298E-04	12839.1827	403.6670
83.640	-.004879	-1647.3678	-3312.9973	2.443E-04	11986.3148	328.9207
88.560	-.003684	-14205.3251	-1882.8708	2.310E-04	12607.9958	252.4315
93.480	-.002606	-20629.3449	-815.4699	2.017E-04	12926.0166	181.4713
98.400	-.001699	-22626.5005	-73.3940	1.654E-04	13024.8857	120.1856
103.320	-9.79E-04	-21676.9966	395.2657	1.282E-04	12977.8805	70.3265
108.240	-4.38E-04	-18989.3121	611.9237	9.401E-05	12844.8269	17.7458
113.160	-5.38E-05	-15840.6777	661.0226	6.476E-05	12688.9539	2.2131
118.080	1.99E-04	-12612.2903	645.9869	4.086E-05	12529.1327	-8.3251
123.000	3.48E-04	-9564.5779	589.2027	2.223E-05	12378.2559	-14.7578
127.920	4.18E-04	-6858.2906	508.6786	8.440E-06	12244.2812	-17.9755
132.840	4.31E-04	-4575.7907	418.1919	-1.163E-06	12131.2862	-18.8077
137.760	4.07E-04	-2740.9936	327.6849	-7.308E-06	12040.4547	-17.9838
142.680	3.59E-04	-1336.9886	243.8044	-1.073E-05	11970.9495	-16.1140
147.600	3.01E-04	-320.8350	170.5019	-1.213E-05	11920.6448	-13.6838
152.520	2.40E-04	364.6132	109.6328	-1.209E-05	11922.8121	-11.0598
157.440	1.82E-04	781.7421	61.5125	-1.113E-05	11943.4620	-8.5013
162.360	1.31E-04	991.7918	25.4033	-9.636E-06	11953.8605	-6.1772
167.280	8.73E-05	1050.6747	-.081295	-7.921E-06	11956.7755	-4.1824
172.200	5.27E-05	1006.5806	-16.6568	-6.193E-06	11954.5926	-2.5556
177.120	2.64E-05	898.9598	-26.1296	-4.593E-06	11949.2649	-1.2951
182.040	7.47E-06	758.5035	-30.2303	-3.201E-06	11942.3116	-.3718

186.960	-5.14E-06	607.7929	-30.5081	-2.053E-06	11934.8507	.2589
191.880	-1.27E-05	462.3448	-28.2745	-1.154E-06	11927.6503	.6491
196.800	-1.65E-05	331.8440	-24.5834	-4.874E-07	11921.1898	.8514
201.720	-1.75E-05	221.4038	-20.2377	-2.276E-08	11915.7225	.9152
206.640	-1.67E-05	132.7502	-15.8129	2.747E-07	11911.3337	.8835
211.560	-1.48E-05	65.2639	-11.6906	4.410E-07	11907.9928	.7923
216.480	-1.24E-05	16.8473	-8.0946	5.100E-07	11905.5959	.6695
221.400	-9.81E-06	-15.3911	-5.1288	5.112E-07	11905.5238	.5361
226.320	-7.35E-06	-34.6263	-2.8097	4.692E-07	11906.4761	.4066
231.240	-5.19E-06	-43.9615	-1.0957	4.032E-07	11906.9382	.2901
236.160	-3.39E-06	-46.2019	.088823	3.274E-07	11907.0491	.1914
241.080	-1.97E-06	-43.7319	.8362	2.519E-07	11906.9268	.1124
246.000	-9.08E-07	-38.4691	1.2417	1.829E-07	11906.6663	.052455
250.920	-1.68E-07	-31.8731	1.3948	1.238E-07	11906.3398	.009779
255.840	3.10E-07	-24.9877	1.3739	7.604E-08	11905.9989	-.018273
260.760	5.81E-07	-18.5032	1.2439	3.951E-08	11905.6779	-.034604
265.680	6.99E-07	-12.8259	1.0553	1.320E-08	11905.3968	-.042062
270.600	7.11E-07	-8.1455	.8455	-4.416E-09	11905.1651	-.043217
275.520	6.55E-07	-4.4978	.6401	-1.504E-08	11904.9846	-.040251
280.440	5.63E-07	-1.8169	.4552	-2.034E-08	11904.8519	-.034910
285.360	4.55E-07	.021833	.2992	-2.185E-08	11904.7630	-.028515
290.280	3.48E-07	1.1703	.1750	-2.085E-08	11904.8198	-.021998
295.200	2.50E-07	1.7844	.081562	-1.836E-08	11904.8502	-.015967
300.120	1.67E-07	2.0090	.015794	-1.518E-08	11904.8614	-.010768
305.040	1.01E-07	1.9697	-.026802	-1.184E-08	11904.8594	-.006548
309.960	5.04E-08	1.7686	-.051066	-8.696E-09	11904.8495	-.003316
314.880	1.50E-08	1.4843	-.061666	-5.964E-09	11904.8354	-9.929E-04
319.800	-8.25E-09	1.1736	-.062750	-3.732E-09	11904.8200	5.524E-04
324.720	-2.18E-08	.8742	-.057773	-2.012E-09	11904.8052	.001471
329.640	-2.80E-08	.6090	-.049450	-7.661E-10	11904.7921	.001913
334.560	-2.93E-08	.3891	-.039785	7.218E-11	11904.7812	.002016
339.480	-2.73E-08	.2174	-.030156	5.816E-10	11904.7727	.001898
344.400	-2.36E-08	.091250	-.021424	8.408E-10	11904.7664	.001651
349.320	-1.91E-08	.004926	-.014049	9.216E-10	11904.7621	.001347
354.240	-1.45E-08	-.048802	-.008192	8.847E-10	11904.7643	.001034
359.160	-1.04E-08	-.077420	-.003817	7.787E-10	11904.7657	7.445E-04
364.080	-6.84E-09	-.087890	-7.646E-04	6.399E-10	11904.7663	4.962E-04
369.000	-4.06E-09	-.086203	.001186	4.937E-10	11904.7662	2.968E-04
373.920	-1.99E-09	-.077191	.002276	3.564E-10	11904.7657	1.464E-04
378.840	-5.51E-10	-.064507	.002737	2.374E-10	11904.7651	4.095E-05
383.760	3.51E-10	-.050725	.002773	1.407E-10	11904.7644	-2.631E-05
388.680	8.33E-10	-.037496	.002553	6.656E-11	11904.7638	-6.299E-05
393.600	1.01E-09	-.025729	.002210	1.346E-11	11904.7632	-7.665E-05
398.520	9.66E-10	-.015776	.001839	-2.140E-11	11904.7627	-7.419E-05
403.440	7.95E-10	-.007592	.001505	-4.102E-11	11904.7623	-6.158E-05
408.360	5.62E-10	-8.863E-04	.001246	-4.815E-11	11904.7619	-4.387E-05
413.280	3.22E-10	.004759	.001075	-4.489E-11	11904.7621	-2.529E-05
418.200	1.20E-10	.009784	9.897E-04	-3.268E-11	11904.7624	-9.541E-06
423.120	1.20E-17	.014562	-9.968E-04	-1.223E-11	11904.7626	-7.980E-04
428.040	-9.05E-18	3.642E-09	-.001480	-1.220E-18	11904.7619	6.016E-04
432.960	-3.62E-24	-1.095E-09	-3.700E-10	9.196E-19	11904.7619	2.409E-10
437.880	6.80E-25	-6.031E-16	1.113E-10	3.682E-25	11904.7619	-4.523E-11
442.800	0.000	8.233E-17	6.127E-17	0.0000	11904.7619	-3.171E-17
447.720	0.000	7.010E-23	-8.367E-18	0.0000	11904.7619	3.401E-18
452.640	0.000	-6.191E-24	-7.123E-24	0.0000	11904.7619	3.407E-24
457.560	0.000	0.0000	6.291E-25	0.0000	11904.7619	-2.557E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-2413254.805 lbs-in
Maximum shear force	=	219623.207 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .300000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	-3.560E+06	3.140E+05	0.0000	1.881E+05	-12895.9432
4.920	.285291	-2.168E+06	2.510E+05	-.004810	1.192E+05	-12717.0821
9.840	.252666	-1.080E+06	1.904E+05	-.007538	65372.8700	-11923.5843
14.760	.211116	-2.792E+05	1.346E+05	-.008680	25727.3527	-10780.4047
19.680	.167258	2.611E+05	86224.9536	-.008695	24831.9815	-8869.3760
24.600	.125559	5.863E+05	47685.3861	-.007983	40931.9266	-6797.1148
29.520	.088705	7.461E+05	18909.9355	-.006864	48838.6616	-4900.2228
34.440	.058016	7.859E+05	-1186.7739	-.005577	50812.2329	-3269.1712
39.360	.033824	7.454E+05	-14009.6168	-.004291	48803.9272	-1943.3665
44.280	.015791	6.565E+05	-21065.1716	-.003114	44405.8244	-924.7452
49.200	.003183	5.442E+05	-23807.3298	-.002105	38845.8452	-189.9533
54.120	-.004926	4.264E+05	-23538.0847	-.001290	33013.7078	299.4025
59.040	-.009512	3.151E+05	-21353.5062	-6.674E-04	27505.4648	588.6375
63.960	-.011493	2.176E+05	-18124.4870	-2.200E-04	22676.8217	723.9719
68.880	-.011676	1.372E+05	-14502.3884	7.805E-05	18697.9357	748.4259
73.800	-.010725	74738.5001	-10940.8872	2.561E-04	15604.6877	699.3388
78.720	-.009157	29059.8306	-7726.8328	3.433E-04	13343.3674	607.1874

83.640	-.007348	-1969.0512	-5014.5385	3.660E-04	12002.2397	495.3713
88.560	-.005555	-21003.5229	-2859.4880	3.467E-04	12944.5403	380.6655
93.480	-.003936	-30788.7366	-1248.8192	3.032E-04	13428.9568	274.0779
98.400	-.002571	-33888.6211	-127.0999	2.489E-04	13582.4164	181.9056
103.320	-.001487	-32529.2124	583.2001	1.931E-04	13515.1190	106.8342
108.240	-6.71E-04	-28529.9647	912.9439	1.418E-04	13317.1364	27.2080
113.160	-9.14E-05	-23824.9539	989.1289	9.785E-05	13084.2151	3.7616
118.080	2.92E-04	-18989.5092	968.4305	6.189E-05	12844.8366	-12.1756
123.000	5.18E-04	-14417.4041	884.5219	3.384E-05	12618.4948	-21.9336
127.920	6.25E-04	-10352.4022	764.5207	1.303E-05	12417.2571	-26.8474
132.840	6.46E-04	-6920.1669	629.1980	-1.475E-06	12247.3444	-28.1619
137.760	6.10E-04	-4158.1917	493.5643	-1.078E-05	12110.6130	-26.9737
142.680	5.40E-04	-2042.2802	367.6753	-1.599E-05	12005.8649	-24.2007
147.600	4.53E-04	-508.8047	257.5291	-1.813E-05	11929.9503	-20.5742
152.520	3.61E-04	527.4850	165.9654	-1.811E-05	11930.8750	-16.6468
157.440	2.74E-04	1159.9430	93.4999	-1.670E-05	11962.1848	-12.8107
162.360	1.97E-04	1480.3831	39.0560	-1.448E-05	11978.0482	-9.3210
167.280	1.32E-04	1572.7489	.5736	-1.191E-05	11982.6208	-6.3223
172.200	7.98E-05	1509.4754	-24.5098	-9.326E-06	11979.4884	-3.8742
177.120	4.02E-05	1349.9262	-38.8990	-6.925E-06	11971.5899	-1.9750
182.040	1.17E-05	1140.3372	-45.1897	-4.833E-06	11961.2142	-.5822
186.960	-7.37E-06	914.7707	-45.7092	-3.107E-06	11950.0476	.3710
191.880	-1.89E-05	696.6732	-42.4295	-1.754E-06	11939.2507	.9622
196.800	-2.46E-05	500.7161	-36.9370	-7.480E-07	11929.5498	1.2705
201.720	-2.62E-05	334.6854	-30.4420	-4.637E-08	11921.3305	1.3698
206.640	-2.51E-05	201.2583	-23.8132	4.038E-07	11914.7252	1.3249
211.560	-2.23E-05	99.5692	-17.6273	6.564E-07	11909.6911	1.1897
216.480	-1.86E-05	26.5137	-12.2246	7.623E-07	11906.0745	1.0065
221.400	-1.48E-05	-22.2208	-7.7634	7.659E-07	11905.8619	.8069
226.320	-1.11E-05	-51.3853	-4.2709	7.041E-07	11907.3057	.6128
231.240	-7.83E-06	-65.6323	-1.6866	6.058E-07	11908.0110	.4378
236.160	-5.12E-06	-69.1738	.1024	4.926E-07	11908.1864	.2895
241.080	-2.98E-06	-65.5943	1.2338	3.794E-07	11908.0091	.1705
246.000	-1.39E-06	-57.7800	1.8503	2.758E-07	11907.6223	.080157
250.920	-2.70E-07	-47.9298	2.0863	1.870E-07	11907.1347	.015753
255.840	4.52E-07	-37.6191	2.0594	1.151E-07	11906.6242	-.026664
260.760	8.63E-07	-27.8917	1.8673	6.013E-08	11906.1427	-.051441
265.680	1.04E-06	-19.3633	1.5861	2.044E-08	11905.7205	-.062845
270.600	1.06E-06	-12.3242	1.2723	-6.173E-09	11905.3720	-.064737
275.520	9.83E-07	-6.8318	.9645	-2.226E-08	11905.1001	-.060396
280.440	8.45E-07	-2.7900	.6869	-3.034E-08	11904.9000	-.052452
285.360	6.84E-07	-.013361	.4523	-3.270E-08	11904.7626	-.042893
290.280	5.24E-07	1.7251	.2653	-3.126E-08	11904.8473	-.033130
295.200	3.77E-07	2.6587	.1246	-2.758E-08	11904.8935	-.024080
300.120	2.52E-07	3.0050	.025306	-2.282E-08	11904.9107	-.016267
305.040	1.52E-07	2.9526	-.039106	-1.782E-08	11904.9081	-.009917
309.960	7.68E-08	2.6552	-.075925	-1.311E-08	11904.8934	-.005050
314.880	2.33E-08	2.2313	-.092149	-9.004E-09	11904.8724	-.001545
319.800	-1.18E-08	1.7662	-.094008	-5.647E-09	11904.8493	7.897E-04
324.720	-3.23E-08	1.3173	-.086699	-3.057E-09	11904.8271	.002181
329.640	-4.19E-08	.9191	-.074308	-1.178E-09	11904.8074	.002856
334.560	-4.39E-08	.5885	-.059856	8.779E-11	11904.7910	.003019
339.480	-4.10E-08	.3299	-.045425	8.592E-10	11904.7782	.002847
344.400	-3.54E-08	.1398	-.032318	1.254E-09	11904.7688	.002481
349.320	-2.87E-08	.009465	-.021232	1.379E-09	11904.7624	.002026
354.240	-2.18E-08	-.071841	-.012418	1.327E-09	11904.7655	.001557
359.160	-1.56E-08	-.1153	-.005825	1.169E-09	11904.7676	.001123

364.080	-1.03E-08	-.1315	-.001220	9.622E-10	11904.7684	7.496E-04
369.000	-6.15E-09	-.1292	.001730	7.432E-10	11904.7683	4.495E-04
373.920	-3.02E-09	-.1159	.003385	5.373E-10	11904.7676	2.230E-04
378.840	-8.60E-10	-.096982	.004091	3.585E-10	11904.7667	6.394E-05
383.760	5.03E-10	-.076354	.004155	2.130E-10	11904.7657	-3.773E-05
388.680	1.24E-09	-.056514	.003833	1.014E-10	11904.7647	-9.339E-05
393.600	1.50E-09	-.038841	.003322	2.128E-11	11904.7638	-1.144E-04
398.520	1.44E-09	-.023871	.002767	-3.139E-11	11904.7631	-1.110E-04
403.440	1.19E-09	-.011549	.002267	-6.114E-11	11904.7625	-9.228E-05
408.360	8.43E-10	-.001441	.001878	-7.205E-11	11904.7620	-6.581E-05
413.280	4.83E-10	.007076	.001623	-6.732E-11	11904.7623	-3.797E-05
418.200	1.81E-10	.014662	.001494	-4.906E-11	11904.7626	-1.433E-05
423.120	1.81E-17	.021877	-.001494	-1.837E-11	11904.7630	-.001200
428.040	-1.36E-17	5.475E-09	-.002223	-1.835E-18	11904.7619	9.038E-04
432.960	-5.44E-24	-1.645E-09	-5.561E-10	1.382E-18	11904.7619	3.620E-10
437.880	1.02E-24	-9.062E-16	1.672E-10	5.533E-25	11904.7619	-6.796E-11
442.800	0.000	1.237E-16	9.207E-17	-1.039E-25	11904.7619	-4.765E-17
447.720	0.000	1.053E-22	-1.257E-17	0.0000	11904.7619	5.110E-18
452.640	0.000	-9.300E-24	-1.070E-23	0.0000	11904.7619	5.119E-24
457.560	0.000	0.0000	9.452E-25	0.0000	11904.7619	-3.842E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =      .30000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =   -3559670.151 lbs-in
Maximum shear force              =     314039.309 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              5
Number of zero deflection points =             14
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .400000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =      200000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	-4.629E+06	3.971E+05	0.0000	2.411E+05	-15269.6852
4.920	.380870	-2.857E+06	3.211E+05	-.006287	1.533E+05	-15621.8535
9.840	.338133	-1.457E+06	2.464E+05	-.009910	84035.4387	-14753.3629
14.760	.283354	-4.123E+05	1.776E+05	-.011480	32314.0745	-13224.9204
19.680	.225168	3.131E+05	1.168E+05	-.011563	27402.6410	-11498.7225
24.600	.169570	7.595E+05	65902.9039	-.010663	49504.8762	-9179.6487
29.520	.120248	9.825E+05	26979.8474	-.009200	60544.6538	-6642.7320
34.440	.079046	1.043E+06	-318.5309	-.007498	63543.8063	-4454.1697
39.360	.046465	9.941E+05	-17843.2388	-.005787	61120.0111	-2669.6953
44.280	.022100	8.789E+05	-27594.5232	-.004214	55415.6755	-1294.2415
49.200	.004999	7.309E+05	-31512.1041	-.002862	48088.4846	-298.2710
54.120	-.006062	5.745E+05	-31339.4981	-.001766	40344.0573	368.4361
59.040	-.012375	4.260E+05	-28549.2117	-9.254E-04	32994.1338	765.8267
63.960	-.015168	2.954E+05	-24314.9360	-3.195E-04	26527.0703	955.4236
68.880	-.015519	1.874E+05	-19517.5432	8.596E-05	21180.7570	994.7360
73.800	-.014322	1.031E+05	-14773.2123	3.300E-04	17011.1402	933.8538
78.720	-.012272	41357.3289	-10474.0024	4.513E-04	13952.1544	813.7925
83.640	-.009881	-803.5559	-6833.3440	4.854E-04	11944.5419	666.1500
88.560	-.007496	-26838.0201	-3930.9921	4.622E-04	13233.3768	513.6679
93.480	-.005333	-40394.0743	-1753.8470	4.057E-04	13904.4686	371.3505
98.400	-.003504	-44894.3044	-230.5906	3.341E-04	14127.2522	247.8595
103.320	-.002046	-43320.5438	740.7040	2.600E-04	14049.3433	146.9757
108.240	-9.46E-04	-38117.4265	1196.5404	1.916E-04	13791.7632	38.3236
113.160	-1.60E-04	-31923.6291	1307.0581	1.328E-04	13485.1396	6.6023
118.080	3.61E-04	-25517.2484	1286.2344	8.452E-05	13167.9920	-15.0672
123.000	6.71E-04	-19433.4135	1179.2027	4.676E-05	12866.8121	-28.4416
127.920	8.21E-04	-14005.9266	1022.4146	1.868E-05	12598.1246	-35.2934
132.840	8.55E-04	-9409.6152	843.8790	-9.866E-07	12370.5844	-37.2821
137.760	8.11E-04	-5700.2154	663.9154	-1.368E-05	12186.9508	-35.8739
142.680	7.20E-04	-2849.7708	496.2084	-2.086E-05	12045.8397	-32.2997
147.600	6.06E-04	-776.4759	348.9943	-2.390E-05	11943.2013	-27.5434
152.520	4.85E-04	631.3750	226.2544	-2.403E-05	11936.0181	-22.3508
157.440	3.70E-04	1497.1492	128.8285	-2.224E-05	11978.8782	-17.2532
162.360	2.66E-04	1942.8109	55.3931	-1.935E-05	12000.9407	-12.5986
167.280	1.79E-04	2080.2955	3.2785	-1.597E-05	12007.7468	-8.5862
172.200	1.09E-04	2006.5002	-30.8838	-1.254E-05	12004.0936	-5.3009
177.120	5.58E-05	1801.0722	-50.6753	-9.339E-06	11993.9239	-2.7444
182.040	1.73E-05	1526.2350	-59.5491	-6.545E-06	11980.3181	-.8628
186.960	-8.55E-06	1227.9893	-60.6119	-4.232E-06	11965.5535	.4308
191.880	-2.43E-05	938.1419	-56.5046	-2.412E-06	11951.2046	1.2388
196.800	-3.23E-05	676.7316	-49.3583	-1.056E-06	11938.2635	1.6662
201.720	-3.47E-05	454.5349	-40.8036	-1.059E-07	11927.2636	1.8113
206.640	-3.33E-05	275.4325	-32.0158	5.071E-07	11918.3972	1.7610
211.560	-2.97E-05	138.5015	-23.7791	8.548E-07	11911.6184	1.5873
216.480	-2.49E-05	39.7640	-16.5601	1.005E-06	11906.7304	1.3473
221.400	-1.98E-05	-26.4269	-10.5807	1.016E-06	11906.0702	1.0834
226.320	-1.49E-05	-66.3492	-5.8853	9.378E-07	11908.0465	.8253
231.240	-1.06E-05	-86.1842	-2.3991	8.097E-07	11909.0285	.5919
236.160	-6.96E-06	-91.5497	.024567	6.604E-07	11909.2941	.3934
241.080	-4.09E-06	-87.2422	1.5669	5.102E-07	11909.0808	.2336
246.000	-1.94E-06	-77.1358	2.4170	3.722E-07	11908.5805	.1120
250.920	-4.26E-07	-64.1917	2.7536	2.535E-07	11907.9397	.024878
255.840	5.56E-07	-50.5394	2.7342	1.571E-07	11907.2639	-.032775

260.760	1.12E-06	-37.5968	2.4893	8.311E-08	11906.6231	-.066744
265.680	1.37E-06	-26.2078	2.1217	2.952E-08	11906.0593	-.082699
270.600	1.41E-06	-16.7773	1.7072	-6.579E-09	11905.5925	-.085792
275.520	1.31E-06	-9.3958	1.2984	-2.856E-08	11905.2270	-.080411
280.440	1.13E-06	-3.9451	.9281	-3.977E-08	11904.9572	-.070086
285.360	9.17E-07	-.1845	.6143	-4.323E-08	11904.7710	-.057498
290.280	7.04E-07	2.1845	.3632	-4.155E-08	11904.8701	-.044552
295.200	5.09E-07	3.4716	.1737	-3.680E-08	11904.9338	-.032498
300.120	3.42E-07	3.9662	.039506	-3.056E-08	11904.9583	-.022054
305.040	2.08E-07	3.9204	-.048054	-2.393E-08	11904.9560	-.013540
309.960	1.06E-07	3.5405	-.098558	-1.767E-08	11904.9372	-.006991
314.880	3.40E-08	2.9854	-.1213	-1.219E-08	11904.9097	-.002259
319.800	-1.36E-08	2.3707	-.1246	-7.688E-09	11904.8793	9.099E-04
324.720	-4.16E-08	1.7742	-.1155	-4.207E-09	11904.8497	.002813
329.640	-5.50E-08	1.2428	-.099328	-1.673E-09	11904.8234	.003750
334.560	-5.81E-08	.8001	-.080271	4.271E-11	11904.8015	.003997
339.480	-5.46E-08	.4528	-.061119	1.095E-09	11904.7843	.003788
344.400	-4.73E-08	.1965	-.043648	1.640E-09	11904.7716	.003314
349.320	-3.84E-08	.020097	-.028818	1.822E-09	11904.7629	.002715
354.240	-2.94E-08	-.090638	-.016989	1.763E-09	11904.7664	.002094
359.160	-2.11E-08	-.1505	-.008112	1.560E-09	11904.7694	.001515
364.080	-1.40E-08	-.1735	-.001885	1.288E-09	11904.7705	.001016
369.000	-8.39E-09	-.1716	.002125	9.984E-10	11904.7704	6.139E-04
373.920	-4.19E-09	-.1546	.004395	7.244E-10	11904.7696	3.091E-04
378.840	-1.27E-09	-.1298	.005387	4.855E-10	11904.7683	9.417E-05
383.760	5.86E-10	-.1025	.005511	2.904E-10	11904.7670	-4.393E-05
388.680	1.59E-09	-.076154	.005107	1.403E-10	11904.7657	-1.203E-04
393.600	1.97E-09	-.052558	.004442	3.223E-11	11904.7645	-1.499E-04
398.520	1.91E-09	-.032504	.003713	-3.921E-11	11904.7635	-1.466E-04
403.440	1.58E-09	-.015944	.003051	-7.990E-11	11904.7627	-1.224E-04
408.360	1.12E-09	-.002321	.002535	-9.524E-11	11904.7620	-8.756E-05
413.280	6.44E-10	.009186	.002195	-8.948E-11	11904.7624	-5.064E-05
418.200	2.42E-10	.019453	.002023	-6.543E-11	11904.7629	-1.915E-05
423.120	2.42E-17	.029223	-.001982	-2.454E-11	11904.7634	-.001609
428.040	-1.82E-17	7.323E-09	-.002970	-2.459E-18	11904.7619	.001207
432.960	-7.28E-24	-2.197E-09	-7.438E-10	1.846E-18	11904.7619	4.839E-10
437.880	1.37E-24	-1.211E-15	2.233E-10	7.398E-25	11904.7619	-9.078E-11
442.800	0.000	1.652E-16	1.231E-16	-1.388E-25	11904.7619	-6.368E-17
447.720	0.000	1.408E-22	-1.679E-17	0.0000	11904.7619	6.826E-18
452.640	0.000	-1.242E-23	-1.430E-23	0.0000	11904.7619	6.840E-24
457.560	0.000	0.0000	1.263E-24	0.0000	11904.7619	-5.132E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = 0.000
Maximum bending moment = -4629445.113 lbs-in
Maximum shear force = 397134.653 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 5
Number of zero deflection points = 14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	-5.564E+06	4.513E+05	0.0000	2.873E+05	-15269.6852
4.920	.477009	-3.524E+06	3.753E+05	-.007633	1.864E+05	-15621.8557
9.840	.424895	-1.856E+06	2.975E+05	-.012151	1.038E+05	-15974.0294
14.760	.357440	-5.722E+05	2.195E+05	-.014191	40230.3870	-15731.9753
19.680	.285257	3.320E+05	1.474E+05	-.014393	28341.0819	-13575.9713
24.600	.215817	9.070E+05	85978.4984	-.013352	56807.2760	-11411.4458
29.520	.153874	1.204E+06	36995.5963	-.011579	71524.4982	-8500.3031
34.440	.101883	1.294E+06	1961.9160	-.009480	75956.9516	-5741.0304
39.360	.060586	1.242E+06	-20724.3353	-.007350	73403.8476	-3481.0230
44.280	.029555	1.104E+06	-33545.4976	-.005380	66577.6558	-1730.8316
49.200	.007651	9.228E+05	-38926.4655	-.003677	57586.9773	-456.5537
54.120	-.006626	7.286E+05	-39058.8961	-.002290	47973.6867	402.7202
59.040	-.014882	5.429E+05	-35802.5989	-.001222	38783.3729	920.9779
63.960	-.018651	3.787E+05	-30646.8236	-4.480E-04	30652.2736	1174.8657
68.880	-.019291	2.423E+05	-24714.8909	7.354E-05	23898.0714	1236.4891
73.800	-.017928	1.354E+05	-18797.4462	3.907E-04	18605.7760	1168.9762
78.720	-.015446	56529.0898	-13402.0738	5.519E-04	14703.2317	1024.2646
83.640	-.012497	2398.0171	-8809.6803	6.014E-04	12023.4756	842.5620
88.560	-.009529	-31341.6255	-5130.6643	5.770E-04	13456.3275	652.9729
93.480	-.006819	-49223.3405	-2356.2256	5.094E-04	14341.5609	474.8477
98.400	-.004517	-55529.3423	-402.1287	4.214E-04	14653.7392	319.5006
103.320	-.002673	-54009.6007	856.2294	3.294E-04	14578.5045	192.0271
108.240	-.001275	-47752.3041	1455.7634	2.439E-04	14268.7374	51.6860
113.160	-2.72E-04	-40164.9478	1610.4849	1.701E-04	13893.1257	11.2090
118.080	3.98E-04	-32239.8753	1597.1251	1.093E-04	13500.7953	-16.6398
123.000	8.03E-04	-24664.3032	1472.4943	6.149E-05	13125.7670	-34.0232
127.920	.001004	-17871.5423	1282.6701	2.576E-05	12789.4917	-43.1411
132.840	.001056	-12093.5335	1063.2217	5.973E-07	12503.4517	-46.0655
137.760	.001009	-7410.6158	840.0976	-1.578E-05	12271.6241	-44.6354
142.680	9.01E-04	-3795.9111	630.9068	-2.520E-05	12092.6783	-40.4015
147.600	7.61E-04	-1152.9072	446.3819	-2.935E-05	11961.8365	-34.6086
152.520	6.12E-04	654.2517	291.8601	-2.977E-05	11937.1506	-28.2051

157.440	4.69E-04	1777.5855	168.6742	-2.773E-05	11992.7612	-21.8705
162.360	3.39E-04	2368.5759	75.3805	-2.425E-05	12022.0181	-16.0538
167.280	2.30E-04	2567.0468	8.7884	-2.010E-05	12031.8434	-11.0162
172.200	1.42E-04	2494.6128	-35.2198	-1.585E-05	12028.2576	-6.8733
177.120	7.40E-05	2251.6768	-61.0703	-1.186E-05	12016.2311	-3.6350
182.040	2.49E-05	1917.0290	-73.0610	-8.362E-06	11999.6643	-1.2393
186.960	-8.31E-06	1549.2139	-75.0795	-5.451E-06	11981.4557	.4188
191.880	-2.87E-05	1188.9747	-70.4458	-3.151E-06	11963.6220	1.4649
196.800	-3.93E-05	862.2297	-61.8506	-1.429E-06	11947.4465	2.0291
201.720	-4.28E-05	583.1763	-51.3628	-2.147E-07	11933.6320	2.2342
206.640	-4.14E-05	357.2421	-40.4815	5.752E-07	11922.4472	2.1891
211.560	-3.71E-05	183.7067	-30.2148	1.029E-06	11913.8563	1.9844
216.480	-3.13E-05	57.9029	-21.1698	1.232E-06	11907.6284	1.6924
221.400	-2.50E-05	-27.0300	-13.6437	1.258E-06	11906.1000	1.3670
226.320	-1.89E-05	-78.8271	-7.7069	1.169E-06	11908.6642	1.0463
231.240	-1.35E-05	-105.1669	-3.2770	1.015E-06	11909.9682	.7545
236.160	-8.94E-06	-113.0696	-.1783	8.316E-07	11910.3594	.5051
241.080	-5.31E-06	-108.5581	1.8110	6.455E-07	11910.1361	.3035
246.000	-2.59E-06	-96.5194	2.9251	4.732E-07	11909.5401	.1493
250.920	-6.56E-07	-80.7064	3.3867	3.244E-07	11908.7573	.038306
255.840	6.06E-07	-63.8329	3.3930	2.030E-07	11907.9219	-.035749
260.760	1.34E-06	-47.7191	3.1084	1.093E-07	11907.1242	-.079919
265.680	1.68E-06	-33.4611	2.6628	4.111E-08	11906.4184	-.1012
270.600	1.75E-06	-21.5985	2.1525	-5.133E-09	11905.8311	-.1062
275.520	1.63E-06	-12.2703	1.6448	-3.358E-08	11905.3693	-.1002
280.440	1.42E-06	-5.3476	1.1822	-4.838E-08	11905.0266	-.087816
285.360	1.16E-06	-.5418	.7882	-5.332E-08	11904.7887	-.072386
290.280	8.90E-07	2.5127	.4715	-5.167E-08	11904.8863	-.056352
295.200	6.47E-07	4.1990	.2312	-4.603E-08	11904.9698	-.041319
300.120	4.38E-07	4.8782	.060104	-3.841E-08	11905.0034	-.028226
305.040	2.69E-07	4.8660	-.052385	-3.022E-08	11905.0028	-.017501
309.960	1.40E-07	4.4222	-.1181	-2.242E-08	11904.9808	-.009212
314.880	4.81E-08	3.7480	-.1486	-1.556E-08	11904.9475	-.003191
319.800	-1.30E-08	2.9904	-.1543	-9.900E-09	11904.9099	8.693E-04
324.720	-4.93E-08	2.2490	-.1440	-5.499E-09	11904.8732	.003334
329.640	-6.71E-08	1.5845	-.1245	-2.280E-09	11904.8403	.004576
334.560	-7.18E-08	1.0281	-.1011	-8.548E-11	11904.8128	.004939
339.480	-6.79E-08	.5896	-.077366	1.273E-09	11904.7911	.004717
344.400	-5.92E-08	.2643	-.055555	1.990E-09	11904.7750	.004149
349.320	-4.83E-08	.039061	-.036943	2.245E-09	11904.7638	.003416
354.240	-3.71E-08	-.1036	-.022026	2.191E-09	11904.7670	.002647
359.160	-2.68E-08	-.1820	-.010776	1.951E-09	11904.7709	.001926
364.080	-1.79E-08	-.2135	-.002839	1.619E-09	11904.7725	.001301
369.000	-1.09E-08	-.2131	.002314	1.261E-09	11904.7725	7.937E-04
373.920	-5.53E-09	-.1932	.005270	9.196E-10	11904.7715	4.079E-04
378.840	-1.81E-09	-.1631	.006604	6.204E-10	11904.7700	1.342E-04
383.760	5.73E-10	-.1294	.006828	3.748E-10	11904.7683	-4.297E-05
388.680	1.88E-09	-.096611	.006372	1.849E-10	11904.7667	-1.423E-04
393.600	2.39E-09	-.067083	.005574	4.746E-11	11904.7652	-1.823E-04
398.520	2.35E-09	-.041858	.004681	-4.404E-11	11904.7640	-1.805E-04
403.440	1.96E-09	-.020932	.003864	-9.678E-11	11904.7629	-1.517E-04
408.360	1.40E-09	-.003644	.003223	-1.174E-10	11904.7621	-1.090E-04
413.280	8.04E-10	.011010	.002799	-1.112E-10	11904.7624	-6.326E-05
418.200	3.02E-10	.024115	.002584	-8.173E-11	11904.7631	-2.398E-05
423.120	3.05E-17	.036599	-.002457	-3.074E-11	11904.7637	-.002025
428.040	-2.27E-17	9.190E-09	-.003719	-3.096E-18	11904.7619	.001512
432.960	-9.13E-24	-2.752E-09	-9.335E-10	2.311E-18	11904.7619	6.068E-10

437.880	1.71E-24	-1.518E-15	2.797E-10	9.277E-25	11904.7619	-1.137E-10
442.800	0.000	2.069E-16	1.543E-16	-1.738E-25	11904.7619	-7.981E-17
447.720	0.000	1.764E-22	-2.103E-17	0.0000	11904.7619	8.548E-18
452.640	0.000	-1.556E-23	-1.792E-23	0.0000	11904.7619	8.571E-24
457.560	0.000	0.0000	1.581E-24	0.0000	11904.7619	-6.428E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-5563893.268 lbs-in
Maximum shear force	=	451260.933 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .600000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	-6.370E+06	4.914E+05	0.0000	3.273E+05	-15269.6852
4.920	.573676	-4.133E+06	4.154E+05	-.008821	2.165E+05	-15621.8640
9.840	.513200	-2.266E+06	3.376E+05	-.014195	1.241E+05	-15974.0572
14.760	.433997	-7.823E+05	2.582E+05	-.016755	50631.1193	-16326.2611
19.680	.348329	3.075E+05	1.793E+05	-.017154	27126.2340	-15756.3737
24.600	.265202	1.015E+06	1.081E+05	-.016043	62167.4646	-13154.7371
29.520	.190466	1.403E+06	49884.5641	-.014012	81361.8137	-10521.7301
34.440	.127325	1.534E+06	6351.4490	-.011545	87832.7840	-7174.6581
39.360	.076860	1.488E+06	-22161.7532	-.009007	85580.5990	-4416.0746
44.280	.038694	1.333E+06	-38599.7950	-.006637	77914.6928	-2266.0562
49.200	.011548	1.121E+06	-45869.4474	-.004576	67424.1821	-689.0870

54.120	-.006329	8.910E+05	-46618.3010	-.002885	56016.1464	384.6750
59.040	-.016843	6.684E+05	-43107.9301	-.001575	44996.1700	1042.3051
63.960	-.021832	4.700E+05	-37160.7915	-6.194E-04	35170.5299	1375.2309
68.880	-.022937	3.040E+05	-30160.9177	3.067E-05	26954.4239	1470.2463
73.800	-.021530	1.731E+05	-23090.5484	4.314E-04	20475.2926	1403.8876
78.720	-.018692	75943.1794	-16587.7255	6.406E-04	15664.3252	1239.5363
83.640	-.015227	8640.8258	-11013.0590	7.116E-04	12332.5256	1026.5883
88.560	-.011690	-33825.8041	-6517.0098	6.905E-04	13579.3067	801.0740
93.480	-.008433	-56845.4057	-3101.8681	6.143E-04	14718.8909	587.1949
98.400	-.005645	-65557.1731	-674.9990	5.115E-04	15150.1665	399.3372
103.320	-.003399	-64494.0665	908.1855	4.023E-04	15097.5375	244.2338
108.240	-.001687	-57412.3391	1677.1593	2.999E-04	14746.9569	68.3572
113.160	-4.48E-04	-48581.0345	1890.6918	2.109E-04	14309.7636	18.4446
118.080	3.89E-04	-39222.9529	1896.1529	1.371E-04	13846.4922	-16.2247
123.000	9.01E-04	-30192.7816	1762.2995	7.884E-05	13399.4541	-38.1873
127.920	.001164	-22037.0812	1545.2278	3.497E-05	12995.7065	-50.0533
132.840	.001245	-15056.5668	1288.5148	3.819E-06	12650.1365	-54.3015
137.760	.001202	-9365.6106	1024.1915	-1.669E-05	12368.4060	-53.1470
142.680	.001081	-4945.6710	774.2169	-2.871E-05	12149.5971	-48.4687
147.600	9.19E-04	-1690.8095	552.1950	-3.429E-05	11988.4653	-41.7841
152.520	7.44E-04	555.4034	365.1338	-3.524E-05	11932.2571	-34.2570
157.440	5.73E-04	1971.4600	215.1108	-3.312E-05	12002.3589	-26.7280
162.360	4.18E-04	2737.2692	100.7523	-2.916E-05	12040.2703	-19.7592
167.280	2.86E-04	3020.2556	18.4827	-2.433E-05	12054.2795	-13.6838
172.200	1.78E-04	2967.0152	-36.4756	-1.930E-05	12051.6438	-8.6570
177.120	9.57E-05	2699.3164	-69.3418	-1.454E-05	12038.3914	-4.7033
182.040	3.53E-05	2313.3064	-85.2361	-1.033E-05	12019.2820	-1.7578
186.960	-5.94E-06	1880.9226	-88.8249	-6.807E-06	11997.8769	.2990
191.880	-3.17E-05	1452.6665	-84.1192	-4.008E-06	11976.6761	1.6139
196.800	-4.54E-05	1061.0766	-74.3899	-1.896E-06	11957.2905	2.3411
201.720	-5.03E-05	724.4015	-62.1681	-3.967E-07	11940.6234	2.6272
206.640	-4.93E-05	450.1234	-49.3016	5.897E-07	11927.0452	2.6031
211.560	-4.45E-05	238.1128	-37.0459	1.168E-06	11916.5497	2.3789
216.480	-3.78E-05	83.2937	-26.1692	1.438E-06	11908.8854	2.0425
221.400	-3.04E-05	-22.2215	-17.0606	1.489E-06	11905.8620	1.6602
226.320	-2.31E-05	-87.5132	-9.8306	1.397E-06	11909.0942	1.2789
231.240	-1.66E-05	-121.7033	-4.3989	1.221E-06	11910.7868	.9291
236.160	-1.11E-05	-133.2018	-.5680	1.007E-06	11911.3561	.6282
241.080	-6.71E-06	-129.2740	1.9205	7.866E-07	11911.1616	.3834
246.000	-3.37E-06	-115.8522	3.3430	5.807E-07	11910.4972	.1949
250.920	-9.96E-07	-97.5218	3.9654	4.015E-07	11909.5897	.058128
255.840	5.76E-07	-77.6232	4.0247	2.544E-07	11908.6046	-.034002
260.760	1.51E-06	-58.4193	3.7201	1.401E-07	11907.6539	-.089835
265.680	1.96E-06	-41.2934	3.2094	5.640E-08	11906.8061	-.1177
270.600	2.06E-06	-26.9494	2.6112	-9.137E-10	11906.0960	-.1254
275.520	1.95E-06	-15.5975	2.0084	-3.665E-08	11905.5341	-.1196
280.440	1.70E-06	-7.1148	1.4544	-5.572E-08	11905.1141	-.1056
285.360	1.40E-06	-1.1767	.9790	-6.269E-08	11904.8202	-.087628
290.280	1.08E-06	2.6422	.5946	-6.146E-08	11904.8927	-.068662
295.200	7.94E-07	4.7947	.3009	-5.521E-08	11904.9993	-.050705
300.120	5.42E-07	5.7118	.090209	-4.639E-08	11905.0447	-.034947
305.040	3.37E-07	5.7736	-.049766	-3.674E-08	11905.0477	-.021953
309.960	1.80E-07	5.2945	-.1329	-2.744E-08	11905.0240	-.011845
314.880	6.70E-08	4.5198	-.1730	-1.920E-08	11904.9857	-.004448
319.800	-8.77E-09	3.6300	-.1825	-1.236E-08	11904.9416	5.875E-04
324.720	-5.46E-08	2.7485	-.1720	-6.999E-09	11904.8980	.003688
329.640	-7.76E-08	1.9516	-.1499	-3.052E-09	11904.8585	.005296

334.560	-8.46E-08	1.2798	-.1225	-3.378E-10	11904.8253	.005822
339.480	-8.10E-08	.7467	-.094366	1.364E-09	11904.7989	.005622
344.400	-7.12E-08	.3485	-.068271	2.284E-09	11904.7792	.004986
349.320	-5.85E-08	.070442	-.045838	2.636E-09	11904.7654	.004133
354.240	-4.52E-08	-.1077	-.027738	2.605E-09	11904.7672	.003224
359.160	-3.29E-08	-.2076	-.013993	2.340E-09	11904.7722	.002363
364.080	-2.22E-08	-.2500	-.004219	1.955E-09	11904.7743	.001610
369.000	-1.36E-08	-.2530	.002193	1.533E-09	11904.7744	9.961E-04
373.920	-7.13E-09	-.2314	.005936	1.126E-09	11904.7734	5.254E-04
378.840	-2.54E-09	-.1968	.007693	7.665E-10	11904.7716	1.889E-04
383.760	4.17E-10	-.1572	.008081	4.691E-10	11904.7697	-3.126E-05
388.680	2.08E-09	-.1182	.007618	2.378E-10	11904.7678	-1.569E-04
393.600	2.76E-09	-.082750	.006716	6.903E-11	11904.7660	-2.101E-04
398.520	2.75E-09	-.052250	.005678	-4.435E-11	11904.7645	-2.116E-04
403.440	2.32E-09	-.026787	.004716	-1.107E-10	11904.7632	-1.797E-04
408.360	1.67E-09	-.005628	.003954	-1.380E-10	11904.7622	-1.300E-04
413.280	9.63E-10	.012394	.003448	-1.323E-10	11904.7625	-7.576E-05
418.200	3.64E-10	.028562	.003191	-9.787E-11	11904.7633	-2.882E-05
423.120	3.69E-17	.043985	-.002910	-3.694E-11	11904.7641	-.002451
428.040	-2.73E-17	1.108E-08	-.004470	-3.747E-18	11904.7619	.001817
432.960	-1.10E-23	-3.307E-09	-1.125E-09	2.778E-18	11904.7619	7.306E-10
437.880	2.06E-24	-1.827E-15	3.361E-10	1.117E-24	11904.7619	-1.366E-10
442.800	0.000	2.487E-16	1.856E-16	-2.089E-25	11904.7619	-9.601E-17
447.720	0.000	2.122E-22	-2.527E-17	0.0000	11904.7619	1.027E-17
452.640	0.000	-1.870E-23	-2.156E-23	0.0000	11904.7619	1.031E-23
457.560	0.000	0.0000	1.900E-24	0.0000	11904.7619	-7.725E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000	in
Computed slope at pile head	=	0.000	
Maximum bending moment	=	-6370408.703	lbs-in
Maximum shear force	=	491351.247	lbs
Depth of maximum bending moment	=	0.000	in
Depth of maximum shear force	=	0.000	in
Number of iterations	=	5	
Number of zero deflection points	=	14	

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .700000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	-7.089E+06	5.240E+05	0.0000	3.629E+05	-15269.6852
4.920	.670706	-4.690E+06	4.480E+05	-.009893	2.441E+05	-15621.8612
9.840	.602649	-2.662E+06	3.702E+05	-.016068	1.437E+05	-15974.0489
14.760	.512593	-1.016E+06	2.908E+05	-.019157	62182.5973	-16326.2471
19.680	.414144	2.371E+05	2.096E+05	-.019811	23642.2405	-16678.4550
24.600	.317655	1.086E+06	1.316E+05	-.018700	65651.7503	-15006.2964
29.520	.230138	1.569E+06	64802.7395	-.016470	89589.8283	-12163.4205
34.440	.155590	1.756E+06	13313.0938	-.013677	98823.6299	-8767.3298
39.360	.095552	1.727E+06	-21760.0217	-.010752	97407.5527	-5490.0342
44.280	.049788	1.563E+06	-42438.2183	-.007989	89271.2408	-2915.7368
49.200	.016940	1.325E+06	-52097.4811	-.005563	77513.0173	-1010.7928
54.120	-.004956	1.061E+06	-53843.0648	-.003559	64435.0812	301.2060
59.040	-.018082	8.025E+05	-50349.3750	-.001994	51631.2651	1118.9931
63.960	-.024576	5.696E+05	-43788.3573	-8.416E-04	40102.7164	1548.0873
68.880	-.026363	3.733E+05	-35823.0917	-4.969E-05	30382.6896	1689.8256
73.800	-.025065	2.172E+05	-27645.5438	4.462E-04	22657.1009	1634.3809
78.720	-.021972	1.003E+05	-20040.6670	7.129E-04	16872.2784	1457.0325
83.640	-.018050	18594.0724	-13462.7265	8.128E-04	12825.2605	1216.9271
88.560	-.013974	-33728.9978	-8113.3708	8.001E-04	13574.5143	957.6077
93.480	-.010177	-62816.0820	-4014.3161	7.190E-04	15014.4689	708.6747
98.400	-.006899	-74644.8766	-1070.3524	6.036E-04	15600.0528	488.0586
103.320	-.004238	-74536.1517	879.3590	4.783E-04	15594.6704	304.5071
108.240	-.002193	-66933.2078	1847.1177	3.594E-04	15218.2870	88.8908
113.160	-7.01E-04	-57067.9064	2136.7731	2.553E-04	14729.9058	28.8553
118.080	3.19E-04	-46409.7945	2174.9906	1.684E-04	14202.2765	-13.3198
123.000	9.56E-04	-35997.3965	2042.6015	9.918E-05	13686.8112	-40.4969
127.920	.001295	-26505.7841	1806.0361	4.669E-05	13216.9294	-55.6679
132.840	.001415	-18317.8800	1517.3007	9.040E-06	12811.5876	-61.7042
137.760	.001384	-11593.3361	1214.9708	-1.608E-05	12478.6894	-61.1941
142.680	.001257	-6330.9186	925.8127	-3.114E-05	12218.1737	-56.3498
147.600	.001077	-2422.0635	666.7226	-3.849E-05	12024.6660	-48.9713
152.520	8.78E-04	305.3753	446.7458	-4.027E-05	11919.8795	-40.4501
157.440	6.81E-04	2053.1570	269.0066	-3.828E-05	12006.4033	-31.8016
162.360	5.01E-04	3027.7440	132.4400	-3.402E-05	12054.6502	-23.7133
167.280	3.47E-04	3423.3117	33.2624	-2.860E-05	12074.2328	-16.6027
172.200	2.20E-04	3411.3291	-33.8395	-2.286E-05	12073.6396	-10.6745
177.120	1.22E-04	3135.3174	-74.7995	-1.736E-05	12059.9756	-5.9759
182.040	4.92E-05	2709.4674	-95.5166	-1.245E-05	12038.8940	-2.4456
186.960	-9.11E-07	2219.9388	-101.4199	-8.311E-06	12014.6599	.045893
191.880	-3.26E-05	1727.8519	-97.2145	-4.996E-06	11990.2991	1.6636
196.800	-5.01E-05	1273.1791	-86.7666	-2.475E-06	11967.7906	2.5835
201.720	-5.70E-05	878.9395	-73.0915	-6.676E-07	11948.2738	2.9755
206.640	-5.66E-05	555.2722	-58.4112	5.369E-07	11932.2506	2.9922
211.560	-5.17E-05	303.1166	-44.2531	1.258E-06	11919.7677	2.7632
216.480	-4.43E-05	117.3464	-31.5697	1.611E-06	11910.5711	2.3927
221.400	-3.58E-05	-10.6994	-20.8620	1.701E-06	11905.2916	1.9600
226.320	-2.75E-05	-91.2821	-12.2964	1.615E-06	11909.2808	1.5219

231.240	-2.00E-05	-134.8739	-5.8077	1.425E-06	11911.4388	1.1157
236.160	-1.35E-05	-151.2346	-1.1854	1.185E-06	11912.2488	.7633
241.080	-8.30E-06	-148.8699	1.8588	9.327E-07	11912.1317	.4742
246.000	-4.33E-06	-134.7794	3.6401	6.944E-07	11911.4342	.2499
250.920	-1.47E-06	-114.4176	4.4655	4.851E-07	11910.4261	.085634
255.840	4.47E-07	-91.7938	4.6113	3.119E-07	11909.3062	-.026352
260.760	1.60E-06	-69.6562	4.3116	1.763E-07	11908.2102	-.095483
265.680	2.18E-06	-49.7147	3.7535	7.608E-08	11907.2230	-.1314
270.600	2.35E-06	-32.8711	3.0786	6.715E-09	11906.3892	-.1430
275.520	2.25E-06	-19.4344	2.3871	-3.721E-08	11905.7240	-.1381
280.440	1.98E-06	-9.3089	1.7444	-6.136E-08	11905.2227	-.1232
285.360	1.64E-06	-2.1492	1.1879	-7.098E-08	11904.8683	-.1030
290.280	1.29E-06	2.5198	.7342	-7.067E-08	11904.8866	-.081395
295.200	9.49E-07	5.2143	.3848	-6.417E-08	11905.0200	-.060634
300.120	6.55E-07	6.4324	.1317	-5.439E-08	11905.0803	-.042239
305.040	4.14E-07	6.6175	-.038461	-4.343E-08	11905.0895	-.026943
309.960	2.27E-07	6.1394	-.1415	-3.272E-08	11905.0658	-.014947
314.880	9.18E-08	5.2894	-.1933	-2.312E-08	11905.0238	-.006089
319.800	-1.17E-10	4.2832	-.2082	-1.508E-08	11904.9739	7.808E-06
324.720	-5.66E-08	3.2702	-.1988	-8.733E-09	11904.9238	.003825
329.640	-8.61E-08	2.3443	-.1749	-4.018E-09	11904.8780	.005869
334.560	-9.61E-08	1.5566	-.1442	-7.416E-10	11904.8390	.006616
339.480	-9.34E-08	.9265	-.1120	1.344E-09	11904.8078	.006482
344.400	-8.29E-08	.4518	-.081779	2.501E-09	11904.7843	.005808
349.320	-6.87E-08	.1169	-.055543	2.979E-09	11904.7677	.004857
354.240	-5.36E-08	-.1006	-.034196	2.993E-09	11904.7669	.003820
359.160	-3.93E-08	-.2255	-.017849	2.719E-09	11904.7731	.002825
364.080	-2.68E-08	-.2816	-.006112	2.293E-09	11904.7758	.001946
369.000	-1.67E-08	-.2902	.001685	1.813E-09	11904.7763	.001223
373.920	-9.01E-09	-.2686	.006329	1.343E-09	11904.7752	6.643E-04
378.840	-3.51E-09	-.2305	.008605	9.240E-10	11904.7733	2.610E-04
383.760	8.33E-11	-.1858	.009232	5.744E-10	11904.7711	-6.246E-06
388.680	2.14E-09	-.1408	.008818	3.001E-10	11904.7689	-1.619E-04
393.600	3.04E-09	-.099574	.007851	9.821E-11	11904.7668	-2.314E-04
398.520	3.11E-09	-.063763	.006694	-3.898E-11	11904.7651	-2.387E-04
403.440	2.65E-09	-.033626	.005602	-1.208E-10	11904.7636	-2.054E-04
408.360	1.92E-09	-.008405	.004728	-1.561E-10	11904.7623	-1.498E-04
413.280	1.12E-09	.013202	.004143	-1.520E-10	11904.7626	-8.787E-05
418.200	4.24E-10	.032661	.003844	-1.135E-10	11904.7635	-3.358E-05
423.120	4.34E-17	.051254	-.003328	-4.305E-11	11904.7644	-.002882
428.040	-3.18E-17	1.295E-08	-.005209	-4.406E-18	11904.7619	.002117
432.960	-1.28E-23	-3.854E-09	-1.316E-09	3.237E-18	11904.7619	8.533E-10
437.880	2.39E-24	-2.133E-15	3.917E-10	1.304E-24	11904.7619	-1.592E-10
442.800	0.000	2.898E-16	2.167E-16	-2.434E-25	11904.7619	-1.120E-16
447.720	0.000	2.475E-22	-2.945E-17	0.0000	11904.7619	1.197E-17
452.640	0.000	-2.179E-23	-2.515E-23	0.0000	11904.7619	1.202E-23
457.560	0.000	0.0000	2.214E-24	0.0000	11904.7619	-9.001E-25
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-7089248.740 lbs-in
Maximum shear force	=	523954.169 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .800000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	-7.765E+06	5.531E+05	0.0000	3.963E+05	-15269.6852
4.920	.767913	-5.222E+06	4.771E+05	-.010908	2.704E+05	-15621.8598
9.840	.692666	-3.049E+06	3.994E+05	-.017855	1.629E+05	-15974.0439
14.760	.592219	-1.258E+06	3.199E+05	-.021472	74162.0463	-16326.2365
19.680	.481379	1.409E+05	2.387E+05	-.022410	18878.4567	-16678.4364
24.600	.371703	1.135E+06	1.561E+05	-.021338	68111.5279	-16914.1818
29.520	.271411	1.719E+06	80879.5254	-.018941	96982.8125	-13650.4531
34.440	.185321	1.969E+06	21610.4677	-.015845	1.094E+05	-10442.6597
39.360	.115500	1.962E+06	-20403.4515	-.012543	1.091E+05	-6636.1692
44.280	.061897	1.792E+06	-45645.6194	-.009390	1.006E+05	-3624.8747
49.200	.023107	1.532E+06	-57954.6872	-.006598	87733.0500	-1378.8114
54.120	-.003024	1.235E+06	-60894.4972	-.004274	73049.9356	183.7667
59.040	-.018947	9.409E+05	-57558.0552	-.002446	58485.9701	1172.5105
63.960	-.027094	6.736E+05	-50475.2671	-.001090	45250.0738	1706.6716
68.880	-.029674	4.464E+05	-41597.7959	-1.495E-04	34004.2290	1902.0565
73.800	-.028565	2.645E+05	-32336.7574	4.476E-04	25001.1603	1862.5933
78.720	-.025270	1.273E+05	-23632.5670	7.767E-04	18208.4588	1675.6954
83.640	-.020922	30474.1901	-16040.3939	9.093E-04	13413.3852	1410.5538
88.560	-.016323	-32292.2374	-9818.8526	9.077E-04	13503.3875	1118.5281
93.480	-.011990	-67929.7521	-5013.4138	8.236E-04	15267.6209	834.9024
98.400	-.008219	-83245.0068	-1529.3162	6.966E-04	16025.8018	581.3975
103.320	-.005136	-84349.1278	808.5917	5.558E-04	16080.4613	368.9716
108.240	-.002749	-76382.3560	1990.3812	4.208E-04	15686.0667	111.4306
113.160	-9.94E-04	-65591.9990	2365.1514	3.016E-04	15151.8906	40.9150
118.080	2.18E-04	-53702.8221	2443.3619	2.014E-04	14563.3175	-9.1221
123.000	9.87E-04	-41945.6935	2317.9854	1.211E-04	13981.2814	-41.8440

127.920	.001410	-31132.1263	2065.9507	5.970E-05	13445.9563	-60.6091
132.840	.001575	-21734.2300	1747.9125	1.530E-05	12980.7139	-68.6747
137.760	.001560	-13962.7769	1409.2315	-1.468E-05	12595.9885	-69.0005
142.680	.001430	-7838.4996	1081.7185	-3.299E-05	12292.8064	-64.1348
147.600	.001236	-3253.7392	785.7810	-4.231E-05	12065.8381	-56.1650
152.520	.001014	-23.1533	532.6912	-4.506E-05	11905.9081	-46.7170
157.440	7.92E-04	2076.6203	326.7781	-4.334E-05	12007.5649	-36.9875
162.360	5.88E-04	3277.6268	167.4084	-3.884E-05	12067.0207	-27.7969
167.280	4.10E-04	3800.3530	50.6833	-3.289E-05	12092.8982	-19.6523
172.200	2.64E-04	3841.0852	-29.1827	-2.648E-05	12094.9146	-12.8135
177.120	1.50E-04	3565.3003	-78.7966	-2.026E-05	12081.2619	-7.3548
182.040	6.47E-05	3105.5898	-104.8140	-1.465E-05	12058.5040	-3.2214
186.960	5.49E-06	2562.7676	-113.4185	-9.892E-06	12031.6316	-.2764
191.880	-3.26E-05	2009.0195	-110.0105	-6.052E-06	12004.2183	1.6617
196.800	-5.41E-05	1492.1750	-99.0595	-3.112E-06	11978.6320	2.7899
201.720	-6.32E-05	1040.3975	-84.0769	-9.847E-07	11956.2667	3.3006
206.640	-6.38E-05	666.7958	-67.6715	4.492E-07	11937.7716	3.3683
211.560	-5.88E-05	373.6258	-51.6559	1.323E-06	11923.2582	3.1421
216.480	-5.07E-05	155.8979	-37.1787	1.768E-06	11912.4796	2.7429
221.400	-4.14E-05	4.3089	-24.8631	1.902E-06	11904.9752	2.2634
226.320	-3.20E-05	-92.4984	-14.9399	1.828E-06	11909.3410	1.7704
231.240	-2.34E-05	-146.2978	-7.3655	1.628E-06	11912.0044	1.3086
236.160	-1.60E-05	-168.1786	-1.9211	1.364E-06	11913.0876	.9046
241.080	-9.99E-06	-167.8853	1.7083	1.081E-06	11913.0731	.5708
246.000	-5.36E-06	-153.4971	3.8746	8.114E-07	11912.3608	.3098
250.920	-2.01E-06	-131.3561	4.9248	5.721E-07	11911.2647	.1171
255.840	2.65E-07	-106.1628	5.1745	3.726E-07	11910.0175	-.015638
260.760	1.66E-06	-81.1724	4.8927	2.153E-07	11908.7803	-.098915
265.680	2.38E-06	-58.4423	4.2963	9.803E-08	11907.6551	-.1435
270.600	2.62E-06	-39.0895	3.5506	1.612E-08	11906.6970	-.1596
275.520	2.54E-06	-23.5362	2.7737	-3.648E-08	11905.9271	-.1562
280.440	2.27E-06	-11.7248	2.0436	-6.610E-08	11905.3423	-.1406
285.360	1.89E-06	-3.2970	1.4061	-7.871E-08	11904.9251	-.1186
290.280	1.49E-06	2.2666	.8824	-7.958E-08	11904.8741	-.094349
295.200	1.11E-06	5.5425	.4760	-7.302E-08	11905.0363	-.070845
300.120	7.72E-07	7.0943	.1792	-6.241E-08	11905.1131	-.049827
305.040	4.95E-07	7.4283	-.022646	-5.021E-08	11905.1296	-.032213
309.960	2.78E-07	6.9703	-.1469	-3.812E-08	11905.1070	-.018294
314.880	1.20E-07	6.0579	-.2114	-2.718E-08	11905.0618	-.007931
319.800	1.08E-08	4.9435	-.2327	-1.794E-08	11905.0066	-7.266E-04
324.720	-5.70E-08	3.8034	-.2250	-1.059E-08	11904.9502	.003850
329.640	-9.33E-08	2.7502	-.1999	-5.085E-09	11904.8981	.006367
334.560	-1.07E-07	1.8465	-.1661	-1.224E-09	11904.8533	.007364
339.480	-1.05E-07	1.1181	-.1300	1.266E-09	11904.8173	.007318
344.400	-9.45E-08	.5649	-.095699	2.679E-09	11904.7899	.006623
349.320	-7.90E-08	.1711	-.065669	3.297E-09	11904.7704	.005585
354.240	-6.21E-08	-.087778	-.041042	3.367E-09	11904.7663	.004426
359.160	-4.59E-08	-.2394	-.022036	3.093E-09	11904.7738	.003300
364.080	-3.17E-08	-.3107	-.008271	2.631E-09	11904.7773	.002296
369.000	-2.00E-08	-.3259	9.769E-04	2.096E-09	11904.7780	.001463
373.920	-1.10E-08	-.3052	.006580	1.566E-09	11904.7770	8.144E-04
378.840	-4.60E-09	-.2643	.009424	1.088E-09	11904.7750	3.421E-04
383.760	-3.42E-10	-.2146	.010329	6.853E-10	11904.7725	2.567E-05
388.680	2.14E-09	-.1640	.009994	3.673E-10	11904.7700	-1.619E-04
393.600	3.27E-09	-.1170	.008982	1.313E-10	11904.7677	-2.493E-04
398.520	3.43E-09	-.075859	.007720	-3.066E-11	11904.7657	-2.638E-04
403.440	2.97E-09	-.040977	.006505	-1.288E-10	11904.7639	-2.300E-04

408.360	2.17E-09	-.011595	.005523	-1.729E-10	11904.7625	-1.692E-04
413.280	1.27E-09	.013711	.004862	-1.712E-10	11904.7626	-9.979E-05
418.200	4.83E-10	.036580	.004522	-1.289E-10	11904.7637	-3.830E-05
423.120	4.99E-17	.058461	-.003727	-4.910E-11	11904.7648	-.003315
428.040	-3.63E-17	1.483E-08	-.005941	-5.068E-18	11904.7619	.002415
432.960	-1.47E-23	-4.396E-09	-1.506E-09	3.692E-18	11904.7619	9.754E-10
437.880	2.73E-24	-2.436E-15	4.467E-10	1.491E-24	11904.7619	-1.816E-10
442.800	0.000	3.305E-16	2.475E-16	-2.776E-25	11904.7619	-1.279E-16
447.720	0.000	2.826E-22	-3.359E-17	0.0000	11904.7619	1.365E-17
452.640	0.000	-2.485E-23	-2.871E-23	0.0000	11904.7619	1.372E-23
457.560	0.000	0.0000	2.526E-24	0.0000	11904.7619	-1.027E-24
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-7765142.076 lbs-in
Maximum shear force	=	553075.677 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .900000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	-8.362E+06	5.766E+05	0.0000	4.258E+05	-15269.6852
4.920	.865449	-5.703E+06	5.006E+05	-.011812	2.942E+05	-15621.8598
9.840	.783769	-3.412E+06	4.229E+05	-.019467	1.808E+05	-15974.0447
14.760	.673889	-1.503E+06	3.434E+05	-.023596	86314.0001	-16326.2398
19.680	.551587	13444.2265	2.622E+05	-.024847	12570.3177	-16678.4455

24.600	.429396	1.126E+06	1.793E+05	-.023890	67657.6193	-17030.6626
29.520	.316512	1.825E+06	99835.8694	-.021411	1.022E+05	-15275.4472
34.440	.218710	2.151E+06	32763.4170	-.018072	1.184E+05	-11989.7774
39.360	.138682	2.183E+06	-16333.0297	-.014432	1.200E+05	-7968.1278
44.280	.076694	2.018E+06	-46983.5703	-.010904	1.118E+05	-4491.4415
49.200	.031387	1.742E+06	-62639.7708	-.007746	98140.2770	-1872.8676
54.120	4.76E-04	1.417E+06	-67318.2241	-.005092	82067.3469	-28.9426
59.040	-.018722	1.090E+06	-64539.3350	-.002987	65843.7636	1158.5723
63.960	-.028915	7.881E+05	-57208.6479	-.001410	50919.3854	1821.3818
68.880	-.032595	5.294E+05	-47588.4183	-3.034E-04	38113.1492	2089.2807
73.800	-.031900	3.204E+05	-37331.8909	4.104E-04	27767.2553	2080.0394
78.720	-.028557	1.613E+05	-27556.5933	8.149E-04	19887.7301	1893.6588
83.640	-.023881	47661.6741	-18937.5235	9.904E-04	14264.2507	1610.0281
88.560	-.018811	-27038.4037	-11805.7837	.001008	13243.2967	1289.0531
93.480	-.013965	-70490.4554	-6242.5759	9.258E-04	15394.3884	972.4135
98.400	-.009701	-90287.3652	-2162.2527	7.908E-04	16374.4334	686.2545
103.320	-.006183	-93323.2907	618.8266	6.366E-04	16524.7268	444.2656
108.240	-.003437	-85450.8938	2054.4188	4.864E-04	16135.0042	139.3085
113.160	-.001397	-74065.1002	2538.5218	3.525E-04	15571.3510	57.4814
118.080	3.10E-05	-61165.4693	2676.7434	2.389E-04	14932.7554	-1.2937
123.000	9.54E-04	-48196.0555	2574.1648	1.470E-04	14290.7052	-40.4049
127.920	.001478	-36125.0363	2318.4915	7.621E-05	13693.1300	-63.5274
132.840	.001703	-25532.0758	1979.4944	2.442E-05	13168.7261	-74.2763
137.760	.001718	-16694.8761	1609.8833	-1.104E-05	12731.2409	-75.9721
142.680	.001595	-9669.0927	1247.1023	-3.318E-05	12383.4299	-71.4999
147.600	.001392	-4358.0822	915.6320	-4.497E-05	12120.5085	-63.2441
152.520	.001152	-570.7809	629.4764	-4.911E-05	11933.0184	-53.0793
157.440	9.08E-04	1932.6055	394.5974	-4.796E-05	12000.4354	-42.4000
162.360	6.80E-04	3406.4466	211.1405	-4.348E-05	12073.3979	-32.1760
167.280	4.80E-04	4095.7924	75.3575	-3.718E-05	12107.5239	-23.0204
172.200	3.15E-04	4221.1284	-18.8157	-3.019E-05	12113.7287	-15.2615
177.120	1.83E-04	3970.0625	-78.5300	-2.331E-05	12101.2997	-9.0126
182.040	8.51E-05	3494.2708	-111.1194	-1.704E-05	12077.7456	-4.2351
186.960	1.57E-05	2910.1879	-123.4839	-1.166E-05	12048.8306	-.7912
191.880	-2.97E-05	2302.1439	-121.7109	-7.286E-06	12018.7294	1.5119
196.800	-5.60E-05	1726.8919	-110.8847	-3.902E-06	11990.2516	2.8890
201.720	-6.81E-05	1218.7176	-95.0367	-1.428E-06	11965.0945	3.5533
206.640	-7.00E-05	794.5411	-77.1929	2.627E-07	11944.0956	3.7003
211.560	-6.55E-05	458.6227	-59.4829	1.315E-06	11927.4660	3.4989
216.480	-5.71E-05	206.6409	-43.2820	1.874E-06	11914.9917	3.0869
221.400	-4.70E-05	29.0395	-29.3632	2.072E-06	11906.1995	2.5712
226.320	-3.67E-05	-86.3700	-18.0444	2.024E-06	11909.0376	2.0299
231.240	-2.71E-05	-152.5000	-9.3219	1.823E-06	11912.3114	1.5158
236.160	-1.88E-05	-181.6854	-2.9826	1.542E-06	11913.7562	1.0612
241.080	-1.19E-05	-184.8838	1.3056	1.235E-06	11913.9146	.6820
246.000	-6.63E-06	-171.2674	3.9249	9.354E-07	11913.2405	.3827
250.920	-2.73E-06	-148.1037	5.2587	6.672E-07	11912.0938	.1595
255.840	-6.22E-08	-120.8344	5.6601	4.413E-07	11910.7438	.003668
260.760	1.61E-06	-93.2767	5.4331	2.615E-07	11909.3796	-.095927
265.680	2.51E-06	-67.8868	4.8253	1.261E-07	11908.1226	-.1512
270.600	2.85E-06	-46.0439	4.0269	3.042E-08	11907.0413	-.1734
275.520	2.81E-06	-28.3219	3.1757	-3.204E-08	11906.1640	-.1726
280.440	2.54E-06	-14.7321	2.3640	-6.820E-08	11905.4912	-.1573
285.360	2.14E-06	-4.9264	1.6472	-8.471E-08	11905.0058	-.1340
290.280	1.70E-06	1.6429	1.0525	-8.747E-08	11904.8432	-.1077
295.200	1.28E-06	5.6025	.5867	-8.138E-08	11905.0393	-.081677
300.120	9.01E-07	7.5757	.2427	-7.031E-08	11905.1369	-.058125

305.040	5.86E-07	8.1294	.005813	-5.712E-08	11905.1643	-.038187
309.960	3.39E-07	7.7453	-.1429	-4.379E-08	11905.1453	-.022278
314.880	1.55E-07	6.8091	-.2231	-3.157E-08	11905.0990	-.010313
319.800	2.82E-08	5.6121	-.2531	-2.113E-08	11905.0397	-.001891
324.720	-5.26E-08	4.3599	-.2490	-1.276E-08	11904.9777	.003552
329.640	-9.73E-08	3.1866	-.2240	-6.421E-09	11904.9197	.006637
334.560	-1.16E-07	2.1686	-.1881	-1.923E-09	11904.8693	.007965
339.480	-1.16E-07	1.3399	-.1486	1.023E-09	11904.8282	.008071
344.400	-1.06E-07	.7043	-.1105	2.740E-09	11904.7968	.007402
349.320	-8.93E-08	.2468	-.076816	3.539E-09	11904.7741	.006309
354.240	-7.08E-08	-.058508	-.048875	3.697E-09	11904.7648	.005050
359.160	-5.29E-08	-.2414	-.027098	3.445E-09	11904.7739	.003803
364.080	-3.69E-08	-.3319	-.011153	2.964E-09	11904.7783	.002679
369.000	-2.37E-08	-.3570	-2.947E-04	2.385E-09	11904.7796	.001735
373.920	-1.35E-08	-.3395	.006418	1.800E-09	11904.7787	9.935E-04
378.840	-6.02E-09	-.2974	.009963	1.265E-09	11904.7766	4.476E-04
383.760	-1.02E-09	-.2440	.011254	8.104E-10	11904.7740	7.681E-05
388.680	1.95E-09	-.1883	.011079	4.473E-10	11904.7712	-1.477E-04
393.600	3.38E-09	-.1358	.010083	1.751E-10	11904.7686	-2.574E-04
398.520	3.68E-09	-.089401	.008755	-1.403E-11	11904.7663	-2.825E-04
403.440	3.24E-09	-.049661	.007443	-1.308E-10	11904.7644	-2.508E-04
408.360	2.39E-09	-.015909	.006367	-1.859E-10	11904.7627	-1.866E-04
413.280	1.41E-09	.013353	.005635	-1.880E-10	11904.7626	-1.109E-04
418.200	5.40E-10	.039908	.005257	-1.433E-10	11904.7639	-4.282E-05
423.120	5.64E-17	.065360	-.004067	-5.489E-11	11904.7651	-.003747
428.040	-4.06E-17	1.665E-08	-.006642	-5.728E-18	11904.7619	.002700
432.960	-1.64E-23	-4.915E-09	-1.691E-09	4.128E-18	11904.7619	1.094E-09
437.880	3.05E-24	-2.729E-15	4.994E-10	1.672E-24	11904.7619	-2.030E-10
442.800	0.000	3.695E-16	2.773E-16	-3.104E-25	11904.7619	-1.433E-16
447.720	0.000	3.163E-22	-3.755E-17	0.0000	11904.7619	1.527E-17
452.640	0.000	-2.779E-23	-3.214E-23	0.0000	11904.7619	1.536E-23
457.560	0.000	0.0000	2.824E-24	0.0000	11904.7619	-1.148E-24
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-8361535.825 lbs-in
Maximum shear force	=	576602.657 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	14

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	-8.944E+06	5.993E+05	0.0000	4.547E+05	-15269.6852
4.920	.963043	-6.173E+06	5.233E+05	-.012696	3.175E+05	-15621.8585
9.840	.875072	-3.770E+06	4.455E+05	-.021046	1.985E+05	-15974.0400
14.760	.755946	-1.747E+06	3.661E+05	-.025680	98403.4682	-16326.2292
19.680	.622379	-1.171E+05	2.849E+05	-.027246	17699.8683	-16678.4266
24.600	.487845	1.110E+06	2.020E+05	-.026412	66836.4644	-17030.6323
29.520	.362482	1.922E+06	1.184E+05	-.023866	1.071E+05	-16931.7052
34.440	.253004	2.322E+06	44165.9627	-.020302	1.268E+05	-13250.4058
39.360	.162715	2.397E+06	-11428.4415	-.016339	1.306E+05	-9348.9455
44.280	.092233	2.241E+06	-47714.4266	-.012443	1.229E+05	-5401.4549
49.200	.040276	1.952E+06	-66914.0569	-.008921	1.085E+05	-2403.2729
54.120	.004449	1.601E+06	-73491.2630	-.005938	91142.5256	-270.3881
59.040	-.018150	1.240E+06	-71393.3063	-.003552	73304.4199	1123.2161
63.960	-.030499	9.051E+05	-63904.0653	-.001750	56710.8190	1921.1908
68.880	-.035369	6.149E+05	-53600.9772	-4.732E-04	42345.3926	2267.0564
73.800	-.035156	3.786E+05	-42384.8505	3.612E-04	30646.3481	2292.3448
78.720	-.031815	1.971E+05	-31555.8454	8.447E-04	21663.3268	2109.6898
83.640	-.026844	66408.1563	-21913.8890	.001066	15192.2944	1809.8047
88.560	-.021325	-20607.6072	-13866.9559	.001104	12924.9405	1461.3063
93.480	-.015976	-72216.3440	-7535.5219	.001027	15479.8284	1112.4474
98.400	-.011224	-96777.3699	-2845.7472	8.846E-04	16695.7208	793.9651
103.320	-.007271	-1.020E+05	392.5732	7.177E-04	16952.2568	522.4253
108.240	-.004162	-94326.8632	2092.6707	5.528E-04	16574.4086	168.6713
113.160	-.001831	-82455.4939	2692.9780	4.044E-04	15986.7170	75.3561
118.080	-1.83E-04	-68623.7360	2897.1286	2.775E-04	15301.9766	7.6319
123.000	8.99E-04	-54493.8098	2822.2069	1.741E-04	14602.4753	-38.0879
127.920	.001530	-41195.7827	2566.6989	9.370E-05	13944.1571	-65.7772
132.840	.001821	-29421.8922	2209.5701	3.439E-05	13361.2912	-79.3972
137.760	.001868	-19521.2904	1811.0016	-6.717E-06	12871.1624	-82.6225
142.680	.001755	-11588.4167	1414.2140	-3.285E-05	12478.4459	-78.6732
147.600	.001545	-5540.7838	1047.9093	-4.723E-05	12179.0581	-70.2312
152.520	.001290	-1184.0366	728.9621	-5.288E-05	11963.3776	-59.4221
157.440	.001025	1736.2720	465.0917	-5.242E-05	11990.7160	-47.8423
162.360	7.74E-04	3495.6212	257.3266	-4.802E-05	12077.8125	-36.6151
167.280	5.52E-04	4362.8735	102.1531	-4.142E-05	12120.7457	-26.4636
172.200	3.67E-04	4582.3269	-6.7078	-3.391E-05	12131.6098	-17.7888
177.120	2.19E-04	4363.6024	-76.9049	-2.640E-05	12120.7818	-10.7466
182.040	1.07E-04	3877.5294	-116.4205	-1.947E-05	12096.7188	-5.3167
186.960	2.71E-05	3256.3496	-132.8534	-1.348E-05	12065.9673	-1.3634
191.880	-2.58E-05	2596.7857	-132.9698	-8.567E-06	12033.3157	1.3160
196.800	-5.72E-05	1964.7856	-122.4679	-4.736E-06	12002.0285	2.9531

201.720	-7.24E-05	1401.0209	-105.9024	-1.909E-06	11974.1194	3.7809
206.640	-7.60E-05	926.4619	-86.7229	4.610E-08	11950.6264	4.0157
211.560	-7.20E-05	547.5766	-67.3839	1.284E-06	11931.8697	3.8457
216.480	-6.34E-05	260.8767	-49.4954	1.963E-06	11917.6766	3.4261
221.400	-5.26E-05	56.6788	-33.9872	2.230E-06	11907.5678	2.8780
226.320	-4.14E-05	-77.9457	-21.2716	2.212E-06	11908.6206	2.2909
231.240	-3.09E-05	-156.9871	-11.3901	2.015E-06	11912.5335	1.7260
236.160	-2.16E-05	-193.9894	-4.1396	1.720E-06	11914.3653	1.2214
241.080	-1.39E-05	-201.1054	.8257	1.388E-06	11914.7176	.7970
246.000	-7.95E-06	-188.5959	3.9161	1.061E-06	11914.0983	.4592
250.920	-3.51E-06	-164.6589	5.5500	7.640E-07	11912.9133	.2050
255.840	-4.33E-07	-135.4877	6.1171	5.120E-07	11911.4692	.025565
260.760	1.53E-06	-105.4738	5.9564	3.096E-07	11909.9834	-.090914
265.680	2.61E-06	-77.4862	5.3457	1.559E-07	11908.5979	-.1573
270.600	3.06E-06	-53.1786	4.5009	4.618E-08	11907.3945	-.1861
275.520	3.07E-06	-33.2883	3.5795	-2.644E-08	11906.4098	-.1885
280.440	2.80E-06	-17.9046	2.6885	-6.944E-08	11905.6483	-.1737
285.360	2.38E-06	-6.6967	1.8936	-9.010E-08	11905.0934	-.1494
290.280	1.91E-06	.9058	1.2283	-9.497E-08	11904.8067	-.1211
295.200	1.45E-06	5.5764	.7026	-8.952E-08	11905.0380	-.092622
300.120	1.03E-06	7.9956	.3110	-7.812E-08	11905.1577	-.066585
305.040	6.81E-07	8.7899	.038083	-6.402E-08	11905.1970	-.044338
309.960	4.02E-07	8.4964	-.1360	-4.951E-08	11905.1825	-.026435
314.880	1.94E-07	7.5489	-.2327	-3.603E-08	11905.1356	-.012849
319.800	4.75E-08	6.2779	-.2721	-2.442E-08	11905.0727	-.003184
324.720	-4.66E-08	4.9195	-.2722	-1.501E-08	11905.0054	.003153
329.640	-1.00E-07	3.6293	-.2476	-7.833E-09	11904.9416	.006833
334.560	-1.24E-07	2.4985	-.2099	-2.686E-09	11904.8856	.008515
339.480	-1.27E-07	1.5697	-.1673	7.304E-10	11904.8396	.008792
344.400	-1.17E-07	.8511	-.1256	2.764E-09	11904.8040	.008163
349.320	-9.94E-08	.3286	-.088201	3.754E-09	11904.7782	.007026
354.240	-7.96E-08	-.024231	-.056961	4.010E-09	11904.7631	.005674
359.160	-6.00E-08	-.2397	-.032398	3.788E-09	11904.7738	.004311
364.080	-4.23E-08	-.3505	-.014244	3.293E-09	11904.7793	.003069
369.000	-2.76E-08	-.3864	-.001736	2.674E-09	11904.7810	.002016
373.920	-1.60E-08	-.3728	.006127	2.036E-09	11904.7804	.001181
378.840	-7.53E-09	-.3301	.010409	1.446E-09	11904.7782	5.601E-04
383.760	-1.78E-09	-.2732	.012115	9.390E-10	11904.7754	1.337E-04
388.680	1.71E-09	-.2127	.012127	5.308E-10	11904.7724	-1.291E-04
393.600	3.44E-09	-.1550	.011164	2.220E-10	11904.7696	-2.622E-04
398.520	3.89E-09	-.1033	.009784	5.123E-12	11904.7670	-2.990E-04
403.440	3.49E-09	-.058701	.008384	-1.309E-10	11904.7648	-2.703E-04
408.360	2.60E-09	-.020547	.007219	-1.975E-10	11904.7629	-2.032E-04
413.280	1.55E-09	.012720	.006419	-2.041E-10	11904.7625	-1.217E-04
418.200	5.96E-10	.043021	.006004	-1.573E-10	11904.7640	-4.724E-05
423.120	6.28E-17	.072107	-.004384	-6.056E-11	11904.7655	-.004175
428.040	-4.48E-17	1.844E-08	-.007328	-6.383E-18	11904.7619	.002979
432.960	-1.82E-23	-5.422E-09	-1.873E-09	4.554E-18	11904.7619	1.210E-09
437.880	3.37E-24	-3.017E-15	5.510E-10	1.849E-24	11904.7619	-2.240E-10
442.800	0.000	4.077E-16	3.065E-16	-3.424E-25	11904.7619	-1.583E-16
447.720	0.000	3.494E-22	-4.143E-17	0.0000	11904.7619	1.684E-17
452.640	0.000	-3.065E-23	-3.550E-23	0.0000	11904.7619	1.697E-23
457.560	0.000	0.0000	3.115E-24	0.0000	11904.7619	-1.266E-24
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-8943677.734 lbs-in
Maximum shear force	=	599254.814 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	14

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .100000	S= 0.000	2.000E+05	.100000	-1.207E+06	1.098E+05
5	y= .200000	S= 0.000	2.000E+05	.2000	-2.413E+06	2.196E+05
5	y= .300000	S= 0.000	2.000E+05	.3000	-3.560E+06	3.140E+05
5	y= .400000	S= 0.000	2.000E+05	.4000	-4.629E+06	3.971E+05
5	y= .500000	S= 0.000	2.000E+05	.5000	-5.564E+06	4.513E+05
5	y= .600000	S= 0.000	2.000E+05	.6000	-6.370E+06	4.914E+05
5	y= .700000	S= 0.000	2.000E+05	.7000	-7.089E+06	5.240E+05
5	y= .800000	S= 0.000	2.000E+05	.8000	-7.765E+06	5.531E+05
5	y= .900000	S= 0.000	2.000E+05	.9000	-8.362E+06	5.766E+05
5	y= 1.000	S= 0.000	2.000E+05	1.0000	-8.944E+06	5.993E+05

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = .10000 in
Slope = .00000
Axial Load = 200000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
492.000	.10000000	-1206627.403	109811.603
467.400	.10000000	-1209563.587	109949.020
442.800	.10000000	-1212352.060	110080.057
418.200	.10000000	-1214994.877	110204.654
393.600	.10000000	-1217495.040	110322.789
369.000	.10000000	-1219847.469	110434.270
344.400	.10000000	-1222051.706	110539.012
319.800	.10000000	-1224106.646	110636.915
295.200	.10000000	-1226014.097	110727.946
270.600	.10000000	-1227770.250	110811.961

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Abut_B20_Free.lpd
Name of output file: ArroyoMocho_Abut_B20_Free.lpo
Name of plot output file: ArroyoMocho_Abut_B20_Free.lpp
Name of runtime file: ArroyoMocho_Abut_B20_Free.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:43:59

Problem Title

SR84 Isabel Abutment - Arroyo Mocho Bridge Widen - H pile - Weak Axis

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 492.00 in
Depth of ground surface below top of pile = -36.00 in
Slope angle of ground surface = 21.80 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	492.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -36.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is stiff clay without free water
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 432.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 432.000 in
Distance from top of pile to bottom of layer = 1092.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 600.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.07230
2	132.00	.07230
3	132.00	.07810
4	420.00	.07810
5	420.00	.04200
6	432.00	.04200
7	432.00	.04200
8	1092.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	.00000	32.00	------	------
2	132.000	.00000	32.00	------	------
3	132.000	.00000	40.00	------	------
4	420.000	.00000	40.00	------	------
5	420.000	20.83300	.00	.00500	.0
6	432.000	20.83300	.00	.00500	.0
7	432.000	20.83300	.00	.00500	.0
8	1092.000	20.83300	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .100 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .200 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .300 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .400 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .500 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .600 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

```
Deflection at pile head     =            .700 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .800 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .900 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           1.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs
```

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	96.000

Depth of ground surface below top of pile = -36.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =           1
Depth below pile head       =      60.000 in
Depth below ground surface  =      96.000 in
Equivalent Depth (see note) =      96.000 in
Pile Diameter               =      10.000 in
Angle of Friction           =      32.000 deg.
Avg. Eff. Unit Weight       =      .07230 lbs/in**3
k                           =      90.000 pci
A (static)                  =       .8800
B (static)                  =       .5000
Pst                         =     788.251 lbs/in
```

Psd	=	2555.186	lbs/in
Ps	=	788.251	lbs/in
pu	=	693.660	lbs/in
Cbar	=	1171.5214	
n	=	1.6447	
m	=	1437.7689	
yk	=	.0061	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	86.995
.0278	132.592
.0417	169.661
.0556	202.090
.0694	231.455
.0833	258.588
.0972	283.996
.1111	308.014
.1250	330.881
.1389	352.770
.1528	373.817
.1667	394.125
.3750	693.660
10.3750	693.660
20.3750	693.660
30.3750	693.660

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .100000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	0.0000	3516.5670	-.002053	4464.2857	-63.6751
4.920	.089899	17288.4462	3205.3706	-.002039	5320.1494	-62.8275

9.840	.079940	33045.3499	2882.3084	-.001996	6100.1941	-68.4986
14.760	.070254	47123.6657	2534.6275	-.001929	6797.1405	-72.8351
19.680	.060958	59409.6985	2161.5898	-.001840	7405.3599	-78.8063
24.600	.052153	69751.2910	1762.3913	-.001731	7917.3199	-83.4696
29.520	.043925	78029.1523	1343.9735	-.001607	8327.1150	-86.6190
34.440	.036341	84161.9153	914.2046	-.001471	8630.7172	-88.0838
39.360	.029453	88110.3199	481.6999	-.001326	8826.1827	-87.7311
44.280	.023293	89880.4577	55.6372	-.001177	8913.8133	-85.4652
49.200	.017876	89526.0805	-354.4181	-.001026	8896.2699	-81.2240
54.120	.013198	87150.0730	-738.6475	-8.775E-04	8778.6458	-74.9668
59.040	.009241	82905.3700	-1087.0205	-7.347E-04	8568.5120	-66.6482
63.960	.005969	76995.9661	-1383.0832	-6.004E-04	8275.9672	-53.7025
68.880	.003334	69738.8947	-1592.6020	-4.771E-04	7916.7062	-31.4678
73.800	.001274	61676.8759	-1700.9951	-3.667E-04	7517.5964	-12.5945
78.720	-2.75E-04	53271.7608	-1724.9918	-2.702E-04	7101.5016	2.8397
83.640	-.001384	44902.3652	-1681.3384	-1.877E-04	6687.1751	14.9056
88.560	-.002122	36865.9489	-1586.1379	-1.191E-04	6289.3327	23.7938
93.480	-.002556	29382.6443	-1454.3333	-6.343E-05	5918.8721	29.7853
98.400	-.002747	22602.1221	-1299.3318	-1.977E-05	5583.2026	33.2234
103.320	-.002751	16611.8099	-1132.7611	1.316E-05	5286.6525	34.4883
108.240	-.002617	11446.0377	-964.3432	3.673E-05	5030.9212	33.9743
113.160	-.002389	7095.5668	-801.8684	5.230E-05	4815.5514	32.0724
118.080	-.002102	3517.0543	-651.2483	6.121E-05	4638.3973	29.1553
123.000	-.001787	642.1068	-516.6279	6.471E-05	4496.0732	25.5685
127.920	-.001466	-1614.3184	-400.5351	6.389E-05	4544.2025	21.6237
132.840	-.001158	-3346.3103	-274.6487	5.973E-05	4629.9446	29.5496
137.760	-8.78E-04	-4360.9390	-144.4506	5.325E-05	4680.1738	23.3765
142.680	-6.34E-04	-4807.0048	-43.6910	4.555E-05	4702.2562	17.5828
147.600	-4.30E-04	-4824.4755	30.0532	3.746E-05	4703.1211	12.3945
152.520	-2.65E-04	-4538.9288	80.0959	2.960E-05	4688.9852	7.9480
157.440	-1.39E-04	-4058.1760	110.2317	2.238E-05	4665.1855	4.3023
162.360	-4.52E-05	-3470.7638	124.3930	1.605E-05	4636.1057	1.4543
167.280	1.94E-05	-2845.9971	126.3810	1.075E-05	4605.1767	-.6462
172.200	6.06E-05	-2235.1083	119.6712	6.482E-06	4574.9346	-2.0814
177.120	8.32E-05	-1673.2164	107.2886	3.200E-06	4547.1182	-2.9522
182.040	9.20E-05	-1181.7499	91.7425	8.018E-07	4522.7882	-3.3673
186.960	9.11E-05	-771.0614	75.0118	-8.383E-07	4502.4571	-3.4338
191.880	8.38E-05	-443.0155	58.5671	-1.858E-06	4486.2172	-3.2510
196.800	7.28E-05	-193.3902	43.4211	-2.393E-06	4473.8595	-2.9059
201.720	6.02E-05	-13.9861	30.1941	-2.567E-06	4464.9781	-2.4709
206.640	4.76E-05	105.6144	19.1876	-2.490E-06	4469.5141	-2.0033
211.560	3.57E-05	176.6574	10.4582	-2.253E-06	4473.0311	-1.5453
216.480	2.54E-05	210.1858	3.8874	-1.928E-06	4474.6910	-1.1258
221.400	1.68E-05	216.3319	-.7576	-1.570E-06	4474.9952	-.7624
226.320	9.95E-06	203.8891	-3.7724	-1.217E-06	4474.3792	-.4631
231.240	4.81E-06	180.1096	-5.4750	-8.941E-07	4473.2020	-.2290
236.160	1.15E-06	150.6747	-6.1765	-6.163E-07	4471.7449	-.056124
241.080	-1.26E-06	119.7879	-6.1601	-3.891E-07	4470.2158	.062764
246.000	-2.68E-06	90.3461	-5.6699	-2.126E-07	4468.7583	.1365
250.920	-3.35E-06	64.1530	-4.9047	-8.288E-08	4467.4616	.1745
255.840	-3.49E-06	42.1448	-4.0182	6.399E-09	4466.3721	.1858
260.760	-3.29E-06	24.6087	-3.1219	6.246E-08	4465.5040	.1785
265.680	-2.88E-06	11.3789	-2.2904	9.269E-08	4464.8490	.1595
270.600	-2.38E-06	2.0032	-1.5677	1.039E-07	4464.3849	.1343
275.520	-1.86E-06	-4.1237	-.9743	1.021E-07	4464.4899	.1070
280.440	-1.37E-06	-7.6589	-.5131	9.225E-08	4464.6649	.080499
285.360	-9.49E-07	-9.2408	-.1755	7.806E-08	4464.7432	.056753

290.280	-6.03E-07	-9.4432	.054479	6.237E-08	4464.7532	.036726
295.200	-3.35E-07	-8.7508	.1959	4.708E-08	4464.7189	.020776
300.120	-1.39E-07	-7.5500	.2687	3.339E-08	4464.6595	.008800
305.040	-6.24E-09	-6.1315	.2913	2.190E-08	4464.5893	4.011E-04
309.960	7.62E-08	-4.6995	.2801	1.281E-08	4464.5184	-.004980
314.880	1.20E-07	-3.3852	.2482	6.016E-09	4464.4533	-.007962
319.800	1.35E-07	-2.2614	.2061	1.274E-09	4464.3977	-.009150
324.720	1.32E-07	-1.3578	.1613	-1.766E-09	4464.3529	-.009088
329.640	1.18E-07	-.6733	.1186	-3.472E-09	4464.3190	-.008237
334.560	9.81E-08	-.1878	.081262	-4.195E-09	4464.2950	-.006959
339.480	7.67E-08	.1294	.050549	-4.244E-09	4464.2921	-.005526
344.400	5.64E-08	.3128	.026813	-3.872E-09	4464.3012	-.004123
349.320	3.86E-08	.3961	.009617	-3.277E-09	4464.3053	-.002867
354.240	2.41E-08	.4098	-.001910	-2.600E-09	4464.3060	-.001819
359.160	1.30E-08	.3792	-.008837	-1.938E-09	4464.3045	-9.970E-04
364.080	5.08E-09	.3243	-.012258	-1.347E-09	4464.3018	-3.937E-04
369.000	-2.08E-10	.2596	-.013186	-8.563E-10	4464.2986	1.638E-05
373.920	-3.35E-09	.1952	-.012489	-4.743E-10	4464.2954	2.671E-04
378.840	-4.88E-09	.1371	-.010862	-1.953E-10	4464.2925	3.943E-04
383.760	-5.27E-09	.088426	-.008829	-5.899E-12	4464.2901	4.320E-04
388.680	-4.93E-09	.050188	-.006758	1.105E-10	4464.2882	4.099E-04
393.600	-4.18E-09	.021842	-.004884	1.710E-10	4464.2868	3.521E-04
398.520	-3.25E-09	.002005	-.003336	1.910E-10	4464.2858	2.773E-04
403.440	-2.30E-09	-.011122	-.002164	1.834E-10	4464.2863	1.989E-04
408.360	-1.45E-09	-.019425	-.001363	1.577E-10	4464.2867	1.266E-04
413.280	-7.51E-10	-.024653	-8.884E-04	1.207E-10	4464.2869	6.651E-05
418.200	-2.59E-10	-.028256	-6.677E-04	7.627E-11	4464.2871	2.319E-05
423.120	-2.84E-17	-.031280	.002874	2.627E-11	4464.2873	.001416
428.040	2.59E-17	-9.709E-09	.003179	2.887E-18	4464.2857	-.001292
432.960	1.32E-23	3.136E-09	9.865E-10	-2.634E-18	4464.2857	-6.601E-10
437.880	-2.60E-24	2.231E-15	-3.187E-10	-1.346E-24	4464.2857	1.296E-10
442.800	0.000	-3.144E-16	-2.267E-16	2.641E-25	4464.2857	1.181E-16
447.720	0.000	-3.497E-22	3.195E-17	0.0000	4464.2857	-1.299E-17
452.640	0.000	3.152E-23	3.554E-23	0.0000	4464.2857	-1.705E-23
457.560	0.000	0.0000	-3.204E-24	0.0000	4464.2857	1.302E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	-.00205314
Maximum bending moment	=	89880.458 lbs-in
Maximum shear force	=	3516.567 lbs
Depth of maximum bending moment	=	44.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7

Number of zero deflection points = 13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .200000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	0.0000	5855.7849	-.003889	4464.2857	-89.2458
4.920	.180866	29165.3535	5406.9884	-.003865	5908.1151	-93.1918
9.840	.161973	56056.7919	4922.7325	-.003793	7239.3744	-103.6602
14.760	.143543	80404.2442	4391.0686	-.003678	8444.6938	-112.4633
19.680	.125778	1.020E+05	3813.2752	-.003525	9512.7772	-122.4120
24.600	.108856	1.205E+05	3190.9484	-.003338	10431.0404	-130.5664
29.520	.092929	1.358E+05	2533.6888	-.003123	11189.1429	-136.6123
34.440	.078126	1.478E+05	1852.5280	-.002885	11779.3696	-140.2823
39.360	.064543	1.562E+05	1159.6888	-.002629	12196.9567	-141.3597
44.280	.052252	1.611E+05	468.3278	-.002363	12440.3545	-139.6814
49.200	.041291	1.626E+05	-207.7244	-.002091	12511.4231	-135.1366
54.120	.031675	1.606E+05	-854.2040	-.001820	12415.5647	-127.6600
59.040	.023386	1.555E+05	-1456.5937	-.001554	12161.7983	-117.2139
63.960	.016381	1.474E+05	-2000.1642	-.001300	11762.7990	-103.7497
68.880	.010595	1.368E+05	-2469.6938	-.001061	11234.9488	-87.1160
73.800	.005940	1.239E+05	-2828.3964	-8.422E-04	10598.5077	-58.6980
78.720	.002308	1.096E+05	-3031.4250	-6.461E-04	9887.9243	-23.8339
83.640	-4.18E-04	94558.8764	-3078.9938	-4.747E-04	9145.4182	4.4970
88.560	-.002362	79610.4987	-3002.7867	-3.284E-04	8405.3995	26.4815
93.480	-.003649	65253.7979	-2833.0403	-2.067E-04	7694.6717	42.5211
98.400	-.004396	51885.9335	-2597.6230	-1.083E-04	7032.8963	53.1770
103.320	-.004715	39773.1322	-2321.3772	-3.134E-05	6433.2527	59.1180
108.240	-.004705	29066.7135	-2025.7044	2.647E-05	5903.2319	61.0742
113.160	-.004454	19820.6640	-1728.3625	6.753E-05	5445.5067	59.7965
118.080	-.004040	12009.7872	-1443.4401	9.427E-05	5058.8296	56.0256
123.000	-.003527	5547.6448	-1181.4668	1.090E-04	4738.9216	50.4676
127.920	-.002967	303.7031	-949.6212	1.139E-04	4479.3205	43.7786
132.840	-.002406	-3880.7057	-690.9191	1.109E-04	4656.3999	61.3849
137.760	-.001876	-6576.8019	-417.0463	1.021E-04	4789.8700	49.9455
142.680	-.001401	-8059.8203	-198.6324	8.985E-05	4863.2867	38.8406
147.600	-9.92E-04	-8597.6509	-32.7181	7.586E-05	4889.9120	28.6042
152.520	-6.54E-04	-8437.7483	85.8407	6.155E-05	4881.9960	19.5905
157.440	-3.86E-04	-7798.4015	163.5394	4.791E-05	4850.3452	11.9944
162.360	-1.83E-04	-6863.8799	207.5047	3.560E-05	4804.0817	5.8777
167.280	-3.60E-05	-5782.8266	224.9093	2.498E-05	4750.5643	1.1974
172.200	6.30E-05	-4669.2041	222.5288	1.620E-05	4695.4344	-2.1651
177.120	1.23E-04	-3605.0973	206.4334	9.248E-06	4642.7559	-4.3777
182.040	1.54E-04	-2644.7246	181.8047	3.999E-06	4595.2127	-5.6340

186.960	1.63E-04	-1819.0907	152.8552	2.499E-07	4554.3397	-6.1341
191.880	1.56E-04	-1140.8142	122.8323	-2.236E-06	4520.7617	-6.0703
196.800	1.41E-04	-608.7710	94.0831	-3.705E-06	4494.4229	-5.6163
201.720	1.20E-04	-212.3019	68.1607	-4.395E-06	4474.7957	-4.9212
206.640	9.75E-05	65.1737	45.9531	-4.519E-06	4467.5121	-4.1063
211.560	7.55E-05	243.2110	27.8203	-4.260E-06	4476.3259	-3.2648
216.480	5.56E-05	342.0689	13.7280	-3.768E-06	4481.2198	-2.4638
221.400	3.84E-05	381.0756	3.3693	-3.161E-06	4483.1508	-1.7471
226.320	2.45E-05	377.5558	-3.7305	-2.524E-06	4482.9766	-1.1390
231.240	1.36E-05	346.2296	-8.1286	-1.916E-06	4481.4258	-.6488
236.160	5.62E-06	298.9843	-10.3987	-1.374E-06	4479.0869	-.2740
241.080	9.56E-08	244.9208	-11.0844	-9.170E-07	4476.4105	-.004765
246.000	-3.40E-06	190.5901	-10.6693	-5.512E-07	4473.7209	.1735
250.920	-5.33E-06	140.3417	-9.5597	-2.733E-07	4471.2333	.2775
255.840	-6.09E-06	96.7242	-8.0797	-7.416E-08	4469.0740	.3241
260.760	-6.06E-06	60.8918	-6.4733	5.822E-08	4467.3002	.3289
265.680	-5.52E-06	32.9841	-4.9117	1.371E-07	4465.9186	.3058
270.600	-4.71E-06	12.4593	-3.5047	1.752E-07	4464.9025	.2661
275.520	-3.80E-06	-1.6310	-2.3119	1.843E-07	4464.3665	.2187
280.440	-2.90E-06	-10.4261	-1.3556	1.742E-07	4464.8019	.1701
285.360	-2.08E-06	-15.0984	-.6308	1.528E-07	4465.0332	.1246
290.280	-1.39E-06	-16.7464	-.1157	1.260E-07	4465.1147	.084858
295.200	-8.42E-07	-16.3298	.2215	9.823E-08	4465.0941	.052225
300.120	-4.26E-07	-14.6390	.4162	7.222E-08	4465.0104	.026895
305.040	-1.31E-07	-12.2881	.5030	4.961E-08	4464.8940	.008419
309.960	6.23E-08	-9.7258	.5137	3.112E-08	4464.7672	-.004072
314.880	1.75E-07	-7.2560	.4751	1.686E-08	4464.6449	-.011647
319.800	2.28E-07	-5.0637	.4085	6.510E-09	4464.5364	-.015420
324.720	2.39E-07	-3.2415	.3301	-4.654E-10	4464.4462	-.016435
329.640	2.24E-07	-1.8151	.2513	-4.712E-09	4464.3756	-.015605
334.560	1.93E-07	-.7653	.1793	-6.879E-09	4464.3236	-.013677
339.480	1.56E-07	-.046115	.1180	-7.561E-09	4464.2880	-.011226
344.400	1.18E-07	.4014	.069065	-7.263E-09	4464.3056	-.008664
349.320	8.44E-08	.6388	.032335	-6.389E-09	4464.3173	-.006266
354.240	5.56E-08	.7243	.006611	-5.244E-09	4464.3216	-.004191
359.160	3.28E-08	.7078	-.009871	-4.041E-09	4464.3208	-.002509
364.080	1.59E-08	.6301	-.019069	-2.918E-09	4464.3169	-.001230
369.000	4.11E-09	.5223	-.022891	-1.950E-09	4464.3116	-3.235E-04
373.920	-3.32E-09	.4063	-.023035	-1.170E-09	4464.3058	2.650E-04
378.840	-7.40E-09	.2965	-.020910	-5.798E-10	4464.3004	5.984E-04
383.760	-9.03E-09	.2010	-.017618	-1.620E-10	4464.2957	7.400E-04
388.680	-8.99E-09	.1232	-.013959	1.103E-10	4464.2918	7.472E-04
393.600	-7.94E-09	.063528	-.010476	2.672E-10	4464.2889	6.686E-04
398.520	-6.36E-09	.019960	-.007496	3.373E-10	4464.2867	5.429E-04
403.440	-4.62E-09	-.010479	-.005178	3.453E-10	4464.2862	3.994E-04
408.360	-2.97E-09	-.031244	-.003556	3.102E-10	4464.2873	2.597E-04
413.280	-1.57E-09	-.045704	-.002575	2.456E-10	4464.2880	1.391E-04
418.200	-5.50E-10	-.056768	-.002112	1.596E-10	4464.2885	4.938E-05
423.120	-6.33E-17	-.066601	.005773	5.594E-11	4464.2890	.003156
428.040	5.52E-17	-2.101E-08	.006768	6.433E-18	4464.2857	-.002751
432.960	2.85E-23	6.677E-09	2.135E-09	-5.608E-18	4464.2857	-1.420E-09
437.880	-5.53E-24	4.784E-15	-6.786E-10	-2.894E-24	4464.2857	2.758E-10
442.800	0.000	-6.695E-16	-4.862E-16	5.623E-25	4464.2857	2.529E-16
447.720	0.000	-7.481E-22	6.803E-17	0.0000	4464.2857	-2.766E-17
452.640	0.000	6.712E-23	7.602E-23	0.0000	4464.2857	-3.645E-23
457.560	0.000	0.0000	-6.821E-24	0.0000	4464.2857	2.773E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	-.00388903
Maximum bending moment	=	162552.175 lbs-in
Maximum shear force	=	5855.785 lbs
Depth of maximum bending moment	=	49.200 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .300000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	0.0000	7935.2549	-.005652	4464.2857	-112.7447
4.920	.272191	39762.5587	7361.1874	-.005619	6432.7292	-120.6161
9.840	.244711	76580.7900	6733.9183	-.005521	8255.4139	-134.3714
14.760	.217863	1.101E+05	6043.8261	-.005364	9914.7267	-146.1539
19.680	.191925	1.400E+05	5294.0238	-.005154	11395.5195	-158.6438
24.600	.167145	1.660E+05	4486.8954	-.004897	12681.9075	-169.4572
29.520	.143736	1.878E+05	3631.9248	-.004600	13760.1352	-178.0918
34.440	.121880	2.051E+05	2741.5957	-.004270	14619.1871	-183.8306
39.360	.101718	2.179E+05	1830.8576	-.003915	15251.6538	-186.3882
44.280	.083357	2.260E+05	915.9043	-.003542	15654.0783	-185.5441
49.200	.066865	2.295E+05	13.8531	-.003159	15827.2229	-181.1434
54.120	.052269	2.285E+05	-857.5671	-.002775	15776.2536	-173.0924
59.040	.039562	2.231E+05	-1680.2840	-.002395	15510.8498	-161.3453
63.960	.028699	2.137E+05	-2436.0453	-.002028	15045.2531	-145.8747
68.880	.019602	2.007E+05	-3106.3463	-.001680	14398.2908	-126.6054
73.800	.012163	1.844E+05	-3671.7941	-.001357	13593.4554	-103.2515
78.720	.006249	1.655E+05	-4084.5128	-.001063	12659.2314	-64.5203

83.640	.001703	1.450E+05	-4288.3368	-8.023E-04	11642.6109	-18.3350
88.560	-.001645	1.239E+05	-4288.0720	-5.764E-04	10599.5696	18.4426
93.480	-.003969	1.032E+05	-4128.9297	-3.856E-04	9574.8258	46.2495
98.400	-.005439	83588.6332	-3853.3017	-2.287E-04	8602.3369	65.7944
103.320	-.006219	65485.1915	-3499.6171	-1.035E-04	7706.1269	77.9798
108.240	-.006458	49228.7703	-3101.5647	-7.135E-06	6901.3535	83.8301
113.160	-.006289	34971.0604	-2687.6450	6.358E-05	6195.5263	84.4300
118.080	-.005832	22735.4203	-2280.9997	1.120E-04	5589.8016	80.8730
123.000	-.005187	12443.3318	-1899.4655	1.416E-04	5080.2922	74.2222
127.920	-.004439	3940.1830	-1555.7910	1.554E-04	4659.3443	65.4829
132.840	-.003658	-2980.3033	-1165.0858	1.562E-04	4611.8255	93.3404
137.760	-.002902	-7639.5080	-745.4023	1.472E-04	4842.4792	77.2627
142.680	-.002209	-10423.7264	-404.6317	1.321E-04	4980.3118	61.2620
147.600	-.001602	-11718.5521	-140.2470	1.135E-04	5044.4121	46.2115
152.520	-.001093	-11887.4999	53.9192	9.365E-05	5052.7758	32.7178
157.440	-6.81E-04	-11257.0992	186.4238	7.421E-05	5021.5679	21.1458
162.360	-3.62E-04	-10107.8562	267.1122	5.626E-05	4964.6746	11.6543
167.280	-1.27E-04	-8670.2383	306.2033	4.049E-05	4893.5054	4.2363
172.200	3.61E-05	-7124.7002	313.5762	2.723E-05	4816.9936	-1.2392
177.120	1.41E-04	-5604.7422	298.2589	1.654E-05	4741.7482	-4.9874
182.040	1.99E-04	-4202.0368	268.1000	8.300E-06	4672.3073	-7.2723
186.960	2.22E-04	-2972.7633	229.6025	2.274E-06	4611.4522	-8.3771
191.880	2.21E-04	-1944.4267	187.8865	-1.856E-06	4560.5445	-8.5806
196.800	2.04E-04	-1122.5906	146.7528	-4.432E-06	4519.8595	-8.1404
201.720	1.78E-04	-497.1086	108.8145	-5.792E-06	4488.8951	-7.2817
206.640	1.47E-04	-47.5817	75.6708	-6.250E-06	4466.6412	-6.1914
211.560	1.16E-04	252.1042	48.0997	-6.078E-06	4476.7661	-5.0164
216.480	8.72E-05	430.2047	26.2507	-5.505E-06	4485.5830	-3.8653
221.400	6.19E-05	514.4733	9.8248	-4.711E-06	4489.7547	-2.8119
226.320	4.08E-05	530.3575	-1.7673	-3.834E-06	4490.5410	-1.9003
231.240	2.42E-05	499.9123	-9.2738	-2.968E-06	4489.0338	-1.1511
236.160	1.16E-05	441.2936	-13.4988	-2.178E-06	4486.1319	-.5664
241.080	2.72E-06	368.6914	-15.2261	-1.498E-06	4482.5378	-.1358
246.000	-3.12E-06	292.5739	-15.1686	-9.423E-07	4478.7696	.1592
250.920	-6.55E-06	220.1278	-13.9379	-5.117E-07	4475.1831	.3411
255.840	-8.16E-06	155.8025	-12.0314	-1.959E-07	4471.9987	.4339
260.760	-8.48E-06	101.8836	-9.8317	2.048E-08	4469.3295	.4603
265.680	-7.96E-06	59.0439	-7.6150	1.556E-07	4467.2087	.4408
270.600	-6.95E-06	26.8375	-5.5650	2.278E-07	4465.6143	.3925
275.520	-5.71E-06	4.1161	-3.7894	2.538E-07	4464.4895	.3293
280.440	-4.45E-06	-10.6376	-2.3367	2.483E-07	4464.8123	.2613
285.360	-3.27E-06	-19.0606	-1.2125	2.233E-07	4465.2293	.1957
290.280	-2.25E-06	-22.7339	-.3936	1.882E-07	4465.4112	.1372
295.200	-1.42E-06	-23.0726	.1604	1.498E-07	4465.4279	.088034
300.120	-7.77E-07	-21.2659	.4977	1.125E-07	4465.3385	.049088
305.040	-3.11E-07	-18.2578	.6677	7.934E-08	4465.1896	.020016
309.960	3.44E-09	-14.7539	.7164	5.161E-08	4465.0161	-2.247E-04
314.880	1.96E-07	-11.2462	.6838	2.978E-08	4464.8425	-.013057
319.800	2.96E-07	-8.0477	.6023	1.357E-08	4464.6841	-.020035
324.720	3.30E-07	-5.3292	.4973	2.338E-09	4464.5495	-.022666
329.640	3.19E-07	-3.1560	.3867	-4.788E-09	4464.4419	-.022297
334.560	2.83E-07	-1.5205	.2825	-8.716E-09	4464.3610	-.020056
339.480	2.34E-07	-.3697	.1918	-1.030E-08	4464.3040	-.016829
344.400	1.81E-07	.3741	.1177	-1.030E-08	4464.3042	-.013269
349.320	1.32E-07	.7964	.060921	-9.317E-09	4464.3251	-.009824
354.240	8.98E-08	.9804	.020114	-7.824E-09	4464.3342	-.006765
359.160	5.54E-08	1.0001	-.006938	-6.161E-09	4464.3352	-.004231

364.080	2.92E-08	.9167	-.022913	-4.551E-09	4464.3311	-.002263
369.000	1.06E-08	.7780	-.030526	-3.128E-09	4464.3242	-8.318E-04
373.920	-1.60E-09	.6186	-.032259	-1.955E-09	4464.3163	1.274E-04
378.840	-8.66E-09	.4620	-.030223	-1.047E-09	4464.3086	7.002E-04
383.760	-1.19E-08	.3220	-.026100	-3.887E-10	4464.3017	9.756E-04
388.680	-1.25E-08	.2055	-.021149	5.436E-11	4464.2959	.001037
393.600	-1.14E-08	.1139	-.016244	3.225E-10	4464.2914	9.569E-04
398.520	-9.31E-09	.045374	-.011937	4.563E-10	4464.2880	7.940E-04
403.440	-6.88E-09	-.003928	-.008522	4.911E-10	4464.2859	5.941E-04
408.360	-4.48E-09	-.038845	-.006097	4.552E-10	4464.2876	3.917E-04
413.280	-2.40E-09	-.064256	-.004610	3.686E-10	4464.2889	2.125E-04
418.200	-8.50E-10	-.084484	-.003900	2.437E-10	4464.2899	7.624E-05
423.120	-1.00E-16	-.1028	.008592	8.635E-11	4464.2908	.005002
428.040	8.52E-17	-3.276E-08	.010449	1.020E-17	4464.2857	-.004247
432.960	4.42E-23	1.031E-08	3.328E-09	-8.657E-18	4464.2857	-2.205E-09
437.880	-8.54E-24	7.417E-15	-1.048E-09	-4.494E-24	4464.2857	4.258E-10
442.800	0.000	-1.033E-15	-7.537E-16	8.680E-25	4464.2857	3.918E-16
447.720	0.000	-1.158E-21	1.050E-16	0.0000	4464.2857	-4.269E-17
452.640	0.000	1.036E-22	1.177E-22	0.0000	4464.2857	-5.640E-23
457.560	0.000	0.0000	-1.053E-23	0.0000	4464.2857	4.280E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      .30000000 in
Computed slope at pile head       =     -.00565224
Maximum bending moment            =     229531.332 lbs-in
Maximum shear force               =       7935.255 lbs
Depth of maximum bending moment   =         49.200 in
Depth of maximum shear force      =          0.000 in
Number of iterations              =              8
Number of zero deflection points  =             13
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head     =         .400000 in
Specified bending moment at pile head =            .000 in-lbs
Specified axial load at pile head     =       75000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	0.0000	9901.8190	-.007377	4464.2857	-130.3688
4.920	.363707	49861.0333	9216.7906	-.007335	6932.6537	-148.0980
9.840	.327826	96106.2409	8446.0451	-.007212	9222.0204	-165.2132
14.760	.292740	1.383E+05	7597.3292	-.007015	11310.4572	-179.7933
19.680	.258796	1.760E+05	6677.6033	-.006751	13179.1976	-194.0790
24.600	.226308	2.090E+05	5693.4909	-.006428	14809.9643	-205.9667
29.520	.195546	2.368E+05	4656.9498	-.006053	16187.5009	-215.3915
34.440	.166741	2.593E+05	3579.9314	-.005637	17299.6597	-222.4209
39.360	.140080	2.762E+05	2475.7788	-.005187	18137.3277	-226.4216
44.280	.115700	2.875E+05	1361.6497	-.004714	18695.1913	-226.4764
49.200	.093697	2.931E+05	257.4395	-.004226	18972.8393	-222.3896
54.120	.074115	2.931E+05	-816.1757	-.003734	18974.9969	-214.0394
59.040	.056956	2.878E+05	-1838.0746	-.003246	18711.6692	-201.3667
63.960	.042176	2.774E+05	-2786.9410	-.002771	18198.2053	-184.3513
68.880	.029688	2.624E+05	-3641.3204	-.002318	17455.3139	-162.9574
73.800	.019369	2.433E+05	-4379.2420	-.001893	16509.0924	-137.0107
78.720	.011061	2.207E+05	-4976.6987	-.001503	15391.2202	-105.8579
83.640	.004577	1.954E+05	-5358.3380	-.001154	14139.7219	-49.2800
88.560	-2.92E-04	1.688E+05	-5471.5085	-8.478E-04	12823.1723	3.2757
93.480	-.003766	1.422E+05	-5355.5002	-5.865E-04	11505.3671	43.8821
98.400	-.006064	1.166E+05	-5067.1181	-3.692E-04	10235.7831	73.3464
103.320	-.007398	92641.8421	-4658.4847	-1.934E-04	9050.5155	92.7647
108.240	-.007967	70887.5147	-4175.8559	-5.609E-05	7973.5686	103.4258
113.160	-.007950	51592.8161	-3658.8820	4.678E-05	7018.3855	106.7262
118.080	-.007507	34849.5950	-3140.2527	1.194E-04	6189.5132	104.0987
123.000	-.006775	20604.6291	-2645.6549	1.660E-04	5484.3169	96.9573
127.920	-.005874	8693.8788	-2193.9662	1.906E-04	4894.6758	86.6560
132.840	-.004900	-1124.6312	-1673.1929	1.969E-04	4519.9605	125.0405
137.760	-.003936	-7915.6640	-1107.7966	1.893E-04	4856.1503	104.7954
142.680	-.003037	-12165.0708	-642.7948	1.725E-04	5066.5169	84.2297
147.600	-.002239	-14368.0387	-276.7390	1.502E-04	5175.5748	64.5734
152.520	-.001560	-14999.0111	-2.9929	1.255E-04	5206.8110	46.7055
157.440	-.001004	-14490.1144	188.6111	1.007E-04	5181.6181	31.1823
162.360	-5.68E-04	-13217.4252	310.2888	7.747E-05	5118.6137	18.2802
167.280	-2.42E-04	-11494.0458	375.0537	5.672E-05	5033.2979	8.0470
172.200	-1.04E-05	-9568.7533	395.7249	3.903E-05	4937.9864	.3559
177.120	1.42E-04	-7628.9143	384.1969	2.458E-05	4841.9547	-5.0421
182.040	2.32E-04	-5806.3973	350.9549	1.330E-05	4751.7311	-8.4709
186.960	2.73E-04	-4185.3323	304.8054	4.906E-06	4671.4804	-10.2890
191.880	2.80E-04	-2810.7330	252.7869	-9.696E-07	4603.4309	-10.8567
196.800	2.63E-04	-1697.1938	200.2184	-4.756E-06	4548.3052	-10.5126
201.720	2.33E-04	-837.0745	150.8474	-6.884E-06	4505.7250	-9.5569
206.640	1.96E-04	-207.7744	107.0610	-7.762E-06	4474.5716	-8.2425
211.560	1.57E-04	222.1337	70.1274	-7.750E-06	4475.2824	-6.7712
216.480	1.19E-04	487.9980	40.4449	-7.153E-06	4488.4440	-5.2948
221.400	8.62E-05	625.3909	17.7780	-6.218E-06	4495.2457	-3.9194
226.320	5.82E-05	667.5223	1.4672	-5.132E-06	4497.3314	-2.7110
231.240	3.57E-05	643.6154	-9.3929	-4.031E-06	4496.1479	-1.7036
236.160	1.86E-05	578.0713	-15.8119	-3.005E-06	4492.9031	-.9057
241.080	6.18E-06	490.2441	-18.7980	-2.108E-06	4488.5552	-.3081
246.000	-2.17E-06	394.6546	-19.2843	-1.365E-06	4483.8231	.1104
250.920	-7.25E-06	301.4933	-18.0839	-7.799E-07	4479.2111	.3776
255.840	-9.84E-06	217.2843	-15.8676	-3.442E-07	4475.0424	.5234

260.760	-1.06E-05	145.6103	-13.1594	-3.938E-08	4471.4941	.5775
265.680	-1.02E-05	87.8248	-10.3448	1.567E-07	4468.6335	.5667
270.600	-9.09E-06	43.7016	-7.6866	2.671E-07	4466.4492	.5139
275.520	-7.60E-06	11.9911	-5.3454	3.139E-07	4464.8793	.4378
280.440	-6.00E-06	-9.1286	-3.4008	3.163E-07	4464.7376	.3526
285.360	-4.49E-06	-21.7067	-1.8731	2.904E-07	4465.3603	.2684
290.280	-3.15E-06	-27.7740	-.7410	2.489E-07	4465.6607	.1918
295.200	-2.04E-06	-29.1820	.041670	2.010E-07	4465.7304	.1264
300.120	-1.17E-06	-27.5123	.5342	1.534E-07	4465.6477	.073804
305.040	-5.27E-07	-24.0390	.7991	1.101E-07	4465.4758	.033897
309.960	-8.50E-08	-19.7302	.8962	7.336E-08	4465.2625	.005558
314.880	1.94E-07	-15.2747	.8781	4.396E-08	4465.0419	-.012922
319.800	3.48E-07	-11.1226	.7885	2.179E-08	4464.8363	-.023489
324.720	4.09E-07	-7.5321	.6616	6.124E-09	4464.6586	-.028081
329.640	4.08E-07	-4.6166	.5225	-4.080E-09	4464.5143	-.028464
334.560	3.69E-07	-2.3874	.3882	-9.962E-09	4464.4039	-.026139
339.480	3.10E-07	-.7893	.2690	-1.263E-08	4464.3248	-.022308
344.400	2.44E-07	.2692	.1702	-1.307E-08	4464.2990	-.017868
349.320	1.81E-07	.8950	.093152	-1.209E-08	4464.3300	-.013449
354.240	1.25E-07	1.1947	.036825	-1.033E-08	4464.3449	-.009448
359.160	7.95E-08	1.2650	-.001368	-8.269E-09	4464.3483	-.006078
364.080	4.41E-08	1.1874	-.024722	-6.209E-09	4464.3445	-.003416
369.000	1.84E-08	1.0263	-.036689	-4.350E-09	4464.3365	-.001448
373.920	1.25E-09	.8296	-.040497	-2.791E-09	4464.3268	-9.992E-05
378.840	-9.05E-09	.6299	-.038942	-1.565E-09	4464.3169	7.320E-04
383.760	-1.42E-08	.4475	-.034288	-6.605E-10	4464.3079	.001160
388.680	-1.56E-08	.2930	-.028257	-3.856E-11	4464.3002	.001292
393.600	-1.45E-08	.1695	-.022070	3.498E-10	4464.2941	.001223
398.520	-1.21E-08	.075535	-.016520	5.556E-10	4464.2895	.001033
403.440	-9.06E-09	.006528	-.012053	6.246E-10	4464.2860	7.830E-04
408.360	-5.96E-09	-.043531	-.008844	5.935E-10	4464.2879	5.217E-04
413.280	-3.22E-09	-.080933	-.006858	4.890E-10	4464.2897	2.855E-04
418.200	-1.15E-09	-.1114	-.005902	3.274E-10	4464.2912	1.033E-04
423.120	-1.38E-16	-.1392	.011327	1.169E-10	4464.2926	.006900
428.040	1.15E-16	-4.467E-08	.014151	1.406E-17	4464.2857	-.005752
432.960	6.01E-23	1.396E-08	4.539E-09	-1.173E-17	4464.2857	-2.998E-09
437.880	-1.16E-23	1.008E-14	-1.419E-09	-6.112E-24	4464.2857	5.767E-10
442.800	0.000	-1.400E-15	-1.024E-15	1.176E-24	4464.2857	5.319E-16
447.720	0.000	-1.571E-21	1.422E-16	0.0000	4464.2857	-5.782E-17
452.640	0.000	1.403E-22	1.597E-22	0.0000	4464.2857	-7.651E-23
457.560	0.000	0.0000	-1.426E-23	0.0000	4464.2857	5.797E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = -.00737659
Maximum bending moment = 293116.367 lbs-in
Maximum shear force = 9901.819 lbs
Depth of maximum bending moment = 54.120 in
Depth of maximum shear force = 0.000 in
Number of iterations = 8
Number of zero deflection points = 13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .500000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	0.0000	11612.5381	-.009068	4464.2857	-130.3688
4.920	.455386	58901.8408	10919.1667	-.009018	7380.2184	-151.4895
9.840	.411259	1.141E+05	10097.0150	-.008873	10112.8084	-182.7185
14.760	.368075	1.648E+05	9121.9764	-.008639	12622.9389	-213.6386
19.680	.326253	2.102E+05	8031.0568	-.008324	14872.0014	-229.8246
24.600	.286169	2.500E+05	6868.1371	-.007937	16839.2057	-242.9070
29.520	.248150	2.837E+05	5648.7343	-.007489	18507.6553	-252.7852
34.440	.212476	3.111E+05	4388.4667	-.006990	19864.4786	-259.5187
39.360	.179372	3.320E+05	3102.2850	-.006449	20900.7657	-263.3194
44.280	.149013	3.464E+05	1804.7332	-.005880	21611.3197	-264.1407
49.200	.121516	3.541E+05	514.1838	-.005291	21994.7160	-260.4729
54.120	.096946	3.553E+05	-746.4959	-.004696	22055.1122	-251.9985
59.040	.075312	3.502E+05	-1953.4760	-.004103	21802.6260	-238.6438
63.960	.056573	3.391E+05	-3082.6979	-.003524	21253.4174	-220.3894
68.880	.040636	3.225E+05	-4110.0285	-.002968	20429.7017	-197.2246
73.800	.027365	3.009E+05	-5011.0529	-.002445	19359.7486	-169.0454
78.720	.016581	2.750E+05	-5759.9799	-.001961	18077.9896	-135.3964
83.640	.008069	2.457E+05	-6306.7880	-.001524	16625.5418	-86.8833
88.560	.001587	2.141E+05	-6564.2962	-.001138	15061.4407	-17.7948
93.480	-.003125	1.819E+05	-6518.4823	-8.051E-04	13469.4471	36.4183
98.400	-.006334	1.505E+05	-6240.4067	-5.259E-04	11915.5132	76.6205
103.320	-.008300	1.209E+05	-5795.9139	-2.979E-04	10448.7779	104.0676
108.240	-.009266	93702.8647	-5244.0043	-1.177E-04	9103.0414	120.2858
113.160	-.009458	69372.5942	-4635.7698	1.928E-05	7898.5726	126.9639
118.080	-.009076	48072.6644	-4013.8192	1.179E-04	6844.1206	125.8615
123.000	-.008297	29789.5925	-3412.1091	1.833E-04	5939.0180	118.7360
127.920	-.007272	14362.2284	-2856.0879	2.204E-04	5175.2871	107.2888
132.840	-.006129	1523.0386	-2207.4523	2.337E-04	4539.6837	156.3842
137.760	-.004973	-7531.5974	-1497.0799	2.287E-04	4837.1371	132.3851
142.680	-.003878	-13376.9990	-906.8346	2.111E-04	5126.5134	107.5521
147.600	-.002895	-16610.6608	-436.8835	1.859E-04	5286.5957	83.4850
152.520	-.002049	-17813.1563	-80.5866	1.570E-04	5346.1251	61.3512

157.440	-.001350	-17519.5202	173.4484	1.274E-04	5331.5887	41.9151
162.360	-7.96E-04	-16200.4111	339.5053	9.903E-05	5266.2863	25.5877
167.280	-3.75E-04	-14251.8742	433.1694	7.346E-05	5169.8240	12.4871
172.200	-7.29E-05	-11992.2353	470.0488	5.141E-05	5057.9607	2.5045
177.120	1.31E-04	-9664.5384	464.8161	3.323E-05	4942.7282	-4.6316
182.040	2.54E-04	-7442.9651	430.5548	1.886E-05	4832.7493	-9.2958
186.960	3.16E-04	-5441.7961	378.3764	8.036E-06	4733.6816	-11.9149
191.880	3.33E-04	-3725.6717	317.2667	3.364E-07	4648.7249	-12.9264
196.800	3.19E-04	-2320.1399	254.1105	-4.741E-06	4579.1441	-12.7469
201.720	2.86E-04	-1221.7257	193.8470	-7.716E-06	4524.7672	-11.7505
206.640	2.43E-04	-406.9909	139.7113	-9.084E-06	4484.4338	-10.2559
211.560	1.97E-04	159.7373	93.5207	-9.292E-06	4472.1935	-8.5207
216.480	1.52E-04	520.1103	55.9759	-8.721E-06	4490.0337	-6.7414
221.400	1.11E-04	716.9760	26.9503	-7.682E-06	4499.7796	-5.0576
226.320	7.65E-05	790.9700	5.7522	-6.415E-06	4503.4426	-3.5595
231.240	4.82E-05	778.3116	-8.6516	-5.097E-06	4502.8160	-2.2957
236.160	2.63E-05	709.5999	-17.4552	-3.848E-06	4499.4144	-1.2830
241.080	1.03E-05	609.3922	-21.8764	-2.740E-06	4494.4536	-.5143
246.000	-6.49E-07	496.3577	-23.0602	-1.811E-06	4488.8579	.033082
250.920	-7.51E-06	383.8164	-22.0168	-1.072E-06	4483.2865	.3911
255.840	-1.12E-05	280.5035	-19.5898	-5.139E-07	4478.1720	.5955
260.760	-1.26E-05	191.4318	-16.4465	-1.175E-07	4473.7625	.6822
265.680	-1.24E-05	118.7562	-13.0847	1.430E-07	4470.1647	.6844
270.600	-1.12E-05	62.5727	-9.8501	2.953E-07	4467.3834	.6305
275.520	-9.45E-06	21.6133	-6.9601	3.660E-07	4465.3557	.5443
280.440	-7.56E-06	-6.1848	-4.5297	3.790E-07	4464.5919	.4437
285.360	-5.72E-06	-23.2382	-2.5967	3.543E-07	4465.4361	.3420
290.280	-4.07E-06	-31.9974	-1.1451	3.079E-07	4465.8697	.2480
295.200	-2.69E-06	-34.7334	-.1249	2.518E-07	4466.0052	.1667
300.120	-1.59E-06	-33.4118	.5326	1.946E-07	4465.9398	.1005
305.040	-7.72E-07	-29.6363	.9020	1.416E-07	4465.7529	.049631
309.960	-1.98E-07	-24.6409	1.0559	9.606E-08	4465.5056	.012936
314.880	1.73E-07	-19.3172	1.0594	5.914E-08	4465.2420	-.011493
319.800	3.84E-07	-14.2597	.9673	3.094E-08	4464.9916	-.025954
324.720	4.77E-07	-9.8216	.8228	1.071E-08	4464.7719	-.032788
329.640	4.89E-07	-6.1711	.6581	-2.718E-09	4464.5912	-.034163
334.560	4.51E-07	-3.3438	.4955	-1.071E-08	4464.4512	-.031948
339.480	3.84E-07	-1.2877	.3489	-1.460E-08	4464.3495	-.027658
344.400	3.07E-07	.099714	.2256	-1.560E-08	4464.2907	-.022442
349.320	2.31E-07	.9438	.1283	-1.472E-08	4464.3324	-.017117
354.240	1.62E-07	1.3730	.056148	-1.277E-08	4464.3537	-.012210
359.160	1.05E-07	1.5057	.006386	-1.036E-08	4464.3603	-.008019
364.080	6.02E-08	1.4434	-.024818	-7.880E-09	4464.3572	-.004666
369.000	2.74E-08	1.2673	-.041591	-5.603E-09	4464.3485	-.002152
373.920	5.03E-09	1.0383	-.047873	-3.667E-09	4464.3371	-4.014E-04
378.840	-8.72E-09	.7990	-.047126	-2.124E-09	4464.3253	7.050E-04
383.760	-1.59E-08	.5762	-.042192	-9.688E-10	4464.3142	.001301
388.680	-1.83E-08	.3845	-.035263	-1.620E-10	4464.3047	.001516
393.600	-1.75E-08	.2293	-.027917	3.535E-10	4464.2971	.001470
398.520	-1.48E-08	.1095	-.021202	6.381E-10	4464.2911	.001260
403.440	-1.12E-08	.020208	-.015726	7.471E-10	4464.2867	9.660E-04
408.360	-7.42E-09	-.045752	-.011752	7.256E-10	4464.2880	6.494E-04
413.280	-4.04E-09	-.095964	-.009273	6.066E-10	4464.2905	3.580E-04
418.200	-1.45E-09	-.1375	-.008072	4.106E-10	4464.2925	1.303E-04
423.120	-1.77E-16	-.1757	.013980	1.476E-10	4464.2944	.008834
428.040	1.46E-16	-5.667E-08	.017856	1.801E-17	4464.2857	-.007258
432.960	7.61E-23	1.762E-08	5.758E-09	-1.479E-17	4464.2857	-3.796E-09

437.880	-1.46E-23	1.274E-14	-1.790E-09	-7.738E-24	4464.2857	7.277E-10
442.800	0.000	-1.766E-15	-1.295E-15	1.483E-24	4464.2857	6.724E-16
447.720	0.000	-1.986E-21	1.795E-16	0.0000	4464.2857	-7.296E-17
452.640	0.000	1.771E-22	2.018E-22	0.0000	4464.2857	-9.667E-23
457.560	0.000	0.0000	-1.799E-23	0.0000	4464.2857	7.315E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	-.00906784
Maximum bending moment	=	355334.695 lbs-in
Maximum shear force	=	11612.538 lbs
Depth of maximum bending moment	=	54.120 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .600000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	0.0000	13058.6766	-.010717	4464.2857	-130.3688
4.920	.547272	66625.3724	12365.3058	-.010661	7762.5715	-151.4892
9.840	.495096	1.295E+05	11543.1563	-.010496	10877.2778	-182.7179
14.760	.443989	1.880E+05	10560.4660	-.010230	13769.0516	-216.7497
19.680	.394436	2.410E+05	9398.3482	-.009869	16395.3189	-255.6559
24.600	.346875	2.877E+05	8079.7291	-.009425	18707.8291	-280.3681
29.520	.301692	3.275E+05	6674.5467	-.008909	20675.5354	-290.8443
34.440	.259215	3.600E+05	5227.3929	-.008331	22284.6642	-297.4297
39.360	.219713	3.851E+05	3756.8550	-.007705	23526.3266	-300.3500
44.280	.183393	4.026E+05	2280.0044	-.007044	24396.2533	-299.9958
49.200	.150400	4.127E+05	812.5573	-.006359	24894.3297	-296.5274

54.120	.120819	4.153E+05	-625.5816	-.005664	25024.4033	-288.0819
59.040	.094669	4.107E+05	-2008.9057	-.004970	24796.5140	-274.2450
63.960	.071914	3.992E+05	-3310.8356	-.004290	24227.3844	-254.9948
68.880	.052458	3.813E+05	-4504.7532	-.003634	23340.4355	-230.3376
73.800	.036153	3.576E+05	-5563.9282	-.003014	22165.7646	-200.2214
78.720	.022804	3.288E+05	-6460.7181	-.002437	20740.1892	-164.3274
83.640	.012171	2.958E+05	-7163.7236	-.001913	19107.6061	-121.4473
88.560	.003983	2.597E+05	-7572.3281	-.001446	17320.4119	-44.6521
93.480	-.002059	2.224E+05	-7623.1570	-.001041	15471.7408	23.9900
98.400	-.006263	1.855E+05	-7377.7842	-6.987E-04	13644.9950	75.7551
103.320	-.008934	1.503E+05	-6915.8425	-4.168E-04	11903.3388	112.0261
108.240	-.010364	1.177E+05	-6309.2867	-1.917E-04	10291.3167	134.5413
113.160	-.010821	88326.9816	-5620.9659	-1.868E-05	8836.9086	145.2639
118.080	-.010548	62409.5056	-4903.7965	1.079E-04	7553.8652	146.2684
123.000	-.009759	39993.9779	-4200.4364	1.939E-04	6444.1856	139.6503
127.920	-.008640	20934.0922	-3543.3513	2.451E-04	5500.6269	127.4574
132.840	-.007347	4946.5168	-2768.6227	2.668E-04	4709.1628	187.4729
137.760	-.006014	-6506.0804	-1913.5692	2.655E-04	4786.3689	160.1098
142.680	-.004734	-14078.9635	-1196.7361	2.482E-04	5161.2641	131.2858
147.600	-.003571	-18465.1632	-620.4314	2.209E-04	5378.4027	102.9844
152.520	-.002561	-20347.0369	-178.4637	1.883E-04	5471.5648	76.6773
157.440	-.001718	-20360.2172	141.4142	1.541E-04	5472.2173	53.3544
162.360	-.001044	-19069.2603	355.2667	1.210E-04	5408.3085	33.5775
167.280	-5.28E-04	-16953.6932	481.0418	9.075E-05	5303.5775	17.5506
172.200	-1.51E-04	-14402.7805	536.9987	6.441E-05	5177.2946	5.1961
177.120	1.06E-04	-11717.1618	540.5101	4.247E-05	5044.3432	-3.7687
182.040	2.67E-04	-9115.5073	507.2282	2.498E-05	4915.5484	-9.7605
186.960	3.52E-04	-6744.4695	450.5776	1.166E-05	4798.1703	-13.2682
191.880	3.81E-04	-4690.4265	381.5253	2.053E-06	4696.4850	-14.8019
196.800	3.72E-04	-2991.7760	308.5722	-4.399E-06	4612.3934	-14.8539
201.720	3.38E-04	-1650.8297	237.9085	-8.298E-06	4546.0100	-13.8712
206.640	2.91E-04	-644.6325	173.6783	-1.023E-05	4496.1982	-12.2386
211.560	2.38E-04	65.7110	118.3064	-1.071E-05	4467.5387	-10.2703
216.480	1.85E-04	527.4079	72.8483	-1.021E-05	4490.3950	-8.2087
221.400	1.37E-04	790.0758	37.3315	-9.107E-06	4503.3984	-6.2291
226.320	9.55E-05	901.4709	11.0685	-7.687E-06	4508.9130	-4.4470
231.240	6.14E-05	904.6623	-7.0738	-6.170E-06	4509.0710	-2.9279
236.160	3.48E-05	836.4181	-18.4536	-4.708E-06	4505.6926	-1.6980
241.080	1.51E-05	726.5530	-24.4852	-3.395E-06	4500.2537	-.7539
246.000	1.42E-06	597.9890	-26.5174	-2.282E-06	4493.8891	-.072206
250.920	-7.34E-06	467.3065	-25.7543	-1.388E-06	4487.4197	.3824
255.840	-1.22E-05	345.5907	-23.2123	-7.049E-07	4481.3942	.6509
260.760	-1.43E-05	239.4177	-19.7038	-2.136E-07	4476.1381	.7753
265.680	-1.43E-05	151.8627	-15.8423	1.151E-07	4471.8037	.7945
270.600	-1.31E-05	83.4449	-12.0604	3.127E-07	4468.4166	.7429
275.520	-1.13E-05	32.9581	-8.6365	4.105E-07	4465.9173	.6489
280.440	-9.11E-06	-1.8410	-5.7245	4.366E-07	4464.3769	.5348
285.360	-6.97E-06	-23.6932	-3.3835	4.151E-07	4465.4586	.4168
290.280	-5.02E-06	-35.4412	-1.6054	3.655E-07	4466.0402	.3060
295.200	-3.37E-06	-39.7596	-.3382	3.023E-07	4466.2540	.2091
300.120	-2.05E-06	-38.9920	.4942	2.362E-07	4466.2160	.1293
305.040	-1.05E-06	-35.0714	.9775	1.740E-07	4466.0219	.067206
309.960	-3.35E-07	-29.5022	1.1966	1.197E-07	4465.7462	.021884
314.880	1.32E-07	-23.3849	1.2288	7.533E-08	4465.4434	-.008805
319.800	4.06E-07	-17.4663	1.1396	4.102E-08	4465.1504	-.027468
324.720	5.36E-07	-12.2018	.9814	1.610E-08	4464.8898	-.036822
329.640	5.65E-07	-7.8211	.7939	-7.182E-10	4464.6729	-.039424

334.560	5.29E-07	-4.3898	.6046	-1.097E-08	4464.5030	-.037507
339.480	4.57E-07	-1.8637	.4314	-1.623E-08	4464.3780	-.032899
344.400	3.69E-07	-.1329	.2840	-1.790E-08	4464.2923	-.027004
349.320	2.81E-07	.9444	.1664	-1.722E-08	4464.3325	-.020835
354.240	2.00E-07	1.5168	.078061	-1.515E-08	4464.3608	-.015057
359.160	1.32E-07	1.7237	.016280	-1.243E-08	4464.3710	-.010058
364.080	7.75E-08	1.6861	-.023253	-9.569E-09	4464.3692	-.006012
369.000	3.74E-08	1.5020	-.045284	-6.891E-09	4464.3601	-.002943
373.920	9.73E-09	1.2456	-.054433	-4.584E-09	4464.3474	-7.757E-04
378.840	-7.68E-09	.9697	-.054814	-2.723E-09	4464.3337	6.210E-04
383.760	-1.71E-08	.7083	-.049844	-1.314E-09	4464.3208	.001399
388.680	-2.06E-08	.4802	-.042191	-3.154E-10	4464.3095	.001712
393.600	-2.02E-08	.2933	-.033803	3.343E-10	4464.3002	.001698
398.520	-1.73E-08	.1474	-.025992	7.045E-10	4464.2930	.001477
403.440	-1.32E-08	.037055	-.019545	8.594E-10	4464.2875	.001144
408.360	-8.86E-09	-.045590	-.014824	8.522E-10	4464.2880	7.752E-04
413.280	-4.85E-09	-.1094	-.011859	7.220E-10	4464.2911	4.302E-04
418.200	-1.75E-09	-.1628	-.010413	4.933E-10	4464.2938	1.574E-04
423.120	-2.17E-16	-.2123	.016560	1.783E-10	4464.2962	.010807
428.040	1.76E-16	-6.879E-08	.021573	2.203E-17	4464.2857	-.008769
432.960	9.23E-23	2.128E-08	6.990E-09	-1.787E-17	4464.2857	-4.600E-09
437.880	-1.76E-23	1.543E-14	-2.163E-09	-9.376E-24	4464.2857	8.792E-10
442.800	0.000	-2.134E-15	-1.568E-15	1.792E-24	4464.2857	8.137E-16
447.720	0.000	-2.403E-21	2.168E-16	0.0000	4464.2857	-8.815E-17
452.640	0.000	2.139E-22	2.442E-22	0.0000	4464.2857	-1.169E-22
457.560	0.000	0.0000	-2.174E-23	0.0000	4464.2857	8.837E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	-.01071697
Maximum bending moment	=	415314.375 lbs-in
Maximum shear force	=	13058.677 lbs
Depth of maximum bending moment	=	54.120 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .700000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	0.0000	14324.1817	-.012325	4464.2857	-130.3688
4.920	.639362	73444.9667	13630.8110	-.012263	8100.1752	-151.4892
9.840	.579330	1.432E+05	12808.6615	-.012081	11552.2759	-182.7179
14.760	.520482	2.084E+05	11825.9712	-.011786	14781.0257	-216.7497
19.680	.463357	2.682E+05	10663.8534	-.011386	17743.6418	-255.6559
24.600	.408448	3.217E+05	9302.5364	-.010890	20391.6652	-297.7250
29.520	.356198	3.678E+05	7759.3418	-.010311	22673.0415	-329.5899
34.440	.306988	4.057E+05	6121.5453	-.009661	24548.1718	-336.1810
39.360	.261130	4.352E+05	4462.1445	-.008955	26007.9956	-338.3722
44.280	.218869	4.562E+05	2801.7430	-.008206	27048.9821	-336.5878
49.200	.180379	4.688E+05	1158.4424	-.007430	27672.6245	-331.4206
54.120	.145763	4.731E+05	-451.1996	-.006638	27884.7283	-322.9054
59.040	.115056	4.693E+05	-2005.1251	-.005847	27695.3660	-308.7716
63.960	.088228	4.577E+05	-3475.0217	-.005068	27121.5921	-288.7474
68.880	.065183	4.388E+05	-4831.9552	-.004316	26187.7580	-262.8516
73.800	.045763	4.133E+05	-6047.0125	-.003600	24925.4743	-231.0741
78.720	.029760	3.820E+05	-7090.7318	-.002932	23373.6036	-193.2020
83.640	.016914	3.457E+05	-7930.9347	-.002321	21578.4913	-148.3439
88.560	.006924	3.056E+05	-8486.8078	-.001774	19595.0052	-77.6208
93.480	-5.40E-04	2.635E+05	-8662.2865	-.001296	17509.1248	6.2881
98.400	-.005825	2.214E+05	-8473.4738	-8.885E-04	15422.6939	70.4651
103.320	-.009282	1.808E+05	-8013.8232	-5.507E-04	13413.9117	116.3847
108.240	-.011244	1.429E+05	-7368.4299	-2.788E-04	11539.0503	145.9702
113.160	-.012026	1.085E+05	-6612.2043	-6.770E-05	9834.7252	161.4385
118.080	-.011911	77896.1165	-5808.7565	8.883E-05	8320.5291	165.1663
123.000	-.011152	51259.1537	-5009.8814	1.973E-04	7001.8676	159.5797
127.920	-.009969	28453.2692	-4255.5198	2.643E-04	5872.8634	147.0714
132.840	-.008551	9189.8167	-3356.9541	2.959E-04	4919.2271	218.1993
137.760	-.007058	-4797.5134	-2357.9526	2.996E-04	4701.7864	187.8989
142.680	-.005604	-14233.5136	-1513.4592	2.836E-04	5168.9151	155.3911
147.600	-.004267	-19899.2334	-828.4791	2.549E-04	5449.3963	123.0562
152.520	-.003095	-22573.8721	-297.7508	2.192E-04	5581.8041	92.6870
157.440	-.002110	-22990.8995	91.4291	1.810E-04	5602.4491	65.5162
162.360	-.001315	-21807.7660	356.5928	1.433E-04	5543.8781	42.2739
167.280	-6.99E-04	-19587.8153	517.8214	1.086E-04	5433.9795	23.2661
172.200	-2.46E-04	-16792.5341	595.8693	7.802E-05	5295.5993	8.4607
177.120	6.83E-05	-13782.0422	610.7182	5.234E-05	5146.5650	-2.4245
182.040	2.69E-04	-10821.6964	580.5507	3.168E-05	5000.0133	-9.8387
186.960	3.80E-04	-8092.8033	521.1055	1.579E-05	4864.9195	-14.3259
191.880	4.24E-04	-5705.6738	445.3618	4.205E-06	4746.7448	-16.4642
196.800	4.21E-04	-3713.5465	363.4860	-3.706E-06	4648.1246	-16.8186
201.720	3.88E-04	-2126.2362	282.9786	-8.611E-06	4569.5449	-15.9080
206.640	3.37E-04	-922.6826	208.9553	-1.117E-05	4509.9631	-14.1828
211.560	2.78E-04	-61.8711	144.5095	-1.200E-05	4467.3486	-12.0147
216.480	2.19E-04	508.1460	91.1065	-1.162E-05	4489.4415	-9.6938
221.400	1.64E-04	843.1953	48.9756	-1.049E-05	4506.0281	-7.4325
226.320	1.15E-04	997.8068	17.4724	-8.942E-06	4513.6821	-5.3737

231.240	7.56E-05	1021.7229	-4.6059	-7.246E-06	4514.8661	-3.6012
236.160	4.41E-05	957.8329	-18.7595	-5.584E-06	4511.7032	-2.1523
241.080	2.06E-05	841.2504	-26.5842	-4.073E-06	4505.9318	-1.0285
246.000	4.06E-06	699.2503	-29.6237	-2.779E-06	4498.9021	-.2071
250.920	-6.72E-06	551.8039	-29.2721	-1.728E-06	4491.6027	.3500
255.840	-1.29E-05	412.4878	-26.7177	-9.182E-07	4484.7059	.6884
260.760	-1.58E-05	289.5797	-22.9198	-3.285E-07	4478.6213	.8555
265.680	-1.62E-05	187.1999	-18.6107	7.190E-08	4473.5530	.8962
270.600	-1.50E-05	106.3970	-14.3143	3.185E-07	4469.5529	.8504
275.520	-1.30E-05	46.1123	-10.3740	4.466E-07	4466.5685	.7514
280.440	-1.07E-05	3.9877	-6.9865	4.887E-07	4464.4831	.6256
285.360	-8.23E-06	-22.9955	-4.2358	4.727E-07	4465.4241	.4926
290.280	-6.00E-06	-38.0411	-2.1243	4.214E-07	4466.1689	.3657
295.200	-4.09E-06	-44.2097	-.6010	3.523E-07	4466.4743	.2535
300.120	-2.53E-06	-44.2147	.4164	2.781E-07	4466.4746	.1601
305.040	-1.35E-06	-40.3174	1.0235	2.071E-07	4466.2816	.086701
309.960	-4.97E-07	-34.2964	1.3167	1.444E-07	4465.9836	.032483
314.880	7.19E-08	-27.4679	1.3848	9.254E-08	4465.6455	-.004779
319.800	4.14E-07	-20.7380	1.3043	5.206E-08	4465.3123	-.027960
324.720	5.84E-07	-14.6721	1.1368	2.232E-08	4465.0121	-.040124
329.640	6.33E-07	-9.5684	.9294	1.958E-09	4464.7594	-.044203
334.560	6.03E-07	-5.5287	.7154	-1.072E-08	4464.5594	-.042784
339.480	5.28E-07	-2.5212	.5166	-1.748E-08	4464.4105	-.038008
344.400	4.31E-07	-.4323	.3455	-1.996E-08	4464.3071	-.031541
349.320	3.31E-07	.8935	.2074	-1.958E-08	4464.3299	-.024596
354.240	2.39E-07	1.6233	.1027	-1.746E-08	4464.3661	-.017986
359.160	1.60E-07	1.9168	.028435	-1.449E-08	4464.3806	-.012196
364.080	9.62E-08	1.9138	-.019915	-1.127E-08	4464.3805	-.007459
369.000	4.86E-08	1.7291	-.047674	-8.212E-09	4464.3713	-.003825
373.920	1.54E-08	1.4508	-.060102	-5.541E-09	4464.3575	-.001227
378.840	-5.89E-09	1.1418	-.061949	-3.364E-09	4464.3422	4.761E-04
383.760	-1.77E-08	.8437	-.057204	-1.696E-09	4464.3275	.001453
388.680	-2.26E-08	.5802	-.049016	-5.004E-10	4464.3144	.001876
393.600	-2.26E-08	.3617	-.039712	2.907E-10	4464.3036	.001906
398.520	-1.97E-08	.1892	-.030886	7.534E-10	4464.2951	.001682
403.440	-1.52E-08	.057240	-.023511	9.603E-10	4464.2885	.001316
408.360	-1.03E-08	-.042880	-.018063	9.724E-10	4464.2878	8.986E-04
413.280	-5.66E-09	-.1212	-.014618	8.346E-10	4464.2917	5.017E-04
418.200	-2.06E-09	-.1873	-.012930	5.754E-10	4464.2950	1.845E-04
423.120	-2.57E-16	-.2489	.019054	2.090E-10	4464.2980	.012817
428.040	2.06E-16	-8.101E-08	.025293	2.613E-17	4464.2857	-.010282
432.960	1.08E-22	2.495E-08	8.231E-09	-2.096E-17	4464.2857	-5.408E-09
437.880	-2.07E-23	1.813E-14	-2.536E-09	-1.102E-23	4464.2857	1.031E-09
442.800	0.000	-2.502E-15	-1.842E-15	2.101E-24	4464.2857	9.555E-16
447.720	0.000	-2.821E-21	2.542E-16	0.0000	4464.2857	-1.033E-16
452.640	0.000	2.508E-22	2.866E-22	0.0000	4464.2857	-1.372E-22
457.560	0.000	0.0000	-2.549E-23	0.0000	4464.2857	1.036E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	-.01232486
Maximum bending moment	=	473092.940 lbs-in
Maximum shear force	=	14324.182 lbs
Depth of maximum bending moment	=	54.120 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .800000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	0.0000	15454.0254	-.013896	4464.2857	-130.3688
4.920	.731630	79583.7053	14760.6546	-.013830	8404.0731	-151.4892
9.840	.663917	1.555E+05	13938.5051	-.013632	12159.8834	-182.7179
14.760	.597489	2.268E+05	12955.8147	-.013311	15691.9662	-216.7498
19.680	.532935	2.928E+05	11793.6968	-.012875	18957.3506	-255.6559
24.600	.470801	3.524E+05	10432.3796	-.012333	21907.3899	-297.7251
29.520	.411579	4.045E+05	8856.3011	-.011697	24489.8426	-342.9572
34.440	.355700	4.481E+05	7088.4176	-.010981	26648.9047	-375.6946
39.360	.303524	4.824E+05	5236.0730	-.010200	28344.0075	-377.2910
44.280	.255335	5.072E+05	3387.4042	-.009369	29572.1873	-374.2003
49.200	.211338	5.226E+05	1563.8859	-.008504	30336.3865	-367.0672
54.120	.171659	5.288E+05	-216.5771	-.007621	30644.6793	-356.6982
59.040	.136351	5.261E+05	-1936.2479	-.006735	30509.3001	-342.3550
63.960	.105391	5.148E+05	-3569.8286	-.005860	29947.5211	-321.7022
68.880	.078686	4.953E+05	-5086.2498	-.005012	28984.4392	-294.7292
73.800	.056073	4.684E+05	-6454.4667	-.004203	27652.9742	-261.4566
78.720	.037332	4.349E+05	-7643.1601	-.003444	25993.8232	-221.7521
83.640	.022185	3.957E+05	-8619.0409	-.002746	24055.5939	-174.9473
88.560	.010309	3.521E+05	-9333.7029	-.002118	21895.5755	-115.5657
93.480	.001342	3.055E+05	-9656.4756	-.001566	19586.2661	-15.6428
98.400	-.005100	2.582E+05	-9543.2122	-.001092	17248.8383	61.6848
103.320	-.009407	2.124E+05	-9101.2951	-6.972E-04	14977.4055	117.9563
108.240	-.011960	1.692E+05	-8429.1853	-3.767E-04	12840.8077	155.2591
113.160	-.013114	1.297E+05	-7614.1649	-1.257E-04	10885.0705	176.0500
118.080	-.013197	94375.1079	-6730.9040	6.252E-05	9136.3208	182.9991
123.000	-.012499	63421.6149	-5840.7309	1.951E-04	7603.9696	178.8599

127.920	-.011277	36758.3663	-4991.4641	2.792E-04	6284.0068	166.3705
132.840	-.009752	14099.5636	-3970.0751	3.219E-04	5162.2839	248.8283
137.760	-.008110	-2544.7402	-2826.8272	3.316E-04	4590.2630	215.9066
142.680	-.006489	-13961.1453	-1853.0629	3.177E-04	5155.4315	179.9326
147.600	-.004983	-21013.3776	-1056.9345	2.884E-04	5504.5519	143.6969
152.520	-.003651	-24574.2015	-434.4936	2.501E-04	5680.8303	109.3279
157.440	-.002522	-25473.3581	27.1111	2.081E-04	5725.3430	78.3163
162.360	-.001604	-24460.9708	346.6444	1.661E-04	5675.2249	51.5753
167.280	-8.88E-04	-22184.9691	546.1534	1.269E-04	5562.5515	29.5259
172.200	-3.55E-04	-19180.5010	648.7814	9.220E-05	5413.8155	12.1928
177.120	1.96E-05	-15869.0001	677.0636	6.276E-05	5249.8798	-.6960
182.040	2.63E-04	-12564.5103	651.6978	3.888E-05	5086.2912	-9.6154
186.960	4.02E-04	-9484.9856	590.7525	2.036E-05	4933.8395	-15.1591
191.880	4.63E-04	-6766.5302	509.2548	6.709E-06	4799.2625	-17.9700
196.800	4.68E-04	-4478.8698	419.0855	-2.736E-06	4686.0119	-18.6842
201.720	4.36E-04	-2640.7098	329.1097	-8.715E-06	4595.0139	-17.8914
206.640	3.82E-04	-1233.9986	245.4699	-1.197E-05	4525.3748	-16.1085
211.560	3.18E-04	-216.4522	171.9792	-1.319E-05	4475.0012	-13.7658
216.480	2.53E-04	468.0090	110.5585	-1.298E-05	4487.4545	-11.2020
221.400	1.91E-04	881.0199	61.6774	-1.184E-05	4507.9006	-8.6684
226.320	1.36E-04	1083.6545	24.7651	-1.019E-05	4517.9320	-6.3366
231.240	9.05E-05	1132.2310	-1.4273	-8.332E-06	4520.3368	-4.3107
236.160	5.41E-05	1075.7591	-18.5259	-6.478E-06	4517.5411	-2.6400
241.080	2.67E-05	954.7167	-28.2974	-4.772E-06	4511.5489	-1.3322
246.000	7.18E-06	800.8351	-32.4747	-3.298E-06	4503.9310	-.3659
250.920	-5.74E-06	637.5998	-32.6395	-2.090E-06	4495.8501	.2989
255.840	-1.34E-05	481.2045	-30.1527	-1.150E-06	4488.1077	.7120
260.760	-1.71E-05	341.7463	-26.1228	-4.590E-07	4481.2038	.9261
265.680	-1.79E-05	224.4946	-21.4045	1.659E-08	4475.3993	.9919
270.600	-1.69E-05	131.1136	-16.6160	3.153E-07	4470.7765	.9547
275.520	-1.48E-05	60.7603	-12.1697	4.764E-07	4467.2937	.8528
280.440	-1.22E-05	11.0121	-8.3086	5.367E-07	4464.8309	.7168
285.360	-9.52E-06	-21.3928	-5.1443	5.280E-07	4465.3448	.5696
290.280	-7.01E-06	-39.9973	-2.6923	4.764E-07	4466.2658	.4272
295.200	-4.83E-06	-48.2364	-.9040	4.023E-07	4466.6737	.2998
300.120	-3.05E-06	-49.1894	.3075	3.205E-07	4466.7208	.1927
305.040	-1.68E-06	-45.4473	1.0467	2.410E-07	4466.5356	.1078
309.960	-6.80E-07	-39.0674	1.4213	1.700E-07	4466.2197	.044438
314.880	-4.77E-09	-31.5875	1.5314	1.107E-07	4465.8495	3.173E-04
319.800	4.09E-07	-24.0804	1.4641	6.392E-08	4465.4778	-.027656
324.720	6.24E-07	-17.2278	1.2906	2.923E-08	4465.1386	-.042875
329.640	6.97E-07	-11.4023	1.0655	5.179E-09	4464.8502	-.048633
334.560	6.75E-07	-6.7471	.8281	-1.006E-08	4464.6197	-.047871
339.480	5.98E-07	-3.2464	.6044	-1.846E-08	4464.4464	-.043045
344.400	4.94E-07	-.7857	.4098	-2.184E-08	4464.3246	-.036086
349.320	3.83E-07	.8020	.2511	-2.183E-08	4464.3254	-.028414
354.240	2.79E-07	1.7014	.1296	-1.973E-08	4464.3699	-.020997
359.160	1.89E-07	2.0915	.042430	-1.654E-08	4464.3893	-.014424
364.080	1.16E-07	2.1311	-.015172	-1.300E-08	4464.3912	-.008992
369.000	6.08E-08	1.9518	-.049060	-9.566E-09	4464.3823	-.004784
373.920	2.18E-08	1.6554	-.065110	-6.537E-09	4464.3677	-.001740
378.840	-3.50E-09	1.3159	-.068695	-4.041E-09	4464.3509	2.829E-04
383.760	-1.79E-08	.9825	-.064381	-2.111E-09	4464.3344	.001471
388.680	-2.43E-08	.6840	-.055802	-7.112E-10	4464.3196	.002016
393.600	-2.49E-08	.4339	-.045677	2.277E-10	4464.3072	.002100
398.520	-2.20E-08	.2344	-.035889	7.889E-10	4464.2973	.001879
403.440	-1.72E-08	.080156	-.027616	1.053E-09	4464.2897	.001484

408.360	-1.17E-08	-.038162	-.021453	1.088E-09	4464.2876	.001021
413.280	-6.47E-09	-.1317	-.017531	9.456E-10	4464.2922	5.733E-04
418.200	-2.36E-09	-.2114	-.015599	6.575E-10	4464.2962	2.119E-04
423.120	-2.98E-16	-.2857	.021498	2.400E-10	4464.2999	.014868
428.040	2.37E-16	-9.338E-08	.029037	3.031E-17	4464.2857	-.011804
432.960	1.25E-22	2.865E-08	9.488E-09	-2.406E-17	4464.2857	-6.224E-09
437.880	-2.37E-23	2.085E-14	-2.911E-09	-1.269E-23	4464.2857	1.183E-09
442.800	0.000	-2.872E-15	-2.119E-15	2.412E-24	4464.2857	1.098E-15
447.720	0.000	-3.242E-21	2.919E-16	0.0000	4464.2857	-1.186E-16
452.640	0.000	2.879E-22	3.294E-22	0.0000	4464.2857	-1.577E-22
457.560	0.000	0.0000	-2.926E-23	0.0000	4464.2857	1.190E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	-.01389642
Maximum bending moment	=	528843.950 lbs-in
Maximum shear force	=	15454.025 lbs
Depth of maximum bending moment	=	54.120 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .900000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	0.0000	16475.7522	-.015432	4464.2857	-130.3688
4.920	.824074	85177.2370	15782.3812	-.015360	8680.9806	-151.4893
9.840	.748853	1.666E+05	14960.2309	-.015149	12713.5267	-182.7181
14.760	.675008	2.436E+05	13977.5389	-.014804	16522.0018	-216.7502
19.680	.603177	3.151E+05	12815.4180	-.014335	20063.2635	-255.6567

24.600	.533949	3.802E+05	11454.0960	-.013751	23288.4938	-297.7263
29.520	.467864	4.380E+05	9878.0100	-.013064	26145.2800	-342.9591
34.440	.405399	4.871E+05	8071.5967	-.012287	28577.6472	-391.3553
39.360	.346959	5.264E+05	6082.6343	-.011436	30526.0929	-417.1660
44.280	.292870	5.554E+05	4040.6316	-.010527	31958.4793	-412.9164
49.200	.243370	5.740E+05	2031.1349	-.009579	32879.0113	-403.9522
54.120	.198615	5.824E+05	75.1873	-.008608	33297.8603	-391.1485
59.040	.158673	5.811E+05	-1810.5607	-.007630	33230.1098	-375.4158
63.960	.123532	5.703E+05	-3605.7116	-.006663	32694.6550	-354.3204
68.880	.093105	5.505E+05	-5280.4883	-.005722	31717.1071	-326.4832
73.800	.067228	5.225E+05	-6801.8400	-.004821	30331.4303	-291.9525
78.720	.045668	4.871E+05	-8136.6838	-.003973	28579.8630	-250.6669
83.640	.028135	4.454E+05	-9250.5928	-.003190	26512.9648	-202.1416
88.560	.014282	3.985E+05	-10103.2672	-.002481	24190.1664	-144.4740
93.480	.003722	3.478E+05	-10565.3840	-.001854	21682.0129	-43.3784
98.400	-.003963	2.959E+05	-10554.1761	-.001314	19111.2055	47.9345
103.320	-.009203	2.449E+05	-10152.3883	-8.594E-04	16588.7610	115.3939
108.240	-.012419	1.966E+05	-9471.9219	-4.885E-04	14197.0823	161.2184
113.160	-.014010	1.521E+05	-8612.6502	-1.957E-04	11992.5647	188.0791
118.080	-.014345	1.120E+05	-7660.6302	2.608E-05	10008.7630	198.9209
123.000	-.013754	76671.3857	-6687.1229	1.845E-04	8259.8989	196.8137
127.920	-.012529	46060.9589	-5748.2671	2.876E-04	6744.5312	184.8350
132.840	-.010923	19896.1718	-4607.9086	3.430E-04	5449.2447	278.7254
137.760	-.009154	465.9908	-3322.7480	3.601E-04	4487.3546	243.6976
142.680	-.007380	-13065.4370	-2219.8261	3.495E-04	5111.0895	204.6446
147.600	-.005714	-21635.0578	-1311.0458	3.204E-04	5535.3282	164.7783
152.520	-.004227	-26202.5785	-594.3087	2.802E-04	5761.4431	126.5782
157.440	-.002957	-27689.8555	-57.0734	2.350E-04	5835.0706	91.8101
162.360	-.001915	-26937.5766	320.2873	1.891E-04	5797.8291	61.5885
167.280	-.001096	-24677.7640	561.5030	1.457E-04	5685.9572	36.4666
172.200	-4.81E-04	-21519.9305	691.9034	1.069E-04	5529.6288	16.5417
177.120	-4.41E-05	-17948.3437	736.4462	7.377E-05	5352.8176	1.5652
182.040	2.45E-04	-14327.7445	718.2742	4.667E-05	5173.5800	-8.9522
186.960	4.15E-04	-10914.9649	657.7634	2.547E-05	5004.6305	-15.6457
191.880	4.95E-04	-7874.1455	572.0027	9.685E-06	4854.0949	-19.2164
196.800	5.10E-04	-5293.6058	474.6258	-1.375E-06	4726.3454	-20.3677
201.720	4.82E-04	-3202.8134	375.9163	-8.511E-06	4622.8408	-19.7581
206.640	4.27E-04	-1588.3088	283.1046	-1.253E-05	4542.9149	-17.9702
211.560	3.58E-04	-407.8138	200.7854	-1.421E-05	4484.4745	-15.4929
216.480	2.87E-04	397.9077	131.3941	-1.422E-05	4483.9841	-12.7150
221.400	2.18E-04	895.5978	75.6920	-1.313E-05	4508.6222	-9.9281
226.320	1.58E-04	1152.4096	33.2263	-1.141E-05	4521.3357	-7.3344
231.240	1.06E-04	1230.9670	2.7365	-9.411E-06	4525.2247	-5.0598
236.160	6.50E-05	1186.2821	-17.5026	-7.381E-06	4523.0125	-3.1675
241.080	3.35E-05	1064.1889	-29.4096	-5.491E-06	4516.9683	-1.6728
246.000	1.09E-05	900.9435	-34.8948	-3.840E-06	4508.8869	-.5569
250.920	-4.25E-06	723.6584	-35.7207	-2.476E-06	4500.1104	.2212
255.840	-1.34E-05	551.2792	-33.4181	-1.405E-06	4491.5768	.7148
260.760	-1.81E-05	395.8614	-29.2454	-6.097E-07	4483.8828	.9814
265.680	-1.94E-05	263.9543	-24.1818	-5.554E-08	4477.3528	1.0770
270.600	-1.86E-05	157.9531	-18.9438	2.988E-07	4472.1052	1.0523
275.520	-1.65E-05	77.3263	-14.0167	4.964E-07	4468.1137	.9506
280.440	-1.37E-05	19.6620	-9.6939	5.779E-07	4465.2591	.8067
285.360	-1.08E-05	-18.4882	-6.1182	5.789E-07	4465.2010	.6469
290.280	-8.04E-06	-40.9680	-3.3215	5.289E-07	4466.3138	.4900
295.200	-5.61E-06	-51.5624	-1.2604	4.512E-07	4466.8383	.3479
300.120	-3.60E-06	-53.7035	.1547	3.628E-07	4466.9443	.2274

305.040	-2.04E-06	-50.3078	1.0360	2.754E-07	4466.7762	.1309
309.960	-8.90E-07	-43.7123	1.5011	1.965E-07	4466.4497	.058159
314.880	-1.04E-07	-35.6819	1.6611	1.298E-07	4466.0521	.006892
319.800	3.87E-07	-27.4625	1.6137	7.676E-08	4465.6452	-.026186
324.720	6.52E-07	-19.8600	1.4391	3.702E-08	4465.2689	-.044761
329.640	7.52E-07	-13.3286	1.2000	9.141E-09	4464.9455	-.052465
334.560	7.42E-07	-8.0590	.9416	-8.822E-09	4464.6847	-.052581
339.480	6.65E-07	-4.0572	.6944	-1.900E-08	4464.4866	-.047879
344.400	5.55E-07	-1.2119	.4769	-2.342E-08	4464.3457	-.040554
349.320	4.34E-07	.6525	.2978	-2.389E-08	4464.3180	-.032243
354.240	3.20E-07	1.7361	.1593	-2.189E-08	4464.3717	-.024071
359.160	2.19E-07	2.2358	.058866	-1.855E-08	4464.3964	-.016742
364.080	1.37E-07	2.3290	-.008451	-1.472E-08	4464.4010	-.010623
369.000	7.42E-08	2.1636	-.048940	-1.094E-08	4464.3928	-.005836
373.920	2.93E-08	1.8555	-.069046	-7.569E-09	4464.3776	-.002337
378.840	-2.75E-10	1.4897	-.074739	-4.759E-09	4464.3595	2.223E-05
383.760	-1.75E-08	1.1236	-.071149	-2.564E-09	4464.3413	.001437
388.680	-2.55E-08	.7915	-.062399	-9.560E-10	4464.3249	.002119
393.600	-2.69E-08	.5103	-.051606	1.374E-10	4464.3110	.002268
398.520	-2.42E-08	.2836	-.040958	8.042E-10	4464.2998	.002060
403.440	-1.90E-08	.1067	-.031845	1.132E-09	4464.2910	.001644
408.360	-1.30E-08	-.030577	-.024998	1.196E-09	4464.2872	.001139
413.280	-7.26E-09	-.1402	-.020613	1.052E-09	4464.2927	6.435E-04
418.200	-2.66E-09	-.2342	-.018442	7.379E-10	4464.2973	2.389E-04
423.120	-3.40E-16	-.3222	.023819	2.706E-10	4464.3017	.016940
428.040	2.67E-16	-1.057E-07	.032746	3.453E-17	4464.2857	-.013312
432.960	1.41E-22	3.231E-08	1.074E-08	-2.713E-17	4464.2857	-7.036E-09
437.880	-2.68E-23	2.355E-14	-3.283E-09	-1.434E-23	4464.2857	1.335E-09
442.800	0.000	-3.239E-15	-2.393E-15	2.720E-24	4464.2857	1.241E-15
447.720	0.000	-3.660E-21	3.292E-16	0.0000	4464.2857	-1.338E-16
452.640	0.000	3.247E-22	3.719E-22	0.0000	4464.2857	-1.780E-22
457.560	0.000	0.0000	-3.300E-23	0.0000	4464.2857	1.341E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	-.01543202
Maximum bending moment	=	582438.206 lbs-in
Maximum shear force	=	16475.752 lbs
Depth of maximum bending moment	=	54.120 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = 1.000000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	0.0000	17417.7769	-.016939	4464.2857	-130.3688
4.920	.916661	90367.9806	16724.4058	-.016863	8937.9481	-151.4894
9.840	.834070	1.770E+05	15902.2553	-.016638	13227.3024	-182.7182
14.760	.752941	2.591E+05	14919.5628	-.016272	17292.2672	-216.7503
19.680	.673953	3.358E+05	13757.4410	-.015772	21089.5410	-255.6569
24.600	.597741	4.061E+05	12396.1175	-.015149	24570.1469	-297.7266
29.520	.524886	4.690E+05	10820.0294	-.014414	27681.5139	-342.9596
34.440	.455906	5.232E+05	9013.6130	-.013581	30367.5091	-391.3560
39.360	.391251	5.677E+05	6961.3040	-.012665	32568.4726	-442.9160
44.280	.331287	6.011E+05	4758.4766	-.011683	34221.2538	-452.5423
49.200	.276292	6.231E+05	2558.2504	-.010655	35313.2927	-441.8585
54.120	.226446	6.341E+05	421.5586	-.009599	35856.7152	-426.7154
59.040	.181840	6.344E+05	-1632.3720	-.008533	35869.3311	-408.2157
63.960	.142478	6.244E+05	-3587.2038	-.007476	35373.3014	-386.4314
68.880	.108275	6.046E+05	-5418.1732	-.006444	34395.0384	-357.8651
73.800	.079070	5.758E+05	-7091.1847	-.005453	32969.3807	-322.2208
78.720	.054622	5.388E+05	-8571.4045	-.004516	31139.9256	-279.4945
83.640	.034628	4.948E+05	-9823.1517	-.003648	28959.0076	-229.3458
88.560	.018724	4.449E+05	-10806.3488	-.002859	26488.0736	-170.3278
93.480	.006496	3.906E+05	-11411.5619	-.002157	23799.3786	-75.6938
98.400	-.002505	3.342E+05	-11523.2368	-.001549	21007.9924	30.2975
103.320	-.008743	2.783E+05	-11179.0163	-.001034	18242.6586	109.6296
108.240	-.012682	2.249E+05	-10504.3463	-6.115E-04	15600.1577	164.6265
113.160	-.014761	1.754E+05	-9611.9040	-2.753E-04	13148.0324	198.1549
118.080	-.015390	1.306E+05	-8599.4253	-1.831E-05	10927.9810	213.4218
123.000	-.014941	90806.8493	-7548.4474	1.676E-04	8959.6743	213.8050
127.920	-.013741	56166.2190	-6523.7990	2.911E-04	7244.7916	202.7187
132.840	-.012077	26397.8661	-5267.0364	3.604E-04	5771.1108	308.1604
137.760	-.010195	4072.6046	-3841.2750	3.860E-04	4665.8998	271.4174
142.680	-.008279	-11685.1429	-2608.8367	3.796E-04	5042.7581	229.5738
147.600	-.006459	-21878.4926	-1585.8531	3.514E-04	5547.3794	186.2732
152.520	-.004821	-27549.2785	-772.4984	3.099E-04	5828.1114	144.3589
157.440	-.003410	-29708.5804	-156.8947	2.618E-04	5935.0075	105.8866
162.360	-.002245	-29286.3358	281.1645	2.123E-04	5914.1043	72.1863
167.280	-.001321	-27098.5691	566.8776	1.649E-04	5805.7990	43.9573
172.200	-6.22E-04	-23829.9580	727.6122	1.221E-04	5643.9866	21.3820
177.120	-1.20E-04	-20028.9963	790.6559	8.529E-05	5455.8202	4.2456
182.040	2.17E-04	-16112.8495	781.5504	5.494E-05	5261.9515	-7.9470
186.960	4.21E-04	-12379.0847	722.9700	3.101E-05	5077.1117	-15.8661
191.880	5.22E-04	-9021.7092	634.0830	1.303E-05	4910.9050	-20.2668
196.800	5.49E-04	-6149.3271	530.3123	2.924E-07	4768.7078	-21.9165

201.720	5.25E-04	-3803.6520	423.4064	-8.067E-06	4652.5853	-21.5412
206.640	4.70E-04	-1977.0545	321.7346	-1.292E-05	4562.1597	-19.7888
211.560	3.98E-04	-628.2476	230.7238	-1.511E-05	4495.3871	-17.2074
216.480	3.21E-04	304.4188	153.3704	-1.538E-05	4479.3559	-14.2370
221.400	2.47E-04	892.2696	90.7694	-1.438E-05	4508.4575	-11.2106
226.320	1.80E-04	1208.1995	42.6193	-1.261E-05	4524.0976	-8.3626
231.240	1.23E-04	1320.9515	7.6757	-1.049E-05	4529.6794	-5.8421
236.160	7.64E-05	1291.4686	-15.8657	-8.295E-06	4528.2198	-3.7276
241.080	4.10E-05	1170.9545	-30.0616	-6.226E-06	4522.2538	-2.0431
246.000	1.52E-05	1000.2577	-36.9905	-4.403E-06	4513.8034	-.7735
250.920	-2.36E-06	810.2175	-38.5914	-2.882E-06	4504.3955	.1227
255.840	-1.32E-05	622.6452	-36.5638	-1.679E-06	4495.1097	.7015
260.760	-1.89E-05	451.6687	-32.3166	-7.766E-07	4486.6456	1.0250
265.680	-2.08E-05	305.2227	-26.9560	-1.409E-07	4479.3958	1.1541
270.600	-2.03E-05	186.5252	-21.2999	2.721E-07	4473.5196	1.1451
275.520	-1.82E-05	95.4310	-15.9098	5.089E-07	4469.0100	1.0460
280.440	-1.53E-05	29.5975	-11.1327	6.139E-07	4465.7509	.8959
285.360	-1.21E-05	-14.5679	-7.1459	6.265E-07	4465.0069	.7247
290.280	-9.09E-06	-41.1808	-4.0003	5.797E-07	4466.3244	.5540
295.200	-6.41E-06	-54.3585	-1.6593	4.995E-07	4466.9767	.3976
300.120	-4.18E-06	-57.8774	-.032452	4.052E-07	4467.1509	.2637
305.040	-2.42E-06	-54.9769	.9990	3.104E-07	4467.0073	.1556
309.960	-1.12E-06	-48.2759	1.5621	2.237E-07	4466.6756	.073291
314.880	-2.20E-07	-39.7709	1.7784	1.497E-07	4466.2546	.014632
319.800	3.52E-07	-30.8870	1.7558	9.040E-08	4465.8148	-.023810
324.720	6.69E-07	-22.5604	1.5841	4.551E-08	4465.4026	-.045985
329.640	8.00E-07	-15.3329	1.3336	1.369E-08	4465.0448	-.055849
334.560	8.04E-07	-9.4478	1.0560	-7.125E-09	4464.7534	-.057017
339.480	7.30E-07	-4.9370	.7864	-1.921E-08	4464.5301	-.052572
344.400	6.15E-07	-1.6958	.5464	-2.478E-08	4464.3697	-.044979
349.320	4.86E-07	.4577	.3470	-2.582E-08	4464.3084	-.036092
354.240	3.61E-07	1.7373	.1912	-2.397E-08	4464.3717	-.027204
359.160	2.50E-07	2.3573	.077244	-2.053E-08	4464.4024	-.019137
364.080	1.59E-07	2.5125	-1.789E-04	-1.644E-08	4464.4101	-.012336
369.000	8.86E-08	2.3676	-.047658	-1.235E-08	4464.4029	-.006965
373.920	3.76E-08	2.0527	-.072168	-8.633E-09	4464.3873	-.002999
378.840	3.61E-09	1.6639	-.080262	-5.511E-09	4464.3681	-2.915E-04
383.760	-1.66E-08	1.2670	-.077624	-3.050E-09	4464.3484	.001364
388.680	-2.64E-08	.9023	-.068874	-1.228E-09	4464.3304	.002194
393.600	-2.87E-08	.5902	-.057530	2.571E-11	4464.3149	.002418
398.520	-2.62E-08	.3362	-.046095	8.038E-10	4464.3024	.002231
403.440	-2.08E-08	.1360	-.036186	1.200E-09	4464.2924	.001798
408.360	-1.43E-08	-.020752	-.028676	1.297E-09	4464.2867	.001255
413.280	-8.04E-09	-.1471	-.023836	1.156E-09	4464.2930	7.128E-04
418.200	-2.96E-09	-.2561	-.021428	8.175E-10	4464.2984	2.659E-04
423.120	-3.82E-16	-.3586	.026054	3.012E-10	4464.3035	.019036
428.040	2.97E-16	-1.181E-07	.036441	3.880E-17	4464.2857	-.014813
432.960	1.57E-22	3.595E-08	1.200E-08	-3.019E-17	4464.2857	-7.848E-09
437.880	-2.98E-23	2.626E-14	-3.653E-09	-1.600E-23	4464.2857	1.485E-09
442.800	0.000	-3.604E-15	-2.668E-15	3.027E-24	4464.2857	1.382E-15
447.720	0.000	-4.078E-21	3.663E-16	0.0000	4464.2857	-1.489E-16
452.640	0.000	3.614E-22	4.144E-22	0.0000	4464.2857	-1.983E-22
457.560	0.000	0.0000	-3.672E-23	0.0000	4464.2857	1.493E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.01693875
Maximum bending moment	=	634381.916 lbs-in
Maximum shear force	=	17417.777 lbs
Depth of maximum bending moment	=	59.040 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .100000	M= 0.000	75000.0000	.100000	89880.4577	3516.5670
4	y= .200000	M= 0.000	75000.0000	.2000	1.626E+05	5855.7849
4	y= .300000	M= 0.000	75000.0000	.3000	2.295E+05	7935.2549
4	y= .400000	M= 0.000	75000.0000	.4000	2.931E+05	9901.8190
4	y= .500000	M= 0.000	75000.0000	.5000	3.553E+05	11612.5381
4	y= .600000	M= 0.000	75000.0000	.6000	4.153E+05	13058.6766
4	y= .700000	M= 0.000	75000.0000	.7000	4.731E+05	14324.1817
4	y= .800000	M= 0.000	75000.0000	.8000	5.288E+05	15454.0254
4	y= .900000	M= 0.000	75000.0000	.9000	5.824E+05	16475.7522
4	y= 1.000	M= 0.000	75000.0000	1.0000	6.344E+05	17417.7769

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = .10000 in
Moment = 0. in-lbs
Axial Load = 75000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
492.000	.10000000	89880.458	3516.567
467.400	.10000000	89927.513	3514.703
442.800	.10000000	89880.676	3515.632
418.200	.10000000	90001.248	3515.603
393.600	.10000000	89928.478	3515.670
369.000	.10000000	89888.233	3516.661
344.400	.10000000	89922.751	3516.892
319.800	.10000000	89923.752	3518.130
295.200	.10000000	89912.072	3518.646
270.600	.10000000	89990.687	3518.733

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Abut_B19_ Free.lpd
Name of output file: ArroyoMocho_Abut_B19_ Free.lpo
Name of plot output file: ArroyoMocho_Abut_B19_ Free.lpp
Name of runtime file: ArroyoMocho_Abut_B19_ Free.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:33:17

Problem Title

SR84 Isabel Abutment - Arroyo Mocho Bridge Widen - H pile - Weak Axis

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 444.00 in
Depth of ground surface below top of pile = -36.00 in
Slope angle of ground surface = 21.80 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	444.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -36.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 732.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 732.000 in
Distance from top of pile to bottom of layer = 1092.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 648.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.07230
2	132.00	.07230
3	132.00	.07810
4	420.00	.07810
5	420.00	.04200
6	732.00	.04200
7	732.00	.04200
8	1092.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	.00000	35.00	------	------
2	132.000	.00000	35.00	------	------
3	132.000	.00000	40.00	------	------
4	420.000	.00000	40.00	------	------
5	420.000	.00000	40.00	------	------
6	732.000	.00000	40.00	------	------
7	732.000	27.77800	.00	.00500	.0
8	1092.000	27.77800	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .100 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .200 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .300 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .400 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .500 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .600 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

```
Deflection at pile head     =            .700 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .800 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .900 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           1.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs
```

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	96.000

Depth of ground surface below top of pile = -36.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =           1
Depth below pile head       =      60.000 in
Depth below ground surface  =      96.000 in
Equivalent Depth (see note) =      96.000 in
Pile Diameter               =      10.000 in
Angle of Friction           =      35.000 deg.
Avg. Eff. Unit Weight       =      .07230 lbs/in**3
k                           =      90.000 pci
A (static)                  =       .8800
B (static)                  =       .5000
Pst                         =     971.160 lbs/in
```

Psd	=	3733.696	lbs/in
Ps	=	971.160	lbs/in
pu	=	854.621	lbs/in
Cbar	=	1443.3672	
n	=	1.6447	
m	=	1771.3961	
yk	=	.0104	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	107.181
.0278	163.360
.0417	209.030
.0556	248.984
.0694	285.163
.0833	318.592
.0972	349.895
.1111	379.487
.1250	407.660
.1389	434.629
.1528	460.559
.1667	485.580
.3750	854.621
10.3750	854.621
20.3750	854.621
30.3750	854.621

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .100000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	0.0000	4011.8234	-.002138	4464.2857	-77.7271
4.440	.090508	17758.2790	3670.9065	-.002124	5343.4084	-75.8391

8.880	.081135	34012.5321	3320.0229	-.002085	6148.0744	-82.2166
13.320	.071991	48628.8316	2945.1090	-.002023	6871.6536	-86.6636
17.760	.063174	61512.1333	2546.8354	-.001939	7509.4408	-92.7390
22.200	.054772	72536.1653	2123.1535	-.001837	8055.1850	-98.1087
26.640	.046858	81589.5057	1678.9963	-.001721	8503.3702	-101.9621
31.080	.039492	88591.6213	1221.4758	-.001592	8850.0095	-104.1282
35.520	.032723	93496.2748	758.3895	-.001454	9092.8142	-104.4692
39.960	.026584	96294.2683	298.0736	-.001310	9231.3287	-102.8803
44.400	.021092	97015.5129	-150.7382	-.001163	9267.0339	-99.2872
48.840	.016253	95730.4775	-579.0338	-.001017	9203.4183	-93.6388
53.280	.012059	92551.1616	-977.5888	-8.745E-04	9046.0264	-85.8905
57.720	.008488	87631.9154	-1327.2017	-7.379E-04	8802.4993	-71.5927
62.160	.005506	81257.0836	-1594.1270	-6.099E-04	8486.9136	-48.6439
66.600	.003072	73882.2872	-1765.0810	-4.924E-04	8121.8247	-28.3624
71.040	.001134	65911.0717	-1852.2999	-3.864E-04	7727.2101	-10.9254
75.480	-3.60E-04	57691.2059	-1868.5423	-2.927E-04	7320.2860	3.6090
79.920	-.001465	49513.3654	-1826.5944	-2.115E-04	6915.4424	15.2864
84.360	-.002237	41611.8812	-1738.8516	-1.424E-04	6524.2798	24.2374
88.800	-.002730	34167.1980	-1616.9797	-8.496E-05	6155.7312	30.6599
93.240	-.002992	27309.6838	-1471.6569	-3.836E-05	5816.2503	34.8009
97.680	-.003070	21124.4343	-1312.3922	-1.653E-06	5510.0498	36.9400
102.120	-.003007	15656.7420	-1147.4140	2.622E-05	5239.3720	37.3745
106.560	-.002837	10917.9318	-983.6215	4.637E-05	5004.7774	36.4059
111.000	-.002595	6891.3024	-826.5876	5.987E-05	4805.4393	34.3301
115.440	-.002306	3537.9634	-680.6045	6.777E-05	4639.4324	31.4281
119.880	-.001993	802.4000	-548.7603	7.106E-05	4504.0085	27.9612
124.320	-.001675	-1382.3535	-433.0374	7.062E-05	4532.7191	24.1663
128.760	-.001366	-3090.0050	-334.4221	6.723E-05	4617.2563	20.2550
133.200	-.001078	-4396.7969	-223.3046	6.156E-05	4681.9489	29.7979
137.640	-8.19E-04	-5113.9464	-105.0506	5.435E-05	4717.4514	23.4697
142.080	-5.95E-04	-5365.8414	-13.7749	4.640E-05	4729.9214	17.6454
146.520	-4.07E-04	-5267.1728	53.1036	3.834E-05	4725.0368	12.4800
150.960	-2.55E-04	-4919.8192	98.7041	3.062E-05	4707.8411	8.0607
155.400	-1.35E-04	-4411.0758	126.4059	2.355E-05	4682.6558	4.4175
159.840	-4.56E-05	-3813.0201	139.6193	1.732E-05	4653.0491	1.5345
164.280	1.84E-05	-3182.7900	141.6073	1.202E-05	4621.8496	-.6390
168.720	6.11E-05	-2563.5495	135.3560	7.661E-06	4591.1941	-2.1770
173.160	8.65E-05	-1985.9303	123.4902	4.212E-06	4562.5991	-3.1680
177.600	9.85E-05	-1469.7617	108.2282	1.593E-06	4537.0462	-3.7068
182.040	1.01E-04	-1025.9247	91.3694	-2.985E-07	4515.0741	-3.8873
186.480	9.58E-05	-658.2030	74.3069	-1.575E-06	4496.8700	-3.7985
190.920	8.66E-05	-365.0309	58.0596	-2.351E-06	4482.3565	-3.5201
195.360	7.50E-05	-141.0682	43.3163	-2.734E-06	4471.2693	-3.1210
199.800	6.24E-05	21.4391	30.4865	-2.825E-06	4465.3471	-2.6582
204.240	4.99E-05	131.5334	19.7538	-2.709E-06	4470.7973	-2.1764
208.680	3.83E-05	198.6565	11.1276	-2.459E-06	4474.1202	-1.7092
213.120	2.81E-05	231.9840	4.4916	-2.132E-06	4475.7701	-1.2799
217.560	1.94E-05	239.9621	-.3544	-1.774E-06	4476.1650	-.9030
222.000	1.23E-05	230.0185	-3.6589	-1.418E-06	4475.6728	-.5855
226.440	6.77E-06	208.4156	-5.6898	-1.086E-06	4474.6033	-.3293
230.880	2.65E-06	180.2162	-6.7129	-7.914E-07	4473.2073	-.1316
235.320	-2.56E-07	149.3319	-6.9763	-5.416E-07	4471.6784	.012938
239.760	-2.16E-06	118.6273	-6.7003	-3.385E-07	4470.1584	.1114
244.200	-3.26E-06	90.0586	-6.0720	-1.803E-07	4468.7441	.1716
248.640	-3.76E-06	64.8278	-5.2436	-6.294E-08	4467.4950	.2016
253.080	-3.82E-06	43.5377	-4.3329	1.919E-08	4466.4410	.2087
257.520	-3.59E-06	26.3392	-3.4265	7.216E-08	4465.5896	.1996

261.960	-3.18E-06	13.0621	-2.5838	1.020E-07	4464.9324	.1800
266.400	-2.68E-06	3.3272	-1.8410	1.144E-07	4464.4504	.1546
270.840	-2.16E-06	-3.3622	-1.2164	1.144E-07	4464.4522	.1268
275.280	-1.67E-06	-7.5502	-.7143	1.061E-07	4464.6595	.099359
279.720	-1.22E-06	-9.7756	-.3294	9.301E-08	4464.7697	.073998
284.160	-8.41E-07	-10.5373	-.050138	7.762E-08	4464.8074	.051800
288.600	-5.32E-07	-10.2725	.1387	6.185E-08	4464.7943	.033283
293.040	-2.92E-07	-9.3464	.2538	4.698E-08	4464.7484	.018547
297.480	-1.14E-07	-8.0499	.3114	3.379E-08	4464.6842	.007395
301.920	8.48E-09	-6.6036	.3266	2.268E-08	4464.6126	-5.565E-04
306.360	8.70E-08	-5.1650	.3125	1.376E-08	4464.5414	-.005793
310.800	1.31E-07	-3.8379	.2800	6.940E-09	4464.4757	-.008836
315.240	1.49E-07	-2.6831	.2378	1.997E-09	4464.4185	-.010195
319.680	1.48E-07	-1.7280	.1922	-1.346E-09	4464.3713	-.010332
324.120	1.37E-07	-.9756	.1478	-3.395E-09	4464.3340	-.009648
328.560	1.18E-07	-.4129	.1076	-4.448E-09	4464.3062	-.008470
333.000	9.72E-08	-.016957	.073158	-4.773E-09	4464.2866	-.007053
337.440	7.59E-08	.2399	.045098	-4.604E-09	4464.2976	-.005586
341.880	5.63E-08	.3866	.023378	-4.129E-09	4464.3049	-.004197
346.320	3.92E-08	.4503	.007476	-3.495E-09	4464.3080	-.002966
350.760	2.52E-08	.4553	-.003398	-2.809E-09	4464.3083	-.001932
355.200	1.43E-08	.4220	-.010150	-2.144E-09	4464.3066	-.001109
359.640	6.19E-09	.3666	-.013691	-1.546E-09	4464.3039	-4.866E-04
364.080	5.59E-10	.3014	-.014870	-1.040E-09	4464.3006	-4.451E-05
368.520	-3.04E-09	.2352	-.014425	-6.332E-10	4464.2974	2.453E-04
372.960	-5.06E-09	.1738	-.012963	-3.232E-10	4464.2943	4.131E-04
377.400	-5.91E-09	.1203	-.010962	-1.003E-10	4464.2917	4.884E-04
381.840	-5.95E-09	.076481	-.008773	4.891E-11	4464.2895	4.976E-04
386.280	-5.48E-09	.042400	-.006639	1.390E-10	4464.2878	4.635E-04
390.720	-4.72E-09	.017433	-.004714	1.844E-10	4464.2866	4.039E-04
395.160	-3.84E-09	4.204E-04	-.003078	1.979E-10	4464.2857	3.326E-04
399.600	-2.96E-09	-.010035	-.001764	1.906E-10	4464.2862	2.594E-04
404.040	-2.15E-09	-.015372	-7.656E-04	1.714E-10	4464.2865	1.904E-04
408.480	-1.44E-09	-.016948	-5.654E-05	1.469E-10	4464.2866	1.290E-04
412.920	-8.45E-10	-.015972	3.998E-04	1.219E-10	4464.2865	7.655E-05
417.360	-3.58E-10	-.013479	6.424E-04	9.958E-11	4464.2864	3.275E-05
421.800	3.92E-11	-.010333	7.116E-04	8.154E-11	4464.2862	-1.612E-06
426.240	3.66E-10	-.007214	6.741E-04	6.824E-11	4464.2861	-1.526E-05
430.680	6.45E-10	-.004393	5.798E-04	5.944E-11	4464.2859	-2.722E-05
435.120	8.94E-10	-.002105	4.345E-04	5.451E-11	4464.2858	-3.823E-05
439.560	1.13E-09	-5.708E-04	2.410E-04	5.249E-11	4464.2857	-4.890E-05
444.000	1.36E-09	0.0000	0.0000	5.205E-11	4464.2857	-5.967E-05

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	-.00213791
Maximum bending moment	=	97015.513 lbs-in
Maximum shear force	=	4011.823 lbs
Depth of maximum bending moment	=	44.400 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6

Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .200000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	0.0000	6684.6030	-.004053	4464.2857	-108.9408
4.440	.182004	29955.5004	6193.4520	-.004030	5947.2313	-112.2984
8.880	.164210	57682.0733	5669.0484	-.003964	7319.8339	-123.9194
13.320	.146805	82936.6318	5097.9847	-.003857	8570.0596	-133.3165
17.760	.129957	1.055E+05	4482.8175	-.003715	9688.1063	-143.7858
22.200	.113820	1.252E+05	3823.8412	-.003540	10663.1926	-153.0504
26.640	.098525	1.418E+05	3128.4211	-.003337	11485.7847	-160.2019
31.080	.084185	1.552E+05	2406.5319	-.003112	12148.4881	-164.9735
35.520	.070890	1.653E+05	1669.2342	-.002869	12646.3116	-167.1426
39.960	.058707	1.720E+05	928.4739	-.002614	12976.8870	-166.5332
44.400	.047682	1.753E+05	196.8762	-.002350	13140.6421	-163.0153
48.840	.037836	1.753E+05	-512.4500	-.002085	13140.9274	-156.5009
53.280	.029169	1.721E+05	-1186.0730	-.001821	12984.1004	-146.9328
57.720	.021661	1.659E+05	-1810.3234	-.001565	12679.5778	-134.2611
62.160	.015270	1.571E+05	-2371.2167	-.001320	12239.8802	-118.3936
66.600	.009937	1.458E+05	-2837.7439	-.001091	11680.7148	-91.7539
71.040	.005584	1.326E+05	-3160.8548	-8.799E-04	11028.3621	-53.7915
75.480	.002123	1.183E+05	-3327.5677	-6.897E-04	10320.1997	-21.3044
79.920	-5.41E-04	1.035E+05	-3362.3374	-5.216E-04	9588.2899	5.6423
84.360	-.002508	88779.2898	-3289.4897	-3.759E-04	8859.3001	27.1720
88.800	-.003878	74544.5379	-3132.4587	-2.521E-04	8154.6094	43.5627
93.240	-.004747	61130.9340	-2913.1778	-1.492E-04	7490.5696	55.2125
97.680	-.005204	48774.9091	-2651.6204	-6.593E-05	6878.8852	62.6062
102.120	-.005332	37628.4561	-2365.4839	-4.448E-07	6327.0806	66.2842
106.560	-.005208	27769.7085	-2070.0024	4.912E-05	5839.0238	66.8156
111.000	-.004896	19214.1190	-1777.8721	8.473E-05	5415.4797	64.7746
115.440	-.004455	11925.7717	-1499.2693	1.083E-04	5054.6705	60.7221
119.880	-.003934	5828.4558	-1241.9419	1.218E-04	4752.8231	55.1911
124.320	-.003374	816.2140	-1011.3531	1.268E-04	4504.6923	48.6777
128.760	-.002808	-3236.8276	-810.8592	1.250E-04	4624.5247	41.6349
133.200	-.002264	-6467.4615	-579.5001	1.176E-04	4784.4571	62.5809
137.640	-.001763	-8461.1358	-328.4508	1.063E-04	4883.1538	50.5043
142.080	-.001320	-9454.9167	-129.4942	9.274E-05	4932.3509	39.1158
146.520	-9.40E-04	-9672.8118	21.2587	7.825E-05	4943.1378	28.7909
150.960	-6.25E-04	-9318.2523	129.0566	6.385E-05	4925.5853	19.7667
155.400	-3.73E-04	-8569.3154	199.9353	5.030E-05	4888.5092	12.1606
159.840	-1.78E-04	-7576.3237	240.2314	3.806E-05	4839.3512	5.9908
164.280	-3.46E-05	-6461.4069	256.1924	2.742E-05	4784.1573	1.1988

168.720	6.54E-05	-5319.5959	253.6809	1.849E-05	4727.6320	-2.3301
173.160	1.30E-04	-4221.0343	237.9696	1.126E-05	4673.2478	-4.7471
177.600	1.65E-04	-3213.9236	213.6159	5.622E-06	4623.3908	-6.2231
182.040	1.79E-04	-2327.8697	184.4053	1.422E-06	4579.5268	-6.9349
186.480	1.78E-04	-1577.3515	153.3502	-1.538E-06	4542.3724	-7.0539
190.920	1.66E-04	-965.0956	122.7307	-3.465E-06	4512.0627	-6.7386
195.360	1.47E-04	-485.1949	94.1655	-4.564E-06	4488.3053	-6.1286
199.800	1.25E-04	-125.8667	68.7002	-5.027E-06	4470.5167	-5.3422
204.240	1.03E-04	128.2111	46.9059	-5.025E-06	4470.6328	-4.4751
208.680	8.07E-05	294.0045	28.9770	-4.705E-06	4478.8404	-3.6010
213.120	6.08E-05	388.6609	14.8257	-4.188E-06	4483.5264	-2.7735
217.560	4.35E-05	428.4457	4.1659	-3.569E-06	4485.4959	-2.0282
222.000	2.91E-05	428.0312	-3.4129	-2.920E-06	4485.4754	-1.3857
226.440	1.76E-05	400.0838	-8.3861	-2.292E-06	4484.0918	-.8545
230.880	8.74E-06	355.0894	-11.2463	-1.720E-06	4481.8644	-.4339
235.320	2.30E-06	301.3622	-12.4684	-1.222E-06	4479.2046	-.1166
239.760	-2.11E-06	245.1838	-12.4858	-8.077E-07	4476.4235	.1088
244.200	-4.87E-06	191.0261	-11.6756	-4.771E-07	4473.7425	.2562
248.640	-6.34E-06	141.8224	-10.3517	-2.248E-07	4471.3066	.3402
253.080	-6.86E-06	99.2529	-8.7641	-4.210E-08	4469.1992	.3750
257.520	-6.72E-06	64.0249	-7.1023	8.166E-08	4467.4553	.3736
261.960	-6.14E-06	36.1302	-5.5011	1.576E-07	4466.0743	.3476
266.400	-5.32E-06	15.0699	-4.0492	1.964E-07	4465.0317	.3064
270.840	-4.40E-06	.042909	-2.7968	2.078E-07	4464.2878	.2577
275.280	-3.47E-06	-9.9045	-1.7652	2.004E-07	4464.7760	.2070
279.720	-2.62E-06	-15.7655	-.9534	1.809E-07	4465.0662	.1586
284.160	-1.87E-06	-18.4916	-.3460	1.549E-07	4465.2011	.1150
288.600	-1.24E-06	-18.9412	.081796	1.266E-07	4465.2234	.077698
293.040	-7.43E-07	-17.8496	.3592	9.868E-08	4465.1694	.047248
297.480	-3.65E-07	-15.8175	.5164	7.316E-08	4465.0688	.023564
301.920	-9.31E-08	-13.3128	.5823	5.108E-08	4464.9448	.006109
306.360	8.89E-08	-10.6811	.5827	3.290E-08	4464.8145	-.005921
310.800	1.99E-07	-8.1606	.5397	1.862E-08	4464.6897	-.013454
315.240	2.54E-07	-5.9013	.4711	7.957E-09	4464.5779	-.017439
319.680	2.70E-07	-3.9827	.3907	4.658E-10	4464.4829	-.018770
324.120	2.58E-07	-2.4322	.3085	-4.396E-09	4464.4061	-.018239
328.560	2.31E-07	-1.2400	.2314	-7.180E-09	4464.3471	-.016513
333.000	1.95E-07	-.3727	.1634	-8.402E-09	4464.3042	-.014126
337.440	1.56E-07	.2163	.1065	-8.521E-09	4464.2964	-.011483
341.880	1.19E-07	.5788	.061329	-7.918E-09	4464.3144	-.008871
346.320	8.57E-08	.7662	.027252	-6.899E-09	4464.3236	-.006479
350.760	5.77E-08	.8254	.003065	-5.692E-09	4464.3266	-.004416
355.200	3.52E-08	.7972	-.012796	-4.462E-09	4464.3252	-.002728
359.640	1.80E-08	.7147	-.021998	-3.317E-09	4464.3211	-.001417
364.080	5.71E-09	.6040	-.026152	-2.317E-09	4464.3156	-4.543E-04
368.520	-2.55E-09	.4841	-.026705	-1.492E-09	4464.3097	2.052E-04
372.960	-7.54E-09	.3679	-.024883	-8.466E-10	4464.3039	6.154E-04
377.400	-1.01E-08	.2637	-.021672	-3.679E-10	4464.2988	8.312E-04
381.840	-1.08E-08	.1757	-.017821	-3.491E-11	4464.2944	9.036E-04
386.280	-1.04E-08	.1054	-.013867	1.782E-10	4464.2909	8.775E-04
390.720	-9.23E-09	.052427	-.010165	2.978E-10	4464.2883	7.898E-04
395.160	-7.73E-09	.014965	-.006926	3.489E-10	4464.2865	6.692E-04
399.600	-6.13E-09	-.009310	-.004249	3.532E-10	4464.2862	5.369E-04
404.040	-4.59E-09	-.022997	-.002153	3.287E-10	4464.2869	4.069E-04
408.480	-3.21E-09	-.028652	-6.116E-04	2.895E-10	4464.2871	2.877E-04
412.920	-2.02E-09	-.028621	4.336E-04	2.461E-10	4464.2871	1.832E-04
417.360	-1.03E-09	-.024966	.001049	2.055E-10	4464.2870	9.392E-05

421.800	-1.97E-10	-.019446	.001275	1.718E-10	4464.2867	8.096E-06
426.240	5.01E-10	-.013757	.001247	1.467E-10	4464.2864	-2.084E-05
430.680	1.11E-09	-.008471	.001097	1.298E-10	4464.2861	-4.665E-05
435.120	1.65E-09	-.004101	8.365E-04	1.203E-10	4464.2859	-7.069E-05
439.560	2.17E-09	-.001123	4.706E-04	1.163E-10	4464.2858	-9.414E-05
444.000	2.69E-09	0.0000	0.0000	1.155E-10	4464.2857	-1.178E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	-.00405306
Maximum bending moment	=	175268.162 lbs-in
Maximum shear force	=	6684.603 lbs
Depth of maximum bending moment	=	48.840 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .300000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	0.0000	9060.4559	-.005892	4464.2857	-137.6254
4.440	.273839	40833.9472	8432.4007	-.005861	6485.7683	-145.2824
8.880	.247953	78783.2436	7753.6292	-.005770	8364.4463	-160.4705
13.320	.222597	1.135E+05	7013.0086	-.005625	10084.5490	-173.1424
17.760	.198005	1.448E+05	6214.8473	-.005429	11632.8415	-186.3897
22.200	.174388	1.723E+05	5360.5506	-.005189	12995.6138	-198.4286
26.640	.151931	1.959E+05	4457.2453	-.004909	14160.4290	-208.4657
31.080	.130792	2.152E+05	3515.7018	-.004598	15116.9037	-215.6530
35.520	.111101	2.301E+05	2549.3268	-.004260	15857.5408	-219.6510
39.960	.092960	2.407E+05	1572.8038	-.003904	16378.0648	-220.2242
44.400	.076438	2.467E+05	601.7346	-.003534	16677.6535	-217.1943
48.840	.061576	2.484E+05	-347.6087	-.003159	16759.1126	-210.4378
53.280	.048386	2.457E+05	-1258.5081	-.002784	16628.9948	-199.8773
57.720	.036850	2.390E+05	-2113.9652	-.002417	16297.6720	-185.4637
62.160	.026923	2.286E+05	-2896.7410	-.002063	15779.3779	-167.1380
66.600	.018534	2.147E+05	-3589.1307	-.001727	15092.2588	-144.7493
71.040	.011590	1.978E+05	-4158.3441	-.001414	14258.5109	-111.6531

75.480	.005978	1.787E+05	-4539.3568	-.001129	13310.8544	-59.9742
79.920	.001568	1.583E+05	-4708.8140	-8.732E-04	12300.2022	-16.3579
84.360	-.001776	1.375E+05	-4702.4101	-6.490E-04	11269.6306	19.2425
88.800	-.004195	1.170E+05	-4555.0774	-4.562E-04	10254.4029	47.1235
93.240	-.005827	97322.7023	-4299.9883	-2.938E-04	9282.2413	67.7815
97.680	-.006804	78972.1271	-3967.7779	-1.602E-04	8373.7970	81.8628
102.120	-.007250	62195.4990	-3585.9812	-5.316E-05	7543.2708	90.1177
106.560	-.007276	47164.0191	-3178.6662	2.973E-05	6799.1381	93.3575
111.000	-.006986	33949.1445	-2766.2422	9.121E-05	6144.9364	92.4191
115.440	-.006466	22539.0452	-2365.4145	1.340E-04	5580.0800	88.1340
119.880	-.005795	12855.0062	-1989.2583	1.608E-04	5100.6722	81.3057
124.320	-.005038	4767.3068	-1647.3814	1.742E-04	4700.2910	72.6929
128.760	-.004249	-1889.7603	-1346.1455	1.764E-04	4557.8382	62.9990
133.200	-.003472	-7303.9372	-993.2170	1.694E-04	4825.8668	95.9778
137.640	-.002744	-10822.3589	-605.6464	1.557E-04	5000.0461	78.6036
142.080	-.002089	-12785.7586	-293.6514	1.378E-04	5097.2441	61.9347
146.520	-.001521	-13521.7480	-52.7165	1.178E-04	5133.6792	46.5945
150.960	-.001043	-13332.3662	123.9780	9.749E-05	5124.3038	32.9976
155.400	-6.55E-04	-12485.7529	244.6854	7.792E-05	5082.3923	21.3751
159.840	-3.51E-04	-11211.4563	318.3438	5.996E-05	5019.3083	11.8043
164.280	-1.22E-04	-9698.7946	353.9621	4.411E-05	4944.4241	4.2400
168.720	4.08E-05	-8097.6518	360.1457	3.062E-05	4865.1596	-1.4546
173.160	1.50E-04	-6521.0964	344.7542	1.954E-05	4787.1123	-5.4785
177.600	2.14E-04	-5049.2510	314.6811	1.077E-05	4714.2486	-8.0679
182.040	2.45E-04	-3733.9041	275.7385	4.118E-06	4649.1325	-9.4738
186.480	2.51E-04	-2603.4359	232.6278	-6.857E-07	4593.1687	-9.9454
190.920	2.39E-04	-1667.7130	188.9786	-3.923E-06	4546.8458	-9.7164
195.360	2.16E-04	-922.6932	147.4360	-5.886E-06	4509.9636	-8.9965
199.800	1.87E-04	-354.5611	109.7795	-6.854E-06	4481.8382	-7.9659
204.240	1.55E-04	56.7141	77.0600	-7.080E-06	4467.0933	-6.7727
208.680	1.24E-04	334.4468	49.7406	-6.784E-06	4480.8425	-5.5334
213.120	9.50E-05	502.9283	27.8344	-6.149E-06	4489.1832	-4.3343
217.560	6.94E-05	585.7114	11.0302	-5.324E-06	4493.2813	-3.2351
222.000	4.77E-05	604.4226	-1.1969	-4.422E-06	4494.2076	-2.2726
226.440	3.01E-05	578.0282	-9.4932	-3.526E-06	4492.9010	-1.4645
230.880	1.64E-05	522.4714	-14.5522	-2.691E-06	4490.1506	-.8143
235.320	6.22E-06	450.5973	-17.0588	-1.954E-06	4486.5925	-.3148
239.760	-9.41E-07	372.2901	-17.6499	-1.330E-06	4482.7159	.048559
244.200	-5.59E-06	294.7523	-16.8886	-8.247E-07	4478.8774	.2944
248.640	-8.26E-06	222.8686	-15.2514	-4.323E-07	4475.3188	.4431
253.080	-9.43E-06	159.6075	-13.1239	-1.425E-07	4472.1871	.5152
257.520	-9.53E-06	106.4229	-10.8036	5.918E-08	4469.5542	.5300
261.960	-8.91E-06	63.6320	-8.5075	1.881E-07	4467.4358	.5043
266.400	-7.86E-06	30.7511	-6.3827	2.596E-07	4465.8080	.4528
270.840	-6.60E-06	6.7805	-4.5184	2.881E-07	4464.6214	.3870
275.280	-5.30E-06	-9.5643	-2.9578	2.859E-07	4464.7592	.3160
279.720	-4.06E-06	-19.6751	-1.7095	2.638E-07	4465.2597	.2463
284.160	-2.96E-06	-24.9208	-.7582	2.300E-07	4465.5194	.1823
288.600	-2.02E-06	-26.5609	-.072660	1.910E-07	4465.6006	.1265
293.040	-1.26E-06	-25.6932	.3865	1.514E-07	4465.5577	.080304
297.480	-6.77E-07	-23.2294	.6619	1.143E-07	4465.4357	.043732
301.920	-2.48E-07	-19.8918	.7950	8.160E-08	4465.2705	.016248
306.360	4.77E-08	-16.2239	.8240	5.422E-08	4465.0889	-.003177
310.800	2.34E-07	-12.6104	.7819	3.237E-08	4464.9100	-.015810
315.240	3.35E-07	-9.3022	.6958	1.576E-08	4464.7462	-.022992
319.680	3.74E-07	-6.4425	.5870	3.827E-09	4464.6047	-.026018
324.120	3.69E-07	-4.0925	.4713	-4.158E-09	4464.4883	-.026060

328.560	3.37E-07	-2.2542	.3599	-8.969E-09	4464.3973	-.024121
333.000	2.89E-07	-.8903	.2597	-1.135E-08	4464.3298	-.021016
337.440	2.36E-07	.059834	.1745	-1.198E-08	4464.2887	-.017375
341.880	1.83E-07	.6674	.1056	-1.143E-08	4464.3188	-.013657
346.320	1.35E-07	1.0053	.052715	-1.016E-08	4464.3355	-.010174
350.760	9.28E-08	1.1422	.014343	-8.535E-09	4464.3423	-.007111
355.200	5.88E-08	1.1384	-.011571	-6.806E-09	4464.3421	-.004562
359.640	3.24E-08	1.0440	-.027351	-5.152E-09	4464.3374	-.002547
364.080	1.30E-08	.8989	-.035308	-3.679E-09	4464.3302	-.001038
368.520	-2.70E-10	.7329	-.037564	-2.442E-09	4464.3220	2.177E-05
372.960	-8.65E-09	.5670	-.035949	-1.457E-09	4464.3138	7.055E-04
377.400	-1.32E-08	.4147	-.031961	-7.129E-10	4464.3062	.001091
381.840	-1.50E-08	.2837	-.026760	-1.836E-10	4464.2998	.001252
386.280	-1.48E-08	.1772	-.021194	1.657E-10	4464.2945	.001255
390.720	-1.35E-08	.095351	-.015841	3.722E-10	4464.2904	.001156
395.160	-1.15E-08	.036262	-.011058	4.720E-10	4464.2875	9.986E-04
399.600	-9.32E-09	-.003159	-.007030	4.971E-10	4464.2859	8.159E-04
404.040	-7.12E-09	-.026493	-.003818	4.746E-10	4464.2870	6.306E-04
408.480	-5.10E-09	-.037382	-.001404	4.262E-10	4464.2876	4.570E-04
412.920	-3.33E-09	-.039243	2.812E-04	3.681E-10	4464.2877	3.021E-04
417.360	-1.83E-09	-.035130	.001324	3.117E-10	4464.2875	1.678E-04
421.800	-5.66E-10	-.027691	.001748	2.641E-10	4464.2871	2.327E-05
426.240	5.13E-10	-.019780	.001753	2.282E-10	4464.2867	-2.137E-05
430.680	1.46E-09	-.012280	.001568	2.039E-10	4464.2863	-6.160E-05
435.120	2.32E-09	-.005988	.001211	1.900E-10	4464.2860	-9.933E-05
439.560	3.15E-09	-.001651	6.881E-04	1.842E-10	4464.2858	-1.363E-04
444.000	3.96E-09	0.0000	0.0000	1.830E-10	4464.2857	-1.737E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	.30000000 in
Computed slope at pile head	=	-.00589210
Maximum bending moment	=	248355.502 lbs-in
Maximum shear force	=	9060.456 lbs
Depth of maximum bending moment	=	48.840 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Specified deflection at pile head	=	.400000 in
Specified bending moment at pile head	=	.000 in-lbs
Specified axial load at pile head	=	75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	0.0000	11307.3307	-.007690	4464.2857	-159.1388
4.440	.365858	51196.5700	10558.1446	-.007651	6998.7694	-178.3323
8.880	.332061	98851.7242	9724.5131	-.007537	9357.9354	-197.1774
13.320	.298930	1.426E+05	8813.9418	-.007354	11522.2017	-212.9899
17.760	.266757	1.820E+05	7834.1899	-.007108	13475.0440	-228.3398
22.200	.235810	2.169E+05	6790.7700	-.006806	15200.4963	-241.6692
26.640	.206323	2.469E+05	5693.8587	-.006454	16684.6791	-252.4350
31.080	.178497	2.717E+05	4554.7548	-.006061	17916.3366	-260.6749
35.520	.152500	2.913E+05	3384.8955	-.005634	18886.8056	-266.2888
39.960	.128463	3.055E+05	2198.5938	-.005182	19590.1177	-268.0814
44.400	.106484	3.143E+05	1013.6303	-.004712	20024.1682	-265.6860
48.840	.086619	3.177E+05	-151.0526	-.004233	20191.0759	-258.9459
53.280	.068893	3.158E+05	-1275.9464	-.003753	20097.3341	-247.7630
57.720	.053292	3.089E+05	-2341.2020	-.003280	19753.9039	-232.0819
62.160	.039770	2.972E+05	-3326.7511	-.002820	19176.2622	-211.8591
66.600	.028248	2.812E+05	-4212.2102	-.002382	18384.4364	-186.9963
71.040	.018619	2.614E+05	-4976.3085	-.001971	17403.0903	-157.1921
75.480	.010748	2.383E+05	-5564.6810	-.001592	16261.8057	-107.8405
79.920	.004482	2.130E+05	-5907.8936	-.001250	15009.3222	-46.7598
84.360	-3.51E-04	1.867E+05	-6003.2663	-9.470E-04	13705.8818	3.7991
88.800	-.003927	1.603E+05	-5896.9129	-6.839E-04	12401.4840	44.1078
93.240	-.006424	1.348E+05	-5633.1086	-4.603E-04	11136.1253	74.7230
97.680	-.008014	1.106E+05	-5253.1699	-2.743E-04	9940.3225	96.4206
102.120	-.008860	88305.6862	-4794.6180	-1.235E-04	8835.8543	110.1343
106.560	-.009111	68121.9973	-4290.6058	-4.953E-06	7836.6618	116.8982
111.000	-.008904	50208.4053	-3769.5826	8.473E-05	6949.8503	117.7970
115.440	-.008359	34591.6711	-3255.1614	1.490E-04	6176.7447	113.9243
119.880	-.007581	21203.3336	-2766.1532	1.913E-04	5513.9557	106.3497
124.320	-.006660	9900.8276	-2316.7280	2.149E-04	4954.4257	96.0941
128.760	-.005673	487.6851	-1916.6645	2.227E-04	4488.4285	84.1146
133.200	-.004682	-7267.5012	-1442.5882	2.176E-04	4824.0630	129.4332
137.640	-.003740	-12467.4240	-917.4055	2.026E-04	5081.4849	107.1356
142.080	-.002882	-15549.0258	-489.8793	1.814E-04	5234.0395	85.4438
146.520	-.002129	-16938.3740	-155.3504	1.568E-04	5302.8191	65.2449
150.960	-.001490	-17032.9597	94.1630	1.310E-04	5307.5015	47.1485
155.400	-9.66E-04	-16189.4809	268.8002	1.059E-04	5265.7452	31.5169
159.840	-5.50E-04	-14716.5174	379.8443	8.244E-05	5192.8262	18.5029
164.280	-2.34E-04	-12871.3667	438.8793	6.153E-05	5101.4821	8.0895
168.720	-3.68E-06	-10860.2459	457.1288	4.354E-05	5001.9217	.1310
173.160	1.53E-04	-8841.0604	444.9681	2.861E-05	4901.9620	-5.6088
177.600	2.50E-04	-6927.9817	411.5989	1.666E-05	4807.2551	-9.4224
182.040	3.01E-04	-5197.1545	364.8654	7.466E-06	4721.5706	-11.6288
186.480	3.17E-04	-3692.9489	311.1885	7.274E-07	4647.1050	-12.5500
190.920	3.07E-04	-2434.2854	255.5938	-3.917E-06	4584.7949	-12.4926
195.360	2.82E-04	-1420.6674	201.8091	-6.839E-06	4534.6158	-11.7347
199.800	2.47E-04	-637.6662	152.4077	-8.399E-06	4495.8534	-10.5181
204.240	2.07E-04	-61.6934	108.9797	-8.929E-06	4467.3398	-9.0441
208.680	1.67E-04	336.0197	72.3126	-8.721E-06	4480.9204	-7.4727
213.120	1.30E-04	586.2503	42.5702	-8.022E-06	4493.3080	-5.9248
217.560	9.62E-05	719.3854	19.4585	-7.032E-06	4499.8989	-4.4859
222.000	6.74E-05	763.7248	2.3730	-5.908E-06	4502.0939	-3.2103
226.440	4.37E-05	744.3925	-9.4759	-4.765E-06	4501.1368	-2.1271
230.880	2.51E-05	682.7520	-16.9625	-3.683E-06	4498.0853	-1.2452

235.320	1.10E-05	596.2186	-20.9674	-2.714E-06	4493.8015	-.5588
239.760	9.94E-07	498.3692	-22.3217	-1.884E-06	4488.9575	-.051326
244.200	-5.69E-06	399.2564	-21.7704	-1.204E-06	4484.0509	.2997
248.640	-9.70E-06	305.8495	-19.9509	-6.695E-07	4479.4268	.5199
253.080	-1.16E-05	222.5380	-17.3853	-2.690E-07	4475.3024	.6358
257.520	-1.21E-05	151.6472	-14.4817	1.458E-08	4471.7930	.6722
261.960	-1.15E-05	93.9308	-11.5427	2.007E-07	4468.9358	.6517
266.400	-1.03E-05	49.0141	-8.7781	3.091E-07	4466.7122	.5936
270.840	-8.77E-06	15.7752	-6.3196	3.582E-07	4465.0667	.5138
275.280	-7.12E-06	-7.3423	-4.2363	3.646E-07	4464.6492	.4246
279.720	-5.53E-06	-22.0855	-2.5497	3.423E-07	4465.3791	.3351
284.160	-4.08E-06	-30.2112	-1.2471	3.026E-07	4465.7813	.2516
288.600	-2.84E-06	-33.3618	-.2936	2.544E-07	4465.9373	.1779
293.040	-1.82E-06	-32.9881	.3590	2.041E-07	4465.9188	.1160
297.480	-1.03E-06	-30.3102	.7641	1.562E-07	4465.7862	.066475
301.920	-4.38E-07	-26.3066	.9754	1.133E-07	4465.5880	.028704
306.360	-2.32E-08	-21.7238	1.0426	7.685E-08	4465.3611	.001545
310.800	2.45E-07	-17.0996	1.0093	4.742E-08	4465.1322	-.016557
315.240	3.98E-07	-12.7931	.9119	2.477E-08	4464.9190	-.027299
319.680	4.65E-07	-9.0184	.7795	8.234E-09	4464.7322	-.032353
324.120	4.71E-07	-5.8769	.6338	-3.055E-09	4464.5766	-.033256
328.560	4.38E-07	-3.3880	.4904	-1.008E-08	4464.4534	-.031339
333.000	3.82E-07	-1.5152	.3594	-1.379E-08	4464.3607	-.027700
337.440	3.15E-07	-.1878	.2464	-1.508E-08	4464.2950	-.023199
341.880	2.48E-07	.6824	.1539	-1.471E-08	4464.3195	-.018470
346.320	1.85E-07	1.1882	.081872	-1.329E-08	4464.3445	-.013953
350.760	1.30E-07	1.4183	.028865	-1.132E-08	4464.3559	-.009924
355.200	8.41E-08	1.4521	-.007650	-9.141E-09	4464.3576	-.006525
359.640	4.84E-08	1.3565	-.030578	-7.012E-09	4464.3529	-.003803
364.080	2.18E-08	1.1852	-.042875	-5.086E-09	4464.3444	-.001737
368.520	3.23E-09	.9791	-.047308	-3.445E-09	4464.3342	-2.599E-04
372.960	-8.78E-09	.7674	-.046295	-2.122E-09	4464.3237	7.161E-04
377.400	-1.56E-08	.5694	-.041842	-1.108E-09	4464.3139	.001290
381.840	-1.86E-08	.3966	-.035525	-3.761E-10	4464.3053	.001556
386.280	-1.90E-08	.2542	-.028510	1.172E-10	4464.2983	.001603
390.720	-1.76E-08	.1433	-.021611	4.185E-10	4464.2928	.001504
395.160	-1.52E-08	.062046	-.015343	5.742E-10	4464.2888	.001319
399.600	-1.25E-08	.006722	-.009988	6.263E-10	4464.2860	.001093
404.040	-9.67E-09	-.027060	-.005659	6.109E-10	4464.2871	8.570E-04
408.480	-7.05E-09	-.043933	-.002353	5.571E-10	4464.2879	6.319E-04
412.920	-4.73E-09	-.048328	2.136E-07	4.872E-10	4464.2881	4.282E-04
417.360	-2.73E-09	-.044256	.001505	4.170E-10	4464.2879	2.498E-04
421.800	-1.02E-09	-.035238	.002153	3.568E-10	4464.2875	4.209E-05
426.240	4.41E-10	-.025372	.002206	3.108E-10	4464.2870	-1.836E-05
430.680	1.74E-09	-.015856	.002003	2.796E-10	4464.2865	-7.324E-05
435.120	2.92E-09	-.007776	.001562	2.617E-10	4464.2861	-1.250E-04
439.560	4.06E-09	-.002156	8.947E-04	2.541E-10	4464.2858	-1.758E-04
444.000	5.18E-09	0.0000	0.0000	2.525E-10	4464.2857	-2.272E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = -.00768955
Maximum bending moment = 317681.161 lbs-in
Maximum shear force = 11307.331 lbs
Depth of maximum bending moment = 48.840 in
Depth of maximum shear force = 0.000 in
Number of iterations = 8
Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .500000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	0.0000	13262.2873	-.009454	4464.2857	-159.1388
4.440	.458025	60464.0924	12505.8117	-.009408	7457.5576	-181.6159
8.880	.416457	1.173E+05	11623.2872	-.009273	10272.0758	-215.9176
13.320	.375678	1.699E+05	10582.9504	-.009056	12872.9438	-252.7026
17.760	.336043	2.173E+05	9421.1817	-.008762	15222.9495	-270.6167
22.200	.297870	2.594E+05	8186.9113	-.008401	17303.4240	-285.3609
26.640	.261443	2.956E+05	6894.5605	-.007980	19098.9277	-296.7791
31.080	.227005	3.259E+05	5558.8430	-.007509	20597.4112	-304.8954
35.520	.194761	3.500E+05	4194.0565	-.006997	21790.1971	-309.8733
39.960	.164873	3.678E+05	2813.4948	-.006453	22671.8254	-312.0013
44.400	.137460	3.793E+05	1431.9683	-.005887	23239.7741	-310.3079
48.840	.112599	3.844E+05	68.8235	-.005308	23495.4093	-303.7212
53.280	.090326	3.834E+05	-1253.9466	-.004726	23445.0299	-292.1212
57.720	.070634	3.764E+05	-2513.9399	-.004150	23099.9822	-275.4433
62.160	.053475	3.639E+05	-3688.5281	-.003589	22476.7165	-253.6504
66.600	.038765	3.461E+05	-4754.8542	-.003051	21596.8157	-226.6766
71.040	.026384	3.237E+05	-5689.4335	-.002543	20487.0481	-194.3051
75.480	.016182	2.972E+05	-6466.8030	-.002073	19179.5662	-155.8613
79.920	.007980	2.676E+05	-6997.6376	-.001644	17712.5478	-83.2534
84.360	.001579	2.362E+05	-7220.4422	-.001263	16157.5932	-17.1090
88.800	-.003231	2.043E+05	-7177.8511	-9.286E-04	14580.0389	36.2942
93.240	-.006667	1.731E+05	-6925.1272	-6.426E-04	13032.7986	77.5454
97.680	-.008937	1.433E+05	-6514.2677	-4.028E-04	11556.9111	107.5265
102.120	-.010244	1.155E+05	-5992.8742	-2.067E-04	10182.3807	127.3354
106.560	-.010772	90191.9398	-5403.3550	-5.075E-05	8929.2332	138.2138
111.000	-.010694	67557.5238	-4782.4264	6.882E-05	7808.7176	141.4838
115.440	-.010161	47678.1597	-4160.8761	1.562E-04	6824.5906	138.4939
119.880	-.009307	30504.9413	-3563.5405	2.154E-04	5974.4313	130.5762
124.320	-.008248	15890.4513	-3009.4509	2.506E-04	5250.9417	119.0137
128.760	-.007082	3614.1288	-2512.0985	2.654E-04	4643.2030	105.0189
133.200	-.005892	-6593.7175	-1917.3546	2.631E-04	4790.7074	162.8838
137.640	-.004746	-13587.2101	-1253.9592	2.478E-04	5136.9199	135.9430

142.080	-.003691	-17893.9180	-709.2459	2.240E-04	5350.1232	109.4233
146.520	-.002757	-20034.4653	-278.7647	1.952E-04	5456.0909	84.4871
150.960	-.001958	-20499.3545	46.3280	1.645E-04	5479.1052	61.9510
155.400	-.001297	-19732.6179	277.8129	1.340E-04	5441.1480	42.3214
159.840	-7.68E-04	-18121.6124	429.1273	1.053E-04	5361.3952	25.8382
164.280	-3.62E-04	-15992.0958	514.2907	7.944E-05	5255.9736	12.5237
168.720	-6.27E-05	-13607.6186	547.0503	5.701E-05	5137.9302	2.2328
173.160	1.45E-04	-11172.2551	540.2415	3.822E-05	5017.3677	-5.2999
177.600	2.77E-04	-8835.7318	505.3504	2.306E-05	4901.6982	-10.4168
182.040	3.49E-04	-6700.1015	452.2545	1.128E-05	4795.9739	-13.5002
186.480	3.77E-04	-4827.2271	389.1139	2.548E-06	4703.2574	-14.9415
190.920	3.72E-04	-3246.4669	322.3824	-3.571E-06	4625.0019	-15.1177
195.360	3.45E-04	-1962.0925	256.9099	-7.519E-06	4561.4190	-14.3744
199.800	3.05E-04	-960.0992	196.1062	-9.734E-06	4511.8154	-13.0146
204.240	2.59E-04	-214.1865	142.1432	-1.062E-05	4474.8890	-11.2930
208.680	2.11E-04	309.2081	96.1730	-1.055E-05	4479.5930	-9.4143
213.120	1.65E-04	646.8575	58.5461	-9.827E-06	4496.3084	-7.5348
217.560	1.24E-04	835.6425	29.0166	-8.704E-06	4505.6542	-5.7668
222.000	8.78E-05	910.3219	6.9264	-7.380E-06	4509.3512	-4.1838
226.440	5.81E-05	902.0644	-8.6378	-6.007E-06	4508.9424	-2.8271
230.880	3.45E-05	837.6190	-18.7154	-4.688E-06	4505.7520	-1.7124
235.320	1.65E-05	738.9937	-24.3724	-3.493E-06	4500.8696	-.8358
239.760	3.49E-06	623.5187	-26.6275	-2.461E-06	4495.1530	-.1800
244.200	-5.34E-06	504.1800	-26.4035	-1.606E-06	4489.2451	.2809
248.640	-1.08E-05	390.1251	-24.4975	-9.280E-07	4483.5988	.5776
253.080	-1.36E-05	287.2598	-21.5687	-4.146E-07	4478.5065	.7417
257.520	-1.45E-05	198.8710	-18.1376	-4.611E-08	4474.1308	.8039
261.960	-1.40E-05	126.2289	-14.5947	2.003E-07	4470.5347	.7920
266.400	-1.27E-05	69.1364	-11.2153	3.484E-07	4467.7083	.7303
270.840	-1.09E-05	26.4052	-8.1763	4.208E-07	4465.5929	.6386
275.280	-8.94E-06	-3.7495	-5.5756	4.380E-07	4464.4713	.5328
279.720	-7.01E-06	-23.3979	-3.4499	4.174E-07	4465.4440	.4247
284.160	-5.23E-06	-34.6627	-1.7915	3.734E-07	4466.0017	.3224
288.600	-3.69E-06	-39.5551	-.5629	3.171E-07	4466.2439	.2311
293.040	-2.42E-06	-39.8720	.2913	2.569E-07	4466.2596	.1537
297.480	-1.41E-06	-37.1391	.8347	1.985E-07	4466.1243	.091064
301.920	-6.53E-07	-32.5923	1.1319	1.457E-07	4465.8992	.042835
306.360	-1.16E-07	-27.1846	1.2441	1.004E-07	4465.6315	.007706
310.800	2.39E-07	-21.6113	1.2254	6.341E-08	4465.3556	-.016128
315.240	4.47E-07	-16.3449	1.1215	3.464E-08	4465.0949	-.030690
319.680	5.46E-07	-11.6754	.9690	1.340E-08	4464.8637	-.038013
324.120	5.66E-07	-7.7493	.7958	-1.323E-09	4464.6693	-.039985
328.560	5.34E-07	-4.6076	.6221	-1.069E-08	4464.5138	-.038263
333.000	4.71E-07	-2.2178	.4612	-1.586E-08	4464.3955	-.034226
337.440	3.94E-07	-.5016	.3209	-1.792E-08	4464.3105	-.028964
341.880	3.12E-07	.6438	.2049	-1.782E-08	4464.3176	-.023295
346.320	2.35E-07	1.3297	.1137	-1.632E-08	4464.3515	-.017791
350.760	1.67E-07	1.6642	.045735	-1.405E-08	4464.3681	-.012818
355.200	1.11E-07	1.7452	-.001768	-1.147E-08	4464.3721	-.008579
359.640	6.55E-08	1.6562	-.032248	-8.888E-09	4464.3677	-.005150
364.080	3.16E-08	1.4648	-.049271	-6.523E-09	4464.3582	-.002518
368.520	7.61E-09	1.2230	-.056223	-4.486E-09	4464.3463	-6.130E-04
372.960	-8.19E-09	.9685	-.056099	-2.825E-09	4464.3337	6.686E-04
377.400	-1.75E-08	.7267	-.051411	-1.540E-09	4464.3217	.001443
381.840	-2.19E-08	.5130	-.044149	-6.002E-10	4464.3111	.001828
386.280	-2.28E-08	.3351	-.035808	4.252E-11	4464.3023	.001929
390.720	-2.15E-08	.1950	-.027442	4.443E-10	4464.2954	.001839

395.160	-1.89E-08	.091072	-.019733	6.611E-10	4464.2902	.001633
399.600	-1.56E-08	.019312	-.013070	7.447E-10	4464.2867	.001368
404.040	-1.22E-08	-.025487	-.007624	7.400E-10	4464.2870	.001085
408.480	-9.05E-09	-.048884	-.003416	6.837E-10	4464.2881	8.106E-04
412.920	-6.18E-09	-.056277	-3.743E-04	6.040E-10	4464.2885	5.596E-04
417.360	-3.69E-09	-.052610	.001617	5.214E-10	4464.2883	3.375E-04
421.800	-1.55E-09	-.042264	.002507	4.495E-10	4464.2878	6.356E-05
426.240	3.07E-10	-.030643	.002620	3.943E-10	4464.2872	-1.277E-05
430.680	1.95E-09	-.019259	.002409	3.565E-10	4464.2867	-8.246E-05
435.120	3.47E-09	-.009490	.001896	3.347E-10	4464.2862	-1.484E-04
439.560	4.93E-09	-.002643	.001093	3.255E-10	4464.2858	-2.133E-04
444.000	6.36E-09	0.0000	0.0000	3.235E-10	4464.2857	-2.791E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	-.00945386
Maximum bending moment	=	384428.696 lbs-in
Maximum shear force	=	13262.287 lbs
Depth of maximum bending moment	=	48.840 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .600000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	0.0000	14905.1218	-.011172	4464.2857	-159.1388
4.440	.550397	68330.3387	14148.6461	-.011120	7846.9757	-181.6159
8.880	.501255	1.330E+05	13266.1216	-.010967	11050.7155	-215.9176
13.320	.453007	1.934E+05	12225.7846	-.010720	14040.4119	-252.7026
17.760	.406062	2.488E+05	11011.2393	-.010385	16778.6568	-294.3898
22.200	.360791	2.981E+05	9625.8511	-.009970	19223.3843	-329.6589
26.640	.317526	3.409E+05	8134.9945	-.009486	21338.9406	-341.8981
31.080	.276556	3.767E+05	6598.8351	-.008942	23112.3134	-350.0656
35.520	.238121	4.054E+05	5035.0746	-.008349	24534.6366	-354.3311
39.960	.202415	4.270E+05	3460.3224	-.007718	25601.0295	-355.0167
44.400	.169582	4.413E+05	1889.4523	-.007060	26310.2847	-352.5824

48.840	.139719	4.484E+05	337.9242	-.006386	26664.4198	-346.3041
53.280	.112875	4.485E+05	-1173.4810	-.005706	26669.3831	-334.5091
57.720	.089049	4.418E+05	-2620.0742	-.005031	26336.6833	-317.1095
62.160	.068198	4.286E+05	-3976.8962	-.004371	25683.4689	-294.0716
66.600	.050231	4.094E+05	-5218.8223	-.003736	24732.5527	-265.3545
71.040	.035020	3.848E+05	-6320.2999	-.003134	23512.4403	-230.8065
75.480	.022398	3.554E+05	-7254.3166	-.002573	22057.4637	-189.9217
79.920	.012168	3.221E+05	-7957.7694	-.002060	20408.2579	-126.9489
84.360	.004106	2.861E+05	-8338.3423	-.001599	18627.1116	-44.4803
88.800	-.002030	2.491E+05	-8386.4637	-.001193	16795.4068	22.8040
93.240	-.006490	2.124E+05	-8168.2455	-8.435E-04	14979.7324	75.4924
97.680	-.009521	1.771E+05	-7746.3624	-5.483E-04	13232.4246	114.5450
102.120	-.011359	1.440E+05	-7178.6063	-3.049E-04	11592.4776	141.2010
106.560	-.012228	1.136E+05	-6516.8401	-1.097E-04	10086.7334	156.8919
111.000	-.012333	86192.9827	-5806.3150	4.173E-05	8731.2651	163.1644
115.440	-.011858	61985.5721	-5085.3072	1.540E-04	7532.8784	161.6139
119.880	-.010965	40932.8629	-4385.0208	2.320E-04	6490.6651	153.8305
124.320	-.009797	22892.0443	-3729.7007	2.804E-04	5597.5552	141.3587
128.760	-.008475	7626.3594	-3136.8997	3.036E-04	4841.8283	125.6688
133.200	-.007101	-5165.7915	-2422.0805	3.054E-04	4720.0180	196.3218
137.640	-.005763	-14085.1244	-1619.7892	2.908E-04	5161.5691	165.0706
142.080	-.004519	-19743.2109	-955.9525	2.652E-04	5441.6724	133.9549
146.520	-.003408	-22750.5974	-426.7473	2.330E-04	5590.5529	104.4258
150.960	-.002450	-23687.8918	-22.8235	1.978E-04	5636.9536	77.5219
155.400	-.001652	-23084.9937	268.9508	1.623E-04	5607.1072	53.9080
159.840	-.001009	-21407.7213	463.9415	1.286E-04	5524.0739	33.9256
164.280	-5.10E-04	-19050.8472	578.4373	9.794E-05	5407.3970	17.6491
168.720	-1.39E-04	-16336.4285	628.5968	7.112E-05	5273.0198	4.9452
173.160	1.22E-04	-13516.2756	629.6489	4.850E-05	5133.4083	-4.4713
177.600	2.92E-04	-10777.4443	595.3359	3.008E-05	4997.8226	-10.9851
182.040	3.89E-04	-8249.7280	537.5696	1.566E-05	4872.6881	-15.0358
186.480	4.31E-04	-6014.2566	466.2720	4.850E-06	4762.0212	-17.0803
190.920	4.32E-04	-4112.4628	389.3630	-2.825E-06	4667.8730	-17.5635
195.360	4.06E-04	-2554.8319	312.8609	-7.878E-06	4590.7625	-16.8969
199.800	3.62E-04	-1329.0107	241.0626	-1.082E-05	4530.0783	-15.4446
204.240	3.10E-04	-406.9881	176.7721	-1.214E-05	4484.4336	-13.5150
208.680	2.55E-04	248.8098	121.5535	-1.226E-05	4476.6030	-11.3582
213.120	2.01E-04	680.5703	75.9865	-1.155E-05	4497.9773	-9.1674
217.560	1.52E-04	931.2642	39.9102	-1.033E-05	4510.3879	-7.0831
222.000	1.09E-04	1041.8537	12.6429	-8.836E-06	4515.8626	-5.1994
226.440	7.34E-05	1049.4176	-6.8282	-7.251E-06	4516.2371	-3.5713
230.880	4.48E-05	986.0484	-19.6900	-5.708E-06	4513.1000	-2.2223
235.320	2.28E-05	878.3722	-27.1809	-4.295E-06	4507.7695	-1.1520
239.760	6.64E-06	747.5432	-30.4992	-3.063E-06	4501.2928	-.3428
244.200	-4.44E-06	609.5789	-30.7412	-2.034E-06	4494.4629	.2338
248.640	-1.14E-05	475.9160	-28.8623	-1.212E-06	4487.8459	.6126
253.080	-1.52E-05	354.0888	-25.6591	-5.825E-07	4481.8149	.8303
257.520	-1.66E-05	248.4516	-21.7665	-1.258E-07	4476.5853	.9231
261.960	-1.63E-05	160.8865	-17.6660	1.844E-07	4472.2504	.9240
266.400	-1.50E-05	91.4549	-13.7013	3.757E-07	4468.8132	.8619
270.840	-1.30E-05	38.9684	-10.0984	4.745E-07	4466.2148	.7610
275.280	-1.07E-05	1.4651	-6.9868	5.052E-07	4464.3582	.6406
279.720	-8.50E-06	-23.4105	-4.4212	4.885E-07	4465.4447	.5151
284.160	-6.41E-06	-38.1203	-2.4013	4.419E-07	4466.1729	.3948
288.600	-4.57E-06	-45.0283	-.8891	3.789E-07	4466.5148	.2864
293.040	-3.04E-06	-46.2681	.1763	3.097E-07	4466.5762	.1936
297.480	-1.82E-06	-43.6686	.8677	2.415E-07	4466.4475	.1178

301.920	-8.98E-07	-38.7241	1.2601	1.791E-07	4466.2027	.058946
306.360	-2.34E-07	-32.5980	1.4255	1.250E-07	4465.8995	.015567
310.800	2.12E-07	-26.1486	1.4283	8.048E-08	4465.5802	-.014307
315.240	4.81E-07	-19.9680	1.3233	4.553E-08	4465.2742	-.032998
319.680	6.16E-07	-14.4278	1.1549	1.946E-08	4465.0000	-.042872
324.120	6.54E-07	-9.7256	.9572	1.154E-09	4464.7672	-.046160
328.560	6.26E-07	-5.9283	.7552	-1.071E-08	4464.5792	-.044836
333.000	5.59E-07	-3.0120	.5656	-1.749E-08	4464.4348	-.040561
337.440	4.71E-07	-.8938	.3987	-2.045E-08	4464.3300	-.034659
341.880	3.77E-07	.5416	.2593	-2.071E-08	4464.3125	-.028133
346.320	2.87E-07	1.4222	.1486	-1.923E-08	4464.3561	-.021695
350.760	2.06E-07	1.8744	.065381	-1.673E-08	4464.3785	-.015809
355.200	1.38E-07	2.0139	.006436	-1.378E-08	4464.3854	-.010742
359.640	8.40E-08	1.9407	-.032074	-1.078E-08	4464.3818	-.006605
364.080	4.27E-08	1.7363	-.054280	-7.996E-09	4464.3717	-.003398
368.520	1.30E-08	1.4640	-.064156	-5.570E-09	4464.3582	-.001050
372.960	-6.77E-09	1.1703	-.065262	-3.573E-09	4464.3436	5.523E-04
377.400	-1.87E-08	.8869	-.060608	-2.014E-09	4464.3296	.001544
381.840	-2.47E-08	.6334	-.052605	-8.618E-10	4464.3171	.002061
386.280	-2.63E-08	.4203	-.043082	-6.316E-11	4464.3065	.002229
390.720	-2.52E-08	.2509	-.033343	4.456E-10	4464.2981	.002158
395.160	-2.24E-08	.1239	-.024247	7.297E-10	4464.2918	.001939
399.600	-1.87E-08	.035105	-.016300	8.502E-10	4464.2875	.001641
404.040	-1.48E-08	-.021383	-.009738	8.606E-10	4464.2868	.001315
408.480	-1.11E-08	-.051941	-.004613	8.050E-10	4464.2883	9.938E-04
412.920	-7.69E-09	-.062881	-8.594E-04	7.180E-10	4464.2888	6.969E-04
417.360	-4.72E-09	-.060050	.001647	6.248E-10	4464.2887	4.320E-04
421.800	-2.15E-09	-.048672	.002802	5.424E-10	4464.2881	8.815E-05
426.240	9.91E-11	-.035531	.002988	4.786E-10	4464.2875	-4.128E-06
430.680	2.10E-09	-.022454	.002782	4.347E-10	4464.2868	-8.881E-05
435.120	3.96E-09	-.011116	.002209	4.092E-10	4464.2863	-1.693E-04
439.560	5.74E-09	-.003109	.001282	3.984E-10	4464.2859	-2.485E-04
444.000	7.50E-09	0.0000	0.0000	3.961E-10	4464.2857	-3.288E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	-.01117177
Maximum bending moment	=	448542.968 lbs-in
Maximum shear force	=	14905.122 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .700000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	0.0000	16356.1887	-.012851	4464.2857	-159.1388
4.440	.642943	75332.1487	15599.7136	-.012794	8193.6000	-181.6157
8.880	.586393	1.470E+05	14717.1908	-.012625	11743.7892	-215.9171
13.320	.530833	2.144E+05	13676.8575	-.012351	15079.5859	-252.7015
17.760	.476716	2.767E+05	12462.3188	-.011979	18163.4074	-294.3880
22.200	.424461	3.331E+05	11054.7266	-.011517	20953.0145	-339.6626
26.640	.374449	3.826E+05	9440.0019	-.010974	23402.8145	-387.6908
31.080	.327011	4.242E+05	7700.0788	-.010363	25464.6990	-396.0583
35.520	.282428	4.578E+05	5933.3670	-.009694	27129.4612	-399.7578
39.960	.240926	4.834E+05	4159.8230	-.008981	28392.6505	-399.1360
44.400	.202678	5.008E+05	2397.5097	-.008235	29254.2359	-394.6988
48.840	.167800	5.101E+05	661.9389	-.007469	29718.1129	-387.0898
53.280	.136356	5.116E+05	-1030.4202	-.006694	29791.4731	-375.2341
57.720	.108355	5.054E+05	-2656.6056	-.005923	29485.8497	-357.2818
62.160	.083755	4.920E+05	-4189.4678	-.005167	28818.9170	-333.1966
66.600	.062467	4.717E+05	-5601.7236	-.004437	27814.5168	-302.9546
71.040	.044354	4.452E+05	-6865.8079	-.003742	26502.6701	-266.4527
75.480	.029237	4.132E+05	-7953.0728	-.003092	24919.6619	-223.3062
79.920	.016900	3.766E+05	-8831.3113	-.002493	23108.3990	-172.2967
84.360	.007099	3.364E+05	-9384.5251	-.001953	21119.5768	-76.8988
88.800	-4.38E-04	2.946E+05	-9544.3164	-.001474	19047.3002	4.9207
93.240	-.005993	2.527E+05	-9378.6530	-.001059	16972.4644	69.7024
97.680	-.009846	2.120E+05	-8960.9246	-7.073E-04	14959.3388	118.4635
102.120	-.012273	1.736E+05	-8359.2359	-4.151E-04	13056.5264	152.5675
106.560	-.013532	1.380E+05	-7635.0930	-1.789E-04	11298.2705	173.6231
111.000	-.013862	1.059E+05	-6842.5186	5.996E-06	9706.0073	183.3924
115.440	-.013479	77280.9351	-6027.5461	1.448E-04	8290.0746	183.7123
119.880	-.012576	52261.7146	-5228.0325	2.430E-04	7051.4993	176.4290
124.320	-.011321	30694.1630	-4473.7264	3.059E-04	5983.7987	163.3486
128.760	-.009860	12331.3061	-3786.5240	3.385E-04	5074.7464	146.2020
133.200	-.008315	-3155.6072	-2951.6293	3.454E-04	4620.5039	229.8767
137.640	-.006792	-14109.2309	-2009.3950	3.324E-04	5162.7625	194.5532
142.080	-.005364	-21220.3887	-1224.5038	3.056E-04	5514.8000	159.0014
146.520	-.004078	-25186.3446	-594.0817	2.704E-04	5711.1345	124.9725
150.960	-.002963	-26675.9286	-108.5418	2.311E-04	5784.8762	93.7392
155.400	-.002026	-26304.1105	246.3825	1.909E-04	5766.4694	66.1366
159.840	-.001267	-24615.2236	487.8195	1.524E-04	5682.8611	42.6188
164.280	-6.73E-04	-22073.7410	634.2094	1.170E-04	5557.0452	23.3226
168.720	-2.28E-04	-19061.3441	704.0448	8.579E-05	5407.9166	8.1348
173.160	8.85E-05	-15878.9586	714.9070	5.931E-05	5250.3728	-3.2420
177.600	2.98E-04	-12752.4683	682.7805	3.761E-05	5095.5960	-11.2294
182.040	4.22E-04	-9840.9128	621.6204	2.048E-05	4951.4596	-16.3202
186.480	4.80E-04	-7246.1198	543.1345	7.530E-06	4823.0045	-19.0338
190.920	4.89E-04	-5022.8932	456.7433	-1.769E-06	4712.9438	-19.8812
195.360	4.65E-04	-3189.0615	369.6736	-7.993E-06	4622.1600	-19.3393
199.800	4.18E-04	-1734.8681	287.1511	-1.173E-05	4550.1703	-17.8330
204.240	3.60E-04	-631.3511	212.6528	-1.352E-05	4495.5407	-15.7248

208.680	2.98E-04	162.4919	148.1925	-1.387E-05	4472.3299	-13.3113
213.120	2.37E-04	693.8383	94.6129	-1.322E-05	4498.6341	-10.8236
217.560	1.81E-04	1011.4622	51.8663	-1.193E-05	4514.3581	-8.4316
222.000	1.31E-04	1162.3582	19.2705	-1.028E-05	4521.8282	-6.2512
226.440	8.95E-05	1189.4341	-4.2688	-8.502E-06	4523.1686	-4.3521
230.880	5.58E-05	1130.1140	-20.0729	-6.744E-06	4520.2320	-2.7669
235.320	2.96E-05	1015.6787	-29.5436	-5.118E-06	4514.5668	-1.4992
239.760	1.03E-05	871.1754	-34.0535	-3.688E-06	4507.4132	-.5323
244.200	-3.13E-06	715.7395	-34.8694	-2.485E-06	4499.7184	.1647
248.640	-1.18E-05	563.1900	-33.1044	-1.516E-06	4492.1664	.6303
253.080	-1.66E-05	422.7819	-29.6936	-7.683E-07	4485.2155	.9061
257.520	-1.86E-05	300.0223	-25.3884	-2.204E-07	4479.1383	1.0332
261.960	-1.85E-05	197.4799	-20.7635	1.566E-07	4474.0619	1.0500
266.400	-1.72E-05	115.5378	-16.2342	3.939E-07	4470.0054	.9902
270.840	-1.50E-05	53.0578	-12.0778	5.217E-07	4466.9123	.8821
275.280	-1.26E-05	7.9398	-8.4582	5.679E-07	4464.6788	.7484
279.720	-1.00E-05	-22.4289	-5.4504	5.569E-07	4465.3961	.6065
284.160	-7.61E-06	-40.8308	-3.0634	5.090E-07	4466.3070	.4688
288.600	-5.49E-06	-49.9711	-1.2603	4.402E-07	4466.7595	.3435
293.040	-3.70E-06	-52.3152	.024659	3.626E-07	4466.8756	.2353
297.480	-2.27E-06	-49.9937	.8721	2.851E-07	4466.7606	.1464
301.920	-1.17E-06	-44.7613	1.3671	2.133E-07	4466.5016	.076631
306.360	-3.72E-07	-37.9956	1.5922	1.505E-07	4466.1667	.024759
310.800	1.69E-07	-30.7227	1.6218	9.847E-08	4465.8066	-.011416
315.240	5.03E-07	-23.6592	1.5199	5.725E-08	4465.4570	-.034484
319.680	6.77E-07	-17.2637	1.3387	2.623E-08	4465.1404	-.047137
324.120	7.36E-07	-11.7887	1.1188	4.211E-09	4464.8693	-.051934
328.560	7.15E-07	-7.3315	.8899	-1.028E-08	4464.6487	-.051167
333.000	6.44E-07	-3.8794	.6725	-1.878E-08	4464.4778	-.046776
337.440	5.48E-07	-1.3473	.4791	-2.274E-08	4464.3524	-.040322
341.880	4.42E-07	.3905	.3164	-2.347E-08	4464.3050	-.032999
346.320	3.39E-07	1.4776	.1861	-2.205E-08	4464.3589	-.025664
350.760	2.47E-07	2.0579	.087224	-1.937E-08	4464.3876	-.018886
355.200	1.67E-07	2.2650	.016446	-1.609E-08	4464.3978	-.012996
359.640	1.04E-07	2.2147	-.030491	-1.270E-08	4464.3954	-.008147
364.080	5.47E-08	2.0027	-.058247	-9.501E-09	4464.3849	-.004356
368.520	1.93E-08	1.7038	-.071368	-6.692E-09	4464.3701	-.001554
372.960	-4.69E-09	1.3734	-.073968	-4.360E-09	4464.3537	3.830E-04
377.400	-1.94E-08	1.0499	-.069555	-2.523E-09	4464.3377	.001605
381.840	-2.71E-08	.7574	-.060964	-1.153E-09	4464.3232	.002265
386.280	-2.97E-08	.5093	-.050365	-1.930E-10	4464.3109	.002510
390.720	-2.88E-08	.3103	-.039319	4.283E-10	4464.3011	.002466
395.160	-2.59E-08	.1598	-.028873	7.846E-10	4464.2936	.002240
399.600	-2.18E-08	.053409	-.019654	9.462E-10	4464.2884	.001913
404.040	-1.75E-08	-.015327	-.011973	9.751E-10	4464.2865	.001547
408.480	-1.32E-08	-.053560	-.005917	9.229E-10	4464.2884	.001181
412.920	-9.27E-09	-.068481	-.001431	8.304E-10	4464.2891	8.395E-04
417.360	-5.81E-09	-.066819	.001614	7.278E-10	4464.2890	5.322E-04
421.800	-2.80E-09	-.054632	.003051	6.358E-10	4464.2884	1.152E-04
426.240	-1.65E-10	-.040146	.003323	5.639E-10	4464.2877	6.885E-06
430.680	2.20E-09	-.025503	.003131	5.142E-10	4464.2870	-9.298E-05
435.120	4.40E-09	-.012681	.002507	4.852E-10	4464.2863	-1.881E-04
439.560	6.51E-09	-.003562	.001464	4.729E-10	4464.2859	-2.820E-04
444.000	8.60E-09	0.0000	0.0000	4.702E-10	4464.2857	-3.772E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	-.01285066
Maximum bending moment	=	511609.185 lbs-in
Maximum shear force	=	16356.189 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .800000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	0.0000	17637.1198	-.014486	4464.2857	-159.1388
4.440	.735684	81563.9064	16880.6446	-.014424	8502.1029	-181.6157
8.880	.671917	1.595E+05	15998.1216	-.014241	12360.6392	-215.9171
13.320	.609224	2.331E+05	14957.7880	-.013943	16004.4715	-252.7016
17.760	.548099	3.016E+05	13743.2486	-.013538	19395.8618	-294.3881
22.200	.489005	3.642E+05	12335.6553	-.013034	22492.4152	-339.6629
26.640	.432361	4.198E+05	10719.9418	-.012439	25248.3842	-388.1360
31.080	.378544	4.676E+05	8881.9072	-.011767	27615.0717	-439.8075
35.520	.327874	5.065E+05	6914.6270	-.011028	29540.8557	-446.3548
39.960	.280613	5.364E+05	4936.6980	-.010238	31018.3745	-444.6043
44.400	.236962	5.572E+05	2976.5811	-.009409	32048.5906	-438.3313
48.840	.197062	5.691E+05	1052.7928	-.008555	32637.1059	-428.2401
53.280	.160991	5.722E+05	-819.4323	-.007690	32793.4716	-415.1046
57.720	.128773	5.669E+05	-2621.9126	-.006827	32530.4278	-396.8234
62.160	.100370	5.535E+05	-4328.5893	-.005978	31865.9485	-371.9499
66.600	.075692	5.325E+05	-5910.1727	-.005154	30824.6435	-340.4751
71.040	.054599	5.045E+05	-7337.2200	-.004368	29437.7554	-302.3390
75.480	.036900	4.702E+05	-8579.5317	-.003630	27743.2021	-257.2608
79.920	.022367	4.307E+05	-9604.2068	-.002947	25785.8318	-204.3046
84.360	.010732	3.869E+05	-10315.8536	-.002327	23618.3136	-116.2571
88.800	.001702	3.406E+05	-10616.3785	-.001776	21327.6690	-19.1145
93.240	-.005036	2.938E+05	-10528.7702	-.001295	19009.8577	58.5777
97.680	-.009796	2.480E+05	-10137.0728	-8.842E-04	16741.8712	117.8625
102.120	-.012888	2.044E+05	-9519.7692	-5.413E-04	14582.7117	160.2022
106.560	-.014603	1.638E+05	-8748.1768	-2.622E-04	12574.7891	187.3620
111.000	-.015216	1.269E+05	-7885.3374	-4.184E-05	10745.6229	201.3044

115.440	-.014975	93838.2412	-6985.3459	1.254E-04	9109.7432	204.0971
119.880	-.014102	64769.5914	-6093.0531	2.457E-04	7670.7011	197.8366
124.320	-.012793	39568.3179	-5244.0694	3.247E-04	6423.1133	184.5885
128.760	-.011218	17985.9750	-4464.9958	3.684E-04	5354.6805	166.3455
133.200	-.009522	-326.1778	-3511.3196	3.818E-04	4480.4331	263.2384
137.640	-.007828	-13448.7898	-2429.1386	3.713E-04	5130.0674	224.2305
142.080	-.006225	-22144.2223	-1521.7091	3.443E-04	5560.5343	184.5215
146.520	-.004770	-27190.8936	-787.5608	3.069E-04	5810.3696	146.1760
150.960	-.003499	-29342.1851	-217.2622	2.641E-04	5916.8691	110.7153
155.400	-.002425	-29296.0682	204.2622	2.196E-04	5914.5861	79.1606
159.840	-.001549	-27674.6228	495.6459	1.765E-04	5834.3165	52.0933
164.280	-8.58E-04	-25012.2611	677.2854	1.365E-04	5702.5165	29.7263
168.720	-3.36E-04	-21751.2607	769.8720	1.011E-04	5541.0808	11.9793
173.160	3.95E-05	-18243.1247	793.2532	7.078E-05	5367.4107	-1.4473
177.600	2.92E-04	-14754.3107	765.6128	4.577E-05	5194.6971	-11.0033
182.040	4.46E-04	-11474.9644	702.9390	2.589E-05	5032.3533	-17.2281
186.480	5.22E-04	-8529.4535	618.7416	1.073E-05	4886.5359	-20.6987
190.920	5.41E-04	-5987.6828	523.9745	-2.770E-07	4760.7057	-21.9892
195.360	5.20E-04	-3876.3756	427.1183	-7.753E-06	4656.1855	-21.6397
199.800	4.72E-04	-2189.7089	334.3776	-1.235E-05	4572.6871	-20.1354
204.240	4.10E-04	-898.8771	249.9543	-1.469E-05	4508.7846	-17.8931
208.680	3.42E-04	39.6706	176.3620	-1.534E-05	4466.2496	-15.2566
213.120	2.74E-04	677.4360	114.7515	-1.480E-05	4497.8221	-12.4959
217.560	2.10E-04	1068.5206	65.2282	-1.348E-05	4517.1828	-9.8119
222.000	1.54E-04	1265.6379	27.1428	-1.171E-05	4526.9411	-7.3437
226.440	1.06E-04	1317.3455	-.6539	-9.750E-06	4529.5008	-5.1773
230.880	6.76E-05	1266.3242	-19.5970	-7.791E-06	4526.9750	-3.3556
235.320	3.73E-05	1148.5127	-31.2372	-5.961E-06	4521.1428	-1.8877
239.760	1.47E-05	992.9083	-37.1110	-4.338E-06	4513.4396	-.7582
244.200	-1.23E-06	821.8556	-38.6505	-2.962E-06	4504.9716	.064778
248.640	-1.16E-05	651.6651	-37.1237	-1.846E-06	4496.5464	.6230
253.080	-1.76E-05	493.4267	-33.6042	-9.777E-07	4488.7128	.9624
257.520	-2.03E-05	353.9111	-28.9612	-3.355E-07	4481.8061	1.1291
261.960	-2.06E-05	236.4745	-23.8657	1.120E-07	4475.9924	1.1662
266.400	-1.93E-05	141.9091	-18.8074	3.988E-07	4471.3109	1.1123
270.840	-1.71E-05	69.1995	-14.1185	5.588E-07	4467.7114	.9998
275.280	-1.43E-05	16.1647	-10.0007	6.235E-07	4465.0859	.8551
279.720	-1.15E-05	-20.0221	-6.5523	6.206E-07	4465.2769	.6983
284.160	-8.83E-06	-42.4330	-3.7940	5.733E-07	4466.3864	.5442
288.600	-6.43E-06	-54.0949	-1.6922	5.001E-07	4466.9637	.4026
293.040	-4.39E-06	-57.7932	-.1784	4.153E-07	4467.1468	.2793
297.480	-2.74E-06	-55.9554	.8351	3.291E-07	4467.0558	.1772
301.920	-1.47E-06	-50.5967	1.4424	2.483E-07	4466.7905	.096400
306.360	-5.37E-07	-43.3122	1.7358	1.771E-07	4466.4299	.035773
310.800	1.04E-07	-35.3005	1.7997	1.176E-07	4466.0333	-.007008
315.240	5.07E-07	-27.4092	1.7069	7.003E-08	4465.6426	-.034770
319.680	7.26E-07	-20.1895	1.5177	3.395E-08	4465.2852	-.050497
324.120	8.08E-07	-13.9551	1.2789	8.071E-09	4464.9766	-.057068
328.560	7.97E-07	-8.8386	1.0255	-9.206E-09	4464.7233	-.057078
333.000	7.27E-07	-4.8429	.7816	-1.958E-08	4464.5255	-.052748
337.440	6.23E-07	-1.8846	.5627	-2.467E-08	4464.3790	-.045877
341.880	5.07E-07	.1702	.3768	-2.597E-08	4464.2941	-.037854
346.320	3.93E-07	1.4787	.2269	-2.472E-08	4464.3589	-.029687
350.760	2.88E-07	2.2012	.1120	-2.193E-08	4464.3947	-.022052
355.200	1.98E-07	2.4879	.028958	-1.838E-08	4464.4089	-.015357
359.640	1.25E-07	2.4706	-.026887	-1.462E-08	4464.4080	-.009798
364.080	6.81E-08	2.2589	-.060666	-1.104E-08	4464.3975	-.005417

368.520	2.67E-08	1.9392	-.077460	-7.856E-09	4464.3817	-.002148
372.960	-1.70E-09	1.5762	-.081920	-5.192E-09	4464.3637	1.390E-04
377.400	-1.94E-08	1.2152	-.078046	-3.076E-09	4464.3459	.001606
381.840	-2.90E-08	.8853	-.069095	-1.484E-09	4464.3295	.002426
386.280	-3.26E-08	.6027	-.057583	-3.562E-10	4464.3155	.002760
390.720	-3.22E-08	.3742	-.045342	3.842E-10	4464.3042	.002754
395.160	-2.92E-08	.1998	-.033611	8.192E-10	4464.2956	.002530
399.600	-2.49E-08	.075140	-.023153	1.028E-09	4464.2894	.002181
404.040	-2.01E-08	-.006517	-.014359	1.080E-09	4464.2860	.001780
408.480	-1.53E-08	-.053085	-.007361	1.034E-09	4464.2883	.001372
412.920	-1.09E-08	-.072571	-.002121	9.391E-10	4464.2893	9.879E-04
417.360	-6.98E-09	-.072545	.001491	8.291E-10	4464.2893	6.393E-04
421.800	-3.54E-09	-.059880	.003234	7.288E-10	4464.2887	1.456E-04
426.240	-5.09E-10	-.044315	.003604	6.498E-10	4464.2879	2.120E-05
430.680	2.23E-09	-.028309	.003442	5.948E-10	4464.2871	-9.397E-05
435.120	4.77E-09	-.014141	.002781	5.626E-10	4464.2864	-2.040E-04
439.560	7.22E-09	-.003989	.001634	5.488E-10	4464.2859	-3.128E-04
444.000	9.65E-09	0.0000	0.0000	5.458E-10	4464.2857	-4.231E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	-.01448557
Maximum bending moment	=	572249.554 lbs-in
Maximum shear force	=	17637.120 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .900000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	0.0000	18804.3278	-.016088	4464.2857	-159.1388
4.440	.828570	87279.8396	18047.8526	-.016022	8785.0699	-181.6157
8.880	.757728	1.709E+05	17165.3297	-.015826	12926.4304	-215.9171
13.320	.688036	2.502E+05	16124.9962	-.015507	16852.8013	-252.7016
17.760	.620029	3.245E+05	14910.4572	-.015071	20526.3019	-294.3881

22.200	.554205	3.927E+05	13502.8644	-.014528	23904.3952	-339.6628
26.640	.491024	4.540E+05	11887.1516	-.013886	26941.1915	-388.1358
31.080	.430900	5.075E+05	10049.1183	-.013157	29587.8520	-439.8072
35.520	.374190	5.520E+05	7976.4118	-.012354	31792.6134	-493.8444
39.960	.321197	5.866E+05	5789.8345	-.011491	33501.6269	-491.1004
44.400	.272151	6.111E+05	3627.0773	-.010583	34716.7076	-483.1146
48.840	.227218	6.258E+05	1509.7246	-.009646	35445.0358	-470.6479
53.280	.186497	6.309E+05	-544.3451	-.008693	35698.4102	-454.6087
57.720	.150023	6.268E+05	-2520.2499	-.007740	35492.3560	-435.4385
62.160	.117767	6.137E+05	-4396.9267	-.006800	34845.6857	-409.9115
66.600	.089641	5.923E+05	-6144.6479	-.005886	33783.6382	-377.3503
71.040	.065502	5.631E+05	-7732.1221	-.005010	32338.5267	-337.7282
75.480	.045152	5.269E+05	-9127.5527	-.004184	30549.7487	-290.8442
79.920	.028349	4.848E+05	-10297.0777	-.003417	28463.9622	-235.9689
84.360	.014809	4.378E+05	-11177.0433	-.002718	26135.7741	-160.4120
88.800	.004215	3.874E+05	-11638.2492	-.002092	23640.0970	-47.3384
93.240	-.003772	3.358E+05	-11645.9323	-.001544	21088.5418	43.8775
97.680	-.009499	2.850E+05	-11294.8135	-.001074	18571.4158	114.2841
102.120	-.013308	2.362E+05	-10673.8576	-6.788E-04	16158.7010	165.4258
106.560	-.015527	1.906E+05	-9864.3614	-3.553E-04	13901.5254	199.2121
111.000	-.016462	1.489E+05	-8938.6012	-9.793E-05	11834.0013	217.7970
115.440	-.016396	1.113E+05	-7958.9808	9.928E-05	9975.3097	223.4735
119.880	-.015581	78126.3865	-6977.6096	2.429E-04	8331.9286	218.5856
124.320	-.014240	49199.7607	-6036.2305	3.394E-04	6899.9174	205.4590
128.760	-.012567	24298.6365	-5166.4139	3.951E-04	5667.1885	186.3502
133.200	-.010731	3058.8804	-4094.1137	4.158E-04	4615.7154	296.6679
137.640	-.008875	-12334.0275	-2871.1662	4.088E-04	5074.8811	254.2094
142.080	-.007101	-22709.3274	-1839.5061	3.822E-04	5588.5098	210.5023
146.520	-.005480	-28923.4048	-999.3744	3.431E-04	5896.1374	167.9354
150.960	-.004054	-31812.2711	-341.7542	2.971E-04	6039.1506	128.2899
155.400	-.002843	-32156.0228	149.0300	2.486E-04	6056.1680	92.7840
159.840	-.001847	-30654.4353	492.9552	2.010E-04	5981.8320	62.1372
164.280	-.001058	-27912.4253	712.2586	1.566E-04	5846.0889	36.6481
168.720	-4.57E-04	-24433.8598	829.7528	1.169E-04	5673.8827	16.2772
173.160	-1.99E-05	-20622.0774	867.5088	8.275E-05	5485.1806	.7300
177.600	2.78E-04	-16785.4950	845.8939	5.440E-05	5295.2508	-10.4664
182.040	4.63E-04	-13146.7699	782.9349	3.171E-05	5115.1159	-17.8935
186.480	5.60E-04	-9854.1540	693.9641	1.428E-05	4952.1151	-22.1834
190.920	5.90E-04	-6993.8791	591.5004	1.510E-06	4810.5174	-23.9714
195.360	5.73E-04	-4602.6367	485.3144	-7.279E-06	4692.1390	-23.8601
199.800	5.25E-04	-2679.4399	382.6288	-1.280E-05	4596.9313	-22.3946
204.240	4.59E-04	-1196.3692	288.4089	-1.574E-05	4523.5119	-20.0468
208.680	3.86E-04	-107.8889	205.7032	-1.672E-05	4469.6267	-17.2080
213.120	3.11E-04	641.4135	136.0028	-1.632E-05	4496.0389	-14.1885
217.560	2.41E-04	1110.6853	79.5932	-1.499E-05	4519.2701	-11.2212
222.000	1.78E-04	1358.1861	35.8800	-1.312E-05	4531.5227	-8.4694
226.440	1.24E-04	1438.0383	3.6765	-1.100E-05	4535.4757	-6.0366
230.880	8.01E-05	1398.1609	-18.5534	-8.852E-06	4533.5016	-3.9769
235.320	4.55E-05	1279.1796	-32.5002	-6.823E-06	4527.6114	-2.3055
239.760	1.96E-05	1114.1025	-39.8596	-5.009E-06	4519.4393	-1.0095
244.200	1.07E-06	928.5624	-42.2252	-3.460E-06	4510.2542	-.056113
248.640	-1.12E-05	741.4474	-41.0198	-2.195E-06	4500.9910	.5991
253.080	-1.84E-05	565.7686	-37.4560	-1.204E-06	4492.2941	1.0062
257.520	-2.19E-05	409.6402	-32.5226	-4.646E-07	4484.5649	1.2160
261.960	-2.25E-05	277.2771	-26.9890	5.603E-08	4478.0123	1.2766
266.400	-2.14E-05	169.9404	-21.4221	3.950E-07	4472.6986	1.2310
270.840	-1.90E-05	86.7860	-16.2115	5.896E-07	4468.5821	1.1161

275.280	-1.61E-05	25.5894	-11.5991	6.748E-07	4465.5525	.9616
279.720	-1.30E-05	-16.6632	-7.7084	6.815E-07	4465.1106	.7909
284.160	-1.01E-05	-43.3154	-4.5740	6.361E-07	4466.4300	.6210
288.600	-7.40E-06	-57.7038	-2.1667	5.595E-07	4467.1423	.4634
293.040	-5.11E-06	-62.9285	-.4164	4.681E-07	4467.4010	.3251
297.480	-3.24E-06	-61.7127	.7707	3.736E-07	4467.3408	.2096
301.920	-1.79E-06	-56.3335	1.4972	2.841E-07	4467.0745	.1177
306.360	-7.21E-07	-48.6065	1.8651	2.046E-07	4466.6920	.048052
310.800	2.33E-08	-39.9076	1.9683	1.375E-07	4466.2613	-.001577
315.240	4.99E-07	-31.2197	1.8887	8.358E-08	4465.8312	-.034267
319.680	7.66E-07	-23.1915	1.6944	4.234E-08	4465.4338	-.053283
324.120	8.75E-07	-16.2020	1.4388	1.248E-08	4465.0878	-.061810
328.560	8.76E-07	-10.4229	1.1623	-7.698E-09	4464.8017	-.062748
333.000	8.07E-07	-5.8755	.8929	-2.005E-08	4464.5766	-.058596
337.440	6.98E-07	-2.4802	.6488	-2.638E-08	4464.4085	-.051395
341.880	5.73E-07	-.096881	.4398	-2.834E-08	4464.2905	-.042731
346.320	4.47E-07	1.4441	.2700	-2.732E-08	4464.3572	-.033767
350.760	3.30E-07	2.3187	.1389	-2.446E-08	4464.4005	-.025295
355.200	2.29E-07	2.6935	.043188	-2.067E-08	4464.4191	-.017802
359.640	1.47E-07	2.7160	-.021933	-1.657E-08	4464.4202	-.011532
364.080	8.23E-08	2.5098	-.062080	-1.260E-08	4464.4100	-.006552
368.520	3.48E-08	2.1731	-.082852	-9.055E-09	4464.3933	-.002805
372.960	1.91E-09	1.7801	-.089424	-6.059E-09	4464.3738	-1.557E-04
377.400	-1.90E-08	1.3831	-.086285	-3.661E-09	4464.3542	.001569
381.840	-3.06E-08	1.0163	-.077122	-1.843E-09	4464.3360	.002558
386.280	-3.54E-08	.6995	-.064801	-5.424E-10	4464.3203	.002992
390.720	-3.54E-08	.4413	-.051429	3.222E-10	4464.3076	.003032
395.160	-3.25E-08	.2426	-.038450	8.405E-10	4464.2977	.002815
399.600	-2.80E-08	.099253	-.026766	1.100E-09	4464.2906	.002449
404.040	-2.27E-08	.004156	-.016858	1.178E-09	4464.2859	.002014
408.480	-1.75E-08	-.051230	-.008906	1.142E-09	4464.2883	.001567
412.920	-1.26E-08	-.075691	-.002893	1.046E-09	4464.2895	.001141
417.360	-8.21E-09	-.077619	.001309	9.299E-10	4464.2896	7.516E-04
421.800	-4.34E-09	-.064690	.003373	8.221E-10	4464.2889	1.783E-04
426.240	-9.07E-10	-.048215	.003853	7.365E-10	4464.2881	3.777E-05
430.680	2.20E-09	-.030970	.003730	6.765E-10	4464.2872	-9.286E-05
435.120	5.10E-09	-.015540	.003040	6.412E-10	4464.2865	-2.180E-04
439.560	7.89E-09	-.004401	.001797	6.261E-10	4464.2859	-3.419E-04
444.000	1.07E-08	0.0000	0.0000	6.228E-10	4464.2857	-4.676E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	-.01608776
Maximum bending moment	=	630929.315 lbs-in
Maximum shear force	=	18804.328 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = 1.000000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	0.0000	19863.5486	-.017654	4464.2857	-159.1388
4.440	.921615	92504.4186	19107.0733	-.017584	9043.7124	-181.6158
8.880	.843853	1.814E+05	18224.5499	-.017377	13443.5848	-215.9173
13.320	.767311	2.659E+05	17184.2154	-.017038	17628.2064	-252.7019
17.760	.692560	3.453E+05	15969.6746	-.016574	21559.5660	-294.3886
22.200	.620132	4.188E+05	14562.0789	-.015995	25194.9962	-339.6636
26.640	.550523	4.853E+05	12946.3617	-.015310	28488.4772	-388.1370
31.080	.484180	5.439E+05	11108.3218	-.014530	31391.0400	-439.8089
35.520	.421498	5.936E+05	9033.7577	-.013668	33850.7920	-494.6795
39.960	.362812	6.332E+05	6739.4810	-.012738	35812.9421	-538.7785
44.400	.308387	6.619E+05	4368.4975	-.011756	37233.4626	-529.2321
48.840	.258417	6.799E+05	2051.3574	-.010739	38120.9531	-514.5247
53.280	.213024	6.873E+05	-191.1968	-.009703	38489.3189	-495.6349
57.720	.172256	6.846E+05	-2343.0539	-.008663	38356.8088	-473.6701
62.160	.136096	6.723E+05	-4388.2729	-.007635	37744.9258	-447.5997
66.600	.104461	6.507E+05	-6301.3364	-.006632	36679.4213	-414.1407
71.040	.077205	6.207E+05	-8049.3065	-.005668	35193.4866	-373.2333
75.480	.054128	5.830E+05	-9598.8187	-.004756	33327.7940	-324.7452
79.920	.034974	5.387E+05	-10914.9705	-.003906	31130.6060	-268.1160
84.360	.019446	4.887E+05	-11957.5404	-.003127	28658.2972	-201.5101
88.800	.007208	4.346E+05	-12584.6203	-.002427	25977.1177	-80.9583
93.240	-.002106	3.786E+05	-12709.9660	-.001811	23206.0698	24.4963
97.680	-.008872	3.229E+05	-12418.6248	-.001279	20449.4679	106.7385
102.120	-.013464	2.692E+05	-11810.0991	-8.303E-04	17788.9651	167.3722
106.560	-.016245	2.186E+05	-10975.8113	-4.607E-04	15285.0782	208.4331
111.000	-.017555	1.720E+05	-9997.4874	-1.646E-04	12979.1434	232.2533
115.440	-.017707	1.299E+05	-8946.1059	6.420E-05	10895.5711	241.3420
119.880	-.016985	92515.9482	-7881.3328	2.328E-04	9044.2832	238.2856
124.320	-.015640	59770.6962	-6851.3571	3.482E-04	7423.2311	225.6674
128.760	-.013893	31443.9901	-5893.0350	4.173E-04	6020.9189	206.0092
133.200	-.011934	7162.5947	-4703.2678	4.466E-04	4818.8696	329.9220
137.640	-.009927	-10618.4663	-3339.5752	4.440E-04	4989.9524	284.3540
142.080	-.007991	-22788.5271	-2182.4038	4.187E-04	5592.4306	236.8944
146.520	-.006209	-30277.0425	-1234.1042	3.784E-04	5963.1492	190.2675
150.960	-.004631	-33999.4166	-486.4189	3.297E-04	6147.4252	146.5277
155.400	-.003281	-34816.0404	76.6420	2.776E-04	6187.8521	107.1034
159.840	-.002166	-33503.6966	476.1724	2.258E-04	6122.8846	72.8653
164.280	-.001276	-30738.0032	736.0792	1.771E-04	5985.9690	44.2098
168.720	-5.93E-04	-27085.2592	881.1765	1.333E-04	5805.1401	21.1493
173.160	-9.29E-05	-23001.9132	935.6832	9.531E-05	5602.9943	3.4032
177.600	2.53E-04	-18839.8667	922.1116	6.359E-05	5396.9524	-9.5166

182.040	4.72E-04	-14855.9155	860.5181	3.805E-05	5199.7271	-18.2282
186.480	5.91E-04	-11223.8095	768.0712	1.829E-05	5019.9198	-23.4145
190.920	6.34E-04	-8047.6227	658.8835	3.680E-06	4862.6829	-25.7691
195.360	6.23E-04	-5375.3750	544.0550	-6.494E-06	4730.3934	-25.9555
199.800	5.77E-04	-3212.0893	431.8707	-1.300E-05	4623.3000	-24.5780
204.240	5.08E-04	-1531.7038	328.1041	-1.660E-05	4540.1126	-22.1636
208.680	4.29E-04	-287.4704	236.3829	-1.798E-05	4478.5169	-19.1522
213.120	3.48E-04	579.3486	158.5780	-1.776E-05	4492.9663	-15.8950
217.560	2.71E-04	1132.5271	95.1899	-1.646E-05	4520.3514	-12.6582
222.000	2.02E-04	1435.5956	45.7084	-1.451E-05	4535.3548	-9.6308
226.440	1.43E-04	1548.0822	8.9328	-1.225E-05	4540.9234	-6.9348
230.880	9.34E-05	1523.0777	-16.7560	-9.922E-06	4539.6856	-4.6368
235.320	5.45E-05	1405.8968	-33.1756	-7.702E-06	4533.8846	-2.7594
239.760	2.50E-05	1233.6080	-42.1715	-5.702E-06	4525.3554	-1.2928
244.200	3.88E-06	1035.2115	-45.4945	-3.982E-06	4515.5338	-.2041
248.640	-1.03E-05	832.2684	-44.7195	-2.567E-06	4505.4871	.5532
253.080	-1.89E-05	639.8113	-41.1982	-1.451E-06	4495.9595	1.0330
257.520	-2.32E-05	467.3947	-36.0403	-6.117E-07	4487.4241	1.2904
261.960	-2.43E-05	320.1806	-30.1158	-1.475E-08	4480.1362	1.3783
266.400	-2.33E-05	199.9759	-24.0717	3.795E-07	4474.1855	1.3443
270.840	-2.10E-05	106.1712	-18.3581	6.115E-07	4469.5417	1.2294
275.280	-1.79E-05	36.5489	-13.2596	7.197E-07	4466.0951	1.0672
279.720	-1.46E-05	-12.0536	-8.9281	7.383E-07	4464.8824	.8839
284.160	-1.13E-05	-43.2245	-5.4139	6.964E-07	4466.4255	.6990
288.600	-8.40E-06	-60.5929	-2.6945	6.177E-07	4467.2854	.5259
293.040	-5.86E-06	-67.5633	-.6994	5.206E-07	4467.6304	.3728
297.480	-3.78E-06	-67.1501	.6700	4.184E-07	4467.6100	.2440
301.920	-2.15E-06	-61.8922	1.5242	3.206E-07	4467.3497	.1407
306.360	-9.30E-07	-53.8287	1.9741	2.329E-07	4466.9505	.061928
310.800	-7.67E-08	-44.5172	2.1231	1.584E-07	4466.4895	.005184
315.240	4.77E-07	-35.0810	2.0620	9.806E-08	4466.0224	-.032709
319.680	7.94E-07	-26.2720	1.8667	5.156E-08	4465.5863	-.055274
324.120	9.35E-07	-18.5393	1.5975	1.760E-08	4465.2035	-.065988
328.560	9.50E-07	-12.0981	1.2999	-5.623E-09	4464.8846	-.068049
333.000	8.85E-07	-6.9923	1.0062	-2.009E-08	4464.6319	-.064230
337.440	7.72E-07	-3.1492	.7375	-2.778E-08	4464.4416	-.056816
341.880	6.38E-07	-.4246	.5057	-3.049E-08	4464.3067	-.047596
346.320	5.01E-07	1.3620	.3159	-2.978E-08	4464.3531	-.037892
350.760	3.74E-07	2.4008	.1683	-2.693E-08	4464.4046	-.028617
355.200	2.62E-07	2.8744	.059612	-2.293E-08	4464.4280	-.020340
359.640	1.70E-07	2.9455	-.015207	-1.852E-08	4464.4315	-.013362
364.080	9.77E-08	2.7517	-.062135	-1.420E-08	4464.4219	-.007777
368.520	4.39E-08	2.4032	-.087260	-1.029E-08	4464.4047	-.003540
372.960	6.32E-09	1.9837	-.096264	-6.966E-09	4464.3839	-5.159E-04
377.400	-1.79E-08	1.5530	-.094122	-4.286E-09	4464.3626	.001481
381.840	-3.17E-08	1.1507	-.084946	-2.236E-09	4464.3427	.002653
386.280	-3.78E-08	.8002	-.071960	-7.578E-10	4464.3253	.003197
390.720	-3.85E-08	.5122	-.057555	2.368E-10	4464.3111	.003292
395.160	-3.57E-08	.2889	-.043387	8.440E-10	4464.3000	.003090
399.600	-3.10E-08	.1264	-.030505	1.159E-09	4464.2920	.002712
404.040	-2.54E-08	.017246	-.019489	1.268E-09	4464.2866	.002250
408.480	-1.97E-08	-.047537	-.010574	1.245E-09	4464.2881	.001766
412.920	-1.43E-08	-.077484	-.003770	1.150E-09	4464.2896	.001299
417.360	-9.50E-09	-.081776	.001047	1.029E-09	4464.2898	8.700E-04
421.800	-5.21E-09	-.068875	.003453	9.150E-10	4464.2891	2.139E-04
426.240	-1.37E-09	-.051723	.004055	8.236E-10	4464.2883	5.724E-05
430.680	2.11E-09	-.033417	.003984	7.591E-10	4464.2874	-8.896E-05

435.120	5.37E-09	-.016847	.003278	7.210E-10	4464.2865	-2.294E-04
439.560	8.51E-09	-.004792	.001950	7.046E-10	4464.2860	-3.686E-04
444.000	1.16E-08	0.0000	0.0000	7.010E-10	4464.2857	-5.098E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.01765424
Maximum bending moment	=	687305.670 lbs-in
Maximum shear force	=	19863.549 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .100000	M= 0.000	75000.0000	.100000	97015.5129	4011.8234
4	y= .200000	M= 0.000	75000.0000	.2000	1.753E+05	6684.6030
4	y= .300000	M= 0.000	75000.0000	.3000	2.484E+05	9060.4559
4	y= .400000	M= 0.000	75000.0000	.4000	3.177E+05	11307.3307
4	y= .500000	M= 0.000	75000.0000	.5000	3.844E+05	13262.2873
4	y= .600000	M= 0.000	75000.0000	.6000	4.485E+05	14905.1218
4	y= .700000	M= 0.000	75000.0000	.7000	5.116E+05	16356.1887
4	y= .800000	M= 0.000	75000.0000	.8000	5.722E+05	17637.1198
4	y= .900000	M= 0.000	75000.0000	.9000	6.309E+05	18804.3278
4	y= 1.000	M= 0.000	75000.0000	1.0000	6.873E+05	19863.5486

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = .10000 in
Moment = 0. in-lbs
Axial Load = 75000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
444.000	.10000000	97015.513	4011.823
421.800	.10000000	96901.608	4011.504
399.600	.10000000	97044.680	4011.398
377.400	.10000000	96952.967	4013.243
355.200	.10000000	96972.630	4013.165
333.000	.10000000	97047.562	4014.955
310.800	.10000000	97050.526	4015.779
288.600	.10000000	97031.865	4015.604
266.400	.10000000	96985.223	4015.981
244.200	.10000000	97041.802	4015.617

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Abut_B20_ Fixed.lpd
Name of output file: ArroyoMocho_Abut_B20_ Fixed.lpo
Name of plot output file: ArroyoMocho_Abut_B20_ Fixed.lpp
Name of runtime file: ArroyoMocho_Abut_B20_ Fixed.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:37:25

Problem Title

SR84 Isabel Abutment - Arroyo Mocho Bridge Widen - H pile - Weak Axis

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 492.00 in
Depth of ground surface below top of pile = -36.00 in
Slope angle of ground surface = 21.80 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	492.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -36.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is stiff clay without free water
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 432.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 432.000 in
Distance from top of pile to bottom of layer = 1092.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 600.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.07230
2	132.00	.07230
3	132.00	.07810
4	420.00	.07810
5	420.00	.04200
6	432.00	.04200
7	432.00	.04200
8	1092.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	.00000	32.00	------	------
2	132.000	.00000	32.00	------	------
3	132.000	.00000	40.00	------	------
4	420.000	.00000	40.00	------	------
5	420.000	20.83300	.00	.00500	.0
6	432.000	20.83300	.00	.00500	.0
7	432.000	20.83300	.00	.00500	.0
8	1092.000	20.83300	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .100 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .200 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .300 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .400 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .500 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .600 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

```
Deflection at pile head     =            .700 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .800 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .900 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           1.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs
```

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	96.000

Depth of ground surface below top of pile = -36.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =            1
Depth below pile head       =       60.000 in
Depth below ground surface  =       96.000 in
Equivalent Depth (see note) =       96.000 in
Pile Diameter               =       10.000 in
Angle of Friction           =       32.000 deg.
Avg. Eff. Unit Weight       =       .07230 lbs/in**3
k                           =       90.000 pci
A (static)                  =        .8800
B (static)                  =        .5000
Pst                         =      788.251 lbs/in
```

Psd	=	2555.186	lbs/in
Ps	=	788.251	lbs/in
pu	=	693.660	lbs/in
Cbar	=	1171.5214	
n	=	1.6447	
m	=	1437.7689	
yk	=	.0061	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	86.995
.0278	132.592
.0417	169.661
.0556	202.090
.0694	231.455
.0833	258.588
.0972	283.996
.1111	308.014
.1250	330.881
.1389	352.770
.1528	373.817
.1667	394.125
.3750	693.660
10.3750	693.660
20.3750	693.660
30.3750	693.660

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	-2.568E+05	8233.4752	0.0000	17176.1846	-63.6751
4.920	.098939	-2.170E+05	7913.7151	-3.979E-04	15205.0160	-66.3086

9.840	.096085	-1.786E+05	7562.8855	-7.301E-04	13306.6501	-76.3050
14.760	.091755	-1.420E+05	7164.4218	-9.994E-04	11494.2425	-85.6721
19.680	.086251	-1.074E+05	6714.2610	-.001209	9780.1416	-97.3201
24.600	.079859	-75044.6614	6208.8005	-.001362	8179.3680	-108.1516
29.520	.072848	-45280.4814	5652.9274	-.001463	6705.8937	-117.8130
34.440	.065462	-18340.0649	5053.2014	-.001517	5372.2097	-125.9780
39.360	.057925	5562.2452	4417.6997	-.001527	4739.6444	-132.3560
44.280	.050434	26257.2453	3755.8219	-.001501	5764.1493	-136.7000
49.200	.043159	43626.9550	3078.0599	-.001442	6624.0360	-138.8130
54.120	.036245	57609.4602	2395.7402	-.001357	7316.2392	-138.5527
59.040	.029808	68202.3951	1720.7481	-.001251	7840.6419	-135.8343
63.960	.023934	75464.9965	1065.2451	-.001131	8200.1766	-130.6303
68.880	.018683	79518.7324	441.3980	-.001000	8400.8566	-122.9660
73.800	.014090	80546.6151	-138.8521	-8.659E-04	8451.7419	-112.9080
78.720	.010163	78791.4766	-663.9334	-7.321E-04	8364.8539	-100.5397
83.640	.006886	74553.7971	-1093.6721	-6.033E-04	8155.0677	-74.1509
88.560	.004226	68474.9815	-1392.6342	-4.832E-04	7854.1363	-47.3784
93.480	.002132	61206.8617	-1570.3033	-3.743E-04	7494.3284	-24.8447
98.400	5.44E-04	53299.4021	-1647.5958	-2.781E-04	7102.8700	-6.5750
103.320	-6.04E-04	45199.7496	-1645.1274	-1.954E-04	6701.8971	7.5784
108.240	-.001379	37255.5256	-1582.4530	-1.261E-04	6308.6187	17.8991
113.160	-.001845	29721.4814	-1477.4815	-6.986E-05	5935.6462	24.7723
118.080	-.002066	22768.6628	-1346.0566	-2.577E-05	5591.4472	28.6525
123.000	-.002099	16495.3042	-1201.6842	7.204E-06	5280.8849	30.0355
127.920	-.001995	10938.7738	-1055.3831	3.025E-05	5005.8092	29.4364
132.840	-.001801	6088.0136	-869.9009	4.455E-05	4765.6725	45.9628
137.760	-.001557	2346.0744	-654.8600	5.163E-05	4580.4280	41.4521
142.680	-.001293	-393.9117	-464.6651	5.327E-05	4483.7863	35.8629
147.600	-.001033	-2265.5424	-303.1747	5.104E-05	4576.4413	29.7836
152.520	-7.91E-04	-3414.8146	-171.6335	4.626E-05	4633.3359	23.6884
157.440	-5.78E-04	-3988.5597	-69.2418	4.005E-05	4661.7392	17.9343
162.360	-3.97E-04	-4125.7088	6.2844	3.323E-05	4668.5287	12.7675
167.280	-2.51E-04	-3951.2467	58.1968	2.645E-05	4659.8920	8.3351
172.200	-1.37E-04	-3572.5715	90.2657	2.013E-05	4641.1457	4.7010
177.120	-5.25E-05	-3077.8873	106.4119	1.454E-05	4616.6564	1.8625
182.040	6.34E-06	-2536.2115	110.4228	9.828E-06	4589.8407	-.2320
186.960	4.42E-05	-1998.5799	105.7520	6.020E-06	4563.2253	-1.6667
191.880	6.56E-05	-1500.0540	95.3929	3.081E-06	4538.5458	-2.5444
196.800	7.45E-05	-1062.1880	81.8163	9.293E-07	4516.8693	-2.9746
201.720	7.47E-05	-695.6674	66.9599	-5.471E-07	4498.7247	-3.0646
206.640	6.92E-05	-402.8987	52.2553	-1.470E-06	4484.2312	-2.9129
211.560	6.03E-05	-180.3902	38.6817	-1.960E-06	4473.2159	-2.6049
216.480	4.99E-05	-20.8242	26.8345	-2.129E-06	4465.3166	-2.2111
221.400	3.93E-05	85.2325	17.0006	-2.075E-06	4468.5051	-1.7865
226.320	2.95E-05	147.9925	9.2325	-1.879E-06	4471.6121	-1.3713
231.240	2.08E-05	177.4672	3.4176	-1.605E-06	4473.0712	-.9925
236.160	1.37E-05	182.8060	-.6630	-1.303E-06	4473.3355	-.6662
241.080	8.01E-06	171.9044	-3.2845	-1.005E-06	4472.7958	-.3994
246.000	3.78E-06	151.2285	-4.7404	-7.334E-07	4471.7723	-.1925
250.920	7.92E-07	125.7999	-5.3154	-5.007E-07	4470.5134	-.041257
255.840	-1.15E-06	99.2948	-5.2662	-3.117E-07	4469.2013	.061254
260.760	-2.27E-06	74.2108	-4.8117	-1.659E-07	4467.9595	.1235
265.680	-2.78E-06	52.0705	-4.1283	-5.988E-08	4466.8635	.1543
270.600	-2.86E-06	33.6324	-3.3507	1.210E-08	4465.9507	.1618
275.520	-2.67E-06	19.0911	-2.5747	5.638E-08	4465.2308	.1536
280.440	-2.31E-06	8.2556	-1.8633	7.935E-08	4464.6944	.1356
285.360	-1.88E-06	.6974	-1.2524	8.687E-08	4464.3202	.1128

290.280	-1.45E-06	-4.1317	-.7569	8.398E-08	4464.4903	.088625
295.200	-1.06E-06	-6.8130	-.3774	7.479E-08	4464.6230	.065656
300.120	-7.18E-07	-7.9007	-.1043	6.243E-08	4464.6768	.045366
305.040	-4.44E-07	-7.8853	.077463	4.918E-08	4464.6761	.028520
309.960	-2.34E-07	-7.1747	.1853	3.653E-08	4464.6409	.015325
314.880	-8.44E-08	-6.0887	.2368	2.539E-08	4464.5871	.005609
319.800	1.54E-08	-4.8631	.2481	1.619E-08	4464.5265	-.001039
324.720	7.49E-08	-3.6597	.2328	9.032E-09	4464.4669	-.005147
329.640	1.04E-07	-2.5786	.2023	3.792E-09	4464.4134	-.007276
334.560	1.12E-07	-1.6720	.1648	2.223E-10	4464.3685	-.007958
339.480	1.06E-07	-.9570	.1264	-1.986E-09	4464.3331	-.007664
344.400	9.27E-08	-.4269	.090856	-3.148E-09	4464.3068	-.006778
349.320	7.55E-08	-.060611	.060404	-3.557E-09	4464.2887	-.005600
354.240	5.77E-08	.1701	.035934	-3.465E-09	4464.2941	-.004347
359.160	4.14E-08	.2955	.017465	-3.074E-09	4464.3003	-.003161
364.080	2.75E-08	.3442	.004452	-2.537E-09	4464.3028	-.002129
369.000	1.64E-08	.3412	-.003955	-1.961E-09	4464.3026	-.001289
373.920	8.15E-09	.3068	-.008726	-1.417E-09	4464.3009	-6.502E-04
378.840	2.45E-09	.2564	-.010813	-9.439E-10	4464.2984	-1.980E-04
383.760	-1.14E-09	.2011	-.011071	-5.597E-10	4464.2957	9.316E-05
388.680	-3.06E-09	.1479	-.010216	-2.667E-10	4464.2930	2.542E-04
393.600	-3.76E-09	.1007	-.008812	-5.784E-11	4464.2907	3.166E-04
398.520	-3.63E-09	.061208	-.007272	7.818E-11	4464.2887	3.095E-04
403.440	-2.99E-09	.029127	-.005875	1.540E-10	4464.2872	2.584E-04
408.360	-2.11E-09	.003285	-.004784	1.813E-10	4464.2859	1.849E-04
413.280	-1.21E-09	-.018085	-.004066	1.688E-10	4464.2866	1.070E-04
418.200	-4.51E-10	-.036853	-.003704	1.227E-10	4464.2875	4.050E-05
423.120	-5.99E-17	-.054619	.003749	4.587E-11	4464.2884	.002989
428.040	4.53E-17	-1.821E-08	.005551	6.092E-18	4464.2857	-.002256
432.960	2.42E-23	5.476E-09	1.850E-09	-4.599E-18	4464.2857	-1.204E-09
437.880	-4.54E-24	4.021E-15	-5.565E-10	-2.455E-24	4464.2857	2.262E-10
442.800	0.000	-5.490E-16	-4.086E-16	4.611E-25	4464.2857	2.115E-16
447.720	0.000	-6.233E-22	5.579E-17	0.0000	4464.2857	-2.268E-17
452.640	0.000	5.504E-23	6.334E-23	0.0000	4464.2857	-3.029E-23
457.560	0.000	0.0000	-5.594E-24	0.0000	4464.2857	2.274E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-256780.357 lbs-in
Maximum shear force	=	8233.475 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7

Number of zero deflection points = 13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .200000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	-4.616E+05	13882.4579	0.0000	27317.7125	-89.2458
4.920	.198092	-3.943E+05	13420.9364	-7.189E-04	23982.8312	-98.3645
9.840	.192926	-3.290E+05	12895.6766	-.001326	20753.7256	-115.1557
14.760	.185041	-2.664E+05	12289.1300	-.001826	17652.5187	-131.4079
19.680	.174954	-2.068E+05	11597.7271	-.002224	14700.6082	-149.6502
24.600	.163158	-1.506E+05	10818.7990	-.002524	11921.6842	-166.9873
29.520	.150117	-98453.9752	9958.1823	-.002733	9338.2449	-182.8569
34.440	.136263	-50633.7837	9024.3984	-.002858	6970.9087	-196.7300
39.360	.121990	-7544.3341	8028.3634	-.002907	4837.7676	-208.1622
44.280	.107654	30510.9332	6983.0477	-.002888	5974.7280	-216.7628
49.200	.093571	63300.2410	5903.1882	-.002809	7597.9610	-222.2044
54.120	.080011	90671.5444	4804.9576	-.002680	8952.9760	-224.2308
59.040	.067201	1.126E+05	3705.5992	-.002509	10036.5049	-222.6629
63.960	.055320	1.290E+05	2623.0404	-.002306	10849.7548	-217.4017
68.880	.044506	1.401E+05	1575.4983	-.002080	11398.5264	-208.4284
73.800	.034849	1.460E+05	581.1022	-.001840	11693.2326	-195.7977
78.720	.026399	1.471E+05	-342.4361	-.001594	11748.8265	-179.6243
83.640	.019165	1.438E+05	-1178.0413	-.001350	11584.6548	-160.0525
88.560	.013120	1.366E+05	-1909.2675	-.001114	11224.2728	-137.1939
93.480	.008203	1.259E+05	-2481.9119	-8.936E-04	10695.2964	-95.5883
98.400	.004326	1.128E+05	-2845.7904	-6.932E-04	10047.9107	-52.3298
103.320	.001382	98375.4106	-3017.1435	-5.158E-04	9334.3555	-17.3260
108.240	-7.50E-04	83481.2206	-3035.8265	-3.631E-04	8597.0194	9.7312
113.160	-.002191	68770.8443	-2939.5288	-2.352E-04	7868.7830	29.4142
118.080	-.003064	54729.8533	-2762.6388	-1.315E-04	7173.6844	42.4923
123.000	-.003485	41683.5250	-2535.4247	-5.052E-05	6527.8266	49.8712
127.920	-.003561	29818.5611	-2283.4921	9.529E-06	5940.4521	52.5405
132.840	-.003391	19206.9310	-1941.3695	5.070E-05	5415.1239	86.5337
137.760	-.003062	10678.0658	-1527.9246	7.580E-05	4992.9028	81.5333
142.680	-.002645	4116.2094	-1146.8929	8.823E-05	4668.0585	73.3577
147.600	-.002194	-672.4730	-810.7699	9.112E-05	4497.5765	63.2777
152.520	-.001749	-3929.0141	-526.2881	8.726E-05	4658.7914	52.3653
157.440	-.001336	-5915.5432	-295.4411	7.899E-05	4757.1344	41.4749
162.360	-9.72E-04	-6894.4483	-116.5575	6.823E-05	4805.5950	31.2420
167.280	-6.64E-04	-7112.8227	14.6598	5.647E-05	4816.4056	22.0983
172.200	-4.16E-04	-6791.8674	104.1873	4.479E-05	4800.5168	14.2950
177.120	-2.24E-04	-6120.6720	158.8685	3.394E-05	4767.2893	7.9331
182.040	-8.19E-05	-5253.6502	185.7548	2.439E-05	4724.3674	2.9962

186.960	1.64E-05	-4310.8440	191.6057	1.636E-05	4677.6938	-.6178
191.880	7.90E-05	-3380.3208	182.5407	9.896E-06	4631.6283	-3.0671
196.800	1.14E-04	-2521.9470	163.8263	4.939E-06	4589.1346	-4.5403
201.720	1.28E-04	-1771.9153	139.7776	1.333E-06	4552.0043	-5.2356
206.640	1.27E-04	-1147.5195	113.7501	-1.119E-06	4521.0936	-5.3447
211.560	1.17E-04	-651.7888	88.1982	-2.630E-06	4496.5525	-5.0422
216.480	1.01E-04	-277.7077	64.7781	-3.411E-06	4478.0336	-4.4782
221.400	8.31E-05	-11.8555	44.4745	-3.654E-06	4464.8726	-3.7753
226.320	6.51E-05	162.6183	27.7382	-3.527E-06	4472.3361	-3.0281
231.240	4.84E-05	263.6920	14.6187	-3.169E-06	4477.3398	-2.3051
236.160	3.39E-05	308.8051	4.8859	-2.689E-06	4479.5731	-1.6514
241.080	2.19E-05	313.7535	-1.8647	-2.166E-06	4479.8181	-1.0928
246.000	1.26E-05	292.0546	-6.1274	-1.657E-06	4478.7439	-.6400
250.920	5.61E-06	254.6830	-8.4204	-1.198E-06	4476.8938	-.2922
255.840	7.69E-07	210.0816	-9.2397	-8.073E-07	4474.6858	-.040903
260.760	-2.34E-06	164.3599	-9.0284	-4.929E-07	4472.4223	.1268
265.680	-4.08E-06	121.6055	-8.1603	-2.527E-07	4470.3058	.2261
270.600	-4.82E-06	84.2485	-6.9339	-7.979E-08	4468.4564	.2725
275.520	-4.87E-06	53.4349	-5.5739	3.585E-08	4466.9310	.2804
280.440	-4.47E-06	29.3749	-4.2386	1.054E-07	4465.7399	.2624
285.360	-3.83E-06	11.6491	-3.0295	1.399E-07	4464.8624	.2291
290.280	-3.09E-06	-.5387	-2.0023	1.492E-07	4464.3124	.1885
295.200	-2.36E-06	-8.1642	-1.1784	1.419E-07	4464.6899	.1465
300.120	-1.70E-06	-12.2389	-.5545	1.247E-07	4464.8916	.1071
305.040	-1.13E-06	-13.7127	-.1118	1.029E-07	4464.9646	.072826
309.960	-6.83E-07	-13.4151	.1772	8.016E-08	4464.9498	.044676
314.880	-3.45E-07	-12.0278	.3435	5.879E-08	4464.8811	.022901
319.800	-1.05E-07	-10.0786	.4173	4.022E-08	4464.7847	.007093
324.720	5.13E-08	-7.9515	.4260	2.508E-08	4464.6794	-.003524
329.640	1.42E-07	-5.9048	.3930	1.344E-08	4464.5780	-.009901
334.560	1.84E-07	-4.0941	.3366	5.046E-09	4464.4884	-.013018
339.480	1.92E-07	-2.5960	.2707	-5.729E-10	4464.4142	-.013790
344.400	1.78E-07	-1.4301	.2048	-3.954E-09	4464.3565	-.013012
349.320	1.53E-07	-.5782	.1449	-5.641E-09	4464.3143	-.011326
354.240	1.22E-07	-2.064E-04	.094335	-6.127E-09	4464.2857	-.009224
359.160	9.23E-08	.3545	.054286	-5.829E-09	4464.3033	-.007056
364.080	6.51E-08	.5383	.024513	-5.079E-09	4464.3124	-.005047
369.000	4.23E-08	.5995	.003907	-4.124E-09	4464.3154	-.003329
373.920	2.45E-08	.5798	-.009091	-3.133E-09	4464.3144	-.001955
378.840	1.15E-08	.5124	-.016186	-2.216E-09	4464.3111	-9.291E-04
383.760	2.70E-09	.4221	-.019016	-1.431E-09	4464.3066	-2.216E-04
388.680	-2.60E-09	.3263	-.019031	-8.028E-10	4464.3019	2.156E-04
393.600	-5.20E-09	.2355	-.017424	-3.310E-10	4464.2974	4.375E-04
398.520	-5.85E-09	.1551	-.015120	-3.001E-12	4464.2934	4.992E-04
403.440	-5.23E-09	.086679	-.012781	2.000E-10	4464.2900	4.516E-04
408.360	-3.88E-09	.029159	-.010834	2.973E-10	4464.2872	3.399E-04
413.280	-2.30E-09	-.020152	-.009497	3.049E-10	4464.2867	2.039E-04
418.200	-8.84E-10	-.064516	-.008800	2.338E-10	4464.2889	7.928E-05
423.120	-1.24E-16	-.1069	.006563	8.980E-11	4464.2910	.006166
428.040	8.86E-17	-3.640E-08	.010866	1.257E-17	4464.2857	-.004417
432.960	4.79E-23	1.072E-08	3.699E-09	-9.003E-18	4464.2857	-2.389E-09
437.880	-8.88E-24	7.948E-15	-1.089E-09	-4.870E-24	4464.2857	4.428E-10
442.800	0.000	-1.075E-15	-8.077E-16	9.027E-25	4464.2857	4.171E-16
447.720	0.000	-1.228E-21	1.092E-16	0.0000	4464.2857	-4.440E-17
452.640	0.000	1.078E-22	1.248E-22	0.0000	4464.2857	-5.962E-23
457.560	0.000	0.0000	-1.095E-23	0.0000	4464.2857	4.451E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-461639.221 lbs-in
Maximum shear force	=	13882.458 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .300000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	-6.518E+05	18979.3831	0.0000	36733.8670	-112.7447
4.920	.297306	-5.596E+05	18386.7623	-.001017	32168.7180	-128.1581
9.840	.289988	-4.702E+05	17699.6096	-.001882	27739.9735	-151.1723
14.760	.278784	-3.841E+05	16900.8592	-.002600	23477.9573	-173.5230
19.680	.264405	-3.019E+05	15989.2477	-.003176	19412.0949	-197.0508
24.600	.247532	-2.244E+05	14965.6070	-.003618	15573.1006	-219.0633
29.520	.228803	-1.520E+05	13838.6938	-.003934	11989.7322	-239.0315
34.440	.208819	-85321.8489	12619.5614	-.004134	8688.1396	-256.5508
39.360	.188129	-24786.9636	11320.9107	-.004226	5691.3631	-271.3560
44.280	.167234	29194.7328	9956.3821	-.004222	5909.5695	-283.3304
49.200	.146581	76299.9248	8541.2478	-.004134	8241.5097	-291.9275
54.120	.126558	1.163E+05	7094.1368	-.003972	10221.2813	-296.3290
59.040	.107497	1.490E+05	5636.3296	-.003749	11842.3826	-296.2755
63.960	.089667	1.745E+05	4190.1466	-.003477	13103.8729	-291.6038
68.880	.073279	1.928E+05	2778.4691	-.003169	14010.5687	-282.2489
73.800	.058485	2.042E+05	1424.2630	-.002835	14573.1183	-268.2414
78.720	.045379	2.089E+05	150.1327	-.002488	14807.9586	-249.6977

83.640	.033999	2.075E+05	-1022.0474	-.002139	14737.1656	-226.7982
88.560	.024335	2.005E+05	-2071.3399	-.001796	14388.2246	-199.7434
93.480	.016327	1.885E+05	-2977.6143	-.001469	13793.7726	-168.6608
98.400	.009876	1.722E+05	-3686.3975	-.001166	12991.4254	-119.4624
103.320	.004849	1.530E+05	-4129.8524	-8.932E-04	12040.6367	-60.8038
108.240	.001087	1.323E+05	-4314.1461	-6.536E-04	11012.2885	-14.1124
113.160	-.001582	1.111E+05	-4296.6214	-4.492E-04	9962.9703	21.2362
118.080	-.003333	90322.4069	-4130.6816	-2.800E-04	8935.6920	46.2190
123.000	-.004338	70634.1964	-3864.2890	-1.449E-04	7961.0281	62.0707
127.920	-.004758	52404.7127	-3538.9027	-4.153E-05	7058.5784	70.2001
132.840	-.004746	35842.0398	-3068.2901	3.259E-05	6238.6441	121.1058
137.760	-.004438	22188.6860	-2479.7264	8.133E-05	5562.7355	118.1478
142.680	-.003946	11381.5110	-1919.9054	1.095E-04	5027.7269	109.4217
147.600	-.003360	3215.9877	-1412.3680	1.218E-04	4623.4930	96.8943
152.520	-.002748	-2606.0666	-971.6143	1.223E-04	4593.2989	82.2739
157.440	-.002157	-6434.9516	-604.4838	1.147E-04	4782.8477	66.9662
162.360	-.001619	-8638.8380	-311.6784	1.020E-04	4891.9510	52.0604
167.280	-.001153	-9577.1750	-89.2959	8.674E-05	4938.4033	38.3390
172.200	-7.65E-04	-9581.5265	69.7300	7.065E-05	4938.6187	26.3057
177.120	-4.57E-04	-8943.1734	174.3543	5.509E-05	4907.0171	16.2245
182.040	-2.23E-04	-7906.5396	234.3539	4.094E-05	4855.6986	8.1655
186.960	-5.44E-05	-6667.3472	259.4870	2.870E-05	4794.3524	2.0512
191.880	5.92E-05	-5374.3702	258.8778	1.859E-05	4730.3436	-2.2988
196.800	1.28E-04	-4133.7083	240.6079	1.060E-05	4668.9247	-5.1280
201.720	1.64E-04	-3014.6139	211.4882	4.600E-06	4613.5240	-6.7093
206.640	1.74E-04	-2056.0584	176.9790	3.408E-07	4566.0708	-7.3189
211.560	1.67E-04	-1273.3917	141.2223	-2.456E-06	4527.3249	-7.2164
216.480	1.50E-04	-664.6191	107.1544	-4.083E-06	4497.1876	-6.6323
221.400	1.27E-04	-215.9785	76.6689	-4.823E-06	4474.9777	-5.7602
226.320	1.02E-04	93.3625	50.8030	-4.926E-06	4468.9076	-4.7544
231.240	7.83E-05	287.5583	29.9291	-4.606E-06	4478.5213	-3.7309
236.160	5.68E-05	391.2635	13.9355	-4.036E-06	4483.6552	-2.7705
241.080	3.86E-05	427.6623	2.3875	-3.348E-06	4485.4571	-1.9238
246.000	2.39E-05	417.2274	-5.3386	-2.638E-06	4484.9405	-1.2169
250.920	1.26E-05	377.0771	-9.9485	-1.971E-06	4482.9529	-.6570
255.840	4.47E-06	320.7885	-12.1503	-1.385E-06	4480.1663	-.2380
260.760	-1.01E-06	258.5399	-12.6003	-8.985E-07	4477.0847	.055093
265.680	-4.37E-06	197.4646	-11.8696	-5.156E-07	4474.0612	.2420
270.600	-6.09E-06	142.1239	-10.4280	-2.303E-07	4471.3216	.3440
275.520	-6.63E-06	95.0229	-8.6414	-3.117E-08	4468.9898	.3822
280.440	-6.39E-06	57.1155	-6.7773	9.661E-08	4467.1132	.3755
285.360	-5.68E-06	28.2626	-5.0171	1.683E-07	4465.6849	.3400
290.280	-4.74E-06	7.6234	-3.4702	1.985E-07	4464.6631	.2887
295.200	-3.73E-06	-6.0311	-2.1906	1.998E-07	4464.5843	.2315
300.120	-2.77E-06	-14.0791	-1.1905	1.829E-07	4464.9827	.1751
305.040	-1.93E-06	-17.8803	-.4546	1.561E-07	4465.1709	.1241
309.960	-1.24E-06	-18.6675	.049434	1.254E-07	4465.2098	.080834
314.880	-6.97E-07	-17.4864	.3623	9.500E-08	4465.1514	.046329
319.800	-3.02E-07	-15.1730	.5264	6.757E-08	4465.0369	.020396
324.720	-3.20E-08	-12.3565	.5820	4.445E-08	4464.8974	.002201
329.640	1.36E-07	-9.4791	.5641	2.611E-08	4464.7550	-.009463
334.560	2.25E-07	-6.8248	.5016	1.242E-08	4464.6236	-.015944
339.480	2.58E-07	-4.5523	.4167	2.861E-09	4464.5111	-.018561
344.400	2.53E-07	-2.7262	.3256	-3.252E-09	4464.4207	-.018500
349.320	2.26E-07	-1.3463	.2388	-6.673E-09	4464.3524	-.016756
354.240	1.87E-07	-.3711	.1629	-8.115E-09	4464.3041	-.014114
359.160	1.46E-07	.2626	.1007	-8.206E-09	4464.2987	-.011152

364.080	1.07E-07	.6262	.052969	-7.460E-09	4464.3167	-.008267
369.000	7.25E-08	.7893	.018605	-6.271E-09	4464.3248	-.005702
373.920	4.49E-08	.8139	-.004232	-4.924E-09	4464.3260	-.003582
378.840	2.40E-08	.7513	-.017825	-3.610E-09	4464.3229	-.001944
383.760	9.39E-09	.6412	-.024500	-2.440E-09	4464.3175	-7.694E-04
388.680	2.99E-11	.5120	-.026399	-1.472E-09	4464.3111	-2.480E-06
393.600	-5.09E-09	.3825	-.025350	-7.202E-10	4464.3047	4.289E-04
398.520	-7.06E-09	.2631	-.022814	-1.780E-10	4464.2987	6.019E-04
403.440	-6.85E-09	.1582	-.019879	1.758E-10	4464.2935	5.915E-04
408.360	-5.33E-09	.067392	-.017277	3.653E-10	4464.2891	4.661E-04
413.280	-3.25E-09	-.012125	-.015421	4.117E-10	4464.2863	2.881E-04
418.200	-1.28E-09	-.084659	-.014431	3.304E-10	4464.2899	1.145E-04
423.120	-1.86E-16	-.1544	.008613	1.297E-10	4464.2934	.009253
428.040	1.28E-16	-5.341E-08	.015688	1.886E-17	4464.2857	-.006377
432.960	6.99E-23	1.548E-08	5.427E-09	-1.300E-17	4464.2857	-3.485E-09
437.880	-1.28E-23	1.156E-14	-1.573E-09	-7.103E-24	4464.2857	6.394E-10
442.800	0.000	-1.552E-15	-1.175E-15	1.303E-24	4464.2857	6.058E-16
447.720	0.000	-1.781E-21	1.577E-16	0.0000	4464.2857	-6.410E-17
452.640	0.000	1.556E-22	1.810E-22	0.0000	4464.2857	-8.644E-23
457.560	0.000	0.0000	-1.581E-23	0.0000	4464.2857	6.427E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =      .30000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =    -651845.543 lbs-in
Maximum shear force              =      18979.383 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              8
Number of zero deflection points =             13
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .400000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =       75000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	-8.353E+05	23819.2933	0.0000	45816.2416	-130.3688
4.920	.396548	-7.194E+05	23125.9226	-.001306	40080.0081	-151.4892
9.840	.387151	-6.068E+05	22303.7733	-.002420	34503.2339	-182.7178
14.760	.372739	-4.982E+05	21323.5830	-.003348	29126.7982	-215.7335
19.680	.354210	-3.945E+05	20191.0680	-.004097	23993.5973	-244.6384
24.600	.332420	-2.965E+05	18921.4953	-.004678	19141.4507	-271.4481
29.520	.308180	-2.049E+05	17526.9088	-.005099	14605.4930	-295.4570
34.440	.282248	-1.203E+05	16022.4450	-.005372	10417.3064	-316.1136
39.360	.255321	-43227.0860	14425.5262	-.005509	6604.2405	-333.0404
44.280	.228037	25761.9301	12754.9745	-.005524	5739.6288	-346.0457
49.200	.200967	86358.4579	11030.0872	-.005430	8739.4569	-355.1280
54.120	.174609	1.383E+05	9269.7119	-.005241	11311.0722	-360.4717
59.040	.149395	1.814E+05	7492.6427	-.004972	13446.4773	-361.9142
63.960	.125681	2.157E+05	5721.5181	-.004639	15142.6199	-358.0552
68.880	.103749	2.412E+05	3982.9170	-.004255	16403.0732	-348.6932
73.800	.083810	2.580E+05	2303.9055	-.003836	17238.2745	-333.8317
78.720	.066003	2.667E+05	711.2748	-.003395	17665.5154	-313.5792
83.640	.050401	2.675E+05	-768.9359	-.002947	17708.8003	-288.1325
88.560	.037009	2.613E+05	-2111.7879	-.002502	17398.5962	-257.7423
93.480	.025777	2.486E+05	-3293.5330	-.002074	16771.5130	-222.6419
98.400	.016599	2.304E+05	-4291.1410	-.001672	15870.0015	-182.8898
103.320	.009325	2.076E+05	-5028.6962	-.001304	14742.2568	-116.9294
108.240	.003768	1.819E+05	-5436.6591	-9.769E-04	13468.0208	-48.9092
113.160	-2.87E-04	1.548E+05	-5547.4922	-6.941E-04	12129.5943	3.8550
118.080	-.003062	1.278E+05	-5433.5451	-4.567E-04	10791.0363	42.4649
123.000	-.004781	1.017E+05	-5160.7724	-2.639E-04	9499.4441	68.4183
127.920	-.005659	77213.1529	-4787.0703	-1.137E-04	8286.7190	83.4931
132.840	-.005900	54689.3164	-4211.3517	-2.890E-06	7171.6776	150.5388
137.760	-.005688	35775.5844	-3468.5042	7.309E-05	6235.3542	151.4317
142.680	-.005180	20505.2949	-2742.5861	1.204E-04	5479.3993	143.6569
147.600	-.004504	8699.7128	-2069.7055	1.449E-04	4894.9646	129.8718
152.520	-.003755	32.4665	-1473.6307	1.522E-04	4465.8930	112.4350
157.440	-.003006	-5913.1527	-967.4435	1.473E-04	4757.0160	93.3321
162.360	-.002306	-9595.8722	-555.4564	1.343E-04	4939.3289	74.1423
167.280	-.001685	-11477.9250	-235.2069	1.166E-04	5032.4998	56.0404
172.200	-.001159	-11996.3276	.6202	9.684E-05	5058.1633	39.8243
177.120	-7.32E-04	-11543.2917	162.4522	7.707E-05	5035.7358	25.9611
182.040	-4.00E-04	-10454.6767	262.3383	5.860E-05	4981.8440	14.6430
186.960	-1.55E-04	-9005.1267	312.7457	4.225E-05	4910.0841	5.8478
191.880	1.55E-05	-7408.4407	325.6493	2.847E-05	4831.0402	-.6024
196.800	1.25E-04	-5821.7455	311.8989	1.735E-05	4752.4909	-4.9872
201.720	1.86E-04	-4352.1627	280.8341	8.810E-06	4679.7393	-7.6408
206.640	2.12E-04	-3064.8396	240.1060	2.580E-06	4616.0104	-8.9153
211.560	2.12E-04	-1991.4237	195.6631	-1.666E-06	4562.8710	-9.1509
216.480	1.95E-04	-1138.2847	151.8556	-4.295E-06	4520.6364	-8.6570
221.400	1.69E-04	-493.9951	111.6193	-5.666E-06	4488.7409	-7.6992
226.320	1.40E-04	-35.7692	76.7036	-6.111E-06	4466.0565	-6.4942
231.240	1.09E-04	265.2783	47.9143	-5.918E-06	4477.4183	-5.2088
236.160	8.13E-05	440.0748	25.3505	-5.325E-06	4486.0716	-3.9635
241.080	5.69E-05	518.6570	8.6201	-4.520E-06	4489.9618	-2.8375
246.000	3.68E-05	528.2326	-2.9751	-3.641E-06	4490.4358	-1.8760
250.920	2.11E-05	492.0694	-10.2897	-2.784E-06	4488.6456	-1.0974
255.840	9.41E-06	429.0366	-14.2201	-2.010E-06	4485.5252	-.5003

260.760	1.29E-06	353.6272	-15.6228	-1.353E-06	4481.7920	-.069908
265.680	-3.91E-06	276.3064	-15.2621	-8.240E-07	4477.9642	.2165
270.600	-6.82E-06	204.0561	-13.7812	-4.206E-07	4474.3875	.3855
275.520	-8.05E-06	141.0099	-11.6924	-1.307E-07	4471.2664	.4636
280.440	-8.11E-06	89.0995	-9.3806	6.251E-08	4468.6966	.4761
285.360	-7.43E-06	48.6589	-7.1155	1.782E-07	4466.6946	.4447
290.280	-6.35E-06	18.9516	-5.0691	2.350E-07	4465.2239	.3872
295.200	-5.12E-06	-1.3947	-3.3352	2.497E-07	4464.3548	.3176
300.120	-3.90E-06	-14.0515	-1.9486	2.368E-07	4464.9813	.2461
305.040	-2.79E-06	-20.7432	-.9023	2.075E-07	4465.3126	.1792
309.960	-1.85E-06	-23.0831	-.1632	1.707E-07	4465.4284	.1212
314.880	-1.11E-06	-22.4752	.3163	1.325E-07	4465.3983	.073739
319.800	-5.50E-07	-20.0684	.5892	9.674E-08	4465.2792	.037195
324.720	-1.57E-07	-16.7488	.7073	6.582E-08	4465.1149	.010805
329.640	9.73E-08	-13.1573	.7172	4.071E-08	4464.9371	-.006794
334.560	2.43E-07	-9.7220	.6580	2.149E-08	4464.7670	-.017246
339.480	3.09E-07	-6.6983	.5609	7.699E-09	4464.6173	-.022236
344.400	3.19E-07	-4.2086	.4488	-1.462E-09	4464.4941	-.023324
349.320	2.94E-07	-2.2809	.3377	-6.912E-09	4464.3986	-.021853
354.240	2.51E-07	-.8808	.2374	-9.568E-09	4464.3293	-.018907
359.160	2.00E-07	.062244	.1532	-1.025E-08	4464.2888	-.015308
364.080	1.50E-07	.6347	.086953	-9.670E-09	4464.3171	-.011637
369.000	1.05E-07	.9250	.037987	-8.360E-09	4464.3315	-.008268
373.920	6.78E-08	1.0146	.004343	-6.731E-09	4464.3359	-.005409
378.840	3.89E-08	.9727	-.016698	-5.062E-09	4464.3339	-.003145
383.760	1.80E-08	.8541	-.028065	-3.527E-09	4464.3280	-.001476
388.680	4.18E-09	.6991	-.032549	-2.223E-09	4464.3203	-3.472E-04
393.600	-3.87E-09	.5354	-.032602	-1.186E-09	4464.3122	3.257E-04
398.520	-7.49E-09	.3792	-.030230	-4.178E-10	4464.3045	6.389E-04
403.440	-7.98E-09	.2383	-.026962	1.008E-10	4464.2975	6.894E-04
408.360	-6.50E-09	.1138	-.023867	3.965E-10	4464.2913	5.687E-04
413.280	-4.08E-09	.003115	-.021579	4.948E-10	4464.2859	3.613E-04
418.200	-1.63E-09	-.098864	-.020331	4.144E-10	4464.2906	1.463E-04
423.120	-2.45E-16	-.1972	.010060	1.657E-10	4464.2955	.012207
428.040	1.63E-16	-6.918E-08	.020045	2.488E-17	4464.2857	-.008148
432.960	9.01E-23	1.978E-08	7.029E-09	-1.661E-17	4464.2857	-4.491E-09
437.880	-1.64E-23	1.486E-14	-2.010E-09	-9.154E-24	4464.2857	8.169E-10
442.800	0.000	-1.983E-15	-1.511E-15	1.665E-24	4464.2857	7.778E-16
447.720	0.000	-2.285E-21	2.015E-16	0.0000	4464.2857	-8.191E-17
452.640	0.000	1.988E-22	2.322E-22	0.0000	4464.2857	-1.108E-22
457.560	0.000	0.0000	-2.020E-23	0.0000	4464.2857	8.212E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = 0.000
Maximum bending moment = -835309.509 lbs-in
Maximum shear force = 23819.293 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 8
Number of zero deflection points = 13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	-1.006E+06	27759.7730	0.0000	54286.1712	-130.3688
4.920	.495841	-8.711E+05	27066.4025	-.001577	47587.5523	-151.4891
9.840	.484484	-7.389E+05	26244.2537	-.002929	41043.7393	-182.7177
14.760	.467019	-6.107E+05	25261.5648	-.004063	34696.2106	-216.7494
19.680	.444508	-4.873E+05	24099.4492	-.004985	28589.6819	-255.6553
24.600	.417969	-3.699E+05	22738.1358	-.005705	22774.5607	-297.7242
29.520	.388374	-2.594E+05	21162.0627	-.006233	17304.8641	-342.9559
34.440	.356635	-1.570E+05	19392.3176	-.006583	12238.1852	-376.4526
39.360	.323598	-63701.0838	17492.7761	-.006768	7617.8047	-395.7187
44.280	.290035	20091.1593	15510.7321	-.006805	5458.8976	-409.9902
49.200	.256638	93946.5620	13470.8618	-.006709	9115.1056	-419.2253
54.120	.224017	1.576E+05	11397.4942	-.006498	12266.0579	-423.6070
59.040	.192698	2.109E+05	9313.5353	-.006188	14904.5506	-423.5307
63.960	.163123	2.538E+05	7239.5312	-.005798	17029.0397	-419.5604
68.880	.135645	2.864E+05	5197.8086	-.005344	18642.9662	-410.4081
73.800	.110534	3.089E+05	3216.5082	-.004844	19756.2972	-394.9985
78.720	.087976	3.216E+05	1326.1804	-.004315	20386.8087	-373.4274
83.640	.068076	3.251E+05	-443.3595	-.003772	20559.9591	-345.8978
88.560	.050863	3.201E+05	-2063.4898	-.003230	20308.6310	-312.6917
93.480	.036295	3.072E+05	-3507.0259	-.002703	19672.7721	-274.1116
98.400	.024266	2.875E+05	-4748.0208	-.002203	18699.0086	-230.3579
103.320	.014613	2.621E+05	-5760.5200	-.001742	17440.3757	-181.2272
108.240	.007127	2.321E+05	-6433.9387	-.001327	15956.5287	-92.5203
113.160	.001559	1.998E+05	-6713.0292	-9.639E-04	14354.6881	-20.9311
118.080	-.002358	1.668E+05	-6684.0958	-6.560E-04	12721.6345	32.6927
123.000	-.004896	1.345E+05	-6431.3268	-4.029E-04	11122.6396	70.0590
127.920	-.006323	1.038E+05	-6029.5261	-2.028E-04	9603.4719	93.2747
132.840	-.006891	75317.8722	-5367.5028	-5.234E-05	8192.8932	175.8405
137.760	-.006838	51033.9643	-4487.1177	5.378E-05	6990.7196	182.0396
142.680	-.006362	31124.9473	-3605.2971	1.228E-04	6005.1247	176.4241
147.600	-.005629	15467.2300	-2771.9421	1.619E-04	5229.9902	162.3381
152.520	-.004769	3729.5465	-2021.2970	1.780E-04	4648.9167	142.8022

157.440	-.003878	-4553.7211	-1373.8095	1.773E-04	4689.7175	120.4041
162.360	-.003024	-9919.6170	-838.3983	1.652E-04	4955.3559	97.2428
167.280	-.002252	-12925.4675	-414.8818	1.460E-04	5104.1603	74.9184
172.200	-.001587	-14109.8011	-96.3718	1.233E-04	5162.7907	54.5572
177.120	-.001039	-13964.7560	128.5171	9.971E-05	5155.6103	36.8611
182.040	-6.06E-04	-12918.7812	273.7421	7.713E-05	5103.8293	22.1735
186.960	-2.80E-04	-11328.0588	354.2465	5.677E-05	5025.0807	10.5519
191.880	-4.74E-05	-9474.8924	384.7321	3.930E-05	4933.3398	1.8407
196.800	1.07E-04	-7571.2968	378.7798	2.498E-05	4839.1024	-4.2603
201.720	1.98E-04	-5766.1355	348.2840	1.378E-05	4749.7380	-8.1364
206.640	2.42E-04	-4154.3520	303.1568	5.448E-06	4669.9467	-10.2080
211.560	2.52E-04	-2787.0927	251.2487	-3.823E-07	4602.2606	-10.8928
216.480	2.39E-04	-1681.7823	198.4310	-4.136E-06	4547.5423	-10.5778
221.400	2.11E-04	-831.4797	148.7900	-6.246E-06	4505.4481	-9.6015
226.320	1.77E-04	-213.0792	104.8879	-7.124E-06	4474.8342	-8.2449
231.240	1.41E-04	205.8747	68.0529	-7.130E-06	4474.4775	-6.7287
236.160	1.07E-04	461.8235	38.6692	-6.569E-06	4487.1483	-5.2159
241.080	7.66E-05	591.2271	16.4464	-5.685E-06	4493.5544	-3.8177
246.000	5.10E-05	627.8509	.6556	-4.661E-06	4495.3674	-2.6013
250.920	3.07E-05	601.1179	-9.6760	-3.628E-06	4494.0440	-1.5986
255.840	1.53E-05	535.3166	-15.6136	-2.674E-06	4490.7865	-.8151
260.760	4.38E-06	449.4532	-18.2037	-1.847E-06	4486.5359	-.2378
265.680	-2.85E-06	357.5549	-18.4003	-1.169E-06	4481.9865	.1579
270.600	-7.12E-06	269.2575	-17.0213	-6.427E-07	4477.6153	.4026
275.520	-9.17E-06	190.5397	-14.7304	-2.565E-07	4473.7184	.5286
280.440	-9.65E-06	124.5000	-12.0360	8.063E-09	4470.4491	.5667
285.360	-9.10E-06	72.0999	-9.3033	1.732E-07	4467.8550	.5442
290.280	-7.95E-06	32.8279	-6.7735	2.613E-07	4465.9109	.4842
295.200	-6.52E-06	5.2558	-4.5867	2.933E-07	4464.5459	.4048
300.120	-5.06E-06	-12.5213	-2.8049	2.872E-07	4464.9056	.3195
305.040	-3.70E-06	-22.5567	-1.4344	2.577E-07	4465.4024	.2376
309.960	-2.52E-06	-26.8260	-.4441	2.163E-07	4465.6137	.1649
314.880	-1.57E-06	-27.0865	.2183	1.710E-07	4465.6266	.1044
319.800	-8.41E-07	-24.8041	.6148	1.274E-07	4465.5136	.056807
324.720	-3.16E-07	-21.1313	.8079	8.881E-08	4465.3318	.021725
329.640	3.34E-08	-16.9194	.8557	5.686E-08	4465.1233	-.002329
334.560	2.43E-07	-12.7535	.8075	3.193E-08	4464.9171	-.017243
339.480	3.48E-07	-8.9970	.7035	1.367E-08	4464.7311	-.025031
344.400	3.78E-07	-5.8409	.5740	1.205E-09	4464.5749	-.027614
349.320	3.59E-07	-3.3496	.4405	-6.514E-09	4464.4515	-.026681
354.240	3.14E-07	-1.5021	.3167	-1.059E-08	4464.3601	-.023621
359.160	2.55E-07	-.2254	.2106	-1.204E-08	4464.2969	-.019512
364.080	1.95E-07	.5791	.1254	-1.174E-08	4464.3144	-.015129
369.000	1.40E-07	1.0171	.061137	-1.040E-08	4464.3361	-.010989
373.920	9.27E-08	1.1884	.015909	-8.550E-09	4464.3445	-.007397
378.840	5.56E-08	1.1799	-.013344	-6.561E-09	4464.3441	-.004495
383.760	2.82E-08	1.0619	-.030085	-4.678E-09	4464.3383	-.002310
388.680	9.55E-09	.8874	-.037720	-3.041E-09	4464.3296	-7.938E-04
393.600	-1.74E-09	.6930	-.039313	-1.713E-09	4464.3200	1.463E-04
398.520	-7.30E-09	.5018	-.037421	-7.098E-10	4464.3106	6.230E-04
403.440	-8.72E-09	.3253	-.034034	-1.510E-11	4464.3018	7.536E-04
408.360	-7.45E-09	.1669	-.030576	3.983E-10	4464.2940	6.521E-04
413.280	-4.80E-09	.024159	-.027925	5.588E-10	4464.2869	4.256E-04
418.200	-1.95E-09	-.1083	-.026446	4.881E-10	4464.2911	1.753E-04
423.120	-3.02E-16	-.2364	.011020	1.986E-10	4464.2974	.015055
428.040	1.96E-16	-8.395E-08	.024028	3.069E-17	4464.2857	-.009767
432.960	1.09E-22	2.370E-08	8.530E-09	-1.991E-17	4464.2857	-5.426E-09

437.880	-1.96E-23	1.792E-14	-2.409E-09	-1.106E-23	4464.2857	9.793E-10
442.800	0.000	-2.377E-15	-1.821E-15	1.996E-24	4464.2857	9.366E-16
447.720	0.000	-2.750E-21	2.415E-16	0.0000	4464.2857	-9.818E-17
452.640	0.000	2.383E-22	2.794E-22	0.0000	4464.2857	-1.333E-22
457.560	0.000	0.0000	-2.421E-23	0.0000	4464.2857	9.843E-24
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1006402.087 lbs-in
Maximum shear force	=	27759.773 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .600000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	-1.164E+06	31061.2019	0.0000	62070.4961	-130.3688
4.920	.595192	-1.012E+06	30367.8314	-.001827	54565.3543	-151.4892
9.840	.582019	-8.635E+05	29545.6826	-.003403	47210.6934	-182.7177
14.760	.561711	-7.188E+05	28562.9936	-.004731	40048.4943	-216.7494
19.680	.535462	-5.789E+05	27400.8779	-.005821	33123.9778	-255.6554
24.600	.504429	-4.449E+05	26039.5641	-.006681	26488.0583	-297.7242
29.520	.469719	-3.178E+05	24463.4905	-.007322	20195.2618	-342.9561
34.440	.432382	-1.988E+05	22657.0953	-.007756	14303.6915	-391.3509
39.360	.393404	-89096.2802	20604.8163	-.007997	8874.9927	-442.9088
44.280	.353689	9897.4329	18345.1723	-.008064	4954.2576	-475.6457
49.200	.314055	97371.3424	15981.1540	-.007974	9284.6492	-485.3374

54.120	.275227	1.730E+05	13584.1583	-.007747	13030.4554	-489.0511
59.040	.237828	2.368E+05	11182.5538	-.007402	16184.9042	-487.2109
63.960	.202386	2.885E+05	8802.0611	-.006961	18748.2455	-480.4690
68.880	.169329	3.285E+05	6464.7086	-.006443	20726.9695	-469.6742
73.800	.138987	3.569E+05	4192.4125	-.005867	22132.7856	-454.0234
78.720	.111594	3.741E+05	2013.9807	-.005253	22983.5774	-431.5180
83.640	.087293	3.806E+05	-37.3320	-.004620	23305.7866	-402.3490
88.560	.066137	3.771E+05	-1929.4909	-.003983	23134.1678	-366.8214
93.480	.048098	3.646E+05	-3632.0894	-.003360	22511.4013	-325.2918
98.400	.033072	3.439E+05	-5116.3571	-.002765	21487.6397	-278.0690
103.320	.020887	3.162E+05	-6354.3644	-.002211	20120.1061	-225.1860
108.240	.011317	2.830E+05	-7269.7141	-.001708	18473.0200	-146.9074
113.160	.004084	2.460E+05	-7765.9925	-.001263	16641.2064	-54.8318
118.080	-.001115	2.075E+05	-7862.8495	-8.825E-04	14736.1382	15.4590
123.000	-.004599	1.693E+05	-7662.9137	-5.661E-04	12843.2283	65.8157
127.920	-.006685	1.325E+05	-7258.3967	-3.126E-04	11023.9943	98.6221
132.840	-.007676	98062.7408	-6533.9859	-1.190E-04	9318.8768	195.8538
137.760	-.007856	68299.5022	-5537.6816	2.074E-05	7845.4492	209.1480
142.680	-.007472	43556.6486	-4513.4939	1.147E-04	6620.5554	207.1885
147.600	-.006727	23802.0849	-3526.5759	1.713E-04	5642.6067	193.9977
152.520	-.005786	8728.7536	-2623.1003	1.986E-04	4896.4022	173.2688
157.440	-.004773	-2155.7743	-1832.2461	2.041E-04	4571.0072	148.2167
162.360	-.003778	-9451.1742	-1168.7566	1.944E-04	4932.1656	121.4945
167.280	-.002861	-13799.7713	-635.7690	1.748E-04	5147.4427	95.1671
172.200	-.002058	-15836.1609	-227.6638	1.499E-04	5248.2541	70.7293
177.120	-.001385	-16150.6340	67.2556	1.231E-04	5263.8221	49.1567
182.040	-8.47E-04	-15265.1898	264.3899	9.668E-05	5219.9882	30.9792
186.960	-4.34E-04	-13620.3890	380.8546	7.242E-05	5138.5624	16.3642
191.880	-1.34E-04	-11571.0280	433.9104	5.126E-05	5037.1089	5.2032
196.800	7.03E-05	-9388.5438	439.8081	3.366E-05	4929.0651	-2.8058
201.720	1.97E-04	-7268.1583	413.0167	1.967E-05	4824.0955	-8.0850
206.640	2.64E-04	-5338.9769	365.7849	9.083E-06	4728.5915	-11.1149
211.560	2.87E-04	-3675.5386	307.9745	1.512E-06	4646.2431	-12.3852
216.480	2.79E-04	-2309.6239	247.1039	-3.515E-06	4578.6235	-12.3589
221.400	2.52E-04	-1241.4422	188.5389	-6.497E-06	4525.7432	-11.4480
226.320	2.15E-04	-449.6066	135.7763	-7.917E-06	4486.5435	-10.0002
231.240	1.74E-04	100.4398	90.7749	-8.210E-06	4469.2580	-8.2931
236.160	1.34E-04	449.6782	54.2951	-7.748E-06	4486.5470	-6.5361
241.080	9.78E-05	640.4217	26.2212	-6.833E-06	4495.9898	-4.8760
246.000	6.68E-05	712.7379	5.8491	-5.696E-06	4499.5698	-3.4054
250.920	4.17E-05	702.1806	-7.8737	-4.508E-06	4499.0471	-2.1730
255.840	2.24E-05	638.5879	-16.1558	-3.382E-06	4495.8990	-1.1937
260.760	8.44E-06	545.7034	-20.2200	-2.387E-06	4491.3007	-.4584
265.680	-1.05E-06	441.3853	-21.2045	-1.558E-06	4486.1365	.058129
270.600	-6.89E-06	338.2008	-20.1034	-9.035E-07	4481.0283	.3895
275.520	-9.94E-06	244.2347	-17.7363	-4.144E-07	4476.3765	.5727
280.440	-1.10E-05	163.9812	-14.7427	-7.152E-08	4472.4036	.6442
285.360	-1.06E-05	99.2198	-11.5913	1.495E-07	4469.1976	.6369
290.280	-9.50E-06	49.8127	-8.6007	2.747E-07	4466.7517	.5788
295.200	-7.94E-06	14.3858	-5.9648	3.286E-07	4464.9979	.4927
300.120	-6.26E-06	-9.1236	-3.7796	3.330E-07	4464.7374	.3956
305.040	-4.66E-06	-23.0508	-2.0691	3.060E-07	4465.4268	.2997
309.960	-3.25E-06	-29.7096	-.8088	2.617E-07	4465.7565	.2126
314.880	-2.09E-06	-31.2025	.055803	2.106E-07	4465.8304	.1388
319.800	-1.18E-06	-29.3159	.5937	1.597E-07	4465.7370	.079830
324.720	-5.17E-07	-25.4787	.8773	1.137E-07	4465.5470	.035480
329.640	-6.24E-08	-20.7669	.9753	7.486E-08	4465.3138	.004354

334.560	2.20E-07	-15.9368	.9476	4.404E-08	4465.0747	-.015608
339.480	3.71E-07	-11.4746	.8435	2.101E-08	4464.8538	-.026712
344.400	4.27E-07	-7.6520	.7010	4.951E-09	4464.6645	-.031215
349.320	4.20E-07	-4.5801	.5476	-5.323E-09	4464.5125	-.031149
354.240	3.75E-07	-2.2595	.4016	-1.107E-08	4464.3976	-.028215
359.160	3.11E-07	-.6204	.2737	-1.349E-08	4464.3164	-.023753
364.080	2.42E-07	.4441	.1692	-1.363E-08	4464.3077	-.018753
369.000	1.77E-07	1.0543	.088872	-1.238E-08	4464.3379	-.013889
373.920	1.20E-07	1.3277	.031147	-1.038E-08	4464.3514	-.009576
378.840	7.45E-08	1.3685	-.007230	-8.111E-09	4464.3535	-.006025
383.760	4.02E-08	1.2625	-.030167	-5.901E-09	4464.3482	-.003299
388.680	1.64E-08	1.0760	-.041642	-3.937E-09	4464.3390	-.001365
393.600	1.51E-09	.8557	-.045313	-2.315E-09	4464.3281	-1.271E-04
398.520	-6.34E-09	.6318	-.044295	-1.065E-09	4464.3170	5.410E-04
403.440	-8.97E-09	.4206	-.041056	-1.815E-10	4464.3065	7.754E-04
408.360	-8.13E-09	.2279	-.037399	3.632E-10	4464.2970	7.113E-04
413.280	-5.40E-09	.052337	-.034472	5.986E-10	4464.2883	4.785E-04
418.200	-2.24E-09	-.1117	-.032801	5.488E-10	4464.2912	2.008E-04
423.120	-3.56E-16	-.2708	.011370	2.275E-10	4464.2991	.017755
428.040	2.24E-16	-9.740E-08	.027523	3.619E-17	4464.2857	-.011188
432.960	1.26E-22	2.715E-08	9.896E-09	-2.281E-17	4464.2857	-6.266E-09
437.880	-2.25E-23	2.065E-14	-2.759E-09	-1.277E-23	4464.2857	1.122E-09
442.800	0.000	-2.722E-15	-2.099E-15	2.286E-24	4464.2857	1.078E-15
447.720	0.000	-3.162E-21	2.767E-16	0.0000	4464.2857	-1.125E-16
452.640	0.000	2.729E-22	3.213E-22	0.0000	4464.2857	-1.532E-22
457.560	0.000	0.0000	-2.774E-23	0.0000	4464.2857	1.128E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1163645.450 lbs-in
Maximum shear force	=	31061.202 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .700000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	-1.311E+06	33965.9859	0.0000	69346.9284	-130.3688
4.920	.694584	-1.145E+06	33272.6153	-.002062	61132.0297	-151.4892
9.840	.679708	-9.817E+05	32450.4664	-.003848	53063.5416	-182.7177
14.760	.656719	-8.225E+05	31467.7773	-.005363	45183.8876	-216.7494
19.680	.626932	-6.681E+05	30305.6612	-.006615	37538.7333	-255.6555
24.600	.591624	-5.194E+05	28944.3467	-.007613	30179.4397	-297.7244
29.520	.552023	-3.777E+05	27368.2718	-.008366	23160.9812	-342.9564
34.440	.509300	-2.440E+05	25561.8746	-.008888	16541.9112	-391.3514
39.360	.464561	-1.196E+05	23509.5926	-.009194	10384.3258	-442.9096
44.280	.418834	-5848.7097	21195.8629	-.009299	4753.8258	-497.6309
49.200	.373059	95845.1622	18610.6325	-.009223	9209.0957	-553.2757
54.120	.328076	1.841E+05	15880.3628	-.008988	13577.4942	-556.5900
59.040	.284614	2.587E+05	13150.2111	-.008616	17273.2620	-553.2278
63.960	.243290	3.198E+05	10451.2795	-.008130	20298.1372	-543.8988
68.880	.204610	3.676E+05	7810.6126	-.007553	22661.4242	-529.5430
73.800	.168968	4.023E+05	5250.1665	-.006907	24378.8614	-511.2888
78.720	.136650	4.243E+05	2791.7339	-.006212	25471.2588	-488.0740
83.640	.107839	4.343E+05	465.5518	-.005491	25965.7585	-457.5284
88.560	.082617	4.330E+05	-1693.0679	-.004763	25898.6579	-419.9593
93.480	.060974	4.212E+05	-3650.5428	-.004045	25315.0190	-375.7622
98.400	.042812	4.000E+05	-5375.2202	-.003356	24268.1666	-325.3262
103.320	.027955	3.708E+05	-6836.8955	-.002708	22819.1889	-268.8507
108.240	.016163	3.348E+05	-8004.7148	-.002116	21036.6606	-205.8726
113.160	.007138	2.936E+05	-8746.8825	-.001588	18997.1556	-95.8216
118.080	5.38E-04	2.499E+05	-9000.9734	-.001131	16833.8162	-7.4673
123.000	-.003996	2.058E+05	-8878.6766	-7.488E-04	14653.8613	57.1815
127.920	-.006829	1.631E+05	-8490.1634	-4.389E-04	12536.1134	100.7507
132.840	-.008315	1.226E+05	-7720.3750	-1.990E-04	10534.0955	212.1714
137.760	-.008788	87229.3063	-6622.9000	-2.278E-05	8782.5682	233.9566
142.680	-.008539	57457.6351	-5464.8453	9.874E-05	7308.7231	236.7973
147.600	-.007816	33382.3599	-4327.8534	1.750E-04	6116.8778	225.3945
152.520	-.006817	14742.3836	-3271.2246	2.155E-04	5194.1067	204.1294
157.440	-.005696	1034.5065	-2333.9687	2.287E-04	4515.4989	176.8690
162.360	-.004567	-8392.6507	-1537.6154	2.225E-04	4879.7635	146.8519
167.280	-.003506	-14259.8506	-889.4220	2.035E-04	5170.2189	116.6414
172.200	-.002564	-17294.7433	-385.6731	1.770E-04	5320.4611	88.1346
177.120	-.001765	-18185.4961	-14.8351	1.472E-04	5364.5578	62.6126
182.040	-.001116	-17549.3515	239.6079	1.172E-04	5333.0655	40.8195
186.960	-6.12E-04	-15914.2356	396.7424	8.908E-05	5252.1192	23.0563
191.880	-2.39E-04	-13711.1458	476.2903	6.420E-05	5143.0553	9.2803
196.800	2.00E-05	-11274.9158	497.1556	4.321E-05	5022.4499	-.7984
201.720	1.86E-04	-8851.0242	476.4236	2.631E-05	4902.4552	-7.6292
206.640	2.79E-04	-6606.3219	428.7597	1.332E-05	4791.3314	-11.7464
211.560	3.17E-04	-4641.8628	366.1393	3.878E-06	4694.0809	-13.7090
216.480	3.17E-04	-3006.3729	297.8384	-2.546E-06	4613.1161	-14.0556
221.400	2.92E-04	-1709.2544	230.6105	-6.506E-06	4548.9023	-13.2728
226.320	2.53E-04	-732.3639	168.9872	-8.557E-06	4500.5414	-11.7773

231.240	2.08E-04	-40.1056	115.6442	-9.206E-06	4466.2711	-9.9068
236.160	1.62E-04	412.3693	71.7896	-8.893E-06	4484.7000	-7.9203
241.080	1.20E-04	672.8674	37.5383	-7.982E-06	4497.5960	-6.0030
246.000	8.39E-05	787.6370	12.2516	-6.755E-06	4503.2776	-4.2762
250.920	5.39E-05	798.4079	-5.1744	-5.423E-06	4503.8109	-2.8075
255.840	3.05E-05	740.7233	-16.0748	-4.130E-06	4500.9552	-1.6235
260.760	1.33E-05	643.2797	-21.8403	-2.968E-06	4496.1312	-.7202
265.680	1.32E-06	528.0051	-23.7917	-1.984E-06	4490.4246	-.073106
270.600	-6.26E-06	410.6336	-23.1012	-1.196E-06	4484.6141	.3538
275.520	-1.04E-05	301.5713	-20.7502	-5.975E-07	4479.2150	.6019
280.440	-1.21E-05	206.8921	-17.5157	-1.705E-07	4474.5279	.7129
285.360	-1.21E-05	129.3424	-13.9773	1.119E-07	4470.6888	.7254
290.280	-1.10E-05	69.2724	-10.5379	2.787E-07	4467.7150	.6727
295.200	-9.38E-06	25.4435	-7.4511	3.583E-07	4465.5453	.5821
300.120	-7.51E-06	-4.3107	-4.8518	3.760E-07	4464.4991	.4745
305.040	-5.68E-06	-22.5757	-2.7863	3.534E-07	4465.4033	.3651
309.960	-4.04E-06	-31.9889	-1.2392	3.076E-07	4465.8693	.2638
314.880	-2.65E-06	-34.9961	-.1560	2.513E-07	4466.0182	.1765
319.800	-1.56E-06	-33.7098	.5379	1.936E-07	4465.9545	.1056
324.720	-7.49E-07	-29.8460	.9243	1.403E-07	4465.7632	.051472
329.640	-1.83E-07	-24.7177	1.0823	9.443E-08	4465.5094	.012745
334.560	1.80E-07	-19.2657	1.0823	5.749E-08	4465.2395	-.012752
339.480	3.83E-07	-14.1103	.9831	2.946E-08	4464.9842	-.027587
344.400	4.70E-07	-9.6140	.8307	9.533E-09	4464.7617	-.034345
349.320	4.77E-07	-5.9432	.6591	-3.533E-09	4464.5799	-.035398
354.240	4.35E-07	-3.1255	.4915	-1.115E-08	4464.4404	-.032766
359.160	3.67E-07	-1.0990	.3418	-1.470E-08	4464.3401	-.028068
364.080	2.90E-07	.2488	.2174	-1.541E-08	4464.2980	-.022515
369.000	2.16E-07	1.0514	.1203	-1.432E-08	4464.3378	-.016953
373.920	1.49E-07	1.4430	.049259	-1.222E-08	4464.3571	-.011919
378.840	9.53E-08	1.5451	9.889E-04	-9.715E-09	4464.3622	-.007703
383.760	5.38E-08	1.4599	-.028818	-7.191E-09	4464.3580	-.004414
388.680	2.45E-08	1.2669	-.044682	-4.901E-09	4464.3484	-.002035
393.600	5.62E-09	1.0238	-.050851	-2.977E-09	4464.3364	-4.728E-04
398.520	-4.80E-09	.7687	-.051007	-1.472E-09	4464.3238	4.095E-04
403.440	-8.87E-09	.5230	-.048115	-3.869E-10	4464.3116	7.660E-04
408.360	-8.61E-09	.2955	-.044378	3.006E-10	4464.3003	7.532E-04
413.280	-5.91E-09	.086081	-.041237	6.211E-10	4464.2900	5.235E-04
418.200	-2.50E-09	-.1107	-.039399	6.004E-10	4464.2912	2.240E-04
423.120	-4.09E-16	-.3020	.011272	2.537E-10	4464.3007	.020374
428.040	2.50E-16	-1.100E-07	.030696	4.153E-17	4464.2857	-.012478
432.960	1.41E-22	3.028E-08	1.118E-08	-2.543E-17	4464.2857	-7.046E-09
437.880	-2.51E-23	2.317E-14	-3.077E-09	-1.436E-23	4464.2857	1.251E-09
442.800	0.000	-3.036E-15	-2.355E-15	2.550E-24	4464.2857	1.208E-15
447.720	0.000	-3.541E-21	3.085E-16	0.0000	4464.2857	-1.254E-16
452.640	0.000	3.044E-22	3.598E-22	0.0000	4464.2857	-1.714E-22
457.560	0.000	0.0000	-3.093E-23	0.0000	4464.2857	1.257E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1310629.382 lbs-in
Maximum shear force	=	33965.986 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .800000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	-1.448E+06	36546.3431	0.0000	76154.4809	-130.3688
4.920	.794016	-1.269E+06	35852.9725	-.002282	67308.9894	-151.4892
9.840	.777541	-1.094E+06	35030.8235	-.004267	58606.0798	-182.7177
14.760	.752027	-9.216E+05	34048.1340	-.005960	50088.5690	-216.7496
19.680	.718896	-7.542E+05	32886.0171	-.007367	41802.5179	-255.6557
24.600	.679533	-5.926E+05	31524.7011	-.008498	33799.6850	-297.7248
29.520	.635272	-4.378E+05	29948.6237	-.009364	26135.4437	-342.9570
34.440	.587393	-2.910E+05	28142.2225	-.009976	18868.7480	-391.3524
39.360	.537110	-1.535E+05	26089.9344	-.010349	12062.0959	-442.9110
44.280	.485558	-26607.5457	23776.1960	-.010500	5781.4909	-497.6330
49.200	.433786	88231.2621	21185.4433	-.010449	8832.1700	-555.5185
54.120	.382744	1.896E+05	18302.1113	-.010215	13848.8540	-616.5677
59.040	.333268	2.759E+05	15255.5254	-.009824	18120.8655	-621.8819
63.960	.286072	3.469E+05	12224.5028	-.009301	21639.1884	-610.2411
68.880	.241743	4.030E+05	9265.6232	-.008671	24415.5915	-592.5555
73.800	.200745	4.445E+05	6405.5696	-.007960	26469.5473	-570.0679
78.720	.163421	4.719E+05	3664.5629	-.007190	27826.7303	-544.1624
83.640	.129996	4.859E+05	1064.9711	-.006386	28517.3429	-512.5822
88.560	.100587	4.871E+05	-1360.4085	-.005568	28578.8005	-473.3445
93.480	.075204	4.766E+05	-3574.9536	-.004759	28058.0853	-426.8771
98.400	.053760	4.554E+05	-5544.2180	-.003976	27011.2035	-373.6369
103.320	.036079	4.250E+05	-7235.7073	-.003237	25502.6037	-313.9604
108.240	.021911	3.866E+05	-8617.4033	-.002555	23604.7334	-247.7046
113.160	.010938	3.421E+05	-9587.9605	-.001943	21398.1659	-146.8309
118.080	.002792	2.937E+05	-10044.3928	-.001409	19005.1494	-38.7107
123.000	-.002927	2.443E+05	-10036.5799	-9.572E-04	16556.7316	41.8867

127.920	-.006627	1.957E+05	-9693.0327	-5.877E-04	14151.0129	97.7667
132.840	-.008710	1.493E+05	-8905.8103	-2.979E-04	11856.4474	222.2425
137.760	-.009559	1.083E+05	-7733.0718	-8.158E-05	9823.6214	254.4805
142.680	-.009513	73288.4488	-6458.1327	7.089E-05	8092.4267	263.7874
147.600	-.008861	44658.2353	-5180.6209	1.700E-04	6675.0894	255.5263
152.520	-.007840	22185.7128	-3974.4903	2.261E-04	5562.5883	234.7707
157.440	-.006636	5382.3927	-2890.0419	2.492E-04	4730.7408	206.0620
162.360	-.005388	-6436.2455	-1956.9175	2.484E-04	4782.9117	173.2569
167.280	-.004192	-14056.9676	-1187.6410	2.312E-04	5160.1752	139.4571
172.200	-.003113	-18293.2231	-581.3472	2.040E-04	5369.8908	107.0038
177.120	-.002185	-19927.9625	-127.4060	1.719E-04	5450.8185	77.5251
182.040	-.001422	-19673.7455	191.2686	1.386E-04	5438.2335	52.0174
186.960	-8.21E-04	-18148.1811	395.3640	1.069E-04	5362.7105	30.9483
191.880	-3.70E-04	-15862.2220	506.8435	7.829E-05	5249.5442	14.3686
196.800	-5.07E-05	-13218.6187	547.1658	5.387E-05	5118.6728	2.0226
201.720	1.60E-04	-10517.8630	536.0269	3.393E-05	4984.9720	-6.5506
206.640	2.83E-04	-7969.1541	490.5691	1.840E-05	4858.7983	-11.9282
211.560	3.41E-04	-5704.2444	424.9846	6.919E-06	4746.6741	-14.7321
216.480	3.51E-04	-3792.4113	350.4325	-1.057E-06	4652.0288	-15.5736
221.400	3.30E-04	-2255.2080	275.1872	-6.136E-06	4575.9297	-15.0139
226.320	2.91E-04	-1080.0402	204.9433	-8.938E-06	4517.7531	-13.5405
231.240	2.42E-04	-231.9700	143.2103	-1.004E-05	4475.7694	-11.5542
236.160	1.92E-04	336.5581	91.7436	-9.952E-06	4480.9470	-9.3672
241.080	1.45E-04	678.1311	50.9699	-9.100E-06	4497.8566	-7.2074
246.000	1.03E-04	844.8178	20.3787	-7.820E-06	4506.1084	-5.2280
250.920	6.76E-05	884.4293	-1.1398	-6.368E-06	4508.0693	-3.5193
255.840	3.99E-05	838.3020	-15.0175	-4.921E-06	4505.7858	-2.1220
260.760	1.91E-05	740.2890	-22.7950	-3.595E-06	4500.9337	-1.0396
265.680	4.52E-06	616.6530	-25.9677	-2.456E-06	4494.8131	-.2502
270.600	-5.02E-06	486.5793	-25.8854	-1.529E-06	4488.3738	.2836
275.520	-1.05E-05	363.0695	-23.6949	-8.155E-07	4482.2595	.6068
280.440	-1.30E-05	254.0236	-20.3177	-2.973E-07	4476.8611	.7660
285.360	-1.35E-05	163.3626	-16.4527	5.330E-08	4472.3730	.8051
290.280	-1.25E-05	92.0900	-12.5952	2.679E-07	4468.8446	.7629
295.200	-1.08E-05	39.2280	-9.0668	3.781E-07	4466.2277	.6714
300.120	-8.80E-06	2.5940	-6.0482	4.133E-07	4464.4141	.5556
305.040	-6.75E-06	-20.5913	-3.6136	3.982E-07	4465.3051	.4340
309.960	-4.88E-06	-33.2574	-1.7610	3.529E-07	4465.9321	.3190
314.880	-3.28E-06	-38.1803	-.4396	2.929E-07	4466.1758	.2181
319.800	-2.00E-06	-37.7991	.4292	2.291E-07	4466.1570	.1350
324.720	-1.03E-06	-34.1259	.9349	1.687E-07	4465.9751	.070546
329.640	-3.38E-07	-28.7238	1.1665	1.159E-07	4465.7077	.023592
334.560	1.14E-07	-22.7329	1.2047	7.270E-08	4465.4111	-.008055
339.480	3.77E-07	-16.9228	1.1181	3.940E-08	4465.1235	-.027174
344.400	5.01E-07	-11.7601	.9611	1.531E-08	4464.8679	-.036651
349.320	5.28E-07	-7.4772	.7745	-8.516E-10	4464.6559	-.039188
354.240	4.93E-07	-4.1383	.5868	-1.061E-08	4464.4906	-.037130
359.160	4.24E-07	-1.6956	.4158	-1.551E-08	4464.3697	-.032379
364.080	3.40E-07	-.035694	.2712	-1.696E-08	4464.2875	-.026388
369.000	2.57E-07	.9855	.1566	-1.616E-08	4464.3345	-.020190
373.920	1.81E-07	1.5174	.071391	-1.406E-08	4464.3608	-.014456
378.840	1.18E-07	1.6984	.012288	-1.136E-08	4464.3698	-.009569
383.760	6.95E-08	1.6467	-.025259	-8.551E-09	4464.3672	-.005694
388.680	3.42E-08	1.4561	-.046255	-5.945E-09	4464.3578	-.002841
393.600	1.10E-08	1.1959	-.055513	-3.718E-09	4464.3449	-9.228E-04
398.520	-2.39E-09	.9126	-.057283	-1.947E-09	4464.3309	2.036E-04
403.440	-8.19E-09	.6337	-.055040	-6.479E-10	4464.3171	7.079E-04

408.360	-8.76E-09	.3715	-.051413	1.963E-10	4464.3041	7.668E-04
413.280	-6.26E-09	.1277	-.048161	6.155E-10	4464.2920	5.549E-04
418.200	-2.71E-09	-.1029	-.046199	6.364E-10	4464.2908	2.428E-04
423.120	-4.57E-16	-.3274	.010473	2.750E-10	4464.3019	.022795
428.040	2.71E-16	-1.210E-07	.033274	4.646E-17	4464.2857	-.013526
432.960	1.55E-22	3.283E-08	1.229E-08	-2.757E-17	4464.2857	-7.709E-09
437.880	-2.72E-23	2.529E-14	-3.336E-09	-1.571E-23	4464.2857	1.356E-09
442.800	0.000	-3.291E-15	-2.570E-15	2.764E-24	4464.2857	1.317E-15
447.720	0.000	-3.855E-21	3.345E-16	0.0000	4464.2857	-1.360E-16
452.640	0.000	3.300E-22	3.918E-22	0.0000	4464.2857	-1.865E-22
457.560	0.000	0.0000	-3.353E-23	0.0000	4464.2857	1.363E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1448141.942 lbs-in
Maximum shear force	=	36546.343 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .900000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	-1.579E+06	38906.5024	0.0000	82623.6315	-130.3688
4.920	.893476	-1.388E+06	38213.1318	-.002492	73201.2844	-151.4891
9.840	.875477	-1.201E+06	37390.9831	-.004667	63917.8671	-182.7176
14.760	.847553	-1.017E+06	36408.2943	-.006530	54816.5560	-216.7493
19.680	.811223	-8.379E+05	35246.1793	-.008088	45943.7737	-255.6552

24.600	.767968	-6.643E+05	33884.8666	-.009350	37351.6422	-297.7239
29.520	.719223	-4.976E+05	32308.7950	-.010325	29095.8997	-342.9556
34.440	.666366	-3.388E+05	30502.4030	-.011028	21235.8660	-391.3501
39.360	.610709	-1.893E+05	28450.1289	-.011471	13834.4060	-442.9076
44.280	.553488	-50370.8162	26136.4112	-.011673	6957.8905	-497.6281
49.200	.495851	76520.2341	23545.6879	-.011651	8252.4161	-555.5115
54.120	.438846	1.899E+05	20662.3970	-.011427	13866.1135	-616.5580
59.040	.383411	2.883E+05	17470.9763	-.011025	18735.1394	-680.7675
63.960	.330358	3.700E+05	14126.1694	-.010472	22779.5311	-678.9100
68.880	.280362	4.350E+05	10837.1693	-.009796	25999.0077	-658.0819
73.800	.233962	4.838E+05	7664.7991	-.009025	28416.5328	-631.4995
78.720	.191560	5.171E+05	4633.5671	-.008184	30062.4626	-600.7086
83.640	.153432	5.355E+05	1761.2044	-.007300	30972.6748	-566.9185
88.560	.119729	5.398E+05	-927.9055	-.006397	31187.0971	-526.2156
93.480	.090487	5.311E+05	-3397.4881	-.005497	30754.3724	-477.6797
98.400	.065634	5.104E+05	-5610.2550	-.004623	29732.9312	-421.8190
103.320	.044999	4.793E+05	-7531.2528	-.003792	28190.3465	-359.0744
108.240	.028325	4.391E+05	-9126.8244	-.003020	26202.7638	-289.5320
113.160	.015280	3.917E+05	-10343.6825	-.002322	23854.7502	-205.1258
118.080	.005472	3.390E+05	-11034.9696	-.001709	21248.9080	-75.8852
123.000	-.001533	2.844E+05	-11167.6650	-.001185	18541.7262	21.9440
127.920	-.006189	2.300E+05	-10889.0677	-7.531E-04	15852.1150	91.3070
132.840	-.008944	1.778E+05	-10103.0532	-4.106E-04	13264.8618	228.2111
137.760	-.010229	1.309E+05	-8871.7142	-1.513E-04	10945.6275	272.3332
142.680	-.010432	90585.6283	-7490.1040	3.474E-05	8948.7228	289.2969
147.600	-.009887	57194.8420	-6077.0329	1.589E-04	7295.7135	285.1222
152.520	-.008869	30670.3871	-4722.2902	2.327E-04	5982.6217	265.5862
157.440	-.007598	10555.8073	-3488.5707	2.673E-04	4986.8504	235.9258
162.360	-.006239	-3854.4012	-2414.6063	2.729E-04	4655.0977	200.6451
167.280	-.004912	-13405.3246	-1519.0157	2.584E-04	5127.9156	163.4161
172.200	-.003696	-18992.2242	-804.4507	2.312E-04	5404.4948	127.0575
177.120	-.002637	-21491.7461	-261.6931	1.972E-04	5528.2335	93.5756
182.040	-.001756	-21712.8179	126.5515	1.609E-04	5539.1777	64.2473
186.960	-.001054	-20365.2344	382.3393	1.256E-04	5472.4656	39.7314
191.880	-5.20E-04	-18043.2727	529.7502	9.332E-05	5357.5170	20.1917
196.800	-1.36E-04	-15221.3586	592.7583	6.538E-05	5217.8183	5.4213
201.720	1.23E-04	-12258.7794	593.6937	4.230E-05	5071.1560	-5.0411
206.640	2.80E-04	-9410.6281	552.2426	2.410E-05	4930.1584	-11.8090
211.560	3.60E-04	-6842.4964	484.9065	1.045E-05	4803.0232	-15.5634
216.480	3.83E-04	-4646.8583	404.8320	7.971E-07	4694.3282	-16.9872
221.400	3.68E-04	-2859.5383	321.9198	-5.507E-06	4605.8470	-16.7170
226.320	3.29E-04	-1475.1031	243.1265	-9.148E-06	4537.3106	-15.3128
231.240	2.78E-04	-460.4224	172.8826	-1.077E-05	4487.0789	-13.2416
236.160	2.23E-04	234.0121	113.5639	-1.096E-05	4475.8705	-10.8717
241.080	1.70E-04	665.1377	65.9671	-1.021E-05	4497.2133	-8.4766
246.000	1.22E-04	890.6626	29.7532	-8.902E-06	4508.3779	-6.2445
250.920	8.24E-05	964.4786	3.8367	-7.344E-06	4512.0322	-4.2907
255.840	5.02E-05	933.8356	-13.2913	-5.749E-06	4510.5152	-2.6720
260.760	2.58E-05	837.9352	-23.3112	-4.261E-06	4505.7677	-1.4012
265.680	8.30E-06	707.5984	-27.8895	-2.963E-06	4499.3153	-.4600
270.600	-3.35E-06	565.6892	-28.5548	-1.894E-06	4492.2901	.1895
275.520	-1.03E-05	428.0173	-26.6237	-1.059E-06	4485.4747	.5954
280.440	-1.38E-05	304.4935	-23.1686	-4.440E-07	4479.3596	.8091
285.360	-1.47E-05	200.3657	-19.0141	-2.003E-08	4474.2048	.8798
290.280	-1.40E-05	117.4095	-14.7550	2.469E-07	4470.0981	.8516
295.200	-1.23E-05	54.9943	-10.7866	3.917E-07	4467.0082	.7616
300.120	-1.01E-05	10.9803	-7.3408	4.471E-07	4464.8293	.6391

305.040	-7.88E-06	-17.5694	-4.5236	4.415E-07	4465.1555	.5061
309.960	-5.78E-06	-33.8581	-2.3500	3.983E-07	4465.9619	.3775
314.880	-3.96E-06	-40.9874	-.7745	3.355E-07	4466.3148	.2629
319.800	-2.47E-06	-41.7264	.2837	2.660E-07	4466.3514	.1672
324.720	-1.34E-06	-38.3919	.9211	1.987E-07	4466.1863	.091895
329.640	-5.19E-07	-32.8092	1.2363	1.389E-07	4465.9099	.036207
334.560	2.92E-08	-26.3296	1.3202	8.926E-08	4465.5892	-.002069
339.480	3.60E-07	-19.8839	1.2515	5.044E-08	4465.2701	-.025889
344.400	5.26E-07	-14.0525	1.0932	2.194E-08	4464.9814	-.038426
349.320	5.75E-07	-9.1426	.8937	2.458E-09	4464.7383	-.042709
354.240	5.50E-07	-5.2608	.6867	-9.639E-09	4464.5461	-.041411
359.160	4.81E-07	-2.3782	.4945	-1.605E-08	4464.4034	-.036733
364.080	3.92E-07	-.3833	.3294	-1.837E-08	4464.3047	-.030378
369.000	3.00E-07	.8765	.1967	-1.796E-08	4464.3291	-.023577
373.920	2.15E-07	1.5651	.096464	-1.591E-08	4464.3632	-.017150
378.840	1.43E-07	1.8375	.025782	-1.305E-08	4464.3767	-.011582
383.760	8.66E-08	1.8284	-.020174	-9.972E-09	4464.3762	-.007099
388.680	4.51E-08	1.6463	-.046856	-7.054E-09	4464.3672	-.003747
393.600	1.72E-08	1.3725	-.059635	-4.518E-09	4464.3537	-.001448
398.520	6.39E-10	1.0629	-.063331	-2.473E-09	4464.3383	-5.451E-05
403.440	-7.14E-09	.7512	-.061948	-9.493E-10	4464.3229	6.165E-04
408.360	-8.70E-09	.4540	-.058558	6.291E-11	4464.3082	7.615E-04
413.280	-6.52E-09	.1749	-.055264	5.911E-10	4464.2944	5.775E-04
418.200	-2.89E-09	-.090256	-.053207	6.622E-10	4464.2902	2.589E-04
423.120	-5.04E-16	-.3491	.009194	2.932E-10	4464.3030	.025108
428.040	2.89E-16	-1.309E-07	.035479	5.118E-17	4464.2857	-.014423
432.960	1.66E-22	3.500E-08	1.330E-08	-2.940E-17	4464.2857	-8.300E-09
437.880	-2.90E-23	2.716E-14	-3.557E-09	-1.692E-23	4464.2857	1.446E-09
442.800	0.000	-3.509E-15	-2.760E-15	2.947E-24	4464.2857	1.412E-15
447.720	0.000	-4.130E-21	3.566E-16	0.0000	4464.2857	-1.450E-16
452.640	0.000	3.518E-22	4.197E-22	0.0000	4464.2857	-1.997E-22
457.560	0.000	0.0000	-3.576E-23	0.0000	4464.2857	1.453E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1578818.785 lbs-in
Maximum shear force	=	38906.502 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	13

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	-1.704E+06	41094.8322	0.0000	88810.1036	-130.3688
4.920	.992960	-1.503E+06	40401.4616	-.002693	78852.8401	-151.4891
9.840	.973501	-1.304E+06	39579.3128	-.005050	69031.0034	-182.7177
14.760	.943263	-1.109E+06	38596.6239	-.007078	59388.1036	-216.7494
19.680	.903856	-9.192E+05	37434.5084	-.008782	49970.8992	-255.6553
24.600	.856853	-7.346E+05	36073.1951	-.010171	40831.8495	-297.7241
29.520	.803778	-5.568E+05	34497.1223	-.011255	32027.0318	-342.9559
34.440	.746102	-3.869E+05	32690.7283	-.012048	23616.1066	-391.3506
39.360	.685228	-2.262E+05	30638.4513	-.012563	15662.2803	-442.9083
44.280	.622486	-76113.2090	28324.7293	-.012817	8232.2664	-497.6291
49.200	.559114	61974.4402	25733.9998	-.012828	7532.3273	-555.5130
54.120	.496254	1.866E+05	22850.7004	-.012620	13700.7564	-616.5600
59.040	.434937	2.961E+05	19659.2680	-.012214	19124.6140	-680.7703
63.960	.376066	3.890E+05	16144.1391	-.011639	23723.5927	-748.1439
68.880	.320411	4.636E+05	12517.6444	-.010923	27414.1057	-726.0409
73.800	.268587	5.203E+05	9020.5429	-.010096	30220.3523	-695.5451
78.720	.221063	5.598E+05	5685.9502	-.009189	32177.1374	-659.9804
83.640	.178165	5.830E+05	2534.3014	-.008229	33325.8666	-621.1776
88.560	.140086	5.908E+05	-417.9748	-.007244	33712.3266	-578.9346
93.480	.106889	5.842E+05	-3142.5117	-.006257	33386.8992	-528.6007
98.400	.078521	5.645E+05	-5600.0530	-.005292	32410.1032	-470.3998
103.320	.054817	5.330E+05	-7753.1925	-.004370	30852.2881	-404.8602
108.240	.035519	4.914E+05	-9566.4876	-.003510	28792.9583	-332.2516
113.160	.020283	4.415E+05	-11003.6623	-.002726	26320.3995	-251.9657
118.080	.008695	3.852E+05	-11920.1145	-.002032	23532.3539	-120.5758
123.000	2.90E-04	3.257E+05	-12226.9546	-.001435	20587.9990	-4.1559
127.920	-.005422	2.659E+05	-12040.3858	-9.378E-04	17628.6698	79.9969
132.840	-.008938	2.079E+05	-11282.5683	-5.399E-04	14757.0443	228.0590
137.760	-.010735	1.553E+05	-10018.4892	-2.348E-04	12152.3304	285.7943
142.680	-.011248	1.095E+05	-8548.1180	-1.240E-05	9885.3290	311.9176
147.600	-.010857	71194.1743	-7010.6239	1.394E-04	7988.7498	313.0801
152.520	-.009877	40417.6863	-5512.8841	2.331E-04	6465.1613	295.7572
157.440	-.008563	16775.3639	-4131.2247	2.811E-04	5294.7493	265.8930
162.360	-.007110	-441.0449	-2914.6210	2.949E-04	4486.1196	228.6614
167.280	-.005662	-12122.1116	-1888.8095	2.843E-04	5064.3903	188.3352
172.200	-.004313	-19236.7487	-1060.8233	2.580E-04	5416.6000	148.2446
177.120	-.003123	-22750.9938	-423.5524	2.227E-04	5590.5725	110.8086
182.040	-.002121	-23568.8603	39.9760	1.838E-04	5631.0610	77.6176
186.960	-.001315	-22493.2748	352.8106	1.451E-04	5577.8142	49.5509
191.880	-6.94E-04	-20204.2980	540.9057	1.093E-04	5464.4985	26.9105
196.800	-2.40E-04	-17251.3924	630.6197	7.780E-05	5318.3150	9.5587

201.720	7.19E-05	-14056.4131	646.8749	5.150E-05	5160.1477	-2.9509
206.640	2.67E-04	-10924.1509	611.9240	3.052E-05	5005.0853	-11.2568
211.560	3.72E-04	-8057.6046	544.6448	1.458E-05	4863.1770	-16.0925
216.480	4.11E-04	-5575.6045	460.2651	3.128E-06	4740.3057	-18.2083
221.400	4.03E-04	-3530.9047	370.4174	-4.521E-06	4639.0830	-18.3152
226.320	3.66E-04	-1927.3610	283.4268	-9.105E-06	4559.6996	-17.0468
231.240	3.13E-04	-735.2651	204.7446	-1.134E-05	4500.6850	-14.9378
236.160	2.55E-04	95.6953	137.4548	-1.188E-05	4469.0231	-12.4157
241.080	1.97E-04	626.0567	82.7974	-1.127E-05	4495.2786	-9.8028
246.000	1.44E-04	918.7402	40.6629	-9.975E-06	4509.7679	-7.3251
250.920	9.84E-05	1033.5409	10.0338	-8.335E-06	4515.4511	-5.1258
255.840	6.17E-05	1023.6244	-10.6458	-6.607E-06	4514.9602	-3.2806
260.760	3.34E-05	933.6627	-23.1768	-4.963E-06	4510.5066	-1.8134
265.680	1.28E-05	799.2272	-29.3870	-3.508E-06	4503.8514	-.7111
270.600	-1.12E-06	647.0837	-30.9801	-2.293E-06	4496.3196	.063465
275.520	-9.73E-06	496.0754	-29.4445	-1.333E-06	4488.8439	.5608
280.440	-1.42E-05	358.3339	-26.0075	-6.156E-07	4482.0250	.8364
285.360	-1.58E-05	240.6161	-21.6258	-1.126E-07	4476.1974	.9448
290.280	-1.53E-05	145.6188	-17.0005	2.118E-07	4471.4946	.9354
295.200	-1.37E-05	73.1745	-12.6074	3.956E-07	4467.9082	.8504
300.120	-1.15E-05	21.2705	-8.7353	4.749E-07	4465.3387	.7236
305.040	-9.03E-06	-13.1313	-5.5273	4.817E-07	4464.9358	.5805
309.960	-6.72E-06	-33.4735	-3.0191	4.426E-07	4465.9428	.4391
314.880	-4.68E-06	-43.1661	-1.1739	3.782E-07	4466.4226	.3110
319.800	-3.00E-06	-45.3042	.089107	3.039E-07	4466.5285	.2025
324.720	-1.69E-06	-42.5135	.8723	2.302E-07	4466.3903	.1159
329.640	-7.31E-07	-36.8905	1.2830	1.635E-07	4466.1120	.051018
334.560	-7.92E-08	-30.0096	1.4223	1.073E-07	4465.7713	.005612
339.480	3.25E-07	-22.9743	1.3786	6.278E-08	4465.4231	-.023377
344.400	5.39E-07	-16.4906	1.2242	2.963E-08	4465.1021	-.039378
349.320	6.16E-07	-10.9499	1.0148	6.584E-09	4464.8278	-.045737
354.240	6.03E-07	-6.5095	.7905	-8.080E-09	4464.6080	-.045451
359.160	5.37E-07	-3.1653	.5778	-1.621E-08	4464.4424	-.041024
364.080	4.44E-07	-.8122	.3922	-1.955E-08	4464.3259	-.034421
369.000	3.44E-07	.7083	.2409	-1.963E-08	4464.3208	-.027084
373.920	2.51E-07	1.5726	.1251	-1.772E-08	4464.3636	-.019994
378.840	1.70E-07	1.9520	.042063	-1.476E-08	4464.3823	-.013748
383.760	1.05E-07	1.9974	-.013025	-1.144E-08	4464.3846	-.008646
388.680	5.74E-08	1.8323	-.046031	-8.224E-09	4464.3764	-.004772
393.600	2.45E-08	1.5505	-.062852	-5.383E-09	4464.3625	-.002066
398.520	4.46E-09	1.2178	-.068872	-3.058E-09	4464.3460	-3.808E-04
403.440	-5.55E-09	.8751	-.068629	-1.300E-09	4464.3290	4.794E-04
408.360	-8.33E-09	.5434	-.065657	-1.088E-10	4464.3126	7.289E-04
413.280	-6.62E-09	.2291	-.062421	5.400E-10	4464.2971	5.866E-04
418.200	-3.02E-09	-.071178	-.060313	6.727E-10	4464.2892	2.706E-04
423.120	-5.45E-16	-.3649	.007257	3.064E-10	4464.3038	.027197
428.040	3.02E-16	-1.392E-07	.037080	5.543E-17	4464.2857	-.015073
432.960	1.76E-22	3.658E-08	1.414E-08	-3.072E-17	4464.2857	-8.771E-09
437.880	-3.03E-23	2.862E-14	-3.718E-09	-1.788E-23	4464.2857	1.511E-09
442.800	0.000	-3.668E-15	-2.908E-15	3.080E-24	4464.2857	1.485E-15
447.720	0.000	-4.340E-21	3.727E-16	0.0000	4464.2857	-1.515E-16
452.640	0.000	3.677E-22	4.410E-22	0.0000	4464.2857	-2.097E-22
457.560	0.000	0.0000	-3.737E-23	0.0000	4464.2857	1.519E-23
462.480	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
467.400	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
472.320	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
477.240	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

482.160	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
487.080	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000
492.000	0.000	0.0000	0.0000	0.0000	4464.2857	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1703785.521 lbs-in
Maximum shear force	=	41094.832 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	13

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .100000	S= 0.000	75000.0000	.100000	-2.568E+05	8233.4752
5	y= .200000	S= 0.000	75000.0000	.2000	-4.616E+05	13882.4579
5	y= .300000	S= 0.000	75000.0000	.3000	-6.518E+05	18979.3831
5	y= .400000	S= 0.000	75000.0000	.4000	-8.353E+05	23819.2933
5	y= .500000	S= 0.000	75000.0000	.5000	-1.006E+06	27759.7730
5	y= .600000	S= 0.000	75000.0000	.6000	-1.164E+06	31061.2019
5	y= .700000	S= 0.000	75000.0000	.7000	-1.311E+06	33965.9859
5	y= .800000	S= 0.000	75000.0000	.8000	-1.448E+06	36546.3431
5	y= .900000	S= 0.000	75000.0000	.9000	-1.579E+06	38906.5024
5	y= 1.000	S= 0.000	75000.0000	1.0000	-1.704E+06	41094.8322

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = .10000 in
Slope = .00000
Axial Load = 75000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
492.000	.10000000	-256780.357	8233.475
467.400	.10000000	-256879.457	8233.965
442.800	.10000000	-257002.238	8237.536
418.200	.10000000	-257082.194	8239.006
393.600	.10000000	-257148.891	8240.489
369.000	.10000000	-257230.255	8243.480
344.400	.10000000	-257308.986	8245.679
319.800	.10000000	-257403.270	8249.058
295.200	.10000000	-257465.237	8251.034
270.600	.10000000	-257509.831	8252.087

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Abut_B19_ Free.lpd
Name of output file: ArroyoMocho_Abut_B19_ Free.lpo
Name of plot output file: ArroyoMocho_Abut_B19_ Free.lpp
Name of runtime file: ArroyoMocho_Abut_B19_ Free.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:33:17

Problem Title

SR84 Isabel Abutment - Arroyo Mocho Bridge Widen - H pile - Weak Axis

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 444.00 in
Depth of ground surface below top of pile = -36.00 in
Slope angle of ground surface = 21.80 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	444.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -36.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 732.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 732.000 in
Distance from top of pile to bottom of layer = 1092.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 648.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.07230
2	132.00	.07230
3	132.00	.07810
4	420.00	.07810
5	420.00	.04200
6	732.00	.04200
7	732.00	.04200
8	1092.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	.00000	35.00	------	------
2	132.000	.00000	35.00	------	------
3	132.000	.00000	40.00	------	------
4	420.000	.00000	40.00	------	------
5	420.000	.00000	40.00	------	------
6	732.000	.00000	40.00	------	------
7	732.000	27.77800	.00	.00500	.0
8	1092.000	27.77800	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .100 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .200 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .300 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .400 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .500 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .600 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   75000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

```
Deflection at pile head     =            .700 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .800 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .900 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           1.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =       75000.000 lbs
```

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	96.000

Depth of ground surface below top of pile = -36.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =           1
Depth below pile head       =      60.000 in
Depth below ground surface  =      96.000 in
Equivalent Depth (see note) =      96.000 in
Pile Diameter               =      10.000 in
Angle of Friction           =      35.000 deg.
Avg. Eff. Unit Weight       =      .07230 lbs/in**3
k                           =      90.000 pci
A (static)                  =       .8800
B (static)                  =       .5000
Pst                         =     971.160 lbs/in
```

Psd	=	3733.696	lbs/in
Ps	=	971.160	lbs/in
pu	=	854.621	lbs/in
Cbar	=	1443.3672	
n	=	1.6447	
m	=	1771.3961	
yk	=	.0104	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	107.181
.0278	163.360
.0417	209.030
.0556	248.984
.0694	285.163
.0833	318.592
.0972	349.895
.1111	379.487
.1250	407.660
.1389	434.629
.1528	460.559
.1667	485.580
.3750	854.621
10.3750	854.621
20.3750	854.621
30.3750	854.621

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .100000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	0.0000	4011.8234	-.002138	4464.2857	-77.7271
4.440	.090508	17758.2790	3670.9065	-.002124	5343.4084	-75.8391

8.880	.081135	34012.5321	3320.0229	-.002085	6148.0744	-82.2166
13.320	.071991	48628.8316	2945.1090	-.002023	6871.6536	-86.6636
17.760	.063174	61512.1333	2546.8354	-.001939	7509.4408	-92.7390
22.200	.054772	72536.1653	2123.1535	-.001837	8055.1850	-98.1087
26.640	.046858	81589.5057	1678.9963	-.001721	8503.3702	-101.9621
31.080	.039492	88591.6213	1221.4758	-.001592	8850.0095	-104.1282
35.520	.032723	93496.2748	758.3895	-.001454	9092.8142	-104.4692
39.960	.026584	96294.2683	298.0736	-.001310	9231.3287	-102.8803
44.400	.021092	97015.5129	-150.7382	-.001163	9267.0339	-99.2872
48.840	.016253	95730.4775	-579.0338	-.001017	9203.4183	-93.6388
53.280	.012059	92551.1616	-977.5888	-8.745E-04	9046.0264	-85.8905
57.720	.008488	87631.9154	-1327.2017	-7.379E-04	8802.4993	-71.5927
62.160	.005506	81257.0836	-1594.1270	-6.099E-04	8486.9136	-48.6439
66.600	.003072	73882.2872	-1765.0810	-4.924E-04	8121.8247	-28.3624
71.040	.001134	65911.0717	-1852.2999	-3.864E-04	7727.2101	-10.9254
75.480	-3.60E-04	57691.2059	-1868.5423	-2.927E-04	7320.2860	3.6090
79.920	-.001465	49513.3654	-1826.5944	-2.115E-04	6915.4424	15.2864
84.360	-.002237	41611.8812	-1738.8516	-1.424E-04	6524.2798	24.2374
88.800	-.002730	34167.1980	-1616.9797	-8.496E-05	6155.7312	30.6599
93.240	-.002992	27309.6838	-1471.6569	-3.836E-05	5816.2503	34.8009
97.680	-.003070	21124.4343	-1312.3922	-1.653E-06	5510.0498	36.9400
102.120	-.003007	15656.7420	-1147.4140	2.622E-05	5239.3720	37.3745
106.560	-.002837	10917.9318	-983.6215	4.637E-05	5004.7774	36.4059
111.000	-.002595	6891.3024	-826.5876	5.987E-05	4805.4393	34.3301
115.440	-.002306	3537.9634	-680.6045	6.777E-05	4639.4324	31.4281
119.880	-.001993	802.4000	-548.7603	7.106E-05	4504.0085	27.9612
124.320	-.001675	-1382.3535	-433.0374	7.062E-05	4532.7191	24.1663
128.760	-.001366	-3090.0050	-334.4221	6.723E-05	4617.2563	20.2550
133.200	-.001078	-4396.7969	-223.3046	6.156E-05	4681.9489	29.7979
137.640	-8.19E-04	-5113.9464	-105.0506	5.435E-05	4717.4514	23.4697
142.080	-5.95E-04	-5365.8414	-13.7749	4.640E-05	4729.9214	17.6454
146.520	-4.07E-04	-5267.1728	53.1036	3.834E-05	4725.0368	12.4800
150.960	-2.55E-04	-4919.8192	98.7041	3.062E-05	4707.8411	8.0607
155.400	-1.35E-04	-4411.0758	126.4059	2.355E-05	4682.6558	4.4175
159.840	-4.56E-05	-3813.0201	139.6193	1.732E-05	4653.0491	1.5345
164.280	1.84E-05	-3182.7900	141.6073	1.202E-05	4621.8496	-.6390
168.720	6.11E-05	-2563.5495	135.3560	7.661E-06	4591.1941	-2.1770
173.160	8.65E-05	-1985.9303	123.4902	4.212E-06	4562.5991	-3.1680
177.600	9.85E-05	-1469.7617	108.2282	1.593E-06	4537.0462	-3.7068
182.040	1.01E-04	-1025.9247	91.3694	-2.985E-07	4515.0741	-3.8873
186.480	9.58E-05	-658.2030	74.3069	-1.575E-06	4496.8700	-3.7985
190.920	8.66E-05	-365.0309	58.0596	-2.351E-06	4482.3565	-3.5201
195.360	7.50E-05	-141.0682	43.3163	-2.734E-06	4471.2693	-3.1210
199.800	6.24E-05	21.4391	30.4865	-2.825E-06	4465.3471	-2.6582
204.240	4.99E-05	131.5334	19.7538	-2.709E-06	4470.7973	-2.1764
208.680	3.83E-05	198.6565	11.1276	-2.459E-06	4474.1202	-1.7092
213.120	2.81E-05	231.9840	4.4916	-2.132E-06	4475.7701	-1.2799
217.560	1.94E-05	239.9621	-.3544	-1.774E-06	4476.1650	-.9030
222.000	1.23E-05	230.0185	-3.6589	-1.418E-06	4475.6728	-.5855
226.440	6.77E-06	208.4156	-5.6898	-1.086E-06	4474.6033	-.3293
230.880	2.65E-06	180.2162	-6.7129	-7.914E-07	4473.2073	-.1316
235.320	-2.56E-07	149.3319	-6.9763	-5.416E-07	4471.6784	.012938
239.760	-2.16E-06	118.6273	-6.7003	-3.385E-07	4470.1584	.1114
244.200	-3.26E-06	90.0586	-6.0720	-1.803E-07	4468.7441	.1716
248.640	-3.76E-06	64.8278	-5.2436	-6.294E-08	4467.4950	.2016
253.080	-3.82E-06	43.5377	-4.3329	1.919E-08	4466.4410	.2087
257.520	-3.59E-06	26.3392	-3.4265	7.216E-08	4465.5896	.1996

261.960	-3.18E-06	13.0621	-2.5838	1.020E-07	4464.9324	.1800
266.400	-2.68E-06	3.3272	-1.8410	1.144E-07	4464.4504	.1546
270.840	-2.16E-06	-3.3622	-1.2164	1.144E-07	4464.4522	.1268
275.280	-1.67E-06	-7.5502	-.7143	1.061E-07	4464.6595	.099359
279.720	-1.22E-06	-9.7756	-.3294	9.301E-08	4464.7697	.073998
284.160	-8.41E-07	-10.5373	-.050138	7.762E-08	4464.8074	.051800
288.600	-5.32E-07	-10.2725	.1387	6.185E-08	4464.7943	.033283
293.040	-2.92E-07	-9.3464	.2538	4.698E-08	4464.7484	.018547
297.480	-1.14E-07	-8.0499	.3114	3.379E-08	4464.6842	.007395
301.920	8.48E-09	-6.6036	.3266	2.268E-08	4464.6126	-5.565E-04
306.360	8.70E-08	-5.1650	.3125	1.376E-08	4464.5414	-.005793
310.800	1.31E-07	-3.8379	.2800	6.940E-09	4464.4757	-.008836
315.240	1.49E-07	-2.6831	.2378	1.997E-09	4464.4185	-.010195
319.680	1.48E-07	-1.7280	.1922	-1.346E-09	4464.3713	-.010332
324.120	1.37E-07	-.9756	.1478	-3.395E-09	4464.3340	-.009648
328.560	1.18E-07	-.4129	.1076	-4.448E-09	4464.3062	-.008470
333.000	9.72E-08	-.016957	.073158	-4.773E-09	4464.2866	-.007053
337.440	7.59E-08	.2399	.045098	-4.604E-09	4464.2976	-.005586
341.880	5.63E-08	.3866	.023378	-4.129E-09	4464.3049	-.004197
346.320	3.92E-08	.4503	.007476	-3.495E-09	4464.3080	-.002966
350.760	2.52E-08	.4553	-.003398	-2.809E-09	4464.3083	-.001932
355.200	1.43E-08	.4220	-.010150	-2.144E-09	4464.3066	-.001109
359.640	6.19E-09	.3666	-.013691	-1.546E-09	4464.3039	-4.866E-04
364.080	5.59E-10	.3014	-.014870	-1.040E-09	4464.3006	-4.451E-05
368.520	-3.04E-09	.2352	-.014425	-6.332E-10	4464.2974	2.453E-04
372.960	-5.06E-09	.1738	-.012963	-3.232E-10	4464.2943	4.131E-04
377.400	-5.91E-09	.1203	-.010962	-1.003E-10	4464.2917	4.884E-04
381.840	-5.95E-09	.076481	-.008773	4.891E-11	4464.2895	4.976E-04
386.280	-5.48E-09	.042400	-.006639	1.390E-10	4464.2878	4.635E-04
390.720	-4.72E-09	.017433	-.004714	1.844E-10	4464.2866	4.039E-04
395.160	-3.84E-09	4.204E-04	-.003078	1.979E-10	4464.2857	3.326E-04
399.600	-2.96E-09	-.010035	-.001764	1.906E-10	4464.2862	2.594E-04
404.040	-2.15E-09	-.015372	-7.656E-04	1.714E-10	4464.2865	1.904E-04
408.480	-1.44E-09	-.016948	-5.654E-05	1.469E-10	4464.2866	1.290E-04
412.920	-8.45E-10	-.015972	3.998E-04	1.219E-10	4464.2865	7.655E-05
417.360	-3.58E-10	-.013479	6.424E-04	9.958E-11	4464.2864	3.275E-05
421.800	3.92E-11	-.010333	7.116E-04	8.154E-11	4464.2862	-1.612E-06
426.240	3.66E-10	-.007214	6.741E-04	6.824E-11	4464.2861	-1.526E-05
430.680	6.45E-10	-.004393	5.798E-04	5.944E-11	4464.2859	-2.722E-05
435.120	8.94E-10	-.002105	4.345E-04	5.451E-11	4464.2858	-3.823E-05
439.560	1.13E-09	-5.708E-04	2.410E-04	5.249E-11	4464.2857	-4.890E-05
444.000	1.36E-09	0.0000	0.0000	5.205E-11	4464.2857	-5.967E-05

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	-.00213791
Maximum bending moment	=	97015.513 lbs-in
Maximum shear force	=	4011.823 lbs
Depth of maximum bending moment	=	44.400 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6

Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .200000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	0.0000	6684.6030	-.004053	4464.2857	-108.9408
4.440	.182004	29955.5004	6193.4520	-.004030	5947.2313	-112.2984
8.880	.164210	57682.0733	5669.0484	-.003964	7319.8339	-123.9194
13.320	.146805	82936.6318	5097.9847	-.003857	8570.0596	-133.3165
17.760	.129957	1.055E+05	4482.8175	-.003715	9688.1063	-143.7858
22.200	.113820	1.252E+05	3823.8412	-.003540	10663.1926	-153.0504
26.640	.098525	1.418E+05	3128.4211	-.003337	11485.7847	-160.2019
31.080	.084185	1.552E+05	2406.5319	-.003112	12148.4881	-164.9735
35.520	.070890	1.653E+05	1669.2342	-.002869	12646.3116	-167.1426
39.960	.058707	1.720E+05	928.4739	-.002614	12976.8870	-166.5332
44.400	.047682	1.753E+05	196.8762	-.002350	13140.6421	-163.0153
48.840	.037836	1.753E+05	-512.4500	-.002085	13140.9274	-156.5009
53.280	.029169	1.721E+05	-1186.0730	-.001821	12984.1004	-146.9328
57.720	.021661	1.659E+05	-1810.3234	-.001565	12679.5778	-134.2611
62.160	.015270	1.571E+05	-2371.2167	-.001320	12239.8802	-118.3936
66.600	.009937	1.458E+05	-2837.7439	-.001091	11680.7148	-91.7539
71.040	.005584	1.326E+05	-3160.8548	-8.799E-04	11028.3621	-53.7915
75.480	.002123	1.183E+05	-3327.5677	-6.897E-04	10320.1997	-21.3044
79.920	-5.41E-04	1.035E+05	-3362.3374	-5.216E-04	9588.2899	5.6423
84.360	-.002508	88779.2898	-3289.4897	-3.759E-04	8859.3001	27.1720
88.800	-.003878	74544.5379	-3132.4587	-2.521E-04	8154.6094	43.5627
93.240	-.004747	61130.9340	-2913.1778	-1.492E-04	7490.5696	55.2125
97.680	-.005204	48774.9091	-2651.6204	-6.593E-05	6878.8852	62.6062
102.120	-.005332	37628.4561	-2365.4839	-4.448E-07	6327.0806	66.2842
106.560	-.005208	27769.7085	-2070.0024	4.912E-05	5839.0238	66.8156
111.000	-.004896	19214.1190	-1777.8721	8.473E-05	5415.4797	64.7746
115.440	-.004455	11925.7717	-1499.2693	1.083E-04	5054.6705	60.7221
119.880	-.003934	5828.4558	-1241.9419	1.218E-04	4752.8231	55.1911
124.320	-.003374	816.2140	-1011.3531	1.268E-04	4504.6923	48.6777
128.760	-.002808	-3236.8276	-810.8592	1.250E-04	4624.5247	41.6349
133.200	-.002264	-6467.4615	-579.5001	1.176E-04	4784.4571	62.5809
137.640	-.001763	-8461.1358	-328.4508	1.063E-04	4883.1538	50.5043
142.080	-.001320	-9454.9167	-129.4942	9.274E-05	4932.3509	39.1158
146.520	-9.40E-04	-9672.8118	21.2587	7.825E-05	4943.1378	28.7909
150.960	-6.25E-04	-9318.2523	129.0566	6.385E-05	4925.5853	19.7667
155.400	-3.73E-04	-8569.3154	199.9353	5.030E-05	4888.5092	12.1606
159.840	-1.78E-04	-7576.3237	240.2314	3.806E-05	4839.3512	5.9908
164.280	-3.46E-05	-6461.4069	256.1924	2.742E-05	4784.1573	1.1988

168.720	6.54E-05	-5319.5959	253.6809	1.849E-05	4727.6320	-2.3301
173.160	1.30E-04	-4221.0343	237.9696	1.126E-05	4673.2478	-4.7471
177.600	1.65E-04	-3213.9236	213.6159	5.622E-06	4623.3908	-6.2231
182.040	1.79E-04	-2327.8697	184.4053	1.422E-06	4579.5268	-6.9349
186.480	1.78E-04	-1577.3515	153.3502	-1.538E-06	4542.3724	-7.0539
190.920	1.66E-04	-965.0956	122.7307	-3.465E-06	4512.0627	-6.7386
195.360	1.47E-04	-485.1949	94.1655	-4.564E-06	4488.3053	-6.1286
199.800	1.25E-04	-125.8667	68.7002	-5.027E-06	4470.5167	-5.3422
204.240	1.03E-04	128.2111	46.9059	-5.025E-06	4470.6328	-4.4751
208.680	8.07E-05	294.0045	28.9770	-4.705E-06	4478.8404	-3.6010
213.120	6.08E-05	388.6609	14.8257	-4.188E-06	4483.5264	-2.7735
217.560	4.35E-05	428.4457	4.1659	-3.569E-06	4485.4959	-2.0282
222.000	2.91E-05	428.0312	-3.4129	-2.920E-06	4485.4754	-1.3857
226.440	1.76E-05	400.0838	-8.3861	-2.292E-06	4484.0918	-.8545
230.880	8.74E-06	355.0894	-11.2463	-1.720E-06	4481.8644	-.4339
235.320	2.30E-06	301.3622	-12.4684	-1.222E-06	4479.2046	-.1166
239.760	-2.11E-06	245.1838	-12.4858	-8.077E-07	4476.4235	.1088
244.200	-4.87E-06	191.0261	-11.6756	-4.771E-07	4473.7425	.2562
248.640	-6.34E-06	141.8224	-10.3517	-2.248E-07	4471.3066	.3402
253.080	-6.86E-06	99.2529	-8.7641	-4.210E-08	4469.1992	.3750
257.520	-6.72E-06	64.0249	-7.1023	8.166E-08	4467.4553	.3736
261.960	-6.14E-06	36.1302	-5.5011	1.576E-07	4466.0743	.3476
266.400	-5.32E-06	15.0699	-4.0492	1.964E-07	4465.0317	.3064
270.840	-4.40E-06	.042909	-2.7968	2.078E-07	4464.2878	.2577
275.280	-3.47E-06	-9.9045	-1.7652	2.004E-07	4464.7760	.2070
279.720	-2.62E-06	-15.7655	-.9534	1.809E-07	4465.0662	.1586
284.160	-1.87E-06	-18.4916	-.3460	1.549E-07	4465.2011	.1150
288.600	-1.24E-06	-18.9412	.081796	1.266E-07	4465.2234	.077698
293.040	-7.43E-07	-17.8496	.3592	9.868E-08	4465.1694	.047248
297.480	-3.65E-07	-15.8175	.5164	7.316E-08	4465.0688	.023564
301.920	-9.31E-08	-13.3128	.5823	5.108E-08	4464.9448	.006109
306.360	8.89E-08	-10.6811	.5827	3.290E-08	4464.8145	-.005921
310.800	1.99E-07	-8.1606	.5397	1.862E-08	4464.6897	-.013454
315.240	2.54E-07	-5.9013	.4711	7.957E-09	4464.5779	-.017439
319.680	2.70E-07	-3.9827	.3907	4.658E-10	4464.4829	-.018770
324.120	2.58E-07	-2.4322	.3085	-4.396E-09	4464.4061	-.018239
328.560	2.31E-07	-1.2400	.2314	-7.180E-09	4464.3471	-.016513
333.000	1.95E-07	-.3727	.1634	-8.402E-09	4464.3042	-.014126
337.440	1.56E-07	.2163	.1065	-8.521E-09	4464.2964	-.011483
341.880	1.19E-07	.5788	.061329	-7.918E-09	4464.3144	-.008871
346.320	8.57E-08	.7662	.027252	-6.899E-09	4464.3236	-.006479
350.760	5.77E-08	.8254	.003065	-5.692E-09	4464.3266	-.004416
355.200	3.52E-08	.7972	-.012796	-4.462E-09	4464.3252	-.002728
359.640	1.80E-08	.7147	-.021998	-3.317E-09	4464.3211	-.001417
364.080	5.71E-09	.6040	-.026152	-2.317E-09	4464.3156	-4.543E-04
368.520	-2.55E-09	.4841	-.026705	-1.492E-09	4464.3097	2.052E-04
372.960	-7.54E-09	.3679	-.024883	-8.466E-10	4464.3039	6.154E-04
377.400	-1.01E-08	.2637	-.021672	-3.679E-10	4464.2988	8.312E-04
381.840	-1.08E-08	.1757	-.017821	-3.491E-11	4464.2944	9.036E-04
386.280	-1.04E-08	.1054	-.013867	1.782E-10	4464.2909	8.775E-04
390.720	-9.23E-09	.052427	-.010165	2.978E-10	4464.2883	7.898E-04
395.160	-7.73E-09	.014965	-.006926	3.489E-10	4464.2865	6.692E-04
399.600	-6.13E-09	-.009310	-.004249	3.532E-10	4464.2862	5.369E-04
404.040	-4.59E-09	-.022997	-.002153	3.287E-10	4464.2869	4.069E-04
408.480	-3.21E-09	-.028652	-6.116E-04	2.895E-10	4464.2871	2.877E-04
412.920	-2.02E-09	-.028621	4.336E-04	2.461E-10	4464.2871	1.832E-04
417.360	-1.03E-09	-.024966	.001049	2.055E-10	4464.2870	9.392E-05

421.800	-1.97E-10	-.019446	.001275	1.718E-10	4464.2867	8.096E-06
426.240	5.01E-10	-.013757	.001247	1.467E-10	4464.2864	-2.084E-05
430.680	1.11E-09	-.008471	.001097	1.298E-10	4464.2861	-4.665E-05
435.120	1.65E-09	-.004101	8.365E-04	1.203E-10	4464.2859	-7.069E-05
439.560	2.17E-09	-.001123	4.706E-04	1.163E-10	4464.2858	-9.414E-05
444.000	2.69E-09	0.0000	0.0000	1.155E-10	4464.2857	-1.178E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	-.00405306
Maximum bending moment	=	175268.162 lbs-in
Maximum shear force	=	6684.603 lbs
Depth of maximum bending moment	=	48.840 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .300000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	0.0000	9060.4559	-.005892	4464.2857	-137.6254
4.440	.273839	40833.9472	8432.4007	-.005861	6485.7683	-145.2824
8.880	.247953	78783.2436	7753.6292	-.005770	8364.4463	-160.4705
13.320	.222597	1.135E+05	7013.0086	-.005625	10084.5490	-173.1424
17.760	.198005	1.448E+05	6214.8473	-.005429	11632.8415	-186.3897
22.200	.174388	1.723E+05	5360.5506	-.005189	12995.6138	-198.4286
26.640	.151931	1.959E+05	4457.2453	-.004909	14160.4290	-208.4657
31.080	.130792	2.152E+05	3515.7018	-.004598	15116.9037	-215.6530
35.520	.111101	2.301E+05	2549.3268	-.004260	15857.5408	-219.6510
39.960	.092960	2.407E+05	1572.8038	-.003904	16378.0648	-220.2242
44.400	.076438	2.467E+05	601.7346	-.003534	16677.6535	-217.1943
48.840	.061576	2.484E+05	-347.6087	-.003159	16759.1126	-210.4378
53.280	.048386	2.457E+05	-1258.5081	-.002784	16628.9948	-199.8773
57.720	.036850	2.390E+05	-2113.9652	-.002417	16297.6720	-185.4637
62.160	.026923	2.286E+05	-2896.7410	-.002063	15779.3779	-167.1380
66.600	.018534	2.147E+05	-3589.1307	-.001727	15092.2588	-144.7493
71.040	.011590	1.978E+05	-4158.3441	-.001414	14258.5109	-111.6531

75.480	.005978	1.787E+05	-4539.3568	-.001129	13310.8544	-59.9742
79.920	.001568	1.583E+05	-4708.8140	-8.732E-04	12300.2022	-16.3579
84.360	-.001776	1.375E+05	-4702.4101	-6.490E-04	11269.6306	19.2425
88.800	-.004195	1.170E+05	-4555.0774	-4.562E-04	10254.4029	47.1235
93.240	-.005827	97322.7023	-4299.9883	-2.938E-04	9282.2413	67.7815
97.680	-.006804	78972.1271	-3967.7779	-1.602E-04	8373.7970	81.8628
102.120	-.007250	62195.4990	-3585.9812	-5.316E-05	7543.2708	90.1177
106.560	-.007276	47164.0191	-3178.6662	2.973E-05	6799.1381	93.3575
111.000	-.006986	33949.1445	-2766.2422	9.121E-05	6144.9364	92.4191
115.440	-.006466	22539.0452	-2365.4145	1.340E-04	5580.0800	88.1340
119.880	-.005795	12855.0062	-1989.2583	1.608E-04	5100.6722	81.3057
124.320	-.005038	4767.3068	-1647.3814	1.742E-04	4700.2910	72.6929
128.760	-.004249	-1889.7603	-1346.1455	1.764E-04	4557.8382	62.9990
133.200	-.003472	-7303.9372	-993.2170	1.694E-04	4825.8668	95.9778
137.640	-.002744	-10822.3589	-605.6464	1.557E-04	5000.0461	78.6036
142.080	-.002089	-12785.7586	-293.6514	1.378E-04	5097.2441	61.9347
146.520	-.001521	-13521.7480	-52.7165	1.178E-04	5133.6792	46.5945
150.960	-.001043	-13332.3662	123.9780	9.749E-05	5124.3038	32.9976
155.400	-6.55E-04	-12485.7529	244.6854	7.792E-05	5082.3923	21.3751
159.840	-3.51E-04	-11211.4563	318.3438	5.996E-05	5019.3083	11.8043
164.280	-1.22E-04	-9698.7946	353.9621	4.411E-05	4944.4241	4.2400
168.720	4.08E-05	-8097.6518	360.1457	3.062E-05	4865.1596	-1.4546
173.160	1.50E-04	-6521.0964	344.7542	1.954E-05	4787.1123	-5.4785
177.600	2.14E-04	-5049.2510	314.6811	1.077E-05	4714.2486	-8.0679
182.040	2.45E-04	-3733.9041	275.7385	4.118E-06	4649.1325	-9.4738
186.480	2.51E-04	-2603.4359	232.6278	-6.857E-07	4593.1687	-9.9454
190.920	2.39E-04	-1667.7130	188.9786	-3.923E-06	4546.8458	-9.7164
195.360	2.16E-04	-922.6932	147.4360	-5.886E-06	4509.9636	-8.9965
199.800	1.87E-04	-354.5611	109.7795	-6.854E-06	4481.8382	-7.9659
204.240	1.55E-04	56.7141	77.0600	-7.080E-06	4467.0933	-6.7727
208.680	1.24E-04	334.4468	49.7406	-6.784E-06	4480.8425	-5.5334
213.120	9.50E-05	502.9283	27.8344	-6.149E-06	4489.1832	-4.3343
217.560	6.94E-05	585.7114	11.0302	-5.324E-06	4493.2813	-3.2351
222.000	4.77E-05	604.4226	-1.1969	-4.422E-06	4494.2076	-2.2726
226.440	3.01E-05	578.0282	-9.4932	-3.526E-06	4492.9010	-1.4645
230.880	1.64E-05	522.4714	-14.5522	-2.691E-06	4490.1506	-.8143
235.320	6.22E-06	450.5973	-17.0588	-1.954E-06	4486.5925	-.3148
239.760	-9.41E-07	372.2901	-17.6499	-1.330E-06	4482.7159	.048559
244.200	-5.59E-06	294.7523	-16.8886	-8.247E-07	4478.8774	.2944
248.640	-8.26E-06	222.8686	-15.2514	-4.323E-07	4475.3188	.4431
253.080	-9.43E-06	159.6075	-13.1239	-1.425E-07	4472.1871	.5152
257.520	-9.53E-06	106.4229	-10.8036	5.918E-08	4469.5542	.5300
261.960	-8.91E-06	63.6320	-8.5075	1.881E-07	4467.4358	.5043
266.400	-7.86E-06	30.7511	-6.3827	2.596E-07	4465.8080	.4528
270.840	-6.60E-06	6.7805	-4.5184	2.881E-07	4464.6214	.3870
275.280	-5.30E-06	-9.5643	-2.9578	2.859E-07	4464.7592	.3160
279.720	-4.06E-06	-19.6751	-1.7095	2.638E-07	4465.2597	.2463
284.160	-2.96E-06	-24.9208	-.7582	2.300E-07	4465.5194	.1823
288.600	-2.02E-06	-26.5609	-.072660	1.910E-07	4465.6006	.1265
293.040	-1.26E-06	-25.6932	.3865	1.514E-07	4465.5577	.080304
297.480	-6.77E-07	-23.2294	.6619	1.143E-07	4465.4357	.043732
301.920	-2.48E-07	-19.8918	.7950	8.160E-08	4465.2705	.016248
306.360	4.77E-08	-16.2239	.8240	5.422E-08	4465.0889	-.003177
310.800	2.34E-07	-12.6104	.7819	3.237E-08	4464.9100	-.015810
315.240	3.35E-07	-9.3022	.6958	1.576E-08	4464.7462	-.022992
319.680	3.74E-07	-6.4425	.5870	3.827E-09	4464.6047	-.026018
324.120	3.69E-07	-4.0925	.4713	-4.158E-09	4464.4883	-.026060

328.560	3.37E-07	-2.2542	.3599	-8.969E-09	4464.3973	-.024121
333.000	2.89E-07	-.8903	.2597	-1.135E-08	4464.3298	-.021016
337.440	2.36E-07	.059834	.1745	-1.198E-08	4464.2887	-.017375
341.880	1.83E-07	.6674	.1056	-1.143E-08	4464.3188	-.013657
346.320	1.35E-07	1.0053	.052715	-1.016E-08	4464.3355	-.010174
350.760	9.28E-08	1.1422	.014343	-8.535E-09	4464.3423	-.007111
355.200	5.88E-08	1.1384	-.011571	-6.806E-09	4464.3421	-.004562
359.640	3.24E-08	1.0440	-.027351	-5.152E-09	4464.3374	-.002547
364.080	1.30E-08	.8989	-.035308	-3.679E-09	4464.3302	-.001038
368.520	-2.70E-10	.7329	-.037564	-2.442E-09	4464.3220	2.177E-05
372.960	-8.65E-09	.5670	-.035949	-1.457E-09	4464.3138	7.055E-04
377.400	-1.32E-08	.4147	-.031961	-7.129E-10	4464.3062	.001091
381.840	-1.50E-08	.2837	-.026760	-1.836E-10	4464.2998	.001252
386.280	-1.48E-08	.1772	-.021194	1.657E-10	4464.2945	.001255
390.720	-1.35E-08	.095351	-.015841	3.722E-10	4464.2904	.001156
395.160	-1.15E-08	.036262	-.011058	4.720E-10	4464.2875	9.986E-04
399.600	-9.32E-09	-.003159	-.007030	4.971E-10	4464.2859	8.159E-04
404.040	-7.12E-09	-.026493	-.003818	4.746E-10	4464.2870	6.306E-04
408.480	-5.10E-09	-.037382	-.001404	4.262E-10	4464.2876	4.570E-04
412.920	-3.33E-09	-.039243	2.812E-04	3.681E-10	4464.2877	3.021E-04
417.360	-1.83E-09	-.035130	.001324	3.117E-10	4464.2875	1.678E-04
421.800	-5.66E-10	-.027691	.001748	2.641E-10	4464.2871	2.327E-05
426.240	5.13E-10	-.019780	.001753	2.282E-10	4464.2867	-2.137E-05
430.680	1.46E-09	-.012280	.001568	2.039E-10	4464.2863	-6.160E-05
435.120	2.32E-09	-.005988	.001211	1.900E-10	4464.2860	-9.933E-05
439.560	3.15E-09	-.001651	6.881E-04	1.842E-10	4464.2858	-1.363E-04
444.000	3.96E-09	0.0000	0.0000	1.830E-10	4464.2857	-1.737E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	.30000000 in
Computed slope at pile head	=	-.00589210
Maximum bending moment	=	248355.502 lbs-in
Maximum shear force	=	9060.456 lbs
Depth of maximum bending moment	=	48.840 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Specified deflection at pile head	=	.400000 in
Specified bending moment at pile head	=	.000 in-lbs
Specified axial load at pile head	=	75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	0.0000	11307.3307	-.007690	4464.2857	-159.1388
4.440	.365858	51196.5700	10558.1446	-.007651	6998.7694	-178.3323
8.880	.332061	98851.7242	9724.5131	-.007537	9357.9354	-197.1774
13.320	.298930	1.426E+05	8813.9418	-.007354	11522.2017	-212.9899
17.760	.266757	1.820E+05	7834.1899	-.007108	13475.0440	-228.3398
22.200	.235810	2.169E+05	6790.7700	-.006806	15200.4963	-241.6692
26.640	.206323	2.469E+05	5693.8587	-.006454	16684.6791	-252.4350
31.080	.178497	2.717E+05	4554.7548	-.006061	17916.3366	-260.6749
35.520	.152500	2.913E+05	3384.8955	-.005634	18886.8056	-266.2888
39.960	.128463	3.055E+05	2198.5938	-.005182	19590.1177	-268.0814
44.400	.106484	3.143E+05	1013.6303	-.004712	20024.1682	-265.6860
48.840	.086619	3.177E+05	-151.0526	-.004233	20191.0759	-258.9459
53.280	.068893	3.158E+05	-1275.9464	-.003753	20097.3341	-247.7630
57.720	.053292	3.089E+05	-2341.2020	-.003280	19753.9039	-232.0819
62.160	.039770	2.972E+05	-3326.7511	-.002820	19176.2622	-211.8591
66.600	.028248	2.812E+05	-4212.2102	-.002382	18384.4364	-186.9963
71.040	.018619	2.614E+05	-4976.3085	-.001971	17403.0903	-157.1921
75.480	.010748	2.383E+05	-5564.6810	-.001592	16261.8057	-107.8405
79.920	.004482	2.130E+05	-5907.8936	-.001250	15009.3222	-46.7598
84.360	-3.51E-04	1.867E+05	-6003.2663	-9.470E-04	13705.8818	3.7991
88.800	-.003927	1.603E+05	-5896.9129	-6.839E-04	12401.4840	44.1078
93.240	-.006424	1.348E+05	-5633.1086	-4.603E-04	11136.1253	74.7230
97.680	-.008014	1.106E+05	-5253.1699	-2.743E-04	9940.3225	96.4206
102.120	-.008860	88305.6862	-4794.6180	-1.235E-04	8835.8543	110.1343
106.560	-.009111	68121.9973	-4290.6058	-4.953E-06	7836.6618	116.8982
111.000	-.008904	50208.4053	-3769.5826	8.473E-05	6949.8503	117.7970
115.440	-.008359	34591.6711	-3255.1614	1.490E-04	6176.7447	113.9243
119.880	-.007581	21203.3336	-2766.1532	1.913E-04	5513.9557	106.3497
124.320	-.006660	9900.8276	-2316.7280	2.149E-04	4954.4257	96.0941
128.760	-.005673	487.6851	-1916.6645	2.227E-04	4488.4285	84.1146
133.200	-.004682	-7267.5012	-1442.5882	2.176E-04	4824.0630	129.4332
137.640	-.003740	-12467.4240	-917.4055	2.026E-04	5081.4849	107.1356
142.080	-.002882	-15549.0258	-489.8793	1.814E-04	5234.0395	85.4438
146.520	-.002129	-16938.3740	-155.3504	1.568E-04	5302.8191	65.2449
150.960	-.001490	-17032.9597	94.1630	1.310E-04	5307.5015	47.1485
155.400	-9.66E-04	-16189.4809	268.8002	1.059E-04	5265.7452	31.5169
159.840	-5.50E-04	-14716.5174	379.8443	8.244E-05	5192.8262	18.5029
164.280	-2.34E-04	-12871.3667	438.8793	6.153E-05	5101.4821	8.0895
168.720	-3.68E-06	-10860.2459	457.1288	4.354E-05	5001.9217	.1310
173.160	1.53E-04	-8841.0604	444.9681	2.861E-05	4901.9620	-5.6088
177.600	2.50E-04	-6927.9817	411.5989	1.666E-05	4807.2551	-9.4224
182.040	3.01E-04	-5197.1545	364.8654	7.466E-06	4721.5706	-11.6288
186.480	3.17E-04	-3692.9489	311.1885	7.274E-07	4647.1050	-12.5500
190.920	3.07E-04	-2434.2854	255.5938	-3.917E-06	4584.7949	-12.4926
195.360	2.82E-04	-1420.6674	201.8091	-6.839E-06	4534.6158	-11.7347
199.800	2.47E-04	-637.6662	152.4077	-8.399E-06	4495.8534	-10.5181
204.240	2.07E-04	-61.6934	108.9797	-8.929E-06	4467.3398	-9.0441
208.680	1.67E-04	336.0197	72.3126	-8.721E-06	4480.9204	-7.4727
213.120	1.30E-04	586.2503	42.5702	-8.022E-06	4493.3080	-5.9248
217.560	9.62E-05	719.3854	19.4585	-7.032E-06	4499.8989	-4.4859
222.000	6.74E-05	763.7248	2.3730	-5.908E-06	4502.0939	-3.2103
226.440	4.37E-05	744.3925	-9.4759	-4.765E-06	4501.1368	-2.1271
230.880	2.51E-05	682.7520	-16.9625	-3.683E-06	4498.0853	-1.2452

235.320	1.10E-05	596.2186	-20.9674	-2.714E-06	4493.8015	-.5588
239.760	9.94E-07	498.3692	-22.3217	-1.884E-06	4488.9575	-.051326
244.200	-5.69E-06	399.2564	-21.7704	-1.204E-06	4484.0509	.2997
248.640	-9.70E-06	305.8495	-19.9509	-6.695E-07	4479.4268	.5199
253.080	-1.16E-05	222.5380	-17.3853	-2.690E-07	4475.3024	.6358
257.520	-1.21E-05	151.6472	-14.4817	1.458E-08	4471.7930	.6722
261.960	-1.15E-05	93.9308	-11.5427	2.007E-07	4468.9358	.6517
266.400	-1.03E-05	49.0141	-8.7781	3.091E-07	4466.7122	.5936
270.840	-8.77E-06	15.7752	-6.3196	3.582E-07	4465.0667	.5138
275.280	-7.12E-06	-7.3423	-4.2363	3.646E-07	4464.6492	.4246
279.720	-5.53E-06	-22.0855	-2.5497	3.423E-07	4465.3791	.3351
284.160	-4.08E-06	-30.2112	-1.2471	3.026E-07	4465.7813	.2516
288.600	-2.84E-06	-33.3618	-.2936	2.544E-07	4465.9373	.1779
293.040	-1.82E-06	-32.9881	.3590	2.041E-07	4465.9188	.1160
297.480	-1.03E-06	-30.3102	.7641	1.562E-07	4465.7862	.066475
301.920	-4.38E-07	-26.3066	.9754	1.133E-07	4465.5880	.028704
306.360	-2.32E-08	-21.7238	1.0426	7.685E-08	4465.3611	.001545
310.800	2.45E-07	-17.0996	1.0093	4.742E-08	4465.1322	-.016557
315.240	3.98E-07	-12.7931	.9119	2.477E-08	4464.9190	-.027299
319.680	4.65E-07	-9.0184	.7795	8.234E-09	4464.7322	-.032353
324.120	4.71E-07	-5.8769	.6338	-3.055E-09	4464.5766	-.033256
328.560	4.38E-07	-3.3880	.4904	-1.008E-08	4464.4534	-.031339
333.000	3.82E-07	-1.5152	.3594	-1.379E-08	4464.3607	-.027700
337.440	3.15E-07	-.1878	.2464	-1.508E-08	4464.2950	-.023199
341.880	2.48E-07	.6824	.1539	-1.471E-08	4464.3195	-.018470
346.320	1.85E-07	1.1882	.081872	-1.329E-08	4464.3445	-.013953
350.760	1.30E-07	1.4183	.028865	-1.132E-08	4464.3559	-.009924
355.200	8.41E-08	1.4521	-.007650	-9.141E-09	4464.3576	-.006525
359.640	4.84E-08	1.3565	-.030578	-7.012E-09	4464.3529	-.003803
364.080	2.18E-08	1.1852	-.042875	-5.086E-09	4464.3444	-.001737
368.520	3.23E-09	.9791	-.047308	-3.445E-09	4464.3342	-2.599E-04
372.960	-8.78E-09	.7674	-.046295	-2.122E-09	4464.3237	7.161E-04
377.400	-1.56E-08	.5694	-.041842	-1.108E-09	4464.3139	.001290
381.840	-1.86E-08	.3966	-.035525	-3.761E-10	4464.3053	.001556
386.280	-1.90E-08	.2542	-.028510	1.172E-10	4464.2983	.001603
390.720	-1.76E-08	.1433	-.021611	4.185E-10	4464.2928	.001504
395.160	-1.52E-08	.062046	-.015343	5.742E-10	4464.2888	.001319
399.600	-1.25E-08	.006722	-.009988	6.263E-10	4464.2860	.001093
404.040	-9.67E-09	-.027060	-.005659	6.109E-10	4464.2871	8.570E-04
408.480	-7.05E-09	-.043933	-.002353	5.571E-10	4464.2879	6.319E-04
412.920	-4.73E-09	-.048328	2.136E-07	4.872E-10	4464.2881	4.282E-04
417.360	-2.73E-09	-.044256	.001505	4.170E-10	4464.2879	2.498E-04
421.800	-1.02E-09	-.035238	.002153	3.568E-10	4464.2875	4.209E-05
426.240	4.41E-10	-.025372	.002206	3.108E-10	4464.2870	-1.836E-05
430.680	1.74E-09	-.015856	.002003	2.796E-10	4464.2865	-7.324E-05
435.120	2.92E-09	-.007776	.001562	2.617E-10	4464.2861	-1.250E-04
439.560	4.06E-09	-.002156	8.947E-04	2.541E-10	4464.2858	-1.758E-04
444.000	5.18E-09	0.0000	0.0000	2.525E-10	4464.2857	-2.272E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = -.00768955
Maximum bending moment = 317681.161 lbs-in
Maximum shear force = 11307.331 lbs
Depth of maximum bending moment = 48.840 in
Depth of maximum shear force = 0.000 in
Number of iterations = 8
Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .500000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	0.0000	13262.2873	-.009454	4464.2857	-159.1388
4.440	.458025	60464.0924	12505.8117	-.009408	7457.5576	-181.6159
8.880	.416457	1.173E+05	11623.2872	-.009273	10272.0758	-215.9176
13.320	.375678	1.699E+05	10582.9504	-.009056	12872.9438	-252.7026
17.760	.336043	2.173E+05	9421.1817	-.008762	15222.9495	-270.6167
22.200	.297870	2.594E+05	8186.9113	-.008401	17303.4240	-285.3609
26.640	.261443	2.956E+05	6894.5605	-.007980	19098.9277	-296.7791
31.080	.227005	3.259E+05	5558.8430	-.007509	20597.4112	-304.8954
35.520	.194761	3.500E+05	4194.0565	-.006997	21790.1971	-309.8733
39.960	.164873	3.678E+05	2813.4948	-.006453	22671.8254	-312.0013
44.400	.137460	3.793E+05	1431.9683	-.005887	23239.7741	-310.3079
48.840	.112599	3.844E+05	68.8235	-.005308	23495.4093	-303.7212
53.280	.090326	3.834E+05	-1253.9466	-.004726	23445.0299	-292.1212
57.720	.070634	3.764E+05	-2513.9399	-.004150	23099.9822	-275.4433
62.160	.053475	3.639E+05	-3688.5281	-.003589	22476.7165	-253.6504
66.600	.038765	3.461E+05	-4754.8542	-.003051	21596.8157	-226.6766
71.040	.026384	3.237E+05	-5689.4335	-.002543	20487.0481	-194.3051
75.480	.016182	2.972E+05	-6466.8030	-.002073	19179.5662	-155.8613
79.920	.007980	2.676E+05	-6997.6376	-.001644	17712.5478	-83.2534
84.360	.001579	2.362E+05	-7220.4422	-.001263	16157.5932	-17.1090
88.800	-.003231	2.043E+05	-7177.8511	-9.286E-04	14580.0389	36.2942
93.240	-.006667	1.731E+05	-6925.1272	-6.426E-04	13032.7986	77.5454
97.680	-.008937	1.433E+05	-6514.2677	-4.028E-04	11556.9111	107.5265
102.120	-.010244	1.155E+05	-5992.8742	-2.067E-04	10182.3807	127.3354
106.560	-.010772	90191.9398	-5403.3550	-5.075E-05	8929.2332	138.2138
111.000	-.010694	67557.5238	-4782.4264	6.882E-05	7808.7176	141.4838
115.440	-.010161	47678.1597	-4160.8761	1.562E-04	6824.5906	138.4939
119.880	-.009307	30504.9413	-3563.5405	2.154E-04	5974.4313	130.5762
124.320	-.008248	15890.4513	-3009.4509	2.506E-04	5250.9417	119.0137
128.760	-.007082	3614.1288	-2512.0985	2.654E-04	4643.2030	105.0189
133.200	-.005892	-6593.7175	-1917.3546	2.631E-04	4790.7074	162.8838
137.640	-.004746	-13587.2101	-1253.9592	2.478E-04	5136.9199	135.9430

142.080	-.003691	-17893.9180	-709.2459	2.240E-04	5350.1232	109.4233
146.520	-.002757	-20034.4653	-278.7647	1.952E-04	5456.0909	84.4871
150.960	-.001958	-20499.3545	46.3280	1.645E-04	5479.1052	61.9510
155.400	-.001297	-19732.6179	277.8129	1.340E-04	5441.1480	42.3214
159.840	-7.68E-04	-18121.6124	429.1273	1.053E-04	5361.3952	25.8382
164.280	-3.62E-04	-15992.0958	514.2907	7.944E-05	5255.9736	12.5237
168.720	-6.27E-05	-13607.6186	547.0503	5.701E-05	5137.9302	2.2328
173.160	1.45E-04	-11172.2551	540.2415	3.822E-05	5017.3677	-5.2999
177.600	2.77E-04	-8835.7318	505.3504	2.306E-05	4901.6982	-10.4168
182.040	3.49E-04	-6700.1015	452.2545	1.128E-05	4795.9739	-13.5002
186.480	3.77E-04	-4827.2271	389.1139	2.548E-06	4703.2574	-14.9415
190.920	3.72E-04	-3246.4669	322.3824	-3.571E-06	4625.0019	-15.1177
195.360	3.45E-04	-1962.0925	256.9099	-7.519E-06	4561.4190	-14.3744
199.800	3.05E-04	-960.0992	196.1062	-9.734E-06	4511.8154	-13.0146
204.240	2.59E-04	-214.1865	142.1432	-1.062E-05	4474.8890	-11.2930
208.680	2.11E-04	309.2081	96.1730	-1.055E-05	4479.5930	-9.4143
213.120	1.65E-04	646.8575	58.5461	-9.827E-06	4496.3084	-7.5348
217.560	1.24E-04	835.6425	29.0166	-8.704E-06	4505.6542	-5.7668
222.000	8.78E-05	910.3219	6.9264	-7.380E-06	4509.3512	-4.1838
226.440	5.81E-05	902.0644	-8.6378	-6.007E-06	4508.9424	-2.8271
230.880	3.45E-05	837.6190	-18.7154	-4.688E-06	4505.7520	-1.7124
235.320	1.65E-05	738.9937	-24.3724	-3.493E-06	4500.8696	-.8358
239.760	3.49E-06	623.5187	-26.6275	-2.461E-06	4495.1530	-.1800
244.200	-5.34E-06	504.1800	-26.4035	-1.606E-06	4489.2451	.2809
248.640	-1.08E-05	390.1251	-24.4975	-9.280E-07	4483.5988	.5776
253.080	-1.36E-05	287.2598	-21.5687	-4.146E-07	4478.5065	.7417
257.520	-1.45E-05	198.8710	-18.1376	-4.611E-08	4474.1308	.8039
261.960	-1.40E-05	126.2289	-14.5947	2.003E-07	4470.5347	.7920
266.400	-1.27E-05	69.1364	-11.2153	3.484E-07	4467.7083	.7303
270.840	-1.09E-05	26.4052	-8.1763	4.208E-07	4465.5929	.6386
275.280	-8.94E-06	-3.7495	-5.5756	4.380E-07	4464.4713	.5328
279.720	-7.01E-06	-23.3979	-3.4499	4.174E-07	4465.4440	.4247
284.160	-5.23E-06	-34.6627	-1.7915	3.734E-07	4466.0017	.3224
288.600	-3.69E-06	-39.5551	-.5629	3.171E-07	4466.2439	.2311
293.040	-2.42E-06	-39.8720	.2913	2.569E-07	4466.2596	.1537
297.480	-1.41E-06	-37.1391	.8347	1.985E-07	4466.1243	.091064
301.920	-6.53E-07	-32.5923	1.1319	1.457E-07	4465.8992	.042835
306.360	-1.16E-07	-27.1846	1.2441	1.004E-07	4465.6315	.007706
310.800	2.39E-07	-21.6113	1.2254	6.341E-08	4465.3556	-.016128
315.240	4.47E-07	-16.3449	1.1215	3.464E-08	4465.0949	-.030690
319.680	5.46E-07	-11.6754	.9690	1.340E-08	4464.8637	-.038013
324.120	5.66E-07	-7.7493	.7958	-1.323E-09	4464.6693	-.039985
328.560	5.34E-07	-4.6076	.6221	-1.069E-08	4464.5138	-.038263
333.000	4.71E-07	-2.2178	.4612	-1.586E-08	4464.3955	-.034226
337.440	3.94E-07	-.5016	.3209	-1.792E-08	4464.3105	-.028964
341.880	3.12E-07	.6438	.2049	-1.782E-08	4464.3176	-.023295
346.320	2.35E-07	1.3297	.1137	-1.632E-08	4464.3515	-.017791
350.760	1.67E-07	1.6642	.045735	-1.405E-08	4464.3681	-.012818
355.200	1.11E-07	1.7452	-.001768	-1.147E-08	4464.3721	-.008579
359.640	6.55E-08	1.6562	-.032248	-8.888E-09	4464.3677	-.005150
364.080	3.16E-08	1.4648	-.049271	-6.523E-09	4464.3582	-.002518
368.520	7.61E-09	1.2230	-.056223	-4.486E-09	4464.3463	-6.130E-04
372.960	-8.19E-09	.9685	-.056099	-2.825E-09	4464.3337	6.686E-04
377.400	-1.75E-08	.7267	-.051411	-1.540E-09	4464.3217	.001443
381.840	-2.19E-08	.5130	-.044149	-6.002E-10	4464.3111	.001828
386.280	-2.28E-08	.3351	-.035808	4.252E-11	4464.3023	.001929
390.720	-2.15E-08	.1950	-.027442	4.443E-10	4464.2954	.001839

395.160	-1.89E-08	.091072	-.019733	6.611E-10	4464.2902	.001633
399.600	-1.56E-08	.019312	-.013070	7.447E-10	4464.2867	.001368
404.040	-1.22E-08	-.025487	-.007624	7.400E-10	4464.2870	.001085
408.480	-9.05E-09	-.048884	-.003416	6.837E-10	4464.2881	8.106E-04
412.920	-6.18E-09	-.056277	-3.743E-04	6.040E-10	4464.2885	5.596E-04
417.360	-3.69E-09	-.052610	.001617	5.214E-10	4464.2883	3.375E-04
421.800	-1.55E-09	-.042264	.002507	4.495E-10	4464.2878	6.356E-05
426.240	3.07E-10	-.030643	.002620	3.943E-10	4464.2872	-1.277E-05
430.680	1.95E-09	-.019259	.002409	3.565E-10	4464.2867	-8.246E-05
435.120	3.47E-09	-.009490	.001896	3.347E-10	4464.2862	-1.484E-04
439.560	4.93E-09	-.002643	.001093	3.255E-10	4464.2858	-2.133E-04
444.000	6.36E-09	0.0000	0.0000	3.235E-10	4464.2857	-2.791E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	-.00945386
Maximum bending moment	=	384428.696 lbs-in
Maximum shear force	=	13262.287 lbs
Depth of maximum bending moment	=	48.840 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .600000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	0.0000	14905.1218	-.011172	4464.2857	-159.1388
4.440	.550397	68330.3387	14148.6461	-.011120	7846.9757	-181.6159
8.880	.501255	1.330E+05	13266.1216	-.010967	11050.7155	-215.9176
13.320	.453007	1.934E+05	12225.7846	-.010720	14040.4119	-252.7026
17.760	.406062	2.488E+05	11011.2393	-.010385	16778.6568	-294.3898
22.200	.360791	2.981E+05	9625.8511	-.009970	19223.3843	-329.6589
26.640	.317526	3.409E+05	8134.9945	-.009486	21338.9406	-341.8981
31.080	.276556	3.767E+05	6598.8351	-.008942	23112.3134	-350.0656
35.520	.238121	4.054E+05	5035.0746	-.008349	24534.6366	-354.3311
39.960	.202415	4.270E+05	3460.3224	-.007718	25601.0295	-355.0167
44.400	.169582	4.413E+05	1889.4523	-.007060	26310.2847	-352.5824

48.840	.139719	4.484E+05	337.9242	-.006386	26664.4198	-346.3041
53.280	.112875	4.485E+05	-1173.4810	-.005706	26669.3831	-334.5091
57.720	.089049	4.418E+05	-2620.0742	-.005031	26336.6833	-317.1095
62.160	.068198	4.286E+05	-3976.8962	-.004371	25683.4689	-294.0716
66.600	.050231	4.094E+05	-5218.8223	-.003736	24732.5527	-265.3545
71.040	.035020	3.848E+05	-6320.2999	-.003134	23512.4403	-230.8065
75.480	.022398	3.554E+05	-7254.3166	-.002573	22057.4637	-189.9217
79.920	.012168	3.221E+05	-7957.7694	-.002060	20408.2579	-126.9489
84.360	.004106	2.861E+05	-8338.3423	-.001599	18627.1116	-44.4803
88.800	-.002030	2.491E+05	-8386.4637	-.001193	16795.4068	22.8040
93.240	-.006490	2.124E+05	-8168.2455	-8.435E-04	14979.7324	75.4924
97.680	-.009521	1.771E+05	-7746.3624	-5.483E-04	13232.4246	114.5450
102.120	-.011359	1.440E+05	-7178.6063	-3.049E-04	11592.4776	141.2010
106.560	-.012228	1.136E+05	-6516.8401	-1.097E-04	10086.7334	156.8919
111.000	-.012333	86192.9827	-5806.3150	4.173E-05	8731.2651	163.1644
115.440	-.011858	61985.5721	-5085.3072	1.540E-04	7532.8784	161.6139
119.880	-.010965	40932.8629	-4385.0208	2.320E-04	6490.6651	153.8305
124.320	-.009797	22892.0443	-3729.7007	2.804E-04	5597.5552	141.3587
128.760	-.008475	7626.3594	-3136.8997	3.036E-04	4841.8283	125.6688
133.200	-.007101	-5165.7915	-2422.0805	3.054E-04	4720.0180	196.3218
137.640	-.005763	-14085.1244	-1619.7892	2.908E-04	5161.5691	165.0706
142.080	-.004519	-19743.2109	-955.9525	2.652E-04	5441.6724	133.9549
146.520	-.003408	-22750.5974	-426.7473	2.330E-04	5590.5529	104.4258
150.960	-.002450	-23687.8918	-22.8235	1.978E-04	5636.9536	77.5219
155.400	-.001652	-23084.9937	268.9508	1.623E-04	5607.1072	53.9080
159.840	-.001009	-21407.7213	463.9415	1.286E-04	5524.0739	33.9256
164.280	-5.10E-04	-19050.8472	578.4373	9.794E-05	5407.3970	17.6491
168.720	-1.39E-04	-16336.4285	628.5968	7.112E-05	5273.0198	4.9452
173.160	1.22E-04	-13516.2756	629.6489	4.850E-05	5133.4083	-4.4713
177.600	2.92E-04	-10777.4443	595.3359	3.008E-05	4997.8226	-10.9851
182.040	3.89E-04	-8249.7280	537.5696	1.566E-05	4872.6881	-15.0358
186.480	4.31E-04	-6014.2566	466.2720	4.850E-06	4762.0212	-17.0803
190.920	4.32E-04	-4112.4628	389.3630	-2.825E-06	4667.8730	-17.5635
195.360	4.06E-04	-2554.8319	312.8609	-7.878E-06	4590.7625	-16.8969
199.800	3.62E-04	-1329.0107	241.0626	-1.082E-05	4530.0783	-15.4446
204.240	3.10E-04	-406.9881	176.7721	-1.214E-05	4484.4336	-13.5150
208.680	2.55E-04	248.8098	121.5535	-1.226E-05	4476.6030	-11.3582
213.120	2.01E-04	680.5703	75.9865	-1.155E-05	4497.9773	-9.1674
217.560	1.52E-04	931.2642	39.9102	-1.033E-05	4510.3879	-7.0831
222.000	1.09E-04	1041.8537	12.6429	-8.836E-06	4515.8626	-5.1994
226.440	7.34E-05	1049.4176	-6.8282	-7.251E-06	4516.2371	-3.5713
230.880	4.48E-05	986.0484	-19.6900	-5.708E-06	4513.1000	-2.2223
235.320	2.28E-05	878.3722	-27.1809	-4.295E-06	4507.7695	-1.1520
239.760	6.64E-06	747.5432	-30.4992	-3.063E-06	4501.2928	-.3428
244.200	-4.44E-06	609.5789	-30.7412	-2.034E-06	4494.4629	.2338
248.640	-1.14E-05	475.9160	-28.8623	-1.212E-06	4487.8459	.6126
253.080	-1.52E-05	354.0888	-25.6591	-5.825E-07	4481.8149	.8303
257.520	-1.66E-05	248.4516	-21.7665	-1.258E-07	4476.5853	.9231
261.960	-1.63E-05	160.8865	-17.6660	1.844E-07	4472.2504	.9240
266.400	-1.50E-05	91.4549	-13.7013	3.757E-07	4468.8132	.8619
270.840	-1.30E-05	38.9684	-10.0984	4.745E-07	4466.2148	.7610
275.280	-1.07E-05	1.4651	-6.9868	5.052E-07	4464.3582	.6406
279.720	-8.50E-06	-23.4105	-4.4212	4.885E-07	4465.4447	.5151
284.160	-6.41E-06	-38.1203	-2.4013	4.419E-07	4466.1729	.3948
288.600	-4.57E-06	-45.0283	-.8891	3.789E-07	4466.5148	.2864
293.040	-3.04E-06	-46.2681	.1763	3.097E-07	4466.5762	.1936
297.480	-1.82E-06	-43.6686	.8677	2.415E-07	4466.4475	.1178

301.920	-8.98E-07	-38.7241	1.2601	1.791E-07	4466.2027	.058946
306.360	-2.34E-07	-32.5980	1.4255	1.250E-07	4465.8995	.015567
310.800	2.12E-07	-26.1486	1.4283	8.048E-08	4465.5802	-.014307
315.240	4.81E-07	-19.9680	1.3233	4.553E-08	4465.2742	-.032998
319.680	6.16E-07	-14.4278	1.1549	1.946E-08	4465.0000	-.042872
324.120	6.54E-07	-9.7256	.9572	1.154E-09	4464.7672	-.046160
328.560	6.26E-07	-5.9283	.7552	-1.071E-08	4464.5792	-.044836
333.000	5.59E-07	-3.0120	.5656	-1.749E-08	4464.4348	-.040561
337.440	4.71E-07	-.8938	.3987	-2.045E-08	4464.3300	-.034659
341.880	3.77E-07	.5416	.2593	-2.071E-08	4464.3125	-.028133
346.320	2.87E-07	1.4222	.1486	-1.923E-08	4464.3561	-.021695
350.760	2.06E-07	1.8744	.065381	-1.673E-08	4464.3785	-.015809
355.200	1.38E-07	2.0139	.006436	-1.378E-08	4464.3854	-.010742
359.640	8.40E-08	1.9407	-.032074	-1.078E-08	4464.3818	-.006605
364.080	4.27E-08	1.7363	-.054280	-7.996E-09	4464.3717	-.003398
368.520	1.30E-08	1.4640	-.064156	-5.570E-09	4464.3582	-.001050
372.960	-6.77E-09	1.1703	-.065262	-3.573E-09	4464.3436	5.523E-04
377.400	-1.87E-08	.8869	-.060608	-2.014E-09	4464.3296	.001544
381.840	-2.47E-08	.6334	-.052605	-8.618E-10	4464.3171	.002061
386.280	-2.63E-08	.4203	-.043082	-6.316E-11	4464.3065	.002229
390.720	-2.52E-08	.2509	-.033343	4.456E-10	4464.2981	.002158
395.160	-2.24E-08	.1239	-.024247	7.297E-10	4464.2918	.001939
399.600	-1.87E-08	.035105	-.016300	8.502E-10	4464.2875	.001641
404.040	-1.48E-08	-.021383	-.009738	8.606E-10	4464.2868	.001315
408.480	-1.11E-08	-.051941	-.004613	8.050E-10	4464.2883	9.938E-04
412.920	-7.69E-09	-.062881	-8.594E-04	7.180E-10	4464.2888	6.969E-04
417.360	-4.72E-09	-.060050	.001647	6.248E-10	4464.2887	4.320E-04
421.800	-2.15E-09	-.048672	.002802	5.424E-10	4464.2881	8.815E-05
426.240	9.91E-11	-.035531	.002988	4.786E-10	4464.2875	-4.128E-06
430.680	2.10E-09	-.022454	.002782	4.347E-10	4464.2868	-8.881E-05
435.120	3.96E-09	-.011116	.002209	4.092E-10	4464.2863	-1.693E-04
439.560	5.74E-09	-.003109	.001282	3.984E-10	4464.2859	-2.485E-04
444.000	7.50E-09	0.0000	0.0000	3.961E-10	4464.2857	-3.288E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	-.01117177
Maximum bending moment	=	448542.968 lbs-in
Maximum shear force	=	14905.122 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .700000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	0.0000	16356.1887	-.012851	4464.2857	-159.1388
4.440	.642943	75332.1487	15599.7136	-.012794	8193.6000	-181.6157
8.880	.586393	1.470E+05	14717.1908	-.012625	11743.7892	-215.9171
13.320	.530833	2.144E+05	13676.8575	-.012351	15079.5859	-252.7015
17.760	.476716	2.767E+05	12462.3188	-.011979	18163.4074	-294.3880
22.200	.424461	3.331E+05	11054.7266	-.011517	20953.0145	-339.6626
26.640	.374449	3.826E+05	9440.0019	-.010974	23402.8145	-387.6908
31.080	.327011	4.242E+05	7700.0788	-.010363	25464.6990	-396.0583
35.520	.282428	4.578E+05	5933.3670	-.009694	27129.4612	-399.7578
39.960	.240926	4.834E+05	4159.8230	-.008981	28392.6505	-399.1360
44.400	.202678	5.008E+05	2397.5097	-.008235	29254.2359	-394.6988
48.840	.167800	5.101E+05	661.9389	-.007469	29718.1129	-387.0898
53.280	.136356	5.116E+05	-1030.4202	-.006694	29791.4731	-375.2341
57.720	.108355	5.054E+05	-2656.6056	-.005923	29485.8497	-357.2818
62.160	.083755	4.920E+05	-4189.4678	-.005167	28818.9170	-333.1966
66.600	.062467	4.717E+05	-5601.7236	-.004437	27814.5168	-302.9546
71.040	.044354	4.452E+05	-6865.8079	-.003742	26502.6701	-266.4527
75.480	.029237	4.132E+05	-7953.0728	-.003092	24919.6619	-223.3062
79.920	.016900	3.766E+05	-8831.3113	-.002493	23108.3990	-172.2967
84.360	.007099	3.364E+05	-9384.5251	-.001953	21119.5768	-76.8988
88.800	-4.38E-04	2.946E+05	-9544.3164	-.001474	19047.3002	4.9207
93.240	-.005993	2.527E+05	-9378.6530	-.001059	16972.4644	69.7024
97.680	-.009846	2.120E+05	-8960.9246	-7.073E-04	14959.3388	118.4635
102.120	-.012273	1.736E+05	-8359.2359	-4.151E-04	13056.5264	152.5675
106.560	-.013532	1.380E+05	-7635.0930	-1.789E-04	11298.2705	173.6231
111.000	-.013862	1.059E+05	-6842.5186	5.996E-06	9706.0073	183.3924
115.440	-.013479	77280.9351	-6027.5461	1.448E-04	8290.0746	183.7123
119.880	-.012576	52261.7146	-5228.0325	2.430E-04	7051.4993	176.4290
124.320	-.011321	30694.1630	-4473.7264	3.059E-04	5983.7987	163.3486
128.760	-.009860	12331.3061	-3786.5240	3.385E-04	5074.7464	146.2020
133.200	-.008315	-3155.6072	-2951.6293	3.454E-04	4620.5039	229.8767
137.640	-.006792	-14109.2309	-2009.3950	3.324E-04	5162.7625	194.5532
142.080	-.005364	-21220.3887	-1224.5038	3.056E-04	5514.8000	159.0014
146.520	-.004078	-25186.3446	-594.0817	2.704E-04	5711.1345	124.9725
150.960	-.002963	-26675.9286	-108.5418	2.311E-04	5784.8762	93.7392
155.400	-.002026	-26304.1105	246.3825	1.909E-04	5766.4694	66.1366
159.840	-.001267	-24615.2236	487.8195	1.524E-04	5682.8611	42.6188
164.280	-6.73E-04	-22073.7410	634.2094	1.170E-04	5557.0452	23.3226
168.720	-2.28E-04	-19061.3441	704.0448	8.579E-05	5407.9166	8.1348
173.160	8.85E-05	-15878.9586	714.9070	5.931E-05	5250.3728	-3.2420
177.600	2.98E-04	-12752.4683	682.7805	3.761E-05	5095.5960	-11.2294
182.040	4.22E-04	-9840.9128	621.6204	2.048E-05	4951.4596	-16.3202
186.480	4.80E-04	-7246.1198	543.1345	7.530E-06	4823.0045	-19.0338
190.920	4.89E-04	-5022.8932	456.7433	-1.769E-06	4712.9438	-19.8812
195.360	4.65E-04	-3189.0615	369.6736	-7.993E-06	4622.1600	-19.3393
199.800	4.18E-04	-1734.8681	287.1511	-1.173E-05	4550.1703	-17.8330
204.240	3.60E-04	-631.3511	212.6528	-1.352E-05	4495.5407	-15.7248

208.680	2.98E-04	162.4919	148.1925	-1.387E-05	4472.3299	-13.3113
213.120	2.37E-04	693.8383	94.6129	-1.322E-05	4498.6341	-10.8236
217.560	1.81E-04	1011.4622	51.8663	-1.193E-05	4514.3581	-8.4316
222.000	1.31E-04	1162.3582	19.2705	-1.028E-05	4521.8282	-6.2512
226.440	8.95E-05	1189.4341	-4.2688	-8.502E-06	4523.1686	-4.3521
230.880	5.58E-05	1130.1140	-20.0729	-6.744E-06	4520.2320	-2.7669
235.320	2.96E-05	1015.6787	-29.5436	-5.118E-06	4514.5668	-1.4992
239.760	1.03E-05	871.1754	-34.0535	-3.688E-06	4507.4132	-.5323
244.200	-3.13E-06	715.7395	-34.8694	-2.485E-06	4499.7184	.1647
248.640	-1.18E-05	563.1900	-33.1044	-1.516E-06	4492.1664	.6303
253.080	-1.66E-05	422.7819	-29.6936	-7.683E-07	4485.2155	.9061
257.520	-1.86E-05	300.0223	-25.3884	-2.204E-07	4479.1383	1.0332
261.960	-1.85E-05	197.4799	-20.7635	1.566E-07	4474.0619	1.0500
266.400	-1.72E-05	115.5378	-16.2342	3.939E-07	4470.0054	.9902
270.840	-1.50E-05	53.0578	-12.0778	5.217E-07	4466.9123	.8821
275.280	-1.26E-05	7.9398	-8.4582	5.679E-07	4464.6788	.7484
279.720	-1.00E-05	-22.4289	-5.4504	5.569E-07	4465.3961	.6065
284.160	-7.61E-06	-40.8308	-3.0634	5.090E-07	4466.3070	.4688
288.600	-5.49E-06	-49.9711	-1.2603	4.402E-07	4466.7595	.3435
293.040	-3.70E-06	-52.3152	.024659	3.626E-07	4466.8756	.2353
297.480	-2.27E-06	-49.9937	.8721	2.851E-07	4466.7606	.1464
301.920	-1.17E-06	-44.7613	1.3671	2.133E-07	4466.5016	.076631
306.360	-3.72E-07	-37.9956	1.5922	1.505E-07	4466.1667	.024759
310.800	1.69E-07	-30.7227	1.6218	9.847E-08	4465.8066	-.011416
315.240	5.03E-07	-23.6592	1.5199	5.725E-08	4465.4570	-.034484
319.680	6.77E-07	-17.2637	1.3387	2.623E-08	4465.1404	-.047137
324.120	7.36E-07	-11.7887	1.1188	4.211E-09	4464.8693	-.051934
328.560	7.15E-07	-7.3315	.8899	-1.028E-08	4464.6487	-.051167
333.000	6.44E-07	-3.8794	.6725	-1.878E-08	4464.4778	-.046776
337.440	5.48E-07	-1.3473	.4791	-2.274E-08	4464.3524	-.040322
341.880	4.42E-07	.3905	.3164	-2.347E-08	4464.3050	-.032999
346.320	3.39E-07	1.4776	.1861	-2.205E-08	4464.3589	-.025664
350.760	2.47E-07	2.0579	.087224	-1.937E-08	4464.3876	-.018886
355.200	1.67E-07	2.2650	.016446	-1.609E-08	4464.3978	-.012996
359.640	1.04E-07	2.2147	-.030491	-1.270E-08	4464.3954	-.008147
364.080	5.47E-08	2.0027	-.058247	-9.501E-09	4464.3849	-.004356
368.520	1.93E-08	1.7038	-.071368	-6.692E-09	4464.3701	-.001554
372.960	-4.69E-09	1.3734	-.073968	-4.360E-09	4464.3537	3.830E-04
377.400	-1.94E-08	1.0499	-.069555	-2.523E-09	4464.3377	.001605
381.840	-2.71E-08	.7574	-.060964	-1.153E-09	4464.3232	.002265
386.280	-2.97E-08	.5093	-.050365	-1.930E-10	4464.3109	.002510
390.720	-2.88E-08	.3103	-.039319	4.283E-10	4464.3011	.002466
395.160	-2.59E-08	.1598	-.028873	7.846E-10	4464.2936	.002240
399.600	-2.18E-08	.053409	-.019654	9.462E-10	4464.2884	.001913
404.040	-1.75E-08	-.015327	-.011973	9.751E-10	4464.2865	.001547
408.480	-1.32E-08	-.053560	-.005917	9.229E-10	4464.2884	.001181
412.920	-9.27E-09	-.068481	-.001431	8.304E-10	4464.2891	8.395E-04
417.360	-5.81E-09	-.066819	.001614	7.278E-10	4464.2890	5.322E-04
421.800	-2.80E-09	-.054632	.003051	6.358E-10	4464.2884	1.152E-04
426.240	-1.65E-10	-.040146	.003323	5.639E-10	4464.2877	6.885E-06
430.680	2.20E-09	-.025503	.003131	5.142E-10	4464.2870	-9.298E-05
435.120	4.40E-09	-.012681	.002507	4.852E-10	4464.2863	-1.881E-04
439.560	6.51E-09	-.003562	.001464	4.729E-10	4464.2859	-2.820E-04
444.000	8.60E-09	0.0000	0.0000	4.702E-10	4464.2857	-3.772E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	-.01285066
Maximum bending moment	=	511609.185 lbs-in
Maximum shear force	=	16356.189 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .800000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	0.0000	17637.1198	-.014486	4464.2857	-159.1388
4.440	.735684	81563.9064	16880.6446	-.014424	8502.1029	-181.6157
8.880	.671917	1.595E+05	15998.1216	-.014241	12360.6392	-215.9171
13.320	.609224	2.331E+05	14957.7880	-.013943	16004.4715	-252.7016
17.760	.548099	3.016E+05	13743.2486	-.013538	19395.8618	-294.3881
22.200	.489005	3.642E+05	12335.6553	-.013034	22492.4152	-339.6629
26.640	.432361	4.198E+05	10719.9418	-.012439	25248.3842	-388.1360
31.080	.378544	4.676E+05	8881.9072	-.011767	27615.0717	-439.8075
35.520	.327874	5.065E+05	6914.6270	-.011028	29540.8557	-446.3548
39.960	.280613	5.364E+05	4936.6980	-.010238	31018.3745	-444.6043
44.400	.236962	5.572E+05	2976.5811	-.009409	32048.5906	-438.3313
48.840	.197062	5.691E+05	1052.7928	-.008555	32637.1059	-428.2401
53.280	.160991	5.722E+05	-819.4323	-.007690	32793.4716	-415.1046
57.720	.128773	5.669E+05	-2621.9126	-.006827	32530.4278	-396.8234
62.160	.100370	5.535E+05	-4328.5893	-.005978	31865.9485	-371.9499
66.600	.075692	5.325E+05	-5910.1727	-.005154	30824.6435	-340.4751
71.040	.054599	5.045E+05	-7337.2200	-.004368	29437.7554	-302.3390
75.480	.036900	4.702E+05	-8579.5317	-.003630	27743.2021	-257.2608
79.920	.022367	4.307E+05	-9604.2068	-.002947	25785.8318	-204.3046
84.360	.010732	3.869E+05	-10315.8536	-.002327	23618.3136	-116.2571
88.800	.001702	3.406E+05	-10616.3785	-.001776	21327.6690	-19.1145
93.240	-.005036	2.938E+05	-10528.7702	-.001295	19009.8577	58.5777
97.680	-.009796	2.480E+05	-10137.0728	-8.842E-04	16741.8712	117.8625
102.120	-.012888	2.044E+05	-9519.7692	-5.413E-04	14582.7117	160.2022
106.560	-.014603	1.638E+05	-8748.1768	-2.622E-04	12574.7891	187.3620
111.000	-.015216	1.269E+05	-7885.3374	-4.184E-05	10745.6229	201.3044

115.440	-.014975	93838.2412	-6985.3459	1.254E-04	9109.7432	204.0971
119.880	-.014102	64769.5914	-6093.0531	2.457E-04	7670.7011	197.8366
124.320	-.012793	39568.3179	-5244.0694	3.247E-04	6423.1133	184.5885
128.760	-.011218	17985.9750	-4464.9958	3.684E-04	5354.6805	166.3455
133.200	-.009522	-326.1778	-3511.3196	3.818E-04	4480.4331	263.2384
137.640	-.007828	-13448.7898	-2429.1386	3.713E-04	5130.0674	224.2305
142.080	-.006225	-22144.2223	-1521.7091	3.443E-04	5560.5343	184.5215
146.520	-.004770	-27190.8936	-787.5608	3.069E-04	5810.3696	146.1760
150.960	-.003499	-29342.1851	-217.2622	2.641E-04	5916.8691	110.7153
155.400	-.002425	-29296.0682	204.2622	2.196E-04	5914.5861	79.1606
159.840	-.001549	-27674.6228	495.6459	1.765E-04	5834.3165	52.0933
164.280	-8.58E-04	-25012.2611	677.2854	1.365E-04	5702.5165	29.7263
168.720	-3.36E-04	-21751.2607	769.8720	1.011E-04	5541.0808	11.9793
173.160	3.95E-05	-18243.1247	793.2532	7.078E-05	5367.4107	-1.4473
177.600	2.92E-04	-14754.3107	765.6128	4.577E-05	5194.6971	-11.0033
182.040	4.46E-04	-11474.9644	702.9390	2.589E-05	5032.3533	-17.2281
186.480	5.22E-04	-8529.4535	618.7416	1.073E-05	4886.5359	-20.6987
190.920	5.41E-04	-5987.6828	523.9745	-2.770E-07	4760.7057	-21.9892
195.360	5.20E-04	-3876.3756	427.1183	-7.753E-06	4656.1855	-21.6397
199.800	4.72E-04	-2189.7089	334.3776	-1.235E-05	4572.6871	-20.1354
204.240	4.10E-04	-898.8771	249.9543	-1.469E-05	4508.7846	-17.8931
208.680	3.42E-04	39.6706	176.3620	-1.534E-05	4466.2496	-15.2566
213.120	2.74E-04	677.4360	114.7515	-1.480E-05	4497.8221	-12.4959
217.560	2.10E-04	1068.5206	65.2282	-1.348E-05	4517.1828	-9.8119
222.000	1.54E-04	1265.6379	27.1428	-1.171E-05	4526.9411	-7.3437
226.440	1.06E-04	1317.3455	-.6539	-9.750E-06	4529.5008	-5.1773
230.880	6.76E-05	1266.3242	-19.5970	-7.791E-06	4526.9750	-3.3556
235.320	3.73E-05	1148.5127	-31.2372	-5.961E-06	4521.1428	-1.8877
239.760	1.47E-05	992.9083	-37.1110	-4.338E-06	4513.4396	-.7582
244.200	-1.23E-06	821.8556	-38.6505	-2.962E-06	4504.9716	.064778
248.640	-1.16E-05	651.6651	-37.1237	-1.846E-06	4496.5464	.6230
253.080	-1.76E-05	493.4267	-33.6042	-9.777E-07	4488.7128	.9624
257.520	-2.03E-05	353.9111	-28.9612	-3.355E-07	4481.8061	1.1291
261.960	-2.06E-05	236.4745	-23.8657	1.120E-07	4475.9924	1.1662
266.400	-1.93E-05	141.9091	-18.8074	3.988E-07	4471.3109	1.1123
270.840	-1.71E-05	69.1995	-14.1185	5.588E-07	4467.7114	.9998
275.280	-1.43E-05	16.1647	-10.0007	6.235E-07	4465.0859	.8551
279.720	-1.15E-05	-20.0221	-6.5523	6.206E-07	4465.2769	.6983
284.160	-8.83E-06	-42.4330	-3.7940	5.733E-07	4466.3864	.5442
288.600	-6.43E-06	-54.0949	-1.6922	5.001E-07	4466.9637	.4026
293.040	-4.39E-06	-57.7932	-.1784	4.153E-07	4467.1468	.2793
297.480	-2.74E-06	-55.9554	.8351	3.291E-07	4467.0558	.1772
301.920	-1.47E-06	-50.5967	1.4424	2.483E-07	4466.7905	.096400
306.360	-5.37E-07	-43.3122	1.7358	1.771E-07	4466.4299	.035773
310.800	1.04E-07	-35.3005	1.7997	1.176E-07	4466.0333	-.007008
315.240	5.07E-07	-27.4092	1.7069	7.003E-08	4465.6426	-.034770
319.680	7.26E-07	-20.1895	1.5177	3.395E-08	4465.2852	-.050497
324.120	8.08E-07	-13.9551	1.2789	8.071E-09	4464.9766	-.057068
328.560	7.97E-07	-8.8386	1.0255	-9.206E-09	4464.7233	-.057078
333.000	7.27E-07	-4.8429	.7816	-1.958E-08	4464.5255	-.052748
337.440	6.23E-07	-1.8846	.5627	-2.467E-08	4464.3790	-.045877
341.880	5.07E-07	.1702	.3768	-2.597E-08	4464.2941	-.037854
346.320	3.93E-07	1.4787	.2269	-2.472E-08	4464.3589	-.029687
350.760	2.88E-07	2.2012	.1120	-2.193E-08	4464.3947	-.022052
355.200	1.98E-07	2.4879	.028958	-1.838E-08	4464.4089	-.015357
359.640	1.25E-07	2.4706	-.026887	-1.462E-08	4464.4080	-.009798
364.080	6.81E-08	2.2589	-.060666	-1.104E-08	4464.3975	-.005417

368.520	2.67E-08	1.9392	-.077460	-7.856E-09	4464.3817	-.002148
372.960	-1.70E-09	1.5762	-.081920	-5.192E-09	4464.3637	1.390E-04
377.400	-1.94E-08	1.2152	-.078046	-3.076E-09	4464.3459	.001606
381.840	-2.90E-08	.8853	-.069095	-1.484E-09	4464.3295	.002426
386.280	-3.26E-08	.6027	-.057583	-3.562E-10	4464.3155	.002760
390.720	-3.22E-08	.3742	-.045342	3.842E-10	4464.3042	.002754
395.160	-2.92E-08	.1998	-.033611	8.192E-10	4464.2956	.002530
399.600	-2.49E-08	.075140	-.023153	1.028E-09	4464.2894	.002181
404.040	-2.01E-08	-.006517	-.014359	1.080E-09	4464.2860	.001780
408.480	-1.53E-08	-.053085	-.007361	1.034E-09	4464.2883	.001372
412.920	-1.09E-08	-.072571	-.002121	9.391E-10	4464.2893	9.879E-04
417.360	-6.98E-09	-.072545	.001491	8.291E-10	4464.2893	6.393E-04
421.800	-3.54E-09	-.059880	.003234	7.288E-10	4464.2887	1.456E-04
426.240	-5.09E-10	-.044315	.003604	6.498E-10	4464.2879	2.120E-05
430.680	2.23E-09	-.028309	.003442	5.948E-10	4464.2871	-9.397E-05
435.120	4.77E-09	-.014141	.002781	5.626E-10	4464.2864	-2.040E-04
439.560	7.22E-09	-.003989	.001634	5.488E-10	4464.2859	-3.128E-04
444.000	9.65E-09	0.0000	0.0000	5.458E-10	4464.2857	-4.231E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	-.01448557
Maximum bending moment	=	572249.554 lbs-in
Maximum shear force	=	17637.120 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .900000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	0.0000	18804.3278	-.016088	4464.2857	-159.1388
4.440	.828570	87279.8396	18047.8526	-.016022	8785.0699	-181.6157
8.880	.757728	1.709E+05	17165.3297	-.015826	12926.4304	-215.9171
13.320	.688036	2.502E+05	16124.9962	-.015507	16852.8013	-252.7016
17.760	.620029	3.245E+05	14910.4572	-.015071	20526.3019	-294.3881

22.200	.554205	3.927E+05	13502.8644	-.014528	23904.3952	-339.6628
26.640	.491024	4.540E+05	11887.1516	-.013886	26941.1915	-388.1358
31.080	.430900	5.075E+05	10049.1183	-.013157	29587.8520	-439.8072
35.520	.374190	5.520E+05	7976.4118	-.012354	31792.6134	-493.8444
39.960	.321197	5.866E+05	5789.8345	-.011491	33501.6269	-491.1004
44.400	.272151	6.111E+05	3627.0773	-.010583	34716.7076	-483.1146
48.840	.227218	6.258E+05	1509.7246	-.009646	35445.0358	-470.6479
53.280	.186497	6.309E+05	-544.3451	-.008693	35698.4102	-454.6087
57.720	.150023	6.268E+05	-2520.2499	-.007740	35492.3560	-435.4385
62.160	.117767	6.137E+05	-4396.9267	-.006800	34845.6857	-409.9115
66.600	.089641	5.923E+05	-6144.6479	-.005886	33783.6382	-377.3503
71.040	.065502	5.631E+05	-7732.1221	-.005010	32338.5267	-337.7282
75.480	.045152	5.269E+05	-9127.5527	-.004184	30549.7487	-290.8442
79.920	.028349	4.848E+05	-10297.0777	-.003417	28463.9622	-235.9689
84.360	.014809	4.378E+05	-11177.0433	-.002718	26135.7741	-160.4120
88.800	.004215	3.874E+05	-11638.2492	-.002092	23640.0970	-47.3384
93.240	-.003772	3.358E+05	-11645.9323	-.001544	21088.5418	43.8775
97.680	-.009499	2.850E+05	-11294.8135	-.001074	18571.4158	114.2841
102.120	-.013308	2.362E+05	-10673.8576	-6.788E-04	16158.7010	165.4258
106.560	-.015527	1.906E+05	-9864.3614	-3.553E-04	13901.5254	199.2121
111.000	-.016462	1.489E+05	-8938.6012	-9.793E-05	11834.0013	217.7970
115.440	-.016396	1.113E+05	-7958.9808	9.928E-05	9975.3097	223.4735
119.880	-.015581	78126.3865	-6977.6096	2.429E-04	8331.9286	218.5856
124.320	-.014240	49199.7607	-6036.2305	3.394E-04	6899.9174	205.4590
128.760	-.012567	24298.6365	-5166.4139	3.951E-04	5667.1885	186.3502
133.200	-.010731	3058.8804	-4094.1137	4.158E-04	4615.7154	296.6679
137.640	-.008875	-12334.0275	-2871.1662	4.088E-04	5074.8811	254.2094
142.080	-.007101	-22709.3274	-1839.5061	3.822E-04	5588.5098	210.5023
146.520	-.005480	-28923.4048	-999.3744	3.431E-04	5896.1374	167.9354
150.960	-.004054	-31812.2711	-341.7542	2.971E-04	6039.1506	128.2899
155.400	-.002843	-32156.0228	149.0300	2.486E-04	6056.1680	92.7840
159.840	-.001847	-30654.4353	492.9552	2.010E-04	5981.8320	62.1372
164.280	-.001058	-27912.4253	712.2586	1.566E-04	5846.0889	36.6481
168.720	-4.57E-04	-24433.8598	829.7528	1.169E-04	5673.8827	16.2772
173.160	-1.99E-05	-20622.0774	867.5088	8.275E-05	5485.1806	.7300
177.600	2.78E-04	-16785.4950	845.8939	5.440E-05	5295.2508	-10.4664
182.040	4.63E-04	-13146.7699	782.9349	3.171E-05	5115.1159	-17.8935
186.480	5.60E-04	-9854.1540	693.9641	1.428E-05	4952.1151	-22.1834
190.920	5.90E-04	-6993.8791	591.5004	1.510E-06	4810.5174	-23.9714
195.360	5.73E-04	-4602.6367	485.3144	-7.279E-06	4692.1390	-23.8601
199.800	5.25E-04	-2679.4399	382.6288	-1.280E-05	4596.9313	-22.3946
204.240	4.59E-04	-1196.3692	288.4089	-1.574E-05	4523.5119	-20.0468
208.680	3.86E-04	-107.8889	205.7032	-1.672E-05	4469.6267	-17.2080
213.120	3.11E-04	641.4135	136.0028	-1.632E-05	4496.0389	-14.1885
217.560	2.41E-04	1110.6853	79.5932	-1.499E-05	4519.2701	-11.2212
222.000	1.78E-04	1358.1861	35.8800	-1.312E-05	4531.5227	-8.4694
226.440	1.24E-04	1438.0383	3.6765	-1.100E-05	4535.4757	-6.0366
230.880	8.01E-05	1398.1609	-18.5534	-8.852E-06	4533.5016	-3.9769
235.320	4.55E-05	1279.1796	-32.5002	-6.823E-06	4527.6114	-2.3055
239.760	1.96E-05	1114.1025	-39.8596	-5.009E-06	4519.4393	-1.0095
244.200	1.07E-06	928.5624	-42.2252	-3.460E-06	4510.2542	-.056113
248.640	-1.12E-05	741.4474	-41.0198	-2.195E-06	4500.9910	.5991
253.080	-1.84E-05	565.7686	-37.4560	-1.204E-06	4492.2941	1.0062
257.520	-2.19E-05	409.6402	-32.5226	-4.646E-07	4484.5649	1.2160
261.960	-2.25E-05	277.2771	-26.9890	5.603E-08	4478.0123	1.2766
266.400	-2.14E-05	169.9404	-21.4221	3.950E-07	4472.6986	1.2310
270.840	-1.90E-05	86.7860	-16.2115	5.896E-07	4468.5821	1.1161

275.280	-1.61E-05	25.5894	-11.5991	6.748E-07	4465.5525	.9616
279.720	-1.30E-05	-16.6632	-7.7084	6.815E-07	4465.1106	.7909
284.160	-1.01E-05	-43.3154	-4.5740	6.361E-07	4466.4300	.6210
288.600	-7.40E-06	-57.7038	-2.1667	5.595E-07	4467.1423	.4634
293.040	-5.11E-06	-62.9285	-.4164	4.681E-07	4467.4010	.3251
297.480	-3.24E-06	-61.7127	.7707	3.736E-07	4467.3408	.2096
301.920	-1.79E-06	-56.3335	1.4972	2.841E-07	4467.0745	.1177
306.360	-7.21E-07	-48.6065	1.8651	2.046E-07	4466.6920	.048052
310.800	2.33E-08	-39.9076	1.9683	1.375E-07	4466.2613	-.001577
315.240	4.99E-07	-31.2197	1.8887	8.358E-08	4465.8312	-.034267
319.680	7.66E-07	-23.1915	1.6944	4.234E-08	4465.4338	-.053283
324.120	8.75E-07	-16.2020	1.4388	1.248E-08	4465.0878	-.061810
328.560	8.76E-07	-10.4229	1.1623	-7.698E-09	4464.8017	-.062748
333.000	8.07E-07	-5.8755	.8929	-2.005E-08	4464.5766	-.058596
337.440	6.98E-07	-2.4802	.6488	-2.638E-08	4464.4085	-.051395
341.880	5.73E-07	-.096881	.4398	-2.834E-08	4464.2905	-.042731
346.320	4.47E-07	1.4441	.2700	-2.732E-08	4464.3572	-.033767
350.760	3.30E-07	2.3187	.1389	-2.446E-08	4464.4005	-.025295
355.200	2.29E-07	2.6935	.043188	-2.067E-08	4464.4191	-.017802
359.640	1.47E-07	2.7160	-.021933	-1.657E-08	4464.4202	-.011532
364.080	8.23E-08	2.5098	-.062080	-1.260E-08	4464.4100	-.006552
368.520	3.48E-08	2.1731	-.082852	-9.055E-09	4464.3933	-.002805
372.960	1.91E-09	1.7801	-.089424	-6.059E-09	4464.3738	-1.557E-04
377.400	-1.90E-08	1.3831	-.086285	-3.661E-09	4464.3542	.001569
381.840	-3.06E-08	1.0163	-.077122	-1.843E-09	4464.3360	.002558
386.280	-3.54E-08	.6995	-.064801	-5.424E-10	4464.3203	.002992
390.720	-3.54E-08	.4413	-.051429	3.222E-10	4464.3076	.003032
395.160	-3.25E-08	.2426	-.038450	8.405E-10	4464.2977	.002815
399.600	-2.80E-08	.099253	-.026766	1.100E-09	4464.2906	.002449
404.040	-2.27E-08	.004156	-.016858	1.178E-09	4464.2859	.002014
408.480	-1.75E-08	-.051230	-.008906	1.142E-09	4464.2883	.001567
412.920	-1.26E-08	-.075691	-.002893	1.046E-09	4464.2895	.001141
417.360	-8.21E-09	-.077619	.001309	9.299E-10	4464.2896	7.516E-04
421.800	-4.34E-09	-.064690	.003373	8.221E-10	4464.2889	1.783E-04
426.240	-9.07E-10	-.048215	.003853	7.365E-10	4464.2881	3.777E-05
430.680	2.20E-09	-.030970	.003730	6.765E-10	4464.2872	-9.286E-05
435.120	5.10E-09	-.015540	.003040	6.412E-10	4464.2865	-2.180E-04
439.560	7.89E-09	-.004401	.001797	6.261E-10	4464.2859	-3.419E-04
444.000	1.07E-08	0.0000	0.0000	6.228E-10	4464.2857	-4.676E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	-.01608776
Maximum bending moment	=	630929.315 lbs-in
Maximum shear force	=	18804.328 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = 1.000000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	0.0000	19863.5486	-.017654	4464.2857	-159.1388
4.440	.921615	92504.4186	19107.0733	-.017584	9043.7124	-181.6158
8.880	.843853	1.814E+05	18224.5499	-.017377	13443.5848	-215.9173
13.320	.767311	2.659E+05	17184.2154	-.017038	17628.2064	-252.7019
17.760	.692560	3.453E+05	15969.6746	-.016574	21559.5660	-294.3886
22.200	.620132	4.188E+05	14562.0789	-.015995	25194.9962	-339.6636
26.640	.550523	4.853E+05	12946.3617	-.015310	28488.4772	-388.1370
31.080	.484180	5.439E+05	11108.3218	-.014530	31391.0400	-439.8089
35.520	.421498	5.936E+05	9033.7577	-.013668	33850.7920	-494.6795
39.960	.362812	6.332E+05	6739.4810	-.012738	35812.9421	-538.7785
44.400	.308387	6.619E+05	4368.4975	-.011756	37233.4626	-529.2321
48.840	.258417	6.799E+05	2051.3574	-.010739	38120.9531	-514.5247
53.280	.213024	6.873E+05	-191.1968	-.009703	38489.3189	-495.6349
57.720	.172256	6.846E+05	-2343.0539	-.008663	38356.8088	-473.6701
62.160	.136096	6.723E+05	-4388.2729	-.007635	37744.9258	-447.5997
66.600	.104461	6.507E+05	-6301.3364	-.006632	36679.4213	-414.1407
71.040	.077205	6.207E+05	-8049.3065	-.005668	35193.4866	-373.2333
75.480	.054128	5.830E+05	-9598.8187	-.004756	33327.7940	-324.7452
79.920	.034974	5.387E+05	-10914.9705	-.003906	31130.6060	-268.1160
84.360	.019446	4.887E+05	-11957.5404	-.003127	28658.2972	-201.5101
88.800	.007208	4.346E+05	-12584.6203	-.002427	25977.1177	-80.9583
93.240	-.002106	3.786E+05	-12709.9660	-.001811	23206.0698	24.4963
97.680	-.008872	3.229E+05	-12418.6248	-.001279	20449.4679	106.7385
102.120	-.013464	2.692E+05	-11810.0991	-8.303E-04	17788.9651	167.3722
106.560	-.016245	2.186E+05	-10975.8113	-4.607E-04	15285.0782	208.4331
111.000	-.017555	1.720E+05	-9997.4874	-1.646E-04	12979.1434	232.2533
115.440	-.017707	1.299E+05	-8946.1059	6.420E-05	10895.5711	241.3420
119.880	-.016985	92515.9482	-7881.3328	2.328E-04	9044.2832	238.2856
124.320	-.015640	59770.6962	-6851.3571	3.482E-04	7423.2311	225.6674
128.760	-.013893	31443.9901	-5893.0350	4.173E-04	6020.9189	206.0092
133.200	-.011934	7162.5947	-4703.2678	4.466E-04	4818.8696	329.9220
137.640	-.009927	-10618.4663	-3339.5752	4.440E-04	4989.9524	284.3540
142.080	-.007991	-22788.5271	-2182.4038	4.187E-04	5592.4306	236.8944
146.520	-.006209	-30277.0425	-1234.1042	3.784E-04	5963.1492	190.2675
150.960	-.004631	-33999.4166	-486.4189	3.297E-04	6147.4252	146.5277
155.400	-.003281	-34816.0404	76.6420	2.776E-04	6187.8521	107.1034
159.840	-.002166	-33503.6966	476.1724	2.258E-04	6122.8846	72.8653
164.280	-.001276	-30738.0032	736.0792	1.771E-04	5985.9690	44.2098
168.720	-5.93E-04	-27085.2592	881.1765	1.333E-04	5805.1401	21.1493
173.160	-9.29E-05	-23001.9132	935.6832	9.531E-05	5602.9943	3.4032
177.600	2.53E-04	-18839.8667	922.1116	6.359E-05	5396.9524	-9.5166

182.040	4.72E-04	-14855.9155	860.5181	3.805E-05	5199.7271	-18.2282
186.480	5.91E-04	-11223.8095	768.0712	1.829E-05	5019.9198	-23.4145
190.920	6.34E-04	-8047.6227	658.8835	3.680E-06	4862.6829	-25.7691
195.360	6.23E-04	-5375.3750	544.0550	-6.494E-06	4730.3934	-25.9555
199.800	5.77E-04	-3212.0893	431.8707	-1.300E-05	4623.3000	-24.5780
204.240	5.08E-04	-1531.7038	328.1041	-1.660E-05	4540.1126	-22.1636
208.680	4.29E-04	-287.4704	236.3829	-1.798E-05	4478.5169	-19.1522
213.120	3.48E-04	579.3486	158.5780	-1.776E-05	4492.9663	-15.8950
217.560	2.71E-04	1132.5271	95.1899	-1.646E-05	4520.3514	-12.6582
222.000	2.02E-04	1435.5956	45.7084	-1.451E-05	4535.3548	-9.6308
226.440	1.43E-04	1548.0822	8.9328	-1.225E-05	4540.9234	-6.9348
230.880	9.34E-05	1523.0777	-16.7560	-9.922E-06	4539.6856	-4.6368
235.320	5.45E-05	1405.8968	-33.1756	-7.702E-06	4533.8846	-2.7594
239.760	2.50E-05	1233.6080	-42.1715	-5.702E-06	4525.3554	-1.2928
244.200	3.88E-06	1035.2115	-45.4945	-3.982E-06	4515.5338	-.2041
248.640	-1.03E-05	832.2684	-44.7195	-2.567E-06	4505.4871	.5532
253.080	-1.89E-05	639.8113	-41.1982	-1.451E-06	4495.9595	1.0330
257.520	-2.32E-05	467.3947	-36.0403	-6.117E-07	4487.4241	1.2904
261.960	-2.43E-05	320.1806	-30.1158	-1.475E-08	4480.1362	1.3783
266.400	-2.33E-05	199.9759	-24.0717	3.795E-07	4474.1855	1.3443
270.840	-2.10E-05	106.1712	-18.3581	6.115E-07	4469.5417	1.2294
275.280	-1.79E-05	36.5489	-13.2596	7.197E-07	4466.0951	1.0672
279.720	-1.46E-05	-12.0536	-8.9281	7.383E-07	4464.8824	.8839
284.160	-1.13E-05	-43.2245	-5.4139	6.964E-07	4466.4255	.6990
288.600	-8.40E-06	-60.5929	-2.6945	6.177E-07	4467.2854	.5259
293.040	-5.86E-06	-67.5633	-.6994	5.206E-07	4467.6304	.3728
297.480	-3.78E-06	-67.1501	.6700	4.184E-07	4467.6100	.2440
301.920	-2.15E-06	-61.8922	1.5242	3.206E-07	4467.3497	.1407
306.360	-9.30E-07	-53.8287	1.9741	2.329E-07	4466.9505	.061928
310.800	-7.67E-08	-44.5172	2.1231	1.584E-07	4466.4895	.005184
315.240	4.77E-07	-35.0810	2.0620	9.806E-08	4466.0224	-.032709
319.680	7.94E-07	-26.2720	1.8667	5.156E-08	4465.5863	-.055274
324.120	9.35E-07	-18.5393	1.5975	1.760E-08	4465.2035	-.065988
328.560	9.50E-07	-12.0981	1.2999	-5.623E-09	4464.8846	-.068049
333.000	8.85E-07	-6.9923	1.0062	-2.009E-08	4464.6319	-.064230
337.440	7.72E-07	-3.1492	.7375	-2.778E-08	4464.4416	-.056816
341.880	6.38E-07	-.4246	.5057	-3.049E-08	4464.3067	-.047596
346.320	5.01E-07	1.3620	.3159	-2.978E-08	4464.3531	-.037892
350.760	3.74E-07	2.4008	.1683	-2.693E-08	4464.4046	-.028617
355.200	2.62E-07	2.8744	.059612	-2.293E-08	4464.4280	-.020340
359.640	1.70E-07	2.9455	-.015207	-1.852E-08	4464.4315	-.013362
364.080	9.77E-08	2.7517	-.062135	-1.420E-08	4464.4219	-.007777
368.520	4.39E-08	2.4032	-.087260	-1.029E-08	4464.4047	-.003540
372.960	6.32E-09	1.9837	-.096264	-6.966E-09	4464.3839	-5.159E-04
377.400	-1.79E-08	1.5530	-.094122	-4.286E-09	4464.3626	.001481
381.840	-3.17E-08	1.1507	-.084946	-2.236E-09	4464.3427	.002653
386.280	-3.78E-08	.8002	-.071960	-7.578E-10	4464.3253	.003197
390.720	-3.85E-08	.5122	-.057555	2.368E-10	4464.3111	.003292
395.160	-3.57E-08	.2889	-.043387	8.440E-10	4464.3000	.003090
399.600	-3.10E-08	.1264	-.030505	1.159E-09	4464.2920	.002712
404.040	-2.54E-08	.017246	-.019489	1.268E-09	4464.2866	.002250
408.480	-1.97E-08	-.047537	-.010574	1.245E-09	4464.2881	.001766
412.920	-1.43E-08	-.077484	-.003770	1.150E-09	4464.2896	.001299
417.360	-9.50E-09	-.081776	.001047	1.029E-09	4464.2898	8.700E-04
421.800	-5.21E-09	-.068875	.003453	9.150E-10	4464.2891	2.139E-04
426.240	-1.37E-09	-.051723	.004055	8.236E-10	4464.2883	5.724E-05
430.680	2.11E-09	-.033417	.003984	7.591E-10	4464.2874	-8.896E-05

435.120	5.37E-09	-.016847	.003278	7.210E-10	4464.2865	-2.294E-04
439.560	8.51E-09	-.004792	.001950	7.046E-10	4464.2860	-3.686E-04
444.000	1.16E-08	0.0000	0.0000	7.010E-10	4464.2857	-5.098E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.01765424
Maximum bending moment	=	687305.670 lbs-in
Maximum shear force	=	19863.549 lbs
Depth of maximum bending moment	=	53.280 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .100000	M= 0.000	75000.0000	.100000	97015.5129	4011.8234
4	y= .200000	M= 0.000	75000.0000	.2000	1.753E+05	6684.6030
4	y= .300000	M= 0.000	75000.0000	.3000	2.484E+05	9060.4559
4	y= .400000	M= 0.000	75000.0000	.4000	3.177E+05	11307.3307
4	y= .500000	M= 0.000	75000.0000	.5000	3.844E+05	13262.2873
4	y= .600000	M= 0.000	75000.0000	.6000	4.485E+05	14905.1218
4	y= .700000	M= 0.000	75000.0000	.7000	5.116E+05	16356.1887
4	y= .800000	M= 0.000	75000.0000	.8000	5.722E+05	17637.1198
4	y= .900000	M= 0.000	75000.0000	.9000	6.309E+05	18804.3278
4	y= 1.000	M= 0.000	75000.0000	1.0000	6.873E+05	19863.5486

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = .10000 in
Moment = 0. in-lbs
Axial Load = 75000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
444.000	.10000000	97015.513	4011.823
421.800	.10000000	96901.608	4011.504
399.600	.10000000	97044.680	4011.398
377.400	.10000000	96952.967	4013.243
355.200	.10000000	96972.630	4013.165
333.000	.10000000	97047.562	4014.955
310.800	.10000000	97050.526	4015.779
288.600	.10000000	97031.865	4015.604
266.400	.10000000	96985.223	4015.981
244.200	.10000000	97041.802	4015.617

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Abut_B19_ Fixed.lpd
Name of output file: ArroyoMocho_Abut_B19_ Fixed.lpo
Name of plot output file: ArroyoMocho_Abut_B19_ Fixed.lpp
Name of runtime file: ArroyoMocho_Abut_B19_ Fixed.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 11:26:42

Problem Title

SR84 Isabel Abutment - Arroyo Mocho Bridge Widen - H pile - Weak Axis

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 444.00 in
Depth of ground surface below top of pile = -36.00 in
Slope angle of ground surface = 21.80 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	444.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -36.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 420.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 420.000 in
Distance from top of pile to bottom of layer = 732.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 732.000 in
Distance from top of pile to bottom of layer = 1092.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 648.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.07230
2	132.00	.07230
3	132.00	.07810
4	420.00	.07810
5	420.00	.04200
6	732.00	.04200
7	732.00	.04200
8	1092.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	.00000	35.00	------	------
2	132.000	.00000	35.00	------	------
3	132.000	.00000	40.00	------	------
4	420.000	.00000	40.00	------	------
5	420.000	.00000	40.00	------	------
6	732.000	.00000	40.00	------	------
7	732.000	27.77800	.00	.00500	.0
8	1092.000	27.77800	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .100 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .200 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .300 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .400 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .500 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head   =   .600 in
Slope at pile head   =   .000 in/in
Axial load at pile head   =   75000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

```
Deflection at pile head     =            .700 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .800 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .900 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           1.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =       75000.000 lbs
```

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	96.000

Depth of ground surface below top of pile = -36.00 in

p-y Curve in Sand Computed Using Reese Criteria

```
Soil Layer Number           =            1
Depth below pile head       =       60.000 in
Depth below ground surface  =       96.000 in
Equivalent Depth (see note) =       96.000 in
Pile Diameter               =       10.000 in
Angle of Friction           =       35.000 deg.
Avg. Eff. Unit Weight       =       .07230 lbs/in**3
k                           =       90.000 pci
A (static)                  =        .8800
B (static)                  =        .5000
Pst                         =      971.160 lbs/in
```

Psd	=	3733.696	lbs/in
Ps	=	971.160	lbs/in
pu	=	854.621	lbs/in
Cbar	=	1443.3672	
n	=	1.6447	
m	=	1771.3961	
yk	=	.0104	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	107.181
.0278	163.360
.0417	209.030
.0556	248.984
.0694	285.163
.0833	318.592
.0972	349.895
.1111	379.487
.1250	407.660
.1389	434.629
.1528	460.559
.1667	485.580
.3750	854.621
10.3750	854.621
20.3750	854.621
30.3750	854.621

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	-2.783E+05	9347.4951	0.0000	18241.8653	-77.7271
4.440	.099063	-2.375E+05	8997.8350	-3.909E-04	16221.7177	-79.7775

8.880	.096528	-1.981E+05	8618.7934	-7.211E-04	14273.4917	-90.9620
13.320	.092660	-1.605E+05	8192.7601	-9.930E-04	12409.0857	-100.9449
17.760	.087711	-1.247E+05	7717.3278	-.001209	10639.1836	-113.2138
22.200	.081923	-91149.8029	7187.7957	-.001373	8976.6522	-125.3141
26.640	.075521	-59991.0494	6607.0439	-.001487	7434.1396	-136.2858
31.080	.068715	-31488.6971	5980.7871	-.001557	6023.1321	-145.8119
35.520	.061698	-5844.9265	5316.0799	-.001585	4753.6385	-153.6058
39.960	.054641	16773.6715	4621.1667	-.001577	5294.6655	-159.4182
44.400	.047697	36241.0959	3905.3037	-.001536	6258.3994	-163.0426
48.840	.040997	52476.0699	3178.5592	-.001469	7062.1110	-164.3198
53.280	.034650	65445.2197	2451.5964	-.001380	7704.1481	-163.1409
57.720	.028743	75165.2384	1735.4483	-.001273	8185.3371	-159.4483
62.160	.023343	81704.0148	1041.2951	-.001154	8509.0389	-153.2333
66.600	.018492	85180.7679	380.2598	-.001028	8681.1554	-144.5303
71.040	.014215	85765.3098	-236.7525	-8.983E-04	8710.0931	-133.4031
75.480	.010515	83676.7024	-767.1183	-7.699E-04	8606.6967	-105.5004
79.920	.007378	79466.0641	-1172.2163	-6.463E-04	8398.2493	-76.9762
84.360	.004776	73697.8342	-1457.9635	-5.302E-04	8112.6933	-51.7388
88.800	.002670	66872.4454	-1639.4082	-4.236E-04	7774.8028	-29.9931
93.240	.001014	59422.0282	-1732.1880	-3.279E-04	7405.9703	-11.7996
97.680	-2.42E-04	51709.0035	-1751.9326	-2.437E-04	7024.1374	2.9056
102.120	-.001149	44027.1567	-1713.7622	-1.711E-04	6643.8479	14.2883
106.560	-.001761	36604.7589	-1631.8822	-1.100E-04	6276.4025	22.5946
111.000	-.002126	29609.3045	-1519.2730	-5.982E-05	5930.0929	28.1303
115.440	-.002292	23153.4523	-1387.4674	-1.983E-05	5610.4962	31.2416
119.880	-.002302	17301.7978	-1246.4063	1.084E-05	5320.8104	32.2994
124.320	-.002196	12078.1472	-1104.3608	3.311E-05	5062.2138	31.6850
128.760	-.002008	7473.0259	-967.9079	4.792E-05	4834.2375	29.7802
133.200	-.001770	3451.2080	-793.1417	5.620E-05	4635.1376	48.9433
137.640	-.001509	392.4962	-588.5144	5.912E-05	4483.7162	43.2312
142.080	-.001245	-1814.1717	-410.5811	5.804E-05	4554.0962	36.9190
146.520	-9.94E-04	-3292.1181	-261.0135	5.417E-05	4627.2619	30.4538
150.960	-7.64E-04	-4168.0479	-139.7105	4.851E-05	4670.6247	24.1871
155.400	-5.63E-04	-4565.0584	-45.2167	4.190E-05	4690.2787	18.3777
159.840	-3.92E-04	-4597.4744	24.8845	3.495E-05	4691.8835	13.1994
164.280	-2.53E-04	-4367.3612	73.6168	2.816E-05	4680.4917	8.7521
168.720	-1.42E-04	-3962.5089	104.3087	2.184E-05	4660.4495	5.0731
173.160	-5.87E-05	-3455.6477	120.3456	1.622E-05	4635.3574	2.1508
177.600	1.68E-06	-2904.6427	124.9797	1.140E-05	4608.0799	-.063337
182.040	4.25E-05	-2353.4200	121.1920	7.414E-06	4580.7917	-1.6428
186.480	6.75E-05	-1833.3951	111.6041	4.241E-06	4555.0478	-2.6761
190.920	8.02E-05	-1365.2004	98.4305	1.817E-06	4531.8699	-3.2579
195.360	8.37E-05	-960.5424	83.4665	5.379E-08	4511.8373	-3.4826
199.800	8.07E-05	-624.0534	68.1017	-1.147E-06	4495.1794	-3.4385
204.240	7.35E-05	-355.0348	53.3526	-1.889E-06	4481.8617	-3.2052
208.680	6.39E-05	-149.0236	39.9080	-2.271E-06	4471.6631	-2.8509
213.120	5.33E-05	.8607	28.1805	-2.384E-06	4464.3283	-2.4317
217.560	4.27E-05	102.8068	18.3607	-2.305E-06	4469.3752	-1.9916
222.000	3.28E-05	165.4390	10.4687	-2.102E-06	4472.4758	-1.5633
226.440	2.41E-05	197.1685	4.4019	-1.827E-06	4474.0465	-1.1694
230.880	1.66E-05	205.7445	-.023269	-1.522E-06	4474.4711	-.8239
235.320	1.05E-05	197.9752	-3.0367	-1.216E-06	4474.0865	-.5335
239.760	5.81E-06	179.5885	-4.8867	-9.294E-07	4473.1762	-.2998
244.200	2.29E-06	155.2005	-5.8193	-6.757E-07	4471.9689	-.1203
248.640	-1.92E-07	128.3628	-6.0636	-4.607E-07	4470.6403	.010274
253.080	-1.81E-06	101.6628	-5.8219	-2.864E-07	4469.3185	.098602
257.520	-2.73E-06	76.8553	-5.2653	-1.511E-07	4468.0904	.1521

261.960	-3.15E-06	55.0074	-4.5321	-5.114E-08	4467.0089	.1782
266.400	-3.19E-06	36.6440	-3.7287	1.833E-08	4466.0998	.1837
270.840	-2.98E-06	21.8839	-2.9326	6.269E-08	4465.3691	.1749
275.280	-2.63E-06	10.5610	-2.1959	8.728E-08	4464.8085	.1569
279.720	-2.21E-06	2.3259	-1.5504	9.705E-08	4464.4009	.1339
284.160	-1.77E-06	-3.2708	-1.0110	9.633E-08	4464.4476	.1091
288.600	-1.35E-06	-6.7157	-.5807	8.876E-08	4464.6182	.084749
293.040	-9.82E-07	-8.4865	-.2539	7.724E-08	4464.7058	.062469
297.480	-6.68E-07	-9.0215	-.019422	6.397E-08	4464.7323	.043137
301.920	-4.14E-07	-8.7015	.1366	5.054E-08	4464.7165	.027161
306.360	-2.19E-07	-7.8417	.2293	3.800E-08	4464.6739	.014579
310.800	-7.66E-08	-6.6906	.2732	2.699E-08	4464.6169	.005175
315.240	2.07E-08	-5.4340	.2815	1.780E-08	4464.5547	-.001423
319.680	8.15E-08	-4.2028	.2657	1.049E-08	4464.4938	-.005671
324.120	1.14E-07	-3.0812	.2353	4.971E-09	4464.4383	-.008043
328.560	1.26E-07	-2.1167	.1975	1.032E-09	4464.3905	-.008995
333.000	1.23E-07	-1.3284	.1577	-1.580E-09	4464.3515	-.008935
337.440	1.12E-07	-.7155	.1196	-3.129E-09	4464.3211	-.008213
341.880	9.53E-08	-.2642	.085584	-3.871E-09	4464.2988	-.007109
346.320	7.72E-08	.047053	.056844	-4.036E-09	4464.2880	-.005837
350.760	5.95E-08	.2432	.033775	-3.816E-09	4464.2978	-.004554
355.200	4.33E-08	.3495	.016200	-3.367E-09	4464.3030	-.003362
359.640	2.96E-08	.3893	.003578	-2.807E-09	4464.3050	-.002323
364.080	1.84E-08	.3832	-.004833	-2.221E-09	4464.3047	-.001465
368.520	9.84E-09	.3479	-.009846	-1.667E-09	4464.3029	-7.928E-04
372.960	3.61E-09	.2968	-.012259	-1.178E-09	4464.3004	-2.942E-04
377.400	-6.27E-10	.2398	-.012797	-7.716E-10	4464.2976	5.175E-05
381.840	-3.25E-09	.1837	-.012080	-4.506E-10	4464.2948	2.713E-04
386.280	-4.63E-09	.1328	-.010609	-2.107E-10	4464.2923	3.915E-04
390.720	-5.12E-09	.089638	-.008768	-4.205E-11	4464.2902	4.379E-04
395.160	-5.00E-09	.055017	-.006834	6.759E-11	4464.2884	4.330E-04
399.600	-4.52E-09	.028904	-.004995	1.312E-10	4464.2871	3.955E-04
404.040	-3.84E-09	.010575	-.003362	1.611E-10	4464.2862	3.398E-04
408.480	-3.09E-09	-.001060	-.001994	1.683E-10	4464.2858	2.764E-04
412.920	-2.34E-09	-.007247	-9.099E-04	1.620E-10	4464.2861	2.121E-04
417.360	-1.65E-09	-.009248	-1.043E-04	1.495E-10	4464.2862	1.508E-04
421.800	-1.01E-09	-.008272	3.229E-04	1.363E-10	4464.2861	4.168E-05
426.240	-4.36E-10	-.006471	4.558E-04	1.251E-10	4464.2860	1.819E-05
430.680	9.72E-11	-.004308	4.871E-04	1.169E-10	4464.2859	-4.104E-06
435.120	6.02E-10	-.002224	4.208E-04	1.120E-10	4464.2858	-2.575E-05
439.560	1.09E-09	-6.458E-04	2.586E-04	1.098E-10	4464.2857	-4.730E-05
444.000	1.58E-09	0.0000	0.0000	1.093E-10	4464.2857	-6.921E-05

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-278307.107 lbs-in
Maximum shear force	=	9347.495 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7

Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .200000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	-5.010E+05	15770.3993	0.0000	29266.3351	-108.9408
4.440	.198314	-4.319E+05	15266.2441	-7.071E-04	25846.8690	-118.1561
8.880	.193721	-3.650E+05	14700.2378	-.001311	22531.9203	-136.8017
13.320	.186671	-3.005E+05	14053.7989	-.001815	19341.3589	-154.3870
17.760	.177599	-2.390E+05	13324.9195	-.002224	16293.9573	-173.9370
22.200	.166919	-1.807E+05	12509.9462	-.002542	13410.3329	-193.1681
26.640	.155022	-1.262E+05	11612.6227	-.002775	10710.7095	-211.0317
31.080	.142276	-75741.8687	10640.2549	-.002928	8213.8832	-226.9718
35.520	.129021	-29742.1751	9602.3529	-.003008	5936.6706	-240.5516
39.960	.115565	11530.3944	8510.2664	-.003022	5035.0973	-251.3793
44.400	.102186	47841.5523	7376.9646	-.002977	6832.6794	-259.1170
48.840	.089130	79020.4316	6216.7829	-.002881	8376.1883	-263.4873
53.280	.076606	1.050E+05	5045.1411	-.002741	9660.5797	-264.2793
57.720	.064788	1.256E+05	3878.2404	-.002566	10684.4325	-261.3517
62.160	.053815	1.411E+05	2732.7510	-.002364	11450.0869	-254.6345
66.600	.043793	1.515E+05	1625.5018	-.002143	11963.7118	-244.1264
71.040	.034790	1.570E+05	573.1916	-.001909	12235.3031	-229.8872
75.480	.026844	1.578E+05	-407.8471	-.001670	12278.6200	-212.0221
79.920	.019959	1.545E+05	-1301.7827	-.001433	12111.0755	-190.6516
84.360	.014115	1.472E+05	-2064.4679	-.001205	11753.6102	-152.9003
88.800	.009262	1.369E+05	-2634.8477	-9.893E-04	11243.2468	-104.0275
93.240	.005330	1.245E+05	-3003.4201	-7.912E-04	10627.9388	-61.9961
97.680	.002236	1.108E+05	-3200.7791	-6.128E-04	9949.0161	-26.9044
102.120	-1.12E-04	96491.0099	-3257.4200	-4.557E-04	9241.0684	1.3905
106.560	-.001811	82169.1691	-3202.7637	-3.203E-04	8532.0664	23.2294
111.000	-.002956	68263.7864	-3064.3718	-2.063E-04	7843.6811	39.1093
115.440	-.003642	55094.9293	-2867.3429	-1.128E-04	7191.7575	49.6425
119.880	-.003958	42876.8940	-2633.8777	-3.852E-05	6586.9042	55.5219
124.320	-.003984	31731.7522	-2382.9924	1.802E-05	6035.1645	57.4895
128.760	-.003798	21703.9169	-2130.3544	5.853E-05	5538.7370	56.3115
133.200	-.003465	12775.2275	-1792.7076	8.466E-05	5096.7227	95.7817
137.640	-.003046	5728.2910	-1386.3896	9.868E-05	4747.8645	87.2444
142.080	-.002588	398.3648	-1022.3721	1.033E-04	4484.0067	76.7274
146.520	-.002128	-3419.1890	-707.2616	1.010E-04	4633.5525	65.2143
150.960	-.001691	-5949.4084	-443.6936	9.394E-05	4758.8109	53.5100
155.400	-.001294	-7421.7495	-231.1298	8.380E-05	4831.6991	42.2394
159.840	-9.47E-04	-8057.6530	-66.6382	7.207E-05	4863.1794	31.8559
164.280	-6.54E-04	-8061.4950	54.3811	5.985E-05	4863.3696	22.6573

168.720	-4.15E-04	-7614.6101	137.5524	4.797E-05	4841.2466	14.8072
173.160	-2.28E-04	-6871.9776	188.9792	3.699E-05	4804.4826	8.3580
177.600	-8.70E-05	-5961.1101	214.8047	2.726E-05	4759.3902	3.2751
182.040	1.40E-05	-4982.6692	220.8775	1.897E-05	4710.9525	-.5396
186.480	8.14E-05	-4012.3514	212.5154	1.215E-05	4662.9170	-3.2271
190.920	1.22E-04	-3103.6251	194.3580	6.758E-06	4617.9305	-4.9519
195.360	1.41E-04	-2290.9528	170.2933	2.669E-06	4577.6992	-5.8880
199.800	1.46E-04	-1593.1982	143.4449	-2.748E-07	4543.1569	-6.2059
204.240	1.39E-04	-1016.9792	116.2055	-2.253E-06	4514.6312	-6.0641
208.680	1.26E-04	-559.7925	90.3028	-3.448E-06	4491.9982	-5.6038
213.120	1.08E-04	-212.7939	66.8852	-4.034E-06	4474.8201	-4.9447
217.560	8.97E-05	36.8347	46.6185	-4.167E-06	4466.1092	-4.1845
222.000	7.14E-05	203.9538	29.7836	-3.985E-06	4474.3824	-3.3988
226.440	5.44E-05	303.9667	16.3702	-3.600E-06	4479.3336	-2.6432
230.880	3.94E-05	351.7186	6.1617	-3.103E-06	4481.6975	-1.9552
235.320	2.68E-05	360.7494	-1.1914	-2.563E-06	4482.1446	-1.3571
239.760	1.66E-05	342.8457	-6.1113	-2.029E-06	4481.2583	-.8591
244.200	8.79E-06	307.8325	-9.0449	-1.536E-06	4479.5249	-.4623
248.640	3.00E-06	263.5503	-10.4283	-1.103E-06	4477.3328	-.1609
253.080	-1.01E-06	215.9637	-10.6628	-7.398E-07	4474.9770	.055234
257.520	-3.57E-06	169.3570	-10.0995	-4.478E-07	4472.6697	.1985
261.960	-4.99E-06	126.5781	-9.0320	-2.235E-07	4470.5520	.2824
266.400	-5.55E-06	89.3018	-7.6948	-5.983E-08	4468.7066	.3200
270.840	-5.52E-06	58.2882	-6.2664	5.203E-08	4467.1713	.3235
275.280	-5.09E-06	33.6220	-4.8744	1.217E-07	4465.9502	.3035
279.720	-4.44E-06	14.9223	-3.6034	1.585E-07	4465.0244	.2690
284.160	-3.68E-06	1.5180	-2.5023	1.709E-07	4464.3609	.2270
288.600	-2.92E-06	-7.4124	-1.5926	1.665E-07	4464.6527	.1828
293.040	-2.21E-06	-12.7350	-.8752	1.512E-07	4464.9162	.1403
297.480	-1.58E-06	-15.2851	-.3375	1.300E-07	4465.0424	.1019
301.920	-1.05E-06	-15.8187	.041874	1.064E-07	4465.0688	.068994
306.360	-6.32E-07	-14.9842	.2886	8.305E-08	4465.0275	.042125
310.800	-3.14E-07	-13.3116	.4292	6.160E-08	4464.9447	.021236
315.240	-8.54E-08	-11.2137	.4894	4.302E-08	4464.8408	.005858
319.680	6.79E-08	-8.9947	.4919	2.770E-08	4464.7310	-.004724
324.120	1.61E-07	-6.8643	.4562	1.568E-08	4464.6255	-.011337
328.560	2.07E-07	-4.9539	.3981	6.722E-09	4464.5310	-.014829
333.000	2.20E-07	-3.3333	.3297	4.408E-10	4464.4507	-.015992
337.440	2.11E-07	-2.0262	.2597	-3.621E-09	4464.3860	-.015530
341.880	1.88E-07	-1.0244	.1941	-5.934E-09	4464.3364	-.014033
346.320	1.58E-07	-.2986	.1364	-6.936E-09	4464.3005	-.011969
350.760	1.27E-07	.1913	.088300	-7.018E-09	4464.2952	-.009691
355.200	9.60E-08	.4902	.050248	-6.501E-09	4464.3100	-.007450
359.640	6.88E-08	.6419	.021707	-5.643E-09	4464.3175	-.005407
364.080	4.59E-08	.6867	.001595	-4.636E-09	4464.3197	-.003653
368.520	2.76E-08	.6591	-.011456	-3.616E-09	4464.3183	-.002226
372.960	1.38E-08	.5874	-.018895	-2.671E-09	4464.3148	-.001125
377.400	3.90E-09	.4931	-.022107	-1.852E-09	4464.3101	-3.221E-04
381.840	-2.67E-09	.3923	-.022327	-1.181E-09	4464.3051	2.228E-04
386.280	-6.59E-09	.2956	-.020595	-6.600E-10	4464.3003	5.575E-04
390.720	-8.53E-09	.2098	-.017737	-2.768E-10	4464.2961	7.297E-04
395.160	-9.05E-09	.1383	-.014378	-1.296E-11	4464.2926	7.835E-04
399.600	-8.64E-09	.082172	-.010958	1.542E-10	4464.2898	7.568E-04
404.040	-7.68E-09	.040907	-.007767	2.474E-10	4464.2877	6.803E-04
408.480	-6.44E-09	.013033	-.004976	2.883E-10	4464.2864	5.773E-04
412.920	-5.12E-09	-.003468	-.002664	2.956E-10	4464.2859	4.638E-04
417.360	-3.82E-09	-.010824	-8.583E-04	2.847E-10	4464.2863	3.498E-04

421.800	-2.59E-09	-.011279	1.547E-04	2.680E-10	4464.2863	1.066E-04
426.240	-1.44E-09	-.009628	5.245E-04	2.521E-10	4464.2862	5.999E-05
430.680	-3.52E-10	-.006790	6.907E-04	2.397E-10	4464.2861	1.488E-05
435.120	6.89E-10	-.003655	6.583E-04	2.318E-10	4464.2859	-2.948E-05
439.560	1.71E-09	-.001099	4.287E-04	2.282E-10	4464.2858	-7.393E-05
444.000	2.72E-09	0.0000	0.0000	2.273E-10	4464.2857	-1.192E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-501001.397 lbs-in
Maximum shear force	=	15770.399 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .300000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	-7.078E+05	21565.9241	0.0000	39503.5358	-137.6254
4.440	.297618	-6.132E+05	20918.9092	-.001001	34821.6151	-153.8227
8.880	.291109	-5.214E+05	20179.3668	-.001861	30274.4892	-179.3045
13.320	.281091	-4.328E+05	19329.1476	-.002584	25889.3216	-203.6772
17.760	.268160	-3.480E+05	18368.1711	-.003176	21692.1117	-229.1951
22.200	.252886	-2.676E+05	17296.1645	-.003643	17709.8817	-253.6907
26.640	.235812	-1.920E+05	16119.8993	-.003991	13968.5476	-276.1585
31.080	.217446	-1.218E+05	14849.3083	-.004229	10491.9246	-296.1798
35.520	.198260	-57307.8312	13495.9102	-.004365	7301.3071	-313.4590
39.960	.178689	992.1673	12072.2447	-.004407	4513.4029	-327.8318
44.400	.159124	52828.9201	10591.4737	-.004366	7079.5788	-339.1822
48.840	.139915	97952.5041	9069.0509	-.004252	9313.4196	-346.5939
53.280	.121365	1.362E+05	7523.5394	-.004075	11206.5644	-349.5825
57.720	.103732	1.675E+05	5975.0514	-.003845	12755.1411	-347.9346
62.160	.087225	1.918E+05	4444.4554	-.003572	13959.9759	-341.5230
66.600	.072010	2.093E+05	2952.9948	-.003268	14826.7181	-330.3061
71.040	.058204	2.202E+05	1521.9171	-.002943	15365.8768	-314.3235

75.480	.045880	2.248E+05	172.1381	-.002605	15592.7778	-293.6850
79.920	.035069	2.235E+05	-1076.0186	-.002266	15527.4479	-268.5477
84.360	.025762	2.167E+05	-2202.9365	-.001932	15194.4521	-239.0730
88.800	.017913	2.052E+05	-3180.3513	-.001612	14622.7236	-201.2039
93.240	.011446	1.896E+05	-3922.5927	-.001313	13849.5082	-133.1391
97.680	.006255	1.712E+05	-4385.2323	-.001039	12941.6221	-75.2572
102.120	.002217	1.513E+05	-4613.4720	-7.949E-04	11956.0117	-27.5535
106.560	-8.04E-04	1.308E+05	-4651.7539	-5.811E-04	10939.7295	10.3094
111.000	-.002943	1.104E+05	-4542.4230	-3.982E-04	9930.2398	38.9387
115.440	-.004340	90732.4675	-4324.6673	-2.458E-04	8955.9920	59.1494
119.880	-.005126	72172.9108	-4033.7174	-1.223E-04	8037.2021	71.9091
124.320	-.005426	54994.5086	-3700.2803	-2.592E-05	7186.7861	78.2879
128.760	-.005356	39331.6813	-3350.1735	4.558E-05	6411.3987	79.4179
133.200	-.005021	25214.6131	-2865.7085	9.450E-05	5712.5339	138.8096
137.640	-.004517	13821.2530	-2270.3357	1.241E-04	5148.5062	129.3764
142.080	-.003919	4971.3904	-1725.2054	1.383E-04	4710.3941	116.1778
146.520	-.003288	-1590.6987	-1243.6029	1.409E-04	4543.0332	100.7602
150.960	-.002668	-6165.6381	-832.5009	1.350E-04	4769.5153	84.4208
155.400	-.002089	-9073.2266	-493.6899	1.235E-04	4913.4553	68.1968
159.840	-.001572	-10631.8316	-224.9202	1.085E-04	4990.6140	52.8707
164.280	-.001126	-11142.7985	-20.9919	9.203E-05	5015.9094	38.9890
168.720	-7.55E-04	-10879.5280	125.2564	7.533E-05	5002.8762	26.8886
173.160	-4.57E-04	-10080.6936	222.0889	5.945E-05	4963.3300	16.7296
177.600	-2.27E-04	-8946.9704	278.1626	4.503E-05	4907.2050	8.5288
182.040	-5.68E-05	-7640.5967	301.9695	3.245E-05	4842.5331	2.1950
186.480	6.16E-05	-6287.0945	301.4258	2.190E-05	4775.5280	-2.4400
190.920	1.38E-04	-4978.5190	283.5947	1.336E-05	4710.7471	-5.5921
195.360	1.80E-04	-3777.6701	254.5277	6.721E-06	4651.2991	-7.5012
199.800	1.97E-04	-2722.7893	219.2018	1.794E-06	4599.0773	-8.4114
204.240	1.96E-04	-1832.3530	181.5335	-1.658E-06	4554.9963	-8.5563
208.680	1.83E-04	-1109.6674	144.4490	-3.888E-06	4519.2197	-8.1484
213.120	1.62E-04	-547.0568	109.9919	-5.144E-06	4491.3677	-7.3728
217.560	1.37E-04	-129.5140	79.4530	-5.657E-06	4470.6973	-6.3835
222.000	1.11E-04	162.2530	53.5082	-5.632E-06	4472.3180	-5.3034
226.440	8.69E-05	349.3898	32.3547	-5.244E-06	4481.5822	-4.2253
230.880	6.48E-05	453.0549	15.8372	-4.636E-06	4486.7142	-3.2150
235.320	4.57E-05	493.1115	3.5606	-3.919E-06	4488.6972	-2.3150
239.760	3.00E-05	487.2830	-5.0155	-3.176E-06	4488.4086	-1.5481
244.200	1.75E-05	450.6889	-10.5003	-2.465E-06	4486.5970	-.9225
248.640	8.10E-06	395.6822	-13.5128	-1.823E-06	4483.8739	-.4345
253.080	1.34E-06	331.9097	-14.6400	-1.272E-06	4480.7169	-.073217
257.520	-3.19E-06	266.5262	-14.4088	-8.182E-07	4477.4801	.1774
261.960	-5.92E-06	204.5047	-13.2704	-4.611E-07	4474.4097	.3354
266.400	-7.28E-06	148.9926	-11.5940	-1.932E-07	4471.6616	.4197
270.840	-7.64E-06	101.6784	-9.6682	-3.218E-09	4469.3193	.4478
275.280	-7.31E-06	63.1414	-7.7062	1.217E-07	4467.4115	.4359
279.720	-6.56E-06	33.1661	-5.8558	1.947E-07	4465.9276	.3976
284.160	-5.58E-06	11.0121	-4.2094	2.282E-07	4464.8309	.3440
288.600	-4.53E-06	-4.3658	-2.8156	2.332E-07	4464.5018	.2838
293.040	-3.51E-06	-14.1461	-1.6895	2.192E-07	4464.9860	.2234
297.480	-2.59E-06	-19.5145	-.8224	1.937E-07	4465.2518	.1671
301.920	-1.79E-06	-21.5783	-.1903	1.625E-07	4465.3539	.1176
306.360	-1.14E-06	-21.3125	.2399	1.300E-07	4465.3408	.076174
310.800	-6.38E-07	-19.5344	.5048	9.906E-08	4465.2528	.043136
315.240	-2.64E-07	-16.8960	.6408	7.145E-08	4465.1221	.018108
319.680	-3.56E-09	-13.8921	.6815	4.812E-08	4464.9734	2.477E-04
324.120	1.63E-07	-10.8763	.6565	2.934E-08	4464.8241	-.011532

328.560	2.57E-07	-8.0823	.5900	1.498E-08	4464.6858	-.018403
333.000	2.96E-07	-5.6471	.5014	4.569E-09	4464.5653	-.021512
337.440	2.98E-07	-3.6331	.4050	-2.465E-09	4464.4656	-.021903
341.880	2.74E-07	-2.0490	.3109	-6.771E-09	4464.3872	-.020472
346.320	2.37E-07	-.8675	.2256	-8.982E-09	4464.3287	-.017952
350.760	1.95E-07	-.039476	.1527	-9.669E-09	4464.2877	-.014911
355.200	1.52E-07	.4947	.093456	-9.324E-09	4464.3102	-.011764
359.640	1.12E-07	.7966	.047823	-8.346E-09	4464.3252	-.008792
364.080	7.75E-08	.9249	.014611	-7.041E-09	4464.3315	-.006168
368.520	4.93E-08	.9311	-.007910	-5.634E-09	4464.3318	-.003977
372.960	2.75E-08	.8584	-.021712	-4.278E-09	4464.3282	-.002241
377.400	1.14E-08	.7411	-.028768	-3.066E-09	4464.3224	-9.379E-04
381.840	2.38E-10	.6050	-.030895	-2.045E-09	4464.3157	-1.992E-05
386.280	-6.81E-09	.4681	-.029661	-1.232E-09	4464.3089	5.758E-04
390.720	-1.07E-08	.3424	-.026349	-6.177E-10	4464.3027	9.160E-04
395.160	-1.23E-08	.2346	-.021952	-1.804E-10	4464.2973	.001064
399.600	-1.23E-08	.1476	-.017197	1.092E-10	4464.2930	.001078
404.040	-1.13E-08	.081775	-.012578	2.831E-10	4464.2898	.001003
408.480	-9.79E-09	.035699	-.008404	3.721E-10	4464.2875	8.771E-04
412.920	-8.02E-09	.006897	-.004845	4.044E-10	4464.2861	7.263E-04
417.360	-6.20E-09	-.007591	-.001972	4.039E-10	4464.2861	5.678E-04
421.800	-4.43E-09	-.010883	-3.069E-04	3.899E-10	4464.2863	1.822E-04
426.240	-2.74E-09	-.010576	3.510E-04	3.736E-10	4464.2862	1.141E-04
430.680	-1.11E-09	-.008015	7.088E-04	3.595E-10	4464.2861	4.707E-05
435.120	4.55E-10	-.004521	7.701E-04	3.500E-10	4464.2859	-1.945E-05
439.560	1.99E-09	-.001409	5.351E-04	3.455E-10	4464.2858	-8.640E-05
444.000	3.52E-09	0.0000	0.0000	3.444E-10	4464.2857	-1.546E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =      .30000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =    -707792.852 lbs-in
Maximum shear force              =      21565.924 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              8
Number of zero deflection points =              6
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .400000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =       75000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	-9.072E+05	27067.2038	0.0000	49373.5149	-159.1388
4.440	.396947	-7.883E+05	26310.7288	-.001285	43490.4086	-181.6157
8.880	.388588	-6.727E+05	25428.2062	-.002392	37764.8449	-215.9170
13.320	.375702	-5.609E+05	24387.8732	-.003327	32233.1895	-252.7015
17.760	.359041	-4.539E+05	23194.9539	-.004097	26934.1333	-284.6496
22.200	.339325	-3.522E+05	21864.7407	-.004708	21901.5300	-314.5456
26.640	.317238	-2.566E+05	20407.9534	-.005169	17167.0962	-341.6650
31.080	.293424	-1.676E+05	18838.1786	-.005491	12759.6881	-365.4408
35.520	.268482	-85657.0536	17171.1812	-.005682	8704.7339	-385.4589
39.960	.242963	-11302.5231	15424.1984	-.005756	5023.8166	-401.4703
44.400	.217369	55143.2884	13615.1952	-.005723	7194.1515	-413.3960
48.840	.192146	1.134E+05	11762.1095	-.005595	10078.7283	-421.3272
53.280	.167686	1.633E+05	9882.1139	-.005385	12549.2890	-425.5176
57.720	.144325	2.048E+05	7993.2790	-.005106	14600.4970	-425.3089
62.160	.122342	2.377E+05	6117.7500	-.004771	16231.5206	-419.5240
66.600	.101959	2.623E+05	4280.4680	-.004392	17447.1821	-408.0806
71.040	.083342	2.786E+05	2506.5199	-.003982	18258.0357	-390.9952
75.480	.066599	2.872E+05	820.7243	-.003553	18680.3460	-368.3722
79.920	.051789	2.883E+05	-752.7196	-.003117	18735.9782	-340.3863
84.360	.038920	2.826E+05	-2190.4659	-.002684	18452.2162	-307.2472
88.800	.027952	2.706E+05	-3470.0320	-.002265	17861.5443	-269.1339
93.240	.018806	2.533E+05	-4553.1287	-.001868	17001.4563	-218.7476
97.680	.011365	2.314E+05	-5342.2895	-.001501	15921.5595	-136.7303
102.120	.005481	2.068E+05	-5797.0768	-.001168	14702.4412	-68.1289
106.560	9.89E-04	1.807E+05	-5976.4815	-8.747E-04	13411.6665	-12.6841
111.000	-.002287	1.543E+05	-5937.4692	-6.208E-04	12103.9966	30.2572
115.440	-.004524	1.284E+05	-5733.4138	-4.065E-04	10821.9989	61.6597
119.880	-.005897	1.037E+05	-5412.8830	-2.306E-04	9596.9669	82.7236
124.320	-.006571	80512.9554	-5018.7457	-9.095E-05	8450.0756	94.8157
128.760	-.006704	59174.2693	-4587.5605	1.493E-05	7393.7050	99.4118
133.200	-.006439	39765.4772	-3971.7027	8.992E-05	6432.8737	178.0016
137.640	-.005906	23845.6652	-3200.9926	1.381E-04	5644.7642	169.1651
142.080	-.005212	11248.6691	-2482.4428	1.647E-04	5021.1505	154.5060
146.520	-.004443	1691.8634	-1837.2061	1.745E-04	4548.0413	136.1412
150.960	-.003662	-5181.9630	-1277.7208	1.719E-04	4720.8185	115.8792
155.400	-.002917	-9768.7771	-809.1341	1.606E-04	4947.8885	95.1959
159.840	-.002236	-12474.0064	-430.7790	1.437E-04	5081.8108	75.2343
164.280	-.001640	-13689.8000	-137.6137	1.239E-04	5141.9986	56.8221
168.720	-.001137	-13778.5142	78.4474	1.031E-04	5146.3904	40.5027
173.160	-7.25E-04	-13061.8197	227.3573	8.271E-05	5110.9105	26.5739
177.600	-4.02E-04	-11814.6648	319.9448	6.385E-05	5049.1701	15.1322
182.040	-1.58E-04	-10263.2360	367.1175	4.712E-05	4972.3667	6.1168
186.480	1.63E-05	-8586.0433	379.2582	3.283E-05	4889.3374	-.6480
190.920	1.33E-04	-6917.2901	365.8016	2.108E-05	4806.7258	-5.4136
195.360	2.04E-04	-5351.7664	334.9699	1.178E-05	4729.2246	-8.4745
199.800	2.38E-04	-3950.6047	293.6447	4.733E-06	4659.8602	-10.1404
204.240	2.46E-04	-2747.3535	247.3460	-3.440E-07	4600.2933	-10.7148
208.680	2.35E-04	-1753.9429	200.2949	-3.756E-06	4551.1146	-10.4794
213.120	2.12E-04	-966.2333	155.5327	-5.817E-06	4512.1190	-9.6838
217.560	1.83E-04	-368.9385	115.0761	-6.829E-06	4482.5500	-8.5399
222.000	1.52E-04	60.1906	80.0900	-7.063E-06	4467.2654	-7.2196
226.440	1.20E-04	346.9650	51.0622	-6.755E-06	4481.4622	-5.8560
230.880	9.16E-05	518.1221	27.9700	-6.099E-06	4489.9353	-4.5459

235.320	6.63E-05	599.4007	10.4302	-5.252E-06	4493.9590	-3.3549
239.760	4.50E-05	614.2403	-2.1711	-4.332E-06	4494.6937	-2.3214
244.200	2.78E-05	583.0062	-10.5725	-3.425E-06	4493.1474	-1.4630
248.640	1.46E-05	522.6377	-15.5531	-2.587E-06	4490.1589	-.7806
253.080	4.83E-06	446.6173	-17.8718	-1.852E-06	4486.3955	-.2639
257.520	-1.89E-06	365.1693	-18.2244	-1.237E-06	4482.3634	.1051
261.960	-6.15E-06	285.6085	-17.2179	-7.436E-07	4478.4247	.3483
266.400	-8.49E-06	212.7699	-15.3584	-3.659E-07	4474.8189	.4893
270.840	-9.40E-06	149.4700	-13.0488	-9.133E-08	4471.6852	.5510
275.280	-9.30E-06	96.9577	-10.5942	9.545E-08	4469.0856	.5546
279.720	-8.55E-06	55.3301	-8.2119	2.109E-07	4467.0248	.5185
284.160	-7.43E-06	23.8951	-6.0446	2.709E-07	4465.4686	.4578
288.600	-6.15E-06	1.4739	-4.1736	2.901E-07	4464.3587	.3849
293.040	-4.85E-06	-13.3599	-2.6336	2.811E-07	4464.9471	.3088
297.480	-3.65E-06	-22.0994	-1.4243	2.543E-07	4465.3797	.2359
301.920	-2.60E-06	-26.1772	-.5224	2.177E-07	4465.5816	.1704
306.360	-1.72E-06	-26.8831	.1099	1.775E-07	4465.6166	.1145
310.800	-1.02E-06	-25.3191	.5173	1.379E-07	4465.5391	.069025
315.240	-4.94E-07	-22.3815	.7457	1.017E-07	4465.3937	.033889
319.680	-1.18E-07	-18.7646	.8391	7.055E-08	4465.2147	.008185
324.120	1.32E-07	-14.9769	.8366	4.497E-08	4465.0271	-.009354
328.560	2.82E-07	-11.3660	.7710	2.501E-08	4464.8484	-.020176
333.000	3.55E-07	-8.1471	.6691	1.022E-08	4464.6890	-.025741
337.440	3.73E-07	-5.4315	.5511	-7.315E-11	4464.5546	-.027417
341.880	3.54E-07	-3.2537	.4316	-6.656E-09	4464.4468	-.026401
346.320	3.13E-07	-1.5947	.3204	-1.033E-08	4464.3647	-.023693
350.760	2.62E-07	-.4020	.2232	-1.184E-08	4464.3056	-.020082
355.200	2.08E-07	.3951	.1427	-1.185E-08	4464.3053	-.016158
359.640	1.57E-07	.8734	.079475	-1.089E-08	4464.3290	-.012336
364.080	1.12E-07	1.1081	.032379	-9.386E-09	4464.3406	-.008879
368.520	7.36E-08	1.1672	-5.014E-04	-7.662E-09	4464.3435	-.005932
372.960	4.35E-08	1.1087	-.021553	-5.937E-09	4464.3406	-.003551
377.400	2.09E-08	.9797	-.033265	-4.354E-09	4464.3342	-.001725
381.840	4.85E-09	.8162	-.037996	-2.993E-09	4464.3261	-4.058E-04
386.280	-5.69E-09	.6443	-.037829	-1.886E-09	4464.3176	4.809E-04
390.720	-1.19E-08	.4816	-.034502	-1.032E-09	4464.3096	.001018
395.160	-1.49E-08	.3386	-.029389	-4.106E-10	4464.3025	.001286
399.600	-1.55E-08	.2209	-.023513	1.343E-11	4464.2966	.001361
404.040	-1.47E-08	.1298	-.017595	2.792E-10	4464.2921	.001305
408.480	-1.31E-08	.064426	-.012101	4.264E-10	4464.2889	.001170
412.920	-1.09E-08	.022067	-.007303	4.920E-10	4464.2868	9.915E-04
417.360	-8.69E-09	-7.564E-04	-.003336	5.081E-10	4464.2858	7.956E-04
421.800	-6.43E-09	-.007895	-9.825E-04	5.016E-10	4464.2861	2.646E-04
426.240	-4.23E-09	-.009815	-3.583E-06	4.882E-10	4464.2862	1.764E-04
430.680	-2.10E-09	-.008252	5.848E-04	4.745E-10	4464.2861	8.864E-05
435.120	-2.01E-11	-.004938	7.835E-04	4.645E-10	4464.2860	8.590E-07
439.560	2.03E-09	-.001604	5.905E-04	4.595E-10	4464.2858	-8.778E-05
444.000	4.06E-09	0.0000	0.0000	4.583E-10	4464.2857	-1.782E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = 0.000
Maximum bending moment = -907166.430 lbs-in
Maximum shear force = 27067.204 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 8
Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	-1.093E+06	31534.9780	0.0000	58570.2993	-159.1388
4.440	.496322	-9.542E+05	30778.5030	-.001552	51702.8461	-181.6157
8.880	.486222	-8.186E+05	29895.9803	-.002895	44988.7901	-215.9171
13.320	.470612	-6.868E+05	28855.6469	-.004036	38464.9958	-252.7016
17.760	.450379	-5.597E+05	27641.1076	-.004981	32170.6551	-294.3882
22.200	.426380	-4.380E+05	26233.5136	-.005737	26149.6281	-339.6632
26.640	.399432	-3.229E+05	24617.7981	-.006314	20449.1391	-388.1366
31.080	.370311	-2.152E+05	22789.2548	-.006722	15119.3716	-435.5315
35.520	.339742	-1.160E+05	20804.4515	-.006973	10209.2700	-458.5240
39.960	.308391	-25845.2070	18728.8528	-.007081	5743.7514	-476.4304
44.400	.276867	54979.1567	16585.3359	-.007058	7186.0261	-489.1178
48.840	.245712	1.261E+05	14396.9130	-.006921	10708.5181	-496.6583
53.280	.215407	1.874E+05	12185.8386	-.006684	13743.1590	-499.3212
57.720	.186363	2.388E+05	9972.7630	-.006360	16285.8180	-497.5598
62.160	.158926	2.802E+05	7776.2565	-.005967	18336.9309	-491.8576
66.600	.133375	3.118E+05	5617.6771	-.005518	19901.0269	-480.4754
71.040	.109924	3.338E+05	3523.8883	-.005029	20988.4247	-462.6727
75.480	.088718	3.465E+05	1523.1868	-.004513	21615.9495	-438.5442
79.920	.069844	3.503E+05	-356.7474	-.003985	21806.8319	-408.2730
84.360	.053329	3.459E+05	-2089.1778	-.003458	21590.5179	-372.1011
88.800	.039141	3.341E+05	-3648.4523	-.002942	21002.4177	-330.2748
93.240	.027203	3.155E+05	-5009.7763	-.002450	20083.6472	-282.9342
97.680	.017387	2.912E+05	-6102.2889	-.001990	18880.8708	-209.1886
102.120	.009532	2.626E+05	-6829.7322	-.001570	17466.6657	-118.4886
106.560	.003444	2.316E+05	-7190.8821	-.001196	15930.2617	-44.1916
111.000	-.001084	1.996E+05	-7257.1374	-8.687E-04	14344.9423	14.3469
115.440	-.004270	1.677E+05	-7096.0933	-5.903E-04	12768.6367	58.1955
119.880	-.006326	1.370E+05	-6769.8729	-3.593E-04	11244.9334	88.7506
124.320	-.007461	1.079E+05	-6333.8688	-1.738E-04	9804.4209	107.6477
128.760	-.007869	80840.0481	-5835.8489	-3.072E-05	8466.2683	116.6856
133.200	-.007733	56068.8532	-5102.1847	7.305E-05	7239.9715	213.7937
137.640	-.007220	35483.9989	-4168.4123	1.424E-04	6220.9193	206.8245

142.080	-.006469	18958.4886	-3283.5751	1.837E-04	5402.8248	191.7508
146.520	-.005589	6203.5064	-2477.6803	2.028E-04	4771.3900	171.2649
150.960	-.004668	-3178.3595	-1769.5765	2.051E-04	4621.6302	147.7008
155.400	-.003768	-9646.9065	-1168.6331	1.953E-04	4941.8553	122.9944
159.840	-.002933	-13685.9213	-676.5284	1.777E-04	5141.8066	98.6744
164.280	-.002191	-15772.8004	-289.0245	1.553E-04	5245.1174	75.8769
168.720	-.001554	-16355.9101	2.3630	1.310E-04	5273.9842	55.3787
173.160	-.001027	-15839.0503	208.8679	1.066E-04	5248.3971	37.6416
177.600	-6.08E-04	-14572.1444	343.1916	8.353E-05	5185.6790	22.8646
182.040	-2.86E-04	-12847.1392	418.4549	6.275E-05	5100.2827	11.0378
186.480	-5.03E-05	-10898.0540	447.3878	4.475E-05	5003.7933	1.9950
190.920	1.12E-04	-8904.1387	441.7431	2.974E-05	4905.0847	-4.5377
195.360	2.14E-04	-6995.1826	411.9134	1.769E-05	4810.5819	-8.8991
199.800	2.69E-04	-5258.1294	366.7217	8.403E-06	4724.5892	-11.4575
204.240	2.88E-04	-3744.2901	313.3548	1.579E-06	4649.6466	-12.5817
208.680	2.83E-04	-2476.5908	257.4062	-3.136E-06	4586.8892	-12.6204
213.120	2.61E-04	-1456.4346	202.9990	-6.117E-06	4536.3864	-11.8874
217.560	2.28E-04	-669.8863	152.9596	-7.728E-06	4497.4484	-10.6529
222.000	1.92E-04	-93.0061	109.0205	-8.306E-06	4468.8900	-9.1396
226.440	1.55E-04	303.7477	72.0302	-8.147E-06	4479.3227	-7.5227
230.880	1.20E-04	552.0477	42.1583	-7.498E-06	4491.6148	-5.9331
235.320	8.81E-05	683.1069	19.0829	-6.562E-06	4498.1029	-4.4613
239.760	6.13E-05	725.8737	2.1548	-5.494E-06	4500.2201	-3.1640
244.200	3.93E-05	705.9006	-9.4650	-4.409E-06	4499.2313	-2.0702
248.640	2.21E-05	644.7608	-16.6964	-3.385E-06	4496.2046	-1.1872
253.080	9.28E-06	559.8907	-20.4576	-2.472E-06	4492.0031	-.5070
257.520	1.90E-07	464.7440	-21.6065	-1.695E-06	4487.2928	-.010581
261.960	-5.77E-06	369.1540	-20.9043	-1.063E-06	4482.5607	.3269
266.400	-9.25E-06	279.8216	-18.9952	-5.715E-07	4478.1383	.5331
270.840	-1.08E-05	200.8571	-16.4001	-2.072E-07	4474.2291	.6359
275.280	-1.11E-05	134.3265	-13.5205	4.687E-08	4470.9355	.6613
279.720	-1.04E-05	80.7638	-10.6488	2.099E-07	4468.2839	.6323
284.160	-9.23E-06	39.6256	-7.9828	3.011E-07	4466.2474	.5686
288.600	-7.76E-06	9.6761	-5.6422	3.385E-07	4464.7647	.4857
293.040	-6.22E-06	-10.7028	-3.6852	3.377E-07	4464.8156	.3958
297.480	-4.76E-06	-23.2735	-2.1239	3.120E-07	4465.4379	.3075
301.920	-3.45E-06	-29.7712	-.9386	2.718E-07	4465.7595	.2265
306.360	-2.35E-06	-31.7891	-.088972	2.251E-07	4465.8594	.1562
310.800	-1.45E-06	-30.7112	.4759	1.777E-07	4465.8061	.098230
315.240	-7.67E-07	-27.6813	.8108	1.335E-07	4465.6561	.052629
319.680	-2.68E-07	-23.5999	.9690	9.462E-08	4465.4540	.018626
324.120	7.31E-08	-19.1395	.9989	6.223E-08	4465.2332	-.005161
328.560	2.85E-07	-14.7711	.9421	3.653E-08	4465.0170	-.020405
333.000	3.97E-07	-10.7975	.8328	1.715E-08	4464.8202	-.028855
337.440	4.37E-07	-7.3873	.6973	3.363E-09	4464.6514	-.032181
341.880	4.27E-07	-4.6078	.5551	-5.728E-09	4464.5138	-.031877
346.320	3.86E-07	-2.4544	.4195	-1.108E-08	4464.4072	-.029209
350.760	3.29E-07	-.8755	.2987	-1.360E-08	4464.3291	-.025194
355.200	2.66E-07	.2071	.1970	-1.411E-08	4464.2960	-.020607
359.640	2.04E-07	.8834	.1157	-1.328E-08	4464.3294	-.016003
364.080	1.48E-07	1.2437	.054139	-1.167E-08	4464.3473	-.011748
368.520	10.0E-07	1.3719	.010176	-9.690E-09	4464.3536	-.008056
372.960	6.15E-08	1.3406	-.018856	-7.634E-09	4464.3521	-.005022
377.400	3.22E-08	1.2095	-.035901	-5.702E-09	4464.3456	-.002656
381.840	1.09E-08	1.0256	-.043823	-4.008E-09	4464.3365	-9.125E-04
386.280	-3.43E-09	.8231	-.045205	-2.606E-09	4464.3265	2.898E-04
390.720	-1.22E-08	.6259	-.042238	-1.508E-09	4464.3167	.001047

395.160	-1.68E-08	.4490	-.036682	-6.936E-10	4464.3079	.001456
399.600	-1.84E-08	.3006	-.029873	-1.254E-10	4464.3006	.001611
404.040	-1.79E-08	.1838	-.022771	2.417E-10	4464.2948	.001589
408.480	-1.62E-08	.098225	-.016014	4.555E-10	4464.2906	.001455
412.920	-1.39E-08	.041286	-.009991	5.612E-10	4464.2878	.001258
417.360	-1.13E-08	.009128	-.004909	5.994E-10	4464.2862	.001031
421.800	-8.57E-09	-.002709	-.001839	6.043E-10	4464.2858	3.522E-04
426.240	-5.89E-09	-.007601	-5.115E-04	5.965E-10	4464.2861	2.456E-04
430.680	-3.27E-09	-.007648	3.402E-04	5.849E-10	4464.2861	1.381E-04
435.120	-6.98E-10	-.004969	7.130E-04	5.753E-10	4464.2860	2.988E-05
439.560	1.84E-09	-.001699	6.024E-04	5.703E-10	4464.2858	-7.972E-05
444.000	4.37E-09	0.0000	0.0000	5.690E-10	4464.2857	-1.916E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1092941.474 lbs-in
Maximum shear force	=	31534.978 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .600000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	-1.264E+06	35283.6907	0.0000	67036.6085	-159.1388
4.440	.595746	-1.109E+06	34527.2157	-.001798	59343.0440	-181.6157
8.880	.584032	-9.562E+05	33644.6934	-.003363	51799.0200	-215.9169
13.320	.565882	-8.075E+05	32604.3609	-.004700	44441.8198	-252.7013
17.760	.542297	-6.635E+05	31389.8236	-.005815	37311.0560	-294.3876
22.200	.514246	-5.249E+05	29982.2333	-.006716	30451.0105	-339.6621
26.640	.482662	-3.928E+05	28366.5242	-.007411	23909.3306	-388.1348
31.080	.448434	-2.681E+05	26528.4959	-.007912	17736.6239	-439.8059
35.520	.412402	-1.519E+05	24453.9478	-.008231	11986.4332	-494.6752
39.960	.375347	-45468.6556	22128.6795	-.008380	6715.2093	-552.7429
44.400	.337986	50136.4665	19643.0714	-.008377	6946.2890	-566.9004

48.840	.300963	1.345E+05	17109.4887	-.008237	11124.7131	-574.3531
53.280	.264845	2.076E+05	14556.2052	-.007977	14739.2520	-575.7746
57.720	.230124	2.691E+05	12008.9013	-.007616	17786.6938	-571.6596
62.160	.197214	3.193E+05	9490.6261	-.007170	20269.5162	-562.6986
66.600	.166454	3.582E+05	7020.9939	-.006657	22195.2111	-549.7484
71.040	.138103	3.860E+05	4620.5603	-.006093	23575.4447	-531.5280
75.480	.112351	4.033E+05	2316.6985	-.005494	24427.3020	-506.2476
79.920	.089313	4.103E+05	140.3447	-.004878	24775.0248	-474.0920
84.360	.069037	4.077E+05	-1878.5613	-.004258	24649.8187	-435.3251
88.800	.051505	3.964E+05	-3711.3225	-.003648	24089.5804	-390.2430
93.240	.036641	3.772E+05	-5330.4272	-.003062	23138.5893	-339.0834
97.680	.024316	3.511E+05	-6708.8571	-.002510	21847.2531	-281.8310
102.120	.014354	3.193E+05	-7730.6401	-.002002	20272.0975	-178.4316
106.560	.006541	2.838E+05	-8313.0796	-.001544	18514.8271	-83.9285
111.000	6.39E-04	2.465E+05	-8518.1692	-.001143	16668.5567	-8.4542
115.440	-.003604	2.089E+05	-8427.8856	-7.973E-04	14807.8751	49.1225
119.880	-.006441	1.722E+05	-8118.2314	-5.084E-04	12989.9118	90.3614
124.320	-.008119	1.372E+05	-7657.5718	-2.739E-04	11255.8304	117.1430
128.760	-.008873	1.044E+05	-7105.4211	-9.078E-05	9632.6431	131.5736
133.200	-.008925	74153.5226	-6265.5878	4.455E-05	8135.2522	246.7297
137.640	-.008477	48732.7259	-5178.7629	1.377E-04	6876.7969	242.8310
142.080	-.007702	28074.4026	-4132.8177	1.959E-04	5854.1076	228.3155
146.520	-.006738	11902.8286	-3167.6142	2.262E-04	5053.5347	206.4608
150.960	-.005693	-204.6672	-2309.3500	2.351E-04	4474.4178	180.1446
155.400	-.004650	-8760.7607	-1572.4628	2.283E-04	4897.9867	151.7866
159.840	-.003666	-14320.1721	-961.7083	2.108E-04	5173.2051	123.3280
164.280	-.002778	-17441.1151	-474.2632	1.867E-04	5327.7073	96.2418
168.720	-.002008	-18655.9817	-101.7315	1.594E-04	5387.8492	71.5653
173.160	-.001363	-18450.6211	168.0323	1.312E-04	5377.6828	49.9499
177.600	-8.43E-04	-17251.2541	349.3394	1.042E-04	5318.3082	31.7199
182.040	-4.38E-04	-15417.8648	457.3549	7.941E-05	5227.5463	16.9357
186.480	-1.38E-04	-13242.8297	507.0645	5.769E-05	5119.8713	5.4560
190.920	7.39E-05	-10953.5518	512.5106	3.935E-05	5006.5408	-3.0028
195.360	2.12E-04	-8717.9410	486.2747	2.444E-05	4895.8670	-8.8152
199.800	2.91E-04	-6651.7080	439.1736	1.279E-05	4793.5782	-12.4015
204.240	3.25E-04	-4826.5966	380.1340	4.089E-06	4703.2261	-14.1928
208.680	3.27E-04	-3278.8410	316.2070	-2.055E-06	4626.6046	-14.6031
213.120	3.07E-04	-2017.3099	252.6853	-6.069E-06	4564.1525	-14.0103
217.560	2.73E-04	-1030.9533	193.2907	-8.379E-06	4515.3230	-12.7441
222.000	2.33E-04	-295.3078	140.4012	-9.385E-06	4478.9049	-11.0800
226.440	1.90E-04	222.0597	95.2951	-9.440E-06	4475.2788	-9.2381
230.880	1.49E-04	557.1997	58.3918	-8.849E-06	4491.8699	-7.3850
235.320	1.11E-04	746.4730	29.4772	-7.861E-06	4501.2398	-5.6396
239.760	7.90E-05	824.1931	7.9026	-6.671E-06	4505.0874	-4.0787
244.200	5.22E-05	821.0905	-7.2463	-5.424E-06	4504.9338	-2.7451
248.640	3.08E-05	763.4584	-17.0124	-4.223E-06	4502.0807	-1.6541
253.080	1.47E-05	672.8329	-22.4630	-3.134E-06	4497.5943	-.8012
257.520	3.02E-06	566.0742	-24.6140	-2.195E-06	4492.3092	-.1678
261.960	-4.83E-06	455.7227	-24.3799	-1.421E-06	4486.8462	.2732
266.400	-9.60E-06	350.5270	-22.5454	-8.097E-07	4481.6385	.5531
270.840	-1.20E-05	256.0584	-19.7540	-3.499E-07	4476.9619	.7043
275.280	-1.27E-05	175.3447	-16.5087	-2.297E-08	4472.9661	.7576
279.720	-1.22E-05	109.4766	-13.1826	1.929E-07	4469.7053	.7407
284.160	-1.10E-05	58.1545	-10.0345	3.200E-07	4467.1646	.6774
288.600	-9.38E-06	20.1570	-7.2271	3.793E-07	4465.2836	.5872
293.040	-7.63E-06	-6.2752	-4.8466	3.898E-07	4464.5964	.4851
297.480	-5.92E-06	-23.1408	-2.9211	3.675E-07	4465.4313	.3823

301.920	-4.36E-06	-32.4590	-1.4370	3.254E-07	4465.8926	.2862
306.360	-3.03E-06	-36.1183	-.3540	2.734E-07	4466.0737	.2016
310.800	-1.93E-06	-35.7847	.3839	2.189E-07	4466.0572	.1308
315.240	-1.08E-06	-32.8548	.8392	1.669E-07	4465.9122	.074298
319.680	-4.53E-07	-28.4435	1.0741	1.204E-07	4465.6938	.031496
324.120	-1.35E-08	-23.3970	1.1461	8.115E-08	4465.4440	9.506E-04
328.560	2.68E-07	-18.3199	1.1056	4.953E-08	4465.1926	-.019197
333.000	4.26E-07	-13.6120	.9943	2.533E-08	4464.9596	-.030955
337.440	4.93E-07	-9.5075	.8450	7.806E-09	4464.7564	-.036287
341.880	4.96E-07	-6.1136	.6824	-4.034E-09	4464.5884	-.036978
346.320	4.57E-07	-3.4455	.5235	-1.128E-08	4464.4563	-.034564
350.760	3.96E-07	-1.4570	.3795	-1.499E-08	4464.3578	-.030297
355.200	3.24E-07	-.065136	.2565	-1.615E-08	4464.2889	-.025145
359.640	2.52E-07	.8311	.1566	-1.557E-08	4464.3269	-.019817
364.080	1.86E-07	1.3363	.079821	-1.393E-08	4464.3519	-.014790
368.520	1.28E-07	1.5492	.024000	-1.174E-08	4464.3624	-.010355
372.960	8.16E-08	1.5572	-.013765	-9.384E-09	4464.3628	-.006656
377.400	4.52E-08	1.4332	-.036822	-7.117E-09	4464.3567	-.003730
381.840	1.84E-08	1.2350	-.048513	-5.095E-09	4464.3469	-.001536
386.280	-8.50E-11	1.0058	-.051907	-3.397E-09	4464.3355	7.192E-06
390.720	-1.18E-08	.7763	-.049653	-2.046E-09	4464.3241	.001008
395.160	-1.83E-08	.5662	-.043906	-1.028E-09	4464.3137	.001580
399.600	-2.09E-08	.3871	-.036332	-3.057E-10	4464.3049	.001832
404.040	-2.10E-08	.2438	-.028142	1.724E-10	4464.2978	.001857
408.480	-1.94E-08	.1371	-.020164	4.611E-10	4464.2925	.001736
412.920	-1.69E-08	.064455	-.012917	6.139E-10	4464.2889	.001528
417.360	-1.39E-08	.021947	-.006692	6.794E-10	4464.2868	.001276
421.800	-1.08E-08	.004577	-.002871	6.995E-10	4464.2859	4.457E-04
426.240	-7.72E-09	-.004009	-.001167	6.999E-10	4464.2859	3.217E-04
430.680	-4.62E-09	-.006252	-1.933E-05	6.921E-10	4464.2860	1.953E-04
435.120	-1.57E-09	-.004642	5.636E-04	6.839E-10	4464.2859	6.729E-05
439.560	1.45E-09	-.001703	5.737E-04	6.790E-10	4464.2858	-6.276E-05
444.000	4.46E-09	0.0000	0.0000	6.778E-10	4464.2857	-1.956E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1263960.920 lbs-in
Maximum shear force	=	35283.691 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .700000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	-1.422E+06	38533.3452	0.0000	74880.5632	-159.1388
4.440	.695213	-1.253E+06	37776.8702	-.002027	66470.7384	-181.6157
8.880	.681996	-1.086E+06	36894.3479	-.003800	58206.8562	-215.9169
13.320	.661473	-9.224E+05	35854.0154	-.005322	50126.5632	-252.7013
17.760	.634741	-7.637E+05	34639.4780	-.006599	42269.8370	-294.3876
22.200	.602870	-6.104E+05	33231.8875	-.007641	34681.3261	-339.6621
26.640	.566890	-4.635E+05	31616.1782	-.008455	27409.0453	-388.1349
31.080	.527791	-3.240E+05	29778.1495	-.009052	20503.9712	-439.8060
35.520	.486511	-1.930E+05	27703.6009	-.009444	14020.0163	-494.6754
39.960	.443932	-71704.2639	25378.3319	-.009644	8014.0017	-552.7431
44.400	.400871	38756.8682	22788.1414	-.009669	6382.9426	-614.0093
48.840	.358070	1.371E+05	19971.6909	-.009536	11251.1225	-654.6621
53.280	.316192	2.225E+05	17063.8319	-.009263	15476.9781	-655.1843
57.720	.275811	2.948E+05	14168.4839	-.008871	19057.8667	-649.0265
62.160	.237415	3.542E+05	11313.6281	-.008379	21997.9902	-636.9446
66.600	.201402	4.008E+05	8523.4534	-.007807	24307.6555	-619.8909
71.040	.168087	4.351E+05	5817.5667	-.007174	26002.3397	-598.9770
75.480	.137700	4.573E+05	3215.9872	-.006497	27101.5977	-572.9056
79.920	.110391	4.680E+05	746.9521	-.005796	27630.3181	-539.2724
84.360	.086231	4.678E+05	-1556.5729	-.005087	27621.0575	-498.3515
88.800	.065220	4.575E+05	-3662.9762	-.004386	27113.7561	-450.4788
93.240	.047288	4.382E+05	-5542.0944	-.003707	26155.3899	-395.9708
97.680	.032305	4.108E+05	-7164.7795	-.003063	24799.6382	-334.9684
102.120	.020087	3.766E+05	-8462.7316	-.002466	23106.7188	-249.6947
106.560	.010403	3.373E+05	-9313.3707	-.001925	21160.7067	-133.4761
111.000	.002989	2.952E+05	-9697.4886	-.001446	19076.0044	-39.5500
115.440	-.002438	2.521E+05	-9711.5298	-.001031	16945.3287	33.2252
119.880	-.006168	2.096E+05	-9445.6688	-6.813E-04	14840.7778	86.5320
124.320	-.008488	1.687E+05	-8981.6960	-3.946E-04	12815.4374	122.4647
128.760	-.009672	1.301E+05	-8391.4425	-1.681E-04	10905.3973	143.4152
133.200	-.009980	94289.1968	-7460.5547	1.999E-06	9132.0677	275.9036
137.640	-.009654	63859.3975	-6234.1509	1.219E-04	7625.6420	276.5305
142.080	-.008898	38848.7743	-5034.6955	1.997E-04	6387.4924	263.7647
146.520	-.007880	19018.2932	-3913.0601	2.436E-04	5405.7854	241.4764
150.960	-.006735	3938.5817	-2903.8892	2.610E-04	4659.2650	213.1051
155.400	-.005563	-6942.0503	-2027.6889	2.587E-04	4807.9516	181.5798
159.840	-.004438	-14239.5863	-1293.1696	2.426E-04	5169.2157	149.2847
164.280	-.003408	-18586.9954	-699.6619	2.178E-04	5384.4340	118.0611
168.720	-.002504	-20597.6127	-239.4558	1.881E-04	5483.9695	89.2390
173.160	-.001738	-20838.6114	100.0442	1.567E-04	5495.9001	63.6890
177.600	-.001113	-19813.5518	334.4246	1.258E-04	5445.1546	41.8877
182.040	-6.21E-04	-17952.7325	480.6709	9.722E-05	5353.0348	23.9890
186.480	-2.50E-04	-15609.9420	555.8954	7.178E-05	5237.0551	9.8960
190.920	1.65E-05	-13064.1864	576.3776	5.005E-05	5111.0276	-.6698
195.360	1.95E-04	-10525.0398	556.8937	3.217E-05	4985.3273	-8.1068
199.800	3.02E-04	-8140.3939	510.3030	1.802E-05	4867.2755	-12.8800
204.240	3.55E-04	-6005.5504	447.3495	7.299E-06	4761.5902	-15.4774

208.680	3.67E-04	-4172.7915	376.6346	-4.159E-07	4670.8595	-16.3761
213.120	3.51E-04	-2660.7584	304.7203	-5.595E-06	4596.0064	-16.0177
217.560	3.17E-04	-1463.1488	236.3215	-8.721E-06	4536.7188	-14.7926
222.000	2.74E-04	-556.4153	174.5535	-1.025E-05	4491.8310	-13.0309
226.440	2.26E-04	93.7136	121.2051	-1.060E-05	4468.9250	-10.9999
230.880	1.79E-04	526.9476	77.0151	-1.013E-05	4490.3722	-8.9055
235.320	1.36E-04	784.3553	41.9328	-9.138E-06	4503.1152	-6.8973
239.760	9.83E-05	905.3966	15.3538	-7.857E-06	4509.1073	-5.0752
244.200	6.65E-05	925.9302	-3.6787	-6.469E-06	4510.1238	-3.4980
248.640	4.09E-05	877.0381	-16.3091	-5.103E-06	4507.7034	-2.1913
253.080	2.12E-05	784.5042	-23.7399	-3.843E-06	4503.1226	-1.1559
257.520	6.74E-06	668.7873	-27.1380	-2.742E-06	4497.3940	-.3748
261.960	-3.19E-06	545.3448	-27.5696	-1.822E-06	4491.2830	.1803
266.400	-9.44E-06	425.1822	-25.9620	-1.086E-06	4485.3343	.5438
270.840	-1.28E-05	315.5253	-23.0853	-5.247E-07	4479.9058	.7520
275.280	-1.41E-05	220.5344	-19.5500	-1.184E-07	4475.2033	.8404
279.720	-1.39E-05	142.0001	-15.8164	1.564E-07	4471.3154	.8414
284.160	-1.27E-05	79.9811	-12.2101	3.246E-07	4468.2452	.7830
288.600	-1.10E-05	33.3584	-8.9429	4.105E-07	4465.9371	.6887
293.040	-9.06E-06	.2947	-6.1341	4.360E-07	4464.3003	.5766
297.480	-7.13E-06	-21.4030	-3.8319	4.200E-07	4465.3453	.4605
301.920	-5.33E-06	-34.0124	-2.0327	3.780E-07	4465.9695	.3500
306.360	-3.77E-06	-39.7055	-.6983	3.222E-07	4466.2513	.2511
310.800	-2.47E-06	-40.4279	.2304	2.614E-07	4466.2871	.1672
315.240	-1.45E-06	-37.8334	.8223	2.021E-07	4466.1587	.099402
319.680	-6.79E-07	-33.2602	1.1479	1.482E-07	4465.9323	.047255
324.120	-1.33E-07	-27.7386	1.2736	1.020E-07	4465.6589	.009374
328.560	2.27E-07	-22.0182	1.2584	6.427E-08	4465.3757	-.016230
333.000	4.38E-07	-16.6067	1.1518	3.499E-08	4465.1078	-.031793
337.440	5.37E-07	-11.8135	.9934	1.345E-08	4464.8705	-.039553
341.880	5.57E-07	-7.7942	.8133	-1.410E-09	4464.6716	-.041579
346.320	5.25E-07	-4.5905	.6329	-1.080E-08	4464.5130	-.039680
350.760	4.61E-07	-2.1668	.4663	-1.592E-08	4464.3930	-.035349
355.200	3.84E-07	-.4388	.3218	-1.789E-08	4464.3074	-.029760
359.640	3.03E-07	.7027	.2029	-1.769E-08	4464.3205	-.023783
364.080	2.26E-07	1.3750	.1101	-1.612E-08	4464.3538	-.018021
368.520	1.59E-07	1.6914	.041585	-1.379E-08	4464.3694	-.012853
372.960	1.04E-07	1.7535	-.005772	-1.118E-08	4464.3725	-.008479
377.400	6.02E-08	1.6476	-.035630	-8.605E-09	4464.3673	-.004970
381.840	2.75E-08	1.4428	-.051768	-6.263E-09	4464.3571	-.002300
386.280	4.56E-09	1.1920	-.057730	-4.266E-09	4464.3447	-3.858E-04
390.720	-1.04E-08	.9330	-.056616	-2.655E-09	4464.3319	8.873E-04
395.160	-1.90E-08	.6911	-.050991	-1.424E-09	4464.3199	.001647
399.600	-2.30E-08	.4812	-.042861	-5.356E-10	4464.3095	.002016
404.040	-2.38E-08	.3108	-.033711	6.469E-11	4464.3011	.002106
408.480	-2.24E-08	.1818	-.024574	4.380E-10	4464.2947	.002010
412.920	-1.99E-08	.092303	-.016113	6.458E-10	4464.2903	.001801
417.360	-1.67E-08	.038276	-.008718	7.448E-10	4464.2876	.001530
421.800	-1.33E-08	.014387	-.004111	7.847E-10	4464.2864	5.456E-04
426.240	-9.74E-09	.001248	-.001999	7.965E-10	4464.2858	4.058E-04
430.680	-6.20E-09	-.003894	-5.173E-04	7.945E-10	4464.2859	2.616E-04
435.120	-2.68E-09	-.003875	3.182E-04	7.886E-10	4464.2859	1.147E-04
439.560	8.07E-10	-.001593	4.952E-04	7.845E-10	4464.2858	-3.499E-05
444.000	4.29E-09	0.0000	0.0000	7.833E-10	4464.2857	-1.881E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1422408.805 lbs-in
Maximum shear force	=	38533.345 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .800000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	-1.572E+06	41470.8383	0.0000	82291.9876	-159.1388
4.440	.794709	-1.389E+06	40714.3632	-.002244	73234.6255	-181.6157
8.880	.780069	-1.209E+06	39831.8408	-.004214	64319.7915	-215.9170
13.320	.757291	-1.033E+06	38791.5081	-.005913	55585.4612	-252.7014
17.760	.727563	-8.607E+05	37576.9703	-.007348	47071.9421	-294.3877
22.200	.692042	-6.941E+05	36169.3791	-.008526	38824.2143	-339.6623
26.640	.651849	-5.338E+05	34553.6684	-.009457	30890.6256	-388.1353
31.080	.608064	-3.809E+05	32715.6375	-.010150	23322.4866	-439.8066
35.520	.561715	-2.365E+05	30641.0857	-.010618	16174.0446	-494.6762
39.960	.513774	-1.018E+05	28315.8119	-.010875	9502.4564	-552.7444
44.400	.465148	22149.8234	25725.6147	-.010935	5560.8116	-614.0111
48.840	.416671	1.340E+05	22856.2925	-.010817	11095.7285	-678.4764
53.280	.369095	2.323E+05	19713.9316	-.010539	15965.1587	-737.0015
57.720	.323084	3.160E+05	16459.2342	-.010123	20109.5284	-729.0784
62.160	.279199	3.852E+05	13255.3400	-.009592	23534.4777	-714.1172
66.600	.237907	4.401E+05	10131.1860	-.008966	26252.8789	-693.1594
71.040	.199577	4.812E+05	7110.6717	-.008268	28283.8129	-667.4327
75.480	.164486	5.088E+05	4211.9634	-.007518	29651.3616	-638.2918
79.920	.132819	5.236E+05	1455.2728	-.006735	30383.2740	-603.4607
84.360	.104675	5.262E+05	-1129.1353	-.005940	30513.1730	-560.6870
88.800	.080074	5.175E+05	-3506.8087	-.005149	30082.7367	-510.3370
93.240	.058955	4.985E+05	-5644.9495	-.004379	29141.3200	-452.7895
97.680	.041191	4.703E+05	-7512.1846	-.003644	27745.5600	-388.3073
102.120	.026593	4.342E+05	-9077.4072	-.002959	25959.0908	-316.7479
106.560	.014917	3.916E+05	-10205.4643	-.002333	23852.6504	-191.3859
111.000	.005876	3.451E+05	-10802.9344	-.001774	21549.6454	-77.7447

115.440	-8.41E-04	2.969E+05	-10950.0825	-.001288	19162.1434	11.4618
119.880	-.005560	2.487E+05	-10751.4710	-8.743E-04	16778.4078	78.0029
124.320	-.008605	2.020E+05	-10302.6716	-5.327E-04	14464.5808	124.1590
128.760	-.010290	1.576E+05	-9688.2931	-2.601E-04	12266.8753	152.5880
133.200	-.010915	1.161E+05	-8679.6782	-5.262E-05	10214.1449	301.7430
137.640	-.010758	80571.8120	-7325.7308	9.648E-05	8452.9893	308.1432
142.080	-.010058	51030.4101	-5979.7507	1.962E-04	6990.5436	298.1541
146.520	-.009015	27340.9396	-4704.5893	2.556E-04	5817.7976	276.2429
150.960	-.007788	9083.4104	-3544.2658	2.832E-04	4913.9595	246.4253
155.400	-.006500	-4320.7739	-2526.2049	2.868E-04	4678.1854	212.1607
159.840	-.005241	-13540.3266	-1663.8208	2.733E-04	5134.5989	176.3006
164.280	-.004073	-19277.5244	-959.2321	2.484E-04	5418.6186	141.0817
168.720	-.003035	-22223.7630	-405.9307	2.170E-04	5564.4720	108.1531
173.160	-.002146	-23026.6954	8.7286	1.827E-04	5604.2211	78.6303
177.600	-.001413	-22267.9179	301.3137	1.483E-04	5566.6579	53.1648
182.040	-8.29E-04	-20449.8297	490.4327	1.160E-04	5476.6535	32.0239
186.480	-3.83E-04	-17990.1123	595.2070	8.684E-05	5354.8853	15.1717
190.920	-5.78E-05	-15222.2247	634.1010	6.166E-05	5217.8612	2.3481
195.360	1.65E-04	-12400.3637	624.0853	4.073E-05	5078.1651	-6.8596
199.800	3.04E-04	-9707.4714	580.0988	2.397E-05	4944.8536	-12.9541
204.240	3.78E-04	-7265.0508	514.7643	1.111E-05	4823.9417	-16.4759
208.680	4.02E-04	-5143.7620	438.3102	1.702E-06	4718.9274	-17.9629
213.120	3.93E-04	-3373.9893	358.6505	-4.754E-06	4631.3149	-17.9199
217.560	3.60E-04	-1955.7791	281.5755	-8.794E-06	4561.1065	-16.7986
222.000	3.15E-04	-867.7426	211.0146	-1.093E-05	4507.2433	-14.9856
226.440	2.63E-04	-74.6873	149.3366	-1.165E-05	4467.9831	-12.7974
230.880	2.11E-04	466.1238	97.6578	-1.135E-05	4487.3611	-10.4814
235.320	1.62E-04	800.0737	56.1398	-1.039E-05	4503.8933	-8.2204
239.760	1.19E-04	971.5663	24.2602	-9.049E-06	4512.3831	-6.1398
244.200	8.20E-05	1021.5307	1.0472	-7.538E-06	4514.8565	-4.3165
248.640	5.20E-05	985.8856	-14.7251	-6.017E-06	4513.0919	-2.7881
253.080	2.86E-05	894.7789	-24.3827	-4.591E-06	4508.5817	-1.5621
257.520	1.12E-05	772.4251	-29.2368	-3.328E-06	4502.5246	-.6244
261.960	-9.50E-07	637.3728	-30.5035	-2.259E-06	4495.8388	.053785
266.400	-8.84E-06	503.0590	-29.2538	-1.395E-06	4489.1896	.5091
270.840	-1.33E-05	378.5276	-26.3882	-7.267E-07	4483.0247	.7817
275.280	-1.53E-05	269.2158	-22.6293	-2.358E-07	4477.6132	.9115
279.720	-1.54E-05	177.7364	-18.5296	1.030E-07	4473.0845	.9353
284.160	-1.44E-05	104.6048	-14.4871	3.170E-07	4469.4642	.8857
288.600	-1.26E-05	48.8801	-10.7674	4.333E-07	4466.7055	.7899
293.040	-1.05E-05	8.7018	-7.5273	4.770E-07	4464.7165	.6696
297.480	-8.38E-06	-18.2802	-4.8388	4.697E-07	4465.1907	.5414
301.920	-6.36E-06	-34.5795	-2.7111	4.296E-07	4465.9976	.4170
306.360	-4.56E-06	-42.6406	-1.1103	3.711E-07	4466.3966	.3041
310.800	-3.06E-06	-44.6862	.024053	3.049E-07	4466.4979	.2069
315.240	-1.86E-06	-42.6301	.7663	2.387E-07	4466.3961	.1274
319.680	-9.41E-07	-38.0407	1.1945	1.776E-07	4466.1689	.065472
324.120	-2.80E-07	-32.1415	1.3837	1.244E-07	4465.8769	.019777
328.560	1.64E-07	-25.8361	1.4015	8.046E-08	4465.5647	-.011748
333.000	4.34E-07	-19.7494	1.3055	4.591E-08	4465.2634	-.031537
337.440	5.72E-07	-14.2743	1.1420	2.012E-08	4464.9924	-.042082
341.880	6.13E-07	-9.6216	.9471	2.012E-09	4464.7620	-.045735
346.320	5.90E-07	-5.8657	.7466	-9.727E-09	4464.5761	-.044575
350.760	5.27E-07	-2.9856	.5581	-1.644E-08	4464.4335	-.040344
355.200	4.44E-07	-.8993	.3921	-1.938E-08	4464.3302	-.034428
359.640	3.55E-07	.5088	.2538	-1.968E-08	4464.3109	-.027871
364.080	2.69E-07	1.3672	.1444	-1.825E-08	4464.3534	-.021408

368.520	1.93E-07	1.8028	.062382	-1.585E-08	4464.3750	-.015516
372.960	1.28E-07	1.9317	.004713	-1.302E-08	4464.3813	-.010461
377.400	7.69E-08	1.8533	-.032610	-1.015E-08	4464.3775	-.006351
381.840	3.81E-08	1.6489	-.053773	-7.497E-09	4464.3673	-.003182
386.280	1.03E-08	1.3808	-.062775	-5.201E-09	4464.3541	-8.732E-04
390.720	-8.12E-09	1.0949	-.063171	-3.325E-09	4464.3399	6.952E-04
395.160	-1.92E-08	.8221	-.057937	-1.872E-09	4464.3264	.001662
399.600	-2.47E-08	.5817	-.049435	-8.078E-10	4464.3145	.002167
404.040	-2.64E-08	.3836	-.039438	-7.611E-11	4464.3047	.002336
408.480	-2.54E-08	.2315	-.029196	3.901E-10	4464.2972	.002277
412.920	-2.29E-08	.1241	-.019534	6.597E-10	4464.2919	.002075
417.360	-1.96E-08	.057599	-.010950	7.974E-10	4464.2886	.001791
421.800	-1.58E-08	.026358	-.005529	8.611E-10	4464.2870	6.508E-04
426.240	-1.19E-08	.007932	-.002981	8.870E-10	4464.2861	4.966E-04
430.680	-7.95E-09	-7.085E-04	-.001134	8.925E-10	4464.2857	3.357E-04
435.120	-3.99E-09	-.002730	-9.541E-06	8.899E-10	4464.2858	1.707E-04
439.560	-4.77E-11	-.001386	3.740E-04	8.868E-10	4464.2858	2.066E-06
444.000	3.89E-09	0.0000	0.0000	8.857E-10	4464.2857	-1.705E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1572119.578 lbs-in
Maximum shear force	=	41470.838 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .900000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	-1.714E+06	44141.8354	0.0000	89306.5168	-159.1388
4.440	.894233	-1.519E+06	43385.3604	-.002450	79660.2938	-181.6157
8.880	.878242	-1.327E+06	42502.8379	-.004607	70153.3554	-215.9170
13.320	.853320	-1.138E+06	41462.5051	-.006476	60823.9758	-252.7014
17.760	.820736	-9.544E+05	40247.9671	-.008062	51712.7633	-294.3878

22.200	.781729	-7.757E+05	38840.3755	-.009373	42864.9995	-339.6625
26.640	.737500	-6.033E+05	37224.6642	-.010419	34329.3351	-388.1354
31.080	.689211	-4.382E+05	35386.6323	-.011208	26157.3848	-439.8068
35.520	.637973	-2.816E+05	33312.0791	-.011754	18403.7007	-494.6766
39.960	.584840	-1.346E+05	30986.8033	-.012069	11125.7453	-552.7449
44.400	.530801	1624.5460	28396.6033	-.012170	4544.7088	-614.0118
48.840	.476773	1.257E+05	25527.2774	-.012073	10687.3240	-678.4774
53.280	.423591	2.363E+05	22364.6230	-.011799	16164.6577	-746.1417
57.720	.372000	3.322E+05	18905.7406	-.011368	20907.9101	-811.9134
62.160	.322644	4.118E+05	15339.8204	-.010804	24850.4987	-794.3570
66.600	.276060	4.756E+05	11867.5360	-.010131	28007.5671	-769.7351
71.040	.232677	5.239E+05	8517.2870	-.009374	30401.5507	-739.3860
75.480	.192820	5.575E+05	5311.1664	-.008554	32060.8594	-704.8124
79.920	.156715	5.768E+05	2265.0260	-.007695	33018.3965	-667.3229
84.360	.124493	5.827E+05	-599.5381	-.006816	33310.2656	-623.0212
88.800	.096192	5.760E+05	-3249.2355	-.005938	32979.5543	-570.5361
93.240	.071767	5.578E+05	-5648.6881	-.005078	32077.6507	-510.2984
97.680	.051097	5.292E+05	-7764.2800	-.004254	30663.7975	-442.6709
102.120	.033989	4.917E+05	-9563.3422	-.003480	28804.7074	-367.7174
106.560	.020191	4.466E+05	-10954.7756	-.002769	26574.4674	-259.0544
111.000	.009398	3.962E+05	-11805.8978	-.002130	24080.2500	-124.3340
115.440	.001272	3.432E+05	-12120.4073	-.001570	21454.7905	-17.3369
119.880	-.004544	2.897E+05	-12017.3760	-.001090	18803.8350	63.7475
124.320	-.008410	2.372E+05	-11606.4589	-6.910E-04	16207.8536	121.3503
128.760	-.010680	1.871E+05	-10985.4839	-3.694E-04	13724.3724	158.3681
133.200	-.011691	1.399E+05	-9916.4059	-1.216E-04	11390.7717	323.1985
137.640	-.011760	99077.0603	-8451.0821	5.953E-05	9369.0907	336.8572
142.080	-.011162	64829.7604	-6968.6906	1.838E-04	7673.6798	330.8867
146.520	-.010128	37072.7034	-5545.1417	2.610E-04	6299.5681	310.3515
150.960	-.008845	15415.0786	-4234.8827	3.008E-04	5227.4084	279.8552
155.400	-.007457	-733.3740	-3073.2389	3.119E-04	4500.5914	243.4078
159.840	-.006075	-12083.0123	-2079.2064	3.022E-04	5062.4546	204.3546
164.280	-.004774	-19397.9873	-1258.4484	2.783E-04	5424.5821	165.3562
168.720	-.003603	-23443.4037	-606.2849	2.459E-04	5624.8503	128.4111
173.160	-.002591	-24945.5409	-110.5165	2.092E-04	5699.2135	94.9080
177.600	-.001746	-24564.1077	246.0338	1.717E-04	5680.3307	65.7003
182.040	-.001066	-22875.0861	483.3345	1.357E-04	5596.7157	41.1919
186.480	-5.41E-04	-20362.4764	622.3505	1.029E-04	5472.3291	21.4279
190.920	-1.52E-04	-17417.1666	683.6456	7.430E-05	5326.5217	6.1825
195.360	1.19E-04	-14341.1855	686.3622	5.023E-05	5174.2454	-4.9588
199.800	2.94E-04	-11355.7216	647.5429	3.075E-05	5026.4502	-12.5273
204.240	3.92E-04	-8611.4845	581.7471	1.562E-05	4890.5968	-17.1104
208.680	4.33E-04	-6200.2083	500.9086	4.390E-06	4771.2267	-19.3033
213.120	4.31E-04	-4166.3397	414.3818	-3.467E-06	4670.5402	-19.6728
217.560	4.02E-04	-2518.1888	329.1233	-8.534E-06	4588.9485	-18.7320
222.000	3.55E-04	-1238.0417	249.9641	-1.138E-05	4525.5749	-16.9253
226.440	3.01E-04	-290.9278	179.9319	-1.254E-05	4478.6881	-14.6208
230.880	2.44E-04	368.1052	120.5901	-1.248E-05	4482.5087	-12.1098
235.320	1.90E-04	788.2247	72.3699	-1.160E-05	4503.3067	-9.6110
239.760	1.41E-04	1018.4781	34.8764	-1.024E-05	4514.7054	-7.2779
244.200	9.90E-05	1104.7433	7.1579	-8.626E-06	4518.9760	-5.2079
248.640	6.44E-05	1087.7853	-12.0681	-6.964E-06	4518.1365	-3.4525
253.080	3.71E-05	1002.2166	-24.2348	-5.380E-06	4513.9004	-2.0280
257.520	1.66E-05	876.1633	-30.7885	-3.956E-06	4507.6601	-.9241
261.960	2.00E-06	731.4498	-33.0913	-2.738E-06	4500.4961	-.1132
266.400	-7.70E-06	584.1361	-32.3582	-1.741E-06	4493.2033	.4434
270.840	-1.35E-05	445.2679	-29.6228	-9.604E-07	4486.3287	.7888

275.280	-1.62E-05	321.7254	-25.7246	-3.790E-07	4480.2127	.9671
279.720	-1.68E-05	217.0862	-21.3137	2.934E-08	4475.0326	1.0197
284.160	-1.60E-05	132.4399	-16.8666	2.943E-07	4470.8421	.9835
288.600	-1.42E-05	67.1151	-12.7080	4.455E-07	4467.6082	.8897
293.040	-1.20E-05	19.2963	-9.0372	5.110E-07	4465.2410	.7637
297.480	-9.67E-06	-13.4760	-5.9543	5.154E-07	4464.9528	.6250
301.920	-7.43E-06	-33.9213	-3.4848	4.795E-07	4465.9650	.4875
306.360	-5.42E-06	-44.7399	-1.6019	4.199E-07	4466.5006	.3607
310.800	-3.70E-06	-48.4256	-.2456	3.493E-07	4466.6830	.2502
315.240	-2.31E-06	-47.1536	.6623	2.768E-07	4466.6201	.1587
319.680	-1.24E-06	-42.7286	1.2068	2.087E-07	4466.4010	.086546
324.120	-4.61E-07	-36.5759	1.4712	1.486E-07	4466.0964	.032522
328.560	7.60E-08	-29.7636	1.5313	9.830E-08	4465.7592	-.005439
333.000	4.12E-07	-23.0434	1.4528	5.827E-08	4465.4265	-.029929
337.440	5.93E-07	-16.9017	1.2894	2.800E-08	4465.1224	-.043676
341.880	6.61E-07	-11.6124	1.0830	6.386E-09	4464.8606	-.049299
346.320	6.50E-07	-7.2892	.8644	-7.941E-09	4464.6466	-.049148
350.760	5.90E-07	-3.9311	.6549	-1.644E-08	4464.4803	-.045218
355.200	5.04E-07	-1.4625	.4677	-2.053E-08	4464.3581	-.039116
359.640	4.08E-07	.2358	.3097	-2.146E-08	4464.2974	-.032068
364.080	3.14E-07	1.3017	.1831	-2.030E-08	4464.3502	-.024954
368.520	2.28E-07	1.8751	.086939	-1.789E-08	4464.3785	-.018357
372.960	1.55E-07	2.0857	.018174	-1.489E-08	4464.3890	-.012618
377.400	9.56E-08	2.0464	-.027362	-1.176E-08	4464.3870	-.007893
381.840	5.03E-08	1.8505	-.054212	-8.802E-09	4464.3773	-.004201
386.280	1.74E-08	1.5709	-.066809	-6.209E-09	4464.3635	-.001473
390.720	-4.87E-09	1.2614	-.069153	-4.062E-09	4464.3482	4.169E-04
395.160	-1.87E-08	.9595	-.064640	-2.379E-09	4464.3332	.001616
399.600	-2.60E-08	.6890	-.055997	-1.129E-09	4464.3198	.002277
404.040	-2.87E-08	.4630	-.045300	-2.564E-10	4464.3086	.002542
408.480	-2.83E-08	.2869	-.034035	3.120E-10	4464.2999	.002533
412.920	-2.59E-08	.1606	-.023199	6.511E-10	4464.2937	.002348
417.360	-2.25E-08	.080432	-.013414	8.338E-10	4464.2897	.002060
421.800	-1.85E-08	.040878	-.007151	9.257E-10	4464.2877	7.615E-04
426.240	-1.43E-08	.016315	-.004140	9.691E-10	4464.2865	5.947E-04
430.680	-9.91E-09	.003467	-.001891	9.841E-10	4464.2859	4.186E-04
435.120	-5.53E-09	-.001130	-4.359E-04	9.858E-10	4464.2858	2.367E-04
439.560	-1.16E-09	-.001060	2.010E-04	9.842E-10	4464.2858	5.022E-05
444.000	3.21E-09	0.0000	0.0000	9.834E-10	4464.2857	-1.408E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1713813.067 lbs-in
Maximum shear force	=	44141.835 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 75000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	-1.849E+06	46598.8897	0.0000	95989.0133	-159.1388
4.440	.993778	-1.643E+06	45842.4147	-.002647	85801.0383	-181.6157
8.880	.976498	-1.440E+06	44959.8924	-.004983	75749.2481	-215.9169
13.320	.949527	-1.240E+06	43919.5601	-.007015	65872.1920	-252.7012
17.760	.914207	-1.045E+06	42705.0231	-.008747	56210.7544	-294.3875
22.200	.871851	-8.554E+05	41297.4334	-.010188	46810.4947	-339.6619
26.640	.823739	-6.718E+05	39681.7252	-.011345	37720.3424	-388.1346
31.080	.771105	-4.955E+05	37843.6984	-.012230	28992.1915	-439.8054
35.520	.715136	-3.276E+05	35769.1527	-.012854	20680.8745	-494.6746
39.960	.656962	-1.693E+05	33443.8878	-.013230	12844.1348	-552.7420
44.400	.597649	-21781.8976	30853.7032	-.013375	5542.5975	-614.0078
48.840	.538190	1.136E+05	27984.3985	-.013306	10088.8326	-678.4718
53.280	.479495	2.356E+05	24821.7728	-.013041	16126.7173	-746.1343
57.720	.422386	3.427E+05	21351.6254	-.012603	21430.5470	-816.9952
62.160	.367584	4.336E+05	17590.1726	-.012014	25928.4897	-877.3529
66.600	.315699	5.069E+05	13757.0289	-.011301	29559.3707	-849.2885
71.040	.267227	5.633E+05	10063.4510	-.010490	32348.7458	-814.4853
75.480	.222546	6.033E+05	6535.7336	-.009606	34329.1719	-774.5766
79.920	.181925	6.277E+05	3192.6297	-.008673	35538.5973	-731.3261
84.360	.145528	6.374E+05	48.2798	-.007714	36018.6205	-685.0478
88.800	.113422	6.333E+05	-2872.5526	-.006751	35814.1631	-630.6425
93.240	.085578	6.164E+05	-5533.3563	-.005804	34978.4236	-567.9177
97.680	.061882	5.880E+05	-7898.1762	-.004891	33573.0383	-497.3165
102.120	.042144	5.495E+05	-9932.5379	-.004029	31667.6177	-419.0627
106.560	.026104	5.025E+05	-11601.4640	-.003232	29339.4933	-332.7059
111.000	.013447	4.486E+05	-12735.0067	-.002511	26674.1177	-177.8989
115.440	.003808	3.911E+05	-13245.1784	-.001874	23823.9156	-51.9081
119.880	-.003198	3.323E+05	-13260.8257	-.001326	20913.2827	44.8598
124.320	-.007967	2.742E+05	-12906.0272	-8.664E-04	18038.1263	114.9594
128.760	-.010892	2.182E+05	-12292.2743	-4.932E-04	15268.3091	161.5059
133.200	-.012347	1.654E+05	-11175.9550	-2.025E-04	12650.6553	341.3406
137.640	-.012690	1.191E+05	-9611.2428	1.317E-05	10361.9904	363.4847
142.080	-.012230	80008.0600	-7999.4587	1.641E-04	8425.0808	362.5441
146.520	-.011232	47989.1485	-6430.5199	2.611E-04	6839.9861	344.1850
150.960	-.009911	22731.1385	-4970.2099	3.147E-04	5589.5896	313.6123
155.400	-.008438	3644.0812	-3662.5877	3.347E-04	4644.6858	275.4068
159.840	-.006939	-10015.5570	-2532.9669	3.299E-04	4960.1054	233.4314
164.280	-.005508	-19068.3658	-1591.1792	3.078E-04	5408.2642	190.7973
168.720	-.004206	-24350.2477	-834.8805	2.749E-04	5669.7435	149.8778
173.160	-.003067	-26665.2073	-252.7128	2.363E-04	5784.3455	112.3599
177.600	-.002108	-26751.6883	172.8194	1.958E-04	5788.6267	79.3213

182.040	-.001328	-25260.9573	462.8480	1.564E-04	5714.8282	51.3222
186.480	-7.19E-04	-22745.7292	640.0638	1.200E-04	5590.3119	28.5047
190.920	-2.63E-04	-19657.0890	727.0770	8.783E-05	5437.4089	10.6904
195.360	6.07E-05	-16347.7794	745.1992	6.054E-05	5273.5817	-2.5273
199.800	2.74E-04	-13080.0390	713.6117	3.823E-05	5111.8124	-11.7013
204.240	4.00E-04	-10036.3714	648.8699	2.071E-05	4961.1358	-17.4616
208.680	4.58E-04	-7331.8690	564.6872	7.549E-06	4827.2495	-20.4585
213.120	4.67E-04	-5026.9768	471.9387	-1.818E-06	4713.1459	-21.3201
217.560	4.42E-04	-3139.8429	378.8277	-8.008E-06	4619.7235	-20.6218
222.000	3.96E-04	-1657.6540	291.1622	-1.164E-05	4546.3478	-18.8671
226.440	3.39E-04	-546.5673	212.6965	-1.331E-05	4491.3435	-16.4778
230.880	2.78E-04	239.9586	145.4987	-1.355E-05	4476.1649	-13.7915
235.320	2.19E-04	754.4834	90.3170	-1.279E-05	4501.6364	-11.0651
239.760	1.64E-04	1050.4934	46.9214	-1.143E-05	4516.2903	-8.4824
244.200	1.17E-04	1178.7550	14.4082	-9.736E-06	4522.6399	-6.1632
248.640	7.79E-05	1184.9221	-8.5431	-7.944E-06	4522.9452	-4.1752
253.080	4.66E-05	1108.1830	-23.4604	-6.206E-06	4519.1463	-2.5443
257.520	2.28E-05	980.7272	-31.9186	-4.623E-06	4512.8366	-1.2657
261.960	5.53E-06	827.8243	-35.4240	-3.252E-06	4505.2671	-.3133
266.400	-6.12E-06	668.3279	-35.3367	-2.118E-06	4497.3713	.3526
270.840	-1.33E-05	515.4451	-32.8266	-1.221E-06	4489.8028	.7781
275.280	-1.70E-05	377.6409	-28.8547	-5.439E-07	4482.9808	1.0111
279.720	-1.81E-05	259.5776	-24.1741	-6.089E-08	4477.1361	1.0973
284.160	-1.75E-05	163.0156	-19.3443	2.594E-07	4472.3558	1.0783
288.600	-1.58E-05	87.6276	-14.7544	4.494E-07	4468.6237	.9893
293.040	-1.35E-05	31.6974	-10.6504	5.398E-07	4465.8549	.8594
297.480	-1.10E-05	-7.3071	-7.1638	5.583E-07	4464.6475	.7111
301.920	-8.55E-06	-32.2891	-4.3394	5.283E-07	4465.8842	.5611
306.360	-6.32E-06	-46.1932	-2.1599	4.688E-07	4466.5725	.4207
310.800	-4.39E-06	-51.7814	-.5673	3.946E-07	4466.8492	.2967
315.240	-2.81E-06	-51.4936	.5197	3.163E-07	4466.8349	.1929
319.680	-1.58E-06	-47.3768	1.1923	2.413E-07	4466.6311	.1100
324.120	-6.69E-07	-41.0671	1.5413	1.743E-07	4466.3187	.047213
328.560	-3.30E-08	-33.8058	1.6514	1.176E-07	4465.9593	.002362
333.000	3.75E-07	-26.4810	1.5962	7.187E-08	4465.5967	-.027241
337.440	6.05E-07	-19.6798	1.4368	3.688E-08	4465.2600	-.044541
341.880	7.03E-07	-13.7467	1.2216	1.154E-08	4464.9662	-.052420
346.320	7.08E-07	-8.8401	.9864	-5.576E-09	4464.7233	-.053500
350.760	6.53E-07	-4.9836	.7566	-1.605E-08	4464.5324	-.050032
355.200	5.65E-07	-2.1110	.5481	-2.143E-08	4464.3902	-.043852
359.640	4.63E-07	-.1018	.3700	-2.311E-08	4464.2908	-.036380
364.080	3.60E-07	1.1903	.2257	-2.228E-08	4464.3446	-.028649
368.520	2.65E-07	1.9169	.1146	-1.993E-08	4464.3806	-.021358
372.960	1.83E-07	2.2216	.034086	-1.679E-08	4464.3957	-.014930
377.400	1.16E-07	2.2308	-.020313	-1.342E-08	4464.3961	-.009574
381.840	6.39E-08	2.0501	-.053416	-1.017E-08	4464.3872	-.005338
386.280	2.56E-08	1.7632	-.070071	-7.281E-09	4464.3730	-.002165
390.720	-8.01E-10	1.4328	-.074725	-4.859E-09	4464.3566	6.858E-05
395.160	-1.76E-08	1.1029	-.071199	-2.937E-09	4464.3403	.001520
399.600	-2.69E-08	.8025	-.062598	-1.493E-09	4464.3254	.002354
404.040	-3.08E-08	.5480	-.051313	-4.691E-10	4464.3128	.002729
408.480	-3.10E-08	.3471	-.039080	2.094E-10	4464.3029	.002781
412.920	-2.89E-08	.2009	-.027084	6.247E-10	4464.2957	.002622
417.360	-2.55E-08	.1062	-.016079	8.575E-10	4464.2910	.002335
421.800	-2.13E-08	.057521	-.008947	9.816E-10	4464.2886	8.772E-04
426.240	-1.68E-08	.026101	-.005447	1.045E-09	4464.2870	6.994E-04
430.680	-1.21E-08	.008457	-.002764	1.071E-09	4464.2861	5.091E-04

435.120	-7.27E-09	8.431E-04	-9.433E-04	1.078E-09	4464.2858	3.111E-04
439.560	-2.48E-09	-6.383E-04	-1.407E-05	1.078E-09	4464.2857	1.075E-04
444.000	2.30E-09	0.0000	0.0000	1.078E-09	4464.2857	-1.012E-04

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1848799.497 lbs-in
Maximum shear force	=	46598.890 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	6

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .100000	S= 0.000	75000.0000	.100000	-2.783E+05	9347.4951
5	y= .200000	S= 0.000	75000.0000	.2000	-5.010E+05	15770.3993
5	y= .300000	S= 0.000	75000.0000	.3000	-7.078E+05	21565.9241
5	y= .400000	S= 0.000	75000.0000	.4000	-9.072E+05	27067.2038
5	y= .500000	S= 0.000	75000.0000	.5000	-1.093E+06	31534.9780
5	y= .600000	S= 0.000	75000.0000	.6000	-1.264E+06	35283.6907
5	y= .700000	S= 0.000	75000.0000	.7000	-1.422E+06	38533.3452
5	y= .800000	S= 0.000	75000.0000	.8000	-1.572E+06	41470.8383
5	y= .900000	S= 0.000	75000.0000	.9000	-1.714E+06	44141.8354
5	y= 1.000	S= 0.000	75000.0000	1.0000	-1.849E+06	46598.8897

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = .10000 in
Slope = .00000
Axial Load = 75000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
444.000	.10000000	-278307.107	9347.495
421.800	.10000000	-278433.218	9350.109
399.600	.10000000	-278513.243	9351.286
377.400	.10000000	-278622.604	9356.042
355.200	.10000000	-278655.410	9356.647
333.000	.10000000	-278740.441	9360.382
310.800	.10000000	-278837.664	9363.569
288.600	.10000000	-278903.281	9365.281
266.400	.10000000	-278970.538	9366.999
244.200	.10000000	-278997.907	9367.093

The analysis ended normally.

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

IT - San Jose
URS Corporation

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\ArroyoMocho\
Name of input data file: ArroyoMocho_Pier_B20_Free.lpd
Name of output file: ArroyoMocho_Pier_B20_Free.lpo
Name of plot output file: ArroyoMocho_Pier_B20_Free.lpp
Name of runtime file: ArroyoMocho_Pier_B20_Free.lpr

Time and Date of Analysis

Date: October 29, 2009 Time: 12: 4: 9

Problem Title

SR84 Isabel Pier - Arroyo Mocho Bridge Widen - H pile

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 492.00 in
Depth of ground surface below top of pile = -216.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	10.000	101.0000	16.8000	29000000.000
2	492.0000	10.000	101.0000	16.8000	29000000.000

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -216.000 in
Distance from top of pile to bottom of layer = -180.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -180.000 in
Distance from top of pile to bottom of layer = 108.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 3 is stiff clay without free water
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 120.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 780.000 in
p-y subgrade modulus k for top of soil layer = 1000.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 288.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-216.00	.07230
2	-180.00	.07230
3	-180.00	.07810
4	108.00	.07810
5	108.00	.04200
6	120.00	.04200
7	120.00	.04200
8	780.00	.04200

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-216.000	.00000	32.00	------	------
2	-180.000	.00000	32.00	------	------
3	-180.000	.00000	40.00	------	------
4	108.000	.00000	40.00	------	------
5	108.000	20.83300	.00	.00500	.0
6	120.000	20.83300	.00	.00500	.0
7	120.000	20.83300	.00	.00500	.0
8	780.000	20.83300	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.

(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .100 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .200 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .300 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .400 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .500 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head   =   .600 in
Bending moment at pile head =   .000 in-lbs
Axial load at pile head   =   200000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Deflection at pile head = .700 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .800 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .900 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 200000.000 lbs

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	276.000

Depth of ground surface below top of pile = -216.00 in

p-y Curve in Sand Computed Using Reese Criteria

Soil Layer Number = 2
Depth below pile head = 60.000 in
Depth below ground surface = 276.000 in
Equivalent Depth (see note) = 276.000 in
Pile Diameter = 10.000 in
Angle of Friction = 40.000 deg.
Avg. Eff. Unit Weight = .07734 lbs/in**3
k = 225.000 pci
A (static) = .8800
B (static) = .5000
Pst = 28178.350 lbs/in

Psd	=	22232.297	lbs/in
Ps	=	22232.297	lbs/in
pu	=	19564.422	lbs/in
Cbar	=	33042.3027	
n	=	1.6447	
m	=	40551.7102	
yk	=	.2000	in
ym	=	.1667	in
yu	=	.3750	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0139	862.500
.0278	1725.000
.0417	2587.500
.0556	3450.000
.0694	4312.500
.0833	5175.000
.0972	6037.500
.1111	6900.000
.1250	7762.500
.1389	8625.000
.1528	9487.500
.1667	10350.000
.3750	19564.422
10.3750	19564.422
20.3750	19564.422
30.3750	19564.422

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .100000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	0.0000	55124.8231	-.004532	11904.7619	-4860.0000
4.920	.077701	2.169E+05	33667.9557	-.004350	22640.0241	-3862.3038

9.840	.057195	3.399E+05	17017.1782	-.003883	28729.2021	-2906.3049
14.760	.039497	3.919E+05	4822.8613	-.003268	31307.8396	-2050.7345
19.680	.025039	3.937E+05	-3488.2043	-.002608	31396.9360	-1327.7475
24.600	.013834	3.628E+05	-8596.7732	-.001973	29862.7258	-748.9065
29.520	.005627	3.130E+05	-11203.8221	-.001405	27401.3911	-310.8694
34.440	7.79E-06	2.553E+05	-11969.6402	-9.278E-04	24541.9161	-.4387
39.360	-.003502	1.971E+05	-11475.7147	-5.479E-04	21661.0276	201.2215
44.280	-.005383	1.434E+05	-10205.1453	-2.619E-04	19005.1444	315.2701
49.200	-.006079	97173.3701	-8537.2047	-5.983E-05	16715.3248	362.7545
54.120	-.005972	59539.3797	-6751.9201	7.179E-05	14852.2560	362.9709
59.040	-.005373	30593.1972	-5041.0626	1.475E-04	13419.2766	332.4996
63.960	-.004521	9645.0663	-3522.5663	1.813E-04	12382.2404	284.7753
68.880	-.003589	-4425.6210	-2256.0828	1.857E-04	12123.8521	230.0553
73.800	-.002694	-12920.1822	-1258.0300	1.711E-04	12544.3749	175.6572
78.720	-.001906	-17141.3588	-515.0730	1.459E-04	12753.3440	126.3578
83.640	-.001259	-18275.5351	4.5317	1.161E-04	12809.4914	84.8636
88.560	-7.63E-04	-17325.2620	341.9231	8.620E-05	12762.4481	52.2874
93.480	-4.10E-04	-15080.6633	540.8663	5.899E-05	12651.3294	28.5839
98.400	-1.83E-04	-12119.2256	642.9569	3.614E-05	12504.7236	12.9164
103.320	-5.48E-05	-8825.0979	684.4242	1.855E-05	12341.6479	3.9403
108.240	-3.11E-08	-5421.0026	718.9653	6.588E-06	12173.1284	10.1008
113.160	9.98E-06	-1763.4435	553.2235	5.536E-07	11992.0611	-77.4755
118.080	5.42E-06	21.6273	219.9296	-9.093E-07	11905.8326	-58.0098
123.000	1.03E-06	402.4533	10.9927	-5.531E-07	11924.6853	-26.9239
127.920	-2.61E-08	130.8845	-41.1739	-1.052E-07	11911.2413	5.7179
132.840	-2.75E-09	-2.4907	-13.3352	2.657E-09	11904.8852	5.5986
137.760	2.43E-11	-.3392	.2535	2.800E-10	11904.7787	-.074773
142.680	1.84E-13	.002893	.034473	-2.467E-12	11904.7620	-.014250
147.600	-3.86E-16	2.237E-05	-2.940E-04	-1.871E-14	11904.7619	1.177E-04
152.520	-1.22E-19	-4.668E-08	-2.273E-06	3.923E-17	11904.7619	9.279E-07
157.440	3.86E-23	-1.476E-11	4.743E-09	1.239E-20	11904.7619	-1.927E-09
162.360	0.000	4.674E-15	1.500E-12	-3.928E-24	11904.7619	-6.102E-13
167.280	0.000	1.482E-18	-4.750E-16	0.0000	11904.7619	1.930E-16
172.200	0.000	-4.680E-22	-1.506E-19	0.0000	11904.7619	6.125E-20
177.120	0.000	-1.488E-25	4.756E-23	0.0000	11904.7619	-1.932E-23
182.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
186.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
191.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
196.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000	in
Computed slope at pile head	=	-.00453223	
Maximum bending moment	=	393741.917	lbs-in
Maximum shear force	=	55124.823	lbs
Depth of maximum bending moment	=	19.680	in
Depth of maximum shear force	=	0.000	in
Number of iterations	=	5	

Number of zero deflection points = 40

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .200000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	0.0000	1.102E+05	-.009064	11904.7619	-9720.0000
4.920	.155403	4.337E+05	67335.7722	-.008700	33375.2541	-7724.6118
9.840	.114390	6.797E+05	34034.1862	-.007765	45553.5728	-5812.6182
14.760	.078995	7.839E+05	9645.5022	-.006536	50710.8007	-4101.4810
19.680	.050078	7.875E+05	-6976.6955	-.005216	50888.9321	-2655.5099
24.600	.027668	7.255E+05	-17193.9098	-.003945	47820.4326	-1497.8292
29.520	.011255	6.261E+05	-22408.0848	-.002810	42897.6653	-621.7541
34.440	1.58E-05	5.105E+05	-23939.7850	-.001856	37178.5997	-.8883
39.360	-.007004	3.941E+05	-22951.9648	-.001096	31416.6951	402.4412
44.280	-.010767	2.868E+05	-20410.7969	-5.239E-04	26104.7997	630.5539
49.200	-.012159	1.943E+05	-17074.7918	-1.198E-04	21525.0491	725.5457
54.120	-.011945	1.191E+05	-13503.9622	1.435E-04	17798.8455	726.0110
59.040	-.010748	61168.4955	-10081.8010	2.948E-04	14932.9052	665.1114
63.960	-.009044	19275.3511	-7044.1240	3.624E-04	12858.9872	569.7167
68.880	-.007182	-8858.8639	-4510.1845	3.711E-04	12343.3195	460.3401
73.800	-.005392	-25835.2608	-2512.7787	3.420E-04	13183.7352	351.6135
78.720	-.003817	-34257.6574	-1025.2234	2.915E-04	13600.6855	253.0838
83.640	-.002524	-36497.1835	15.9381	2.321E-04	13711.5532	170.1526
88.560	-.001533	-34557.6024	692.8837	1.724E-04	13615.5343	105.0286
93.480	-8.27E-04	-30018.5386	1092.9430	1.182E-04	13390.8282	57.5972
98.400	-3.70E-04	-24035.6374	1298.9692	7.279E-05	13094.6449	26.1533
103.320	-1.11E-04	-17379.9312	1382.9083	3.801E-05	12765.1545	7.9683
108.240	4.26E-06	-10502.6140	1318.7630	1.459E-05	12424.6933	-34.0437
113.160	3.26E-05	-4432.0117	990.1751	2.044E-06	12124.1684	-99.5286
118.080	2.44E-05	-763.3135	527.7447	-2.319E-06	11942.5497	-88.4512
123.000	9.81E-06	765.5604	158.8250	-2.317E-06	11942.6609	-61.5161
127.920	1.57E-06	804.0853	-58.6322	-9.991E-07	11944.5681	-26.8811
132.840	-1.87E-08	190.5854	-81.0940	-1.637E-07	11914.1968	17.7503
137.760	-3.64E-08	6.4421	-19.7941	1.814E-09	11905.0808	7.1683
142.680	-8.85E-10	-4.1920	-.6652	3.704E-09	11904.9694	.6076
147.600	1.58E-11	-.1109	.4262	8.992E-11	11904.7674	-.1639
152.520	4.51E-14	.001898	.011267	-1.603E-12	11904.7620	-.004737
157.440	-1.06E-16	5.486E-06	-1.929E-04	-4.586E-15	11904.7619	7.796E-05
162.360	-2.05E-20	-1.280E-08	-5.576E-07	1.076E-17	11904.7619	2.277E-07
167.280	1.06E-23	-2.484E-12	1.301E-09	2.084E-21	11904.7619	-5.288E-10
172.200	0.000	1.283E-15	2.524E-13	-1.078E-24	11904.7619	-1.027E-13
177.120	0.000	2.495E-19	-1.304E-16	0.0000	11904.7619	5.297E-17
182.040	0.000	-1.285E-22	-2.536E-20	0.0000	11904.7619	1.032E-20

186.960	0.000	0.0000	1.306E-23	0.0000	11904.7619	-5.307E-24
191.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
196.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	-.00906445
Maximum bending moment	=	787480.238 lbs-in
Maximum shear force	=	110249.517 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	39

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .300000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	0.0000	1.591E+05	-.013557	11904.7619	-12895.9432
4.920	.233300	6.399E+05	1.002E+05	-.013019	43584.3040	-11033.6261
9.840	.171888	1.012E+06	51583.1229	-.011632	61989.4853	-8734.3341
14.760	.118838	1.170E+06	14918.0004	-.009800	69845.2101	-6170.1872
19.680	.075460	1.178E+06	-10104.3663	-.007827	70211.2051	-4001.5066
24.600	.041816	1.086E+06	-25516.8295	-.005926	65685.6747	-2263.7224
29.520	.017150	9.384E+05	-33416.2529	-.004225	58358.5496	-947.4253
34.440	2.40E-04	7.659E+05	-35780.1447	-.002794	49819.3075	-13.5063
39.360	-.010342	5.918E+05	-34351.6711	-.001654	41201.2122	594.1866
44.280	-.016032	4.311E+05	-30580.3069	-7.945E-04	33246.7291	938.8883
49.200	-.018160	2.924E+05	-25605.0006	-1.868E-04	26382.0745	1083.5939
54.120	-.017871	1.795E+05	-20267.5013	2.096E-04	20792.0009	1086.1212
59.040	-.016098	92597.0998	-15145.0045	4.381E-04	16488.7767	996.1946
63.960	-.013560	29633.2035	-10593.1852	5.408E-04	13371.7522	854.1385
68.880	-.010777	-12704.0553	-6792.7216	5.550E-04	12533.6755	690.7654
73.800	-.008099	-38299.3714	-3794.3696	5.121E-04	13800.7704	528.0768
78.720	-.005737	-51048.5441	-1559.3977	4.371E-04	14431.9176	380.4483

83.640	-.003798	-54504.0559	6.3501	3.484E-04	14602.9825	256.0345
88.560	-.002309	-51671.8045	1025.3513	2.593E-04	14462.7720	158.1936
93.480	-.001246	-44924.8484	1628.0146	1.781E-04	14128.7643	86.7915
98.400	-5.56E-04	-36002.7280	1938.2044	1.102E-04	13687.0752	39.3019
103.320	-1.62E-04	-26069.7407	2063.5716	5.804E-05	13195.3431	11.6603
108.240	1.55E-05	-15811.4088	1919.2528	2.287E-05	12687.5049	-70.3265
113.160	6.27E-05	-7229.2939	1436.3215	3.515E-06	12262.6477	-125.9871
118.080	5.01E-05	-1684.9231	837.5846	-3.972E-06	11988.1739	-117.4019
123.000	2.36E-05	1020.3553	323.2363	-4.530E-06	11955.2745	-91.6828
127.920	5.56E-06	1504.6373	-36.5064	-2.409E-06	11979.2489	-54.5541
132.840	-7.71E-08	665.8735	-148.9116	-5.863E-07	11937.7259	8.8610
137.760	-2.10E-07	40.5012	-70.0471	6.994E-09	11906.7669	23.1978
142.680	-8.30E-09	-23.4035	-4.2151	2.135E-08	11905.9205	3.5632
147.600	5.52E-11	-1.0177	2.3792	8.436E-10	11904.8123	-.8826
152.520	7.18E-13	.006503	.1034	-5.608E-12	11904.7622	-.042575
157.440	-1.15E-17	8.687E-05	-6.609E-04	-7.295E-14	11904.7619	2.615E-04
162.360	-7.20E-20	-1.379E-09	-8.828E-06	1.173E-18	11904.7619	3.589E-06
167.280	1.13E-24	-8.710E-12	1.401E-10	7.315E-21	11904.7619	-5.625E-11
172.200	0.000	1.348E-16	8.851E-13	-1.146E-25	11904.7619	-3.598E-13
177.120	0.000	8.733E-19	-1.370E-17	0.0000	11904.7619	5.495E-18
182.040	0.000	-1.316E-23	-8.875E-20	0.0000	11904.7619	3.608E-20
186.960	0.000	0.0000	1.337E-24	0.0000	11904.7619	-5.365E-25
191.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
196.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	.30000000 in
Computed slope at pile head	=	-.01355694
Maximum bending moment	=	1177790.153 lbs-in
Maximum shear force	=	159079.045 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	39

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Specified deflection at pile head	=	.400000 in
Specified bending moment at pile head	=	.000 in-lbs
Specified axial load at pile head	=	200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	0.0000	2.014E+05	-.017936	11904.7619	-15269.6852
4.920	.311753	8.239E+05	1.305E+05	-.017244	52690.1169	-13573.9339
9.840	.230315	1.318E+06	69569.5364	-.015446	77141.9163	-11183.5403
14.760	.159768	1.539E+06	21651.5625	-.013046	88084.2406	-8295.3109
19.680	.101938	1.557E+06	-12052.6134	-.010447	88960.0746	-5405.5737
24.600	.056972	1.441E+06	-32937.3971	-.007929	83230.8487	-3084.1758
29.520	.023913	1.248E+06	-43774.1341	-.005671	73687.8486	-1321.0018
34.440	.001168	1.021E+06	-47185.7287	-.003765	62459.7236	-65.8252
39.360	-.013137	7.911E+05	-45490.8553	-.002243	51069.1567	754.7982
44.280	-.020904	5.780E+05	-40622.5184	-.001093	40518.3581	1224.2006
49.200	-.023894	3.935E+05	-34103.5930	-2.772E-04	31387.2692	1425.7691
54.120	-.023632	2.430E+05	-27062.9387	2.573E-04	23932.5293	1436.2855
59.040	-.021362	1.267E+05	-20277.6473	5.679E-04	18179.0625	1321.9631
63.960	-.018044	42311.3229	-14229.4947	7.098E-04	13999.3819	1136.6356
68.880	-.014377	-14674.3072	-9166.3597	7.330E-04	12631.2128	921.5494
73.800	-.010831	-49328.2884	-5161.9688	6.793E-04	14346.7564	706.2518
78.720	-.007693	-66804.9236	-2169.6533	5.818E-04	15211.9363	510.1367
83.640	-.005107	-71822.5665	-67.7500	4.653E-04	15460.3345	344.2956
88.560	-.003114	-68387.3387	1304.1902	3.476E-04	15290.2737	213.4037
93.480	-.001687	-59673.3400	2118.1034	2.400E-04	14858.8876	117.4553
98.400	-7.53E-04	-48017.5381	2537.9968	1.496E-04	14281.8677	53.2330
103.320	-2.15E-04	-34993.7886	2706.9663	7.984E-05	13637.1277	15.4538
108.240	3.31E-05	-21538.1185	2499.2644	3.236E-05	12971.0054	-99.8855
113.160	1.03E-04	-10464.7156	1886.9846	5.484E-06	12422.8171	-149.0088
118.080	8.71E-05	-2980.9820	1170.9130	-5.809E-06	12052.3353	-142.0773
123.000	4.62E-05	1068.4999	531.4677	-7.415E-06	11957.6579	-117.8598
127.920	1.41E-05	2263.2537	41.9093	-4.617E-06	12016.8042	-81.1477
132.840	7.60E-07	1489.9732	-214.1794	-1.465E-06	11978.5230	-22.9534
137.760	-2.89E-07	158.6106	-154.3012	-8.011E-08	11912.6139	47.2942
142.680	-2.82E-08	-28.1929	-16.4622	2.943E-08	11906.1576	8.7380
147.600	9.75E-11	-3.4352	2.8669	2.866E-09	11904.9320	-.8806
152.520	1.26E-12	.011490	.3491	-9.906E-12	11904.7625	-.1429
157.440	-3.64E-17	1.523E-04	-.001168	-1.279E-13	11904.7619	4.621E-04
162.360	-1.26E-19	-4.375E-09	-1.548E-05	3.700E-18	11904.7619	6.294E-06
167.280	3.60E-24	-1.528E-11	4.447E-10	1.283E-20	11904.7619	-1.795E-10
172.200	0.000	4.325E-16	1.552E-12	-3.659E-25	11904.7619	-6.311E-13
177.120	0.000	1.532E-18	-4.396E-17	0.0000	11904.7619	1.774E-17
182.040	0.000	-4.275E-23	-1.557E-19	0.0000	11904.7619	6.328E-20
186.960	0.000	-1.536E-25	4.345E-24	0.0000	11904.7619	-1.753E-24
191.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
196.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = .40000000 in

Computed slope at pile head = -.01793633
Maximum bending moment = 1556517.317 lbs-in
Maximum shear force = 201428.226 lbs
Depth of maximum bending moment = 19.680 in
Depth of maximum shear force = 0.000 in
Number of iterations = 7
Number of zero deflection points = 39

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .500000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	0.0000	2.345E+05	-.022220	11904.7619	-15269.6852
4.920	.390676	9.906E+05	1.585E+05	-.021388	60944.0702	-15621.8550
9.840	.289539	1.601E+06	87701.3509	-.019211	91182.0813	-13144.4397
14.760	.201637	1.891E+06	29635.3294	-.016278	1.055E+05	-10459.6340
19.680	.129366	1.925E+06	-12970.9905	-.013072	1.072E+05	-6860.0082
24.600	.073004	1.789E+06	-39568.6912	-.009953	1.005E+05	-3952.0652
29.520	.031431	1.555E+06	-53562.0859	-.007144	88898.7850	-1736.3066
34.440	.002711	1.276E+06	-58209.2483	-.004765	75096.9819	-152.7837
39.360	-.015459	9.919E+05	-56400.1228	-.002860	61007.6434	888.2006
44.280	-.025432	7.271E+05	-50551.3311	-.001416	47901.5071	1489.3570
49.200	-.029395	4.972E+05	-42572.6302	-3.880E-04	36520.6237	1754.0173
54.120	-.029249	3.090E+05	-33884.6140	2.891E-04	27200.9564	1777.6966
59.040	-.026550	1.632E+05	-25469.6295	6.858E-04	19986.2854	1643.0288
63.960	-.022502	57012.4048	-17940.9717	8.707E-04	14727.1582	1417.4012
68.880	-.017982	-15006.0184	-11618.7464	9.060E-04	12647.6341	1152.6091
73.800	-.013586	-59099.1226	-6604.0220	8.438E-04	14830.4610	885.8968
78.720	-.009679	-81650.1710	-2845.7881	7.256E-04	15946.8496	641.8406
83.640	-.006447	-88529.6126	-197.6773	5.826E-04	16287.4160	434.6273
88.560	-.003946	-84741.9635	1536.6751	4.371E-04	16099.9086	270.3940
93.480	-.002145	-74268.9810	2569.3456	3.036E-04	15581.4441	149.3907
98.400	-9.59E-04	-60057.0288	3103.6856	1.908E-04	14877.8821	67.8206
103.320	-2.68E-04	-44104.1160	3317.9616	1.033E-04	14088.1340	19.2834
108.240	5.74E-05	-27611.5225	3059.5694	4.304E-05	13271.6690	-124.3209
113.160	1.55E-04	-14082.6516	2337.4935	8.020E-06	12601.9229	-169.2059
118.080	1.36E-04	-4626.3693	1518.7712	-7.693E-06	12133.7901	-163.6081
123.000	7.94E-05	877.1977	769.5460	-1.084E-05	11948.1875	-140.9550
127.920	2.97E-05	2967.3010	161.0911	-7.613E-06	12051.6580	-106.3844
132.840	4.48E-06	2477.3169	-243.2636	-3.041E-06	12027.4014	-57.9874
137.760	-2.47E-07	579.5710	-250.4769	-4.732E-07	11933.4535	55.0552
142.680	-1.80E-07	13.5550	-61.0724	2.494E-08	11905.4329	21.9385
147.600	-1.61E-09	-21.4308	-1.3940	1.833E-08	11905.8228	2.3210
152.520	1.26E-11	-.1982	2.1781	1.639E-10	11904.7717	-.8689

157.440	2.14E-15	.001528	.020139	-1.284E-12	11904.7620	-.008313
162.360	-1.27E-18	2.596E-07	-1.553E-04	-2.178E-16	11904.7619	6.312E-05
167.280	-2.15E-22	-1.531E-10	-2.639E-08	1.287E-19	11904.7619	1.074E-08
172.200	1.27E-25	-2.609E-14	1.556E-11	2.189E-23	11904.7619	-6.324E-12
177.120	0.000	1.534E-17	2.652E-15	0.0000	11904.7619	-1.079E-15
182.040	0.000	2.622E-21	-1.559E-18	0.0000	11904.7619	6.336E-19
186.960	0.000	-1.537E-24	-2.665E-22	0.0000	11904.7619	1.085E-22
191.880	0.000	0.0000	1.562E-25	0.0000	11904.7619	0.0000
196.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	-.02222025
Maximum bending moment	=	1925048.216 lbs-in
Maximum shear force	=	234459.625 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	8
Number of zero deflection points	=	39

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .600000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	0.0000	2.578E+05	-.026252	11904.7619	-15269.6852
4.920	.470840	1.109E+06	1.818E+05	-.025320	66820.6184	-15621.8545
9.840	.350847	1.839E+06	1.060E+05	-.022845	1.029E+05	-15174.3242
14.760	.246050	2.198E+06	39272.0718	-.019455	1.207E+05	-11962.5409
19.680	.159414	2.263E+06	-10951.1083	-.015708	1.240E+05	-8453.3860
24.600	.091483	2.121E+06	-43929.4057	-.012026	1.169E+05	-4952.4260
29.520	.041079	1.855E+06	-61694.7808	-.008687	1.037E+05	-2269.2712
34.440	.006003	1.531E+06	-68109.3012	-.005844	87684.7178	-338.2574
39.360	-.016422	1.196E+06	-66620.2759	-.003553	71115.0770	943.5523
44.280	-.028963	8.822E+05	-60126.6364	-.001808	55578.2620	1696.1386
49.200	-.034212	6.080E+05	-50932.1870	-5.564E-04	42001.8050	2041.4424

54.120	-.034437	3.821E+05	-40761.4596	2.752E-04	30821.9365	2092.9996
59.040	-.031504	2.063E+05	-30816.6086	7.694E-04	22118.9184	1949.6227
63.960	-.026866	77377.3114	-21857.3733	.001008	15735.3219	1692.3428
68.880	-.021589	-10733.7065	-14290.0493	.001064	12436.1335	1383.8051
73.800	-.016400	-65330.0428	-8255.2456	9.998E-04	15138.9224	1069.3671
78.720	-.011751	-93932.8680	-3707.6627	8.660E-04	16554.9039	779.2438
83.640	-.007879	-1.035E+05	-484.0568	7.002E-04	17029.4028	531.1651
88.560	-.004861	-1.001E+05	1642.1265	5.292E-04	16858.9167	333.1371
93.480	-.002671	-88400.6497	2919.2512	3.709E-04	16281.0317	186.0193
98.400	-.001212	-72078.3994	3587.7635	2.361E-04	15472.9995	85.7337
103.320	-3.48E-04	-53561.7076	3860.2054	1.306E-04	14556.3316	25.0150
108.240	7.30E-05	-34350.9613	3585.8019	5.674E-05	13605.3045	-136.5612
113.160	2.10E-04	-18389.0909	2793.8013	1.245E-05	12815.1129	-185.3903
118.080	1.95E-04	-6884.4576	1889.7944	-8.777E-06	12245.5766	-182.0922
123.000	1.24E-04	223.7586	1044.6771	-1.437E-05	11915.8391	-161.4514
127.920	5.41E-05	3423.4472	329.3030	-1.131E-05	12074.2395	-129.3510
132.840	1.26E-05	3486.3543	-202.0211	-5.505E-06	12077.3537	-86.6344
137.760	-1.12E-07	1446.3924	-336.0228	-1.362E-06	11976.3655	32.1622
142.680	-8.34E-07	182.5700	-156.0696	6.503E-09	11913.8000	40.9895
147.600	-4.79E-08	-89.3453	-19.1286	8.480E-08	11909.1849	14.6775
152.520	9.35E-11	-5.8225	9.0819	4.871E-09	11905.0501	-3.2098
157.440	3.48E-13	.011230	.5917	-9.502E-12	11904.7625	-.2415
162.360	-9.23E-18	4.209E-05	-.001141	-3.535E-14	11904.7619	4.604E-04
167.280	-3.49E-20	-1.109E-09	-4.278E-06	9.385E-19	11904.7619	1.739E-06
172.200	9.12E-25	-4.220E-12	1.127E-10	3.544E-21	11904.7619	-4.547E-11
177.120	0.000	1.095E-16	4.289E-13	0.0000	11904.7619	-1.744E-13
182.040	0.000	4.232E-19	-1.113E-17	0.0000	11904.7619	4.488E-18
186.960	0.000	-1.081E-23	-4.301E-20	0.0000	11904.7619	1.748E-20
191.880	0.000	0.0000	1.098E-24	0.0000	11904.7619	-4.430E-25
196.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	.60000000 in
Computed slope at pile head	=	-.02625210
Maximum bending moment	=	2263342.081 lbs-in
Maximum shear force	=	257780.547 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	39

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .700000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	0.0000	2.773E+05	-.030136	11904.7619	-15269.6852
4.920	.551731	1.209E+06	2.013E+05	-.029121	71754.5708	-15621.8545
9.840	.413453	2.038E+06	1.235E+05	-.026394	1.128E+05	-15974.0246
14.760	.292017	2.477E+06	50991.4912	-.022602	1.345E+05	-13518.0527
19.680	.191047	2.584E+06	-7184.8048	-.018352	1.398E+05	-10130.8481
24.600	.111433	2.442E+06	-46946.4755	-.014131	1.328E+05	-6032.4326
29.520	.052001	2.150E+06	-68852.8979	-.010274	1.183E+05	-2872.6171
34.440	.010336	1.785E+06	-77352.2284	-.006970	1.003E+05	-582.3953
39.360	-.016580	1.402E+06	-76441.4405	-.004293	81332.9233	952.6342
44.280	-.031906	1.041E+06	-69501.4813	-.002241	63437.0375	1868.4874
49.200	-.038628	7.230E+05	-59234.8502	-7.592E-04	47695.0521	2304.9399
54.120	-.039376	4.596E+05	-47677.5684	2.340E-04	34656.0035	2393.1422
59.040	-.036325	2.534E+05	-36260.4627	8.328E-04	24447.1398	2247.9577
63.960	-.031181	1.011E+05	-25898.7344	.001131	16911.3552	1964.1269
68.880	-.025201	-3712.3837	-17093.2622	.001212	12088.5433	1615.3333
73.800	-.019252	-69450.4106	-10031.5032	.001151	15342.9010	1255.3004
78.720	-.013876	-1.047E+05	-4679.8798	.001005	17087.3035	920.1563
83.640	-.009366	-1.175E+05	-862.9522	8.181E-04	17720.4830	631.4403
88.560	-.005827	-1.148E+05	1672.5932	6.230E-04	17587.3717	399.2692
93.480	-.003236	-1.022E+05	3209.0823	4.407E-04	16966.4088	225.3199
98.400	-.001490	-84078.6342	4022.6769	2.842E-04	16067.0705	105.4096
103.320	-4.39E-04	-63221.4421	4359.6171	1.605E-04	15034.5363	31.5579
108.240	8.91E-05	-41495.8496	4083.4733	7.254E-05	13959.0119	-143.8115
113.160	2.75E-04	-23182.8273	3241.3223	1.822E-05	13052.4266	-198.5263
118.080	2.68E-04	-9637.0945	2267.0377	-9.345E-06	12381.8458	-197.5243
123.000	1.83E-04	-856.7852	1342.0964	-1.816E-05	11947.1770	-178.4681
127.920	8.97E-05	3604.8700	539.9641	-1.585E-05	12083.2208	-147.6020
132.840	2.67E-05	4487.6548	-82.5698	-9.054E-06	12126.9230	-105.4606
137.760	6.54E-07	2810.2005	-401.0027	-2.924E-06	12043.8807	-23.9837
142.680	-2.12E-06	547.5432	-302.5452	-1.043E-07	11931.8680	64.0070
147.600	-3.72E-07	-166.6391	-60.1825	2.156E-07	11913.0114	34.5144
152.520	2.07E-10	-45.0768	16.9439	3.783E-08	11906.9934	-3.1622
157.440	4.46E-11	.014199	4.5815	-2.099E-11	11904.7626	-1.8631
162.360	-2.83E-18	.005398	-.001444	-4.534E-12	11904.7622	1.409E-04
167.280	-4.47E-18	7.404E-10	-5.486E-04	2.872E-19	11904.7619	2.230E-04
172.200	-1.51E-24	-5.412E-10	-7.516E-11	4.546E-19	11904.7619	7.527E-11
177.120	4.48E-25	-2.912E-16	5.500E-11	1.534E-25	11904.7619	-2.236E-11
182.040	0.000	5.426E-17	2.958E-17	0.0000	11904.7619	-1.651E-17
186.960	0.000	5.095E-23	-5.514E-18	0.0000	11904.7619	2.242E-18
191.880	0.000	-5.440E-24	-5.177E-24	0.0000	11904.7619	2.554E-24
196.800	0.000	0.0000	5.529E-25	0.0000	11904.7619	-2.247E-25
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	.70000000 in
Computed slope at pile head	=	-.03013599
Maximum bending moment	=	2584022.630 lbs-in
Maximum shear force	=	277261.052 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	38

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .800000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	0.0000	2.936E+05	-.033864	11904.7619	-15269.6852
4.920	.633387	1.293E+06	2.176E+05	-.032779	75904.2154	-15621.8545
9.840	.477459	2.205E+06	1.398E+05	-.029841	1.211E+05	-15974.0247
14.760	.339756	2.727E+06	63308.8838	-.025698	1.469E+05	-15133.5385
19.680	.224594	2.879E+06	-2157.6219	-.020989	1.544E+05	-11478.8622
24.600	.133223	2.748E+06	-48137.2457	-.016264	1.479E+05	-7212.0418
29.520	.064560	2.437E+06	-74652.2291	-.011909	1.326E+05	-3566.4068
34.440	.016038	2.036E+06	-85648.7225	-.008152	1.127E+05	-903.7125
39.360	-.015654	1.610E+06	-85659.2279	-.005089	91628.5443	899.4421
44.280	-.034038	1.204E+06	-78542.9844	-.002726	71485.9374	1993.3398
49.200	-.042474	8.429E+05	-67404.6736	-.001007	53633.5423	2534.4288
54.120	-.043944	5.423E+05	-54599.7872	1.566E-04	38749.2735	2670.8096
59.040	-.040933	3.054E+05	-41798.1296	8.685E-04	27021.1630	2533.1162
63.960	-.035399	1.293E+05	-30081.3661	.001233	18303.5928	2229.7958
68.880	-.028796	6923.1506	-20055.5223	.001348	12247.4921	1845.7505
73.800	-.022136	-70742.5516	-11964.3212	.001294	15406.8684	1443.3557
78.720	-.016060	-1.134E+05	-5793.8048	.001140	17516.2906	1064.9843
83.640	-.010922	-1.300E+05	-1362.5973	9.353E-04	18340.2279	736.3195
88.560	-.006857	-1.286E+05	1604.6979	7.181E-04	18271.1695	469.8980
93.480	-.003856	-1.156E+05	3421.1201	5.130E-04	17628.4922	268.4850
98.400	-.001810	-95947.1106	4396.5230	3.353E-04	16654.6189	128.0203
103.320	-5.57E-04	-73017.3707	4809.8441	1.934E-04	15519.4832	39.9965
108.240	9.29E-05	-48998.7719	4552.7559	9.088E-05	14330.4437	-144.5038
113.160	3.38E-04	-28397.1019	3682.3725	2.588E-05	13310.5590	-209.3105
118.080	3.48E-04	-12815.1498	2648.2340	-8.737E-06	12539.1753	-211.0710
123.000	2.52E-04	-2321.2839	1652.0678	-2.145E-05	12019.6770	-193.8746

127.920	1.36E-04	3483.4114	769.9509	-2.047E-05	12077.2080	-164.7095
132.840	5.01E-05	5295.3257	57.0715	-1.310E-05	12166.9067	-125.0789
137.760	7.54E-06	4070.7775	-421.9503	-5.235E-06	12106.2855	-69.6454
142.680	-1.39E-06	1153.6368	-411.7634	-8.468E-07	11961.8726	73.7864
147.600	-7.92E-07	20.6922	-126.4477	1.395E-07	11905.7863	42.1956
152.520	-2.04E-08	-90.8834	-2.3414	8.051E-08	11909.2611	8.2541
157.440	1.32E-10	-2.5059	9.2382	2.078E-09	11904.8860	-3.5470
162.360	2.14E-13	.015934	.2547	-1.343E-11	11904.7627	-.1048
167.280	-1.32E-17	2.588E-05	-.001619	-2.174E-14	11904.7619	6.561E-04
172.200	-2.14E-20	-1.587E-09	-2.630E-06	1.337E-18	11904.7619	1.069E-06
177.120	1.31E-24	-2.596E-12	1.613E-10	2.180E-21	11904.7619	-6.535E-11
182.040	0.000	1.581E-16	2.638E-13	-1.332E-25	11904.7619	-1.072E-13
186.960	0.000	2.603E-19	-1.607E-17	0.0000	11904.7619	6.509E-18
191.880	0.000	-1.574E-23	-2.645E-20	0.0000	11904.7619	1.075E-20
196.800	0.000	0.0000	1.600E-24	0.0000	11904.7619	-6.483E-25
201.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection	=	.80000000 in
Computed slope at pile head	=	-.03386435
Maximum bending moment	=	2878824.703 lbs-in
Maximum shear force	=	293552.540 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	9
Number of zero deflection points	=	38

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .900000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	0.0000	3.084E+05	-.037500	11904.7619	-15269.6852
4.920	.715501	1.370E+06	2.324E+05	-.036350	79706.8722	-15621.8543
9.840	.542320	2.359E+06	1.547E+05	-.033218	1.287E+05	-15974.0239
14.760	.388634	2.957E+06	75260.3857	-.028753	1.583E+05	-16326.1945
19.680	.259389	3.156E+06	3900.9415	-.023619	1.681E+05	-12681.7097

24.600	.156225	3.042E+06	-48100.9115	-.018413	1.625E+05	-8457.2550
29.520	.078205	2.719E+06	-79533.3882	-.013574	1.465E+05	-4320.1746
34.440	.022654	2.286E+06	-93301.2201	-.009371	1.251E+05	-1276.5050
39.360	-.014002	1.819E+06	-94462.3743	-.005922	1.020E+05	804.4911
44.280	-.035623	1.369E+06	-87351.3692	-.003245	79653.6937	2086.1614
49.200	-.045933	9.661E+05	-75476.9727	-.001284	59730.0607	2740.8290
54.120	-.048260	6.284E+05	-61519.1533	5.486E-05	43011.8140	2933.0814
59.040	-.045393	3.606E+05	-47393.3398	8.855E-04	29756.9701	2809.1192
63.960	-.039547	1.603E+05	-34354.8467	.001323	19838.8890	2491.0813
68.880	-.032375	19959.3353	-23121.7970	.001474	12892.8478	2075.1991
73.800	-.025039	-70150.5884	-14000.4040	.001432	15377.5633	1632.6842
78.720	-.018283	-1.206E+05	-7001.5667	.001272	17876.2052	1212.3716
83.640	-.012523	-1.415E+05	-1942.1333	.001052	18912.1477	844.3087
88.560	-.007934	-1.418E+05	1472.2625	8.138E-04	18924.7419	543.6571
93.480	-.004516	-1.287E+05	3583.2016	5.866E-04	18274.2487	314.4482
98.400	-.002161	-1.077E+05	4732.8588	3.881E-04	17236.4126	152.8921
103.320	-6.97E-04	-82856.0761	5232.1502	2.281E-04	16006.5479	50.0719
108.240	8.27E-05	-56663.7951	5005.6341	1.109E-04	14709.9003	-142.1517
113.160	3.94E-04	-33818.8360	4116.4913	3.488E-05	13578.9617	-219.2885
118.080	4.26E-04	-16226.1635	3026.3346	-7.152E-06	12708.0373	-223.8646
123.000	3.24E-04	-4025.6277	1962.4490	-2.416E-05	12104.0504	-208.6092
127.920	1.88E-04	3131.8835	1003.2795	-2.491E-05	12059.8056	-181.2970
132.840	7.86E-05	5895.6693	202.4299	-1.733E-05	12196.6267	-144.2516
137.760	1.77E-05	5157.8985	-389.8743	-8.046E-06	12160.1034	-96.5225
142.680	-6.12E-07	2075.1410	-491.9511	-1.971E-06	12007.4917	55.0278
147.600	-1.74E-06	320.9793	-227.1280	4.113E-08	11920.6520	52.6238
152.520	-2.07E-07	-159.8792	-35.1359	1.764E-07	11912.6767	25.4217
157.440	1.04E-10	-25.1049	16.2531	2.107E-08	11906.0047	-4.5319
162.360	9.31E-12	.010331	2.5514	-1.057E-11	11904.7624	-1.0379
167.280	-6.69E-18	.001127	-.001050	-9.463E-13	11904.7620	3.338E-04
172.200	-9.34E-19	-5.842E-10	-1.145E-04	6.804E-19	11904.7619	4.655E-05
177.120	2.97E-25	-1.130E-10	5.938E-11	9.487E-20	11904.7619	-1.481E-11
182.040	0.000	1.328E-17	1.148E-11	0.0000	11904.7619	-4.667E-12
186.960	0.000	1.133E-17	-1.352E-18	0.0000	11904.7619	-3.861E-19
191.880	0.000	3.208E-24	-1.151E-18	0.0000	11904.7619	4.679E-19
196.800	0.000	-1.135E-24	-3.258E-25	0.0000	11904.7619	2.263E-25
201.720	0.000	0.0000	1.154E-25	0.0000	11904.7619	0.0000
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	-.03749987
Maximum bending moment	=	3155941.144 lbs-in
Maximum shear force	=	308437.970 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	38

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = 1.000000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 200000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	0.0000	3.203E+05	-.040955	11904.7619	-15269.6852
4.920	.798503	1.431E+06	2.443E+05	-.039752	82771.0505	-15621.8541
9.840	.608837	2.482E+06	1.666E+05	-.036465	1.348E+05	-15974.0235
14.760	.439687	3.143E+06	87150.0108	-.031741	1.675E+05	-16326.1938
19.680	.296510	3.403E+06	12633.7488	-.026243	1.803E+05	-13964.9696
24.600	.181452	3.319E+06	-45884.3663	-.020599	1.762E+05	-9822.8821
29.520	.093820	2.992E+06	-82798.3951	-.015299	1.600E+05	-5182.8207
34.440	.030912	2.534E+06	-99833.1455	-.010658	1.374E+05	-1741.8746
39.360	-.011054	2.030E+06	-1.026E+05	-.006825	1.124E+05	635.0964
44.280	-.036241	1.538E+06	-95772.3558	-.003827	88058.5585	2122.4092
49.200	-.048716	1.095E+06	-83400.2718	-.001616	66127.0185	2906.8932
54.120	-.052139	7.208E+05	-68453.9465	-9.028E-05	47589.2922	3168.8488
59.040	-.049605	4.219E+05	-53107.0499	8.695E-04	32789.9314	3069.7271
63.960	-.043584	1.965E+05	-38801.9095	.001389	21634.6163	2745.3707
68.880	-.035938	37336.3740	-26381.5183	.001585	13753.0973	2303.5689
73.800	-.027984	-66170.9145	-16225.9263	.001561	15180.5498	1824.7206
78.720	-.020577	-1.254E+05	-8380.3799	.001400	18112.6290	1364.5259
83.640	-.014207	-1.514E+05	-2667.4544	.001168	19399.2860	957.8015
88.560	-.009087	-1.539E+05	1220.5996	9.113E-04	19525.7867	622.7082
93.480	-.005240	-1.412E+05	3650.0457	6.634E-04	18893.4768	364.8715
98.400	-.002559	-1.193E+05	4993.0111	4.446E-04	17812.3765	181.0494
103.320	-8.65E-04	-92915.7916	5591.2804	2.663E-04	16504.5536	62.1495
108.240	6.14E-05	-64839.7727	5426.1146	1.338E-04	15114.6516	-129.2901
113.160	4.52E-04	-39786.2294	4549.1752	4.597E-05	13874.3772	-227.1893
118.080	5.14E-04	-20166.3604	3412.4063	-4.381E-06	12903.0966	-234.9118
123.000	4.09E-04	-6199.5291	2289.5135	-2.653E-05	12211.6693	-221.5486
127.920	2.53E-04	2414.6549	1262.9595	-2.970E-05	12024.2993	-195.7498
132.840	1.17E-04	6286.4508	387.2584	-2.240E-05	12215.9723	-160.2263
137.760	3.24E-05	6269.3535	-289.0394	-1.185E-05	12215.1259	-114.6915
142.680	-1.59E-08	3465.6258	-556.8440	-3.675E-06	12076.3275	5.8278
147.600	-3.78E-06	797.2408	-375.3487	-9.467E-08	11944.2293	67.9507
152.520	-9.47E-07	-227.6195	-92.5931	3.837E-07	11916.0302	46.9906
157.440	-2.03E-12	-114.6310	23.1488	9.630E-08	11910.4367	.059009
162.360	1.00E-10	-.024480	11.6507	2.066E-13	11904.7631	-4.7330
167.280	4.03E-17	.012117	.002486	-1.018E-11	11904.7625	-.002012
172.200	-1.00E-17	7.312E-09	-.001231	-4.100E-18	11904.7619	5.006E-04
177.120	-8.07E-24	-1.215E-09	-7.429E-10	1.020E-18	11904.7619	4.023E-10
182.040	1.01E-24	-1.220E-15	1.235E-10	8.201E-25	11904.7619	-5.019E-11
186.960	0.000	1.218E-16	1.240E-16	-1.023E-25	11904.7619	-6.046E-17
191.880	0.000	1.711E-22	-1.238E-17	0.0000	11904.7619	5.032E-18
196.800	0.000	-1.221E-23	-1.739E-23	0.0000	11904.7619	8.078E-24

201.720	0.000	0.0000	1.241E-24	0.0000	11904.7619	-5.045E-25
206.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
211.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
216.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
221.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
226.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
231.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
236.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
241.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
246.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
250.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
255.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
260.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
265.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
270.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
275.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
280.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
285.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
290.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
295.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
300.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
305.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
309.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
314.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
319.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
324.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
329.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
334.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
339.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
344.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
349.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
354.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
359.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
364.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
369.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
373.920	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
378.840	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
383.760	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
388.680	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
393.600	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
398.520	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
403.440	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
408.360	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
413.280	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
418.200	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
423.120	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
428.040	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
432.960	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
437.880	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
442.800	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
447.720	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
452.640	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
457.560	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
462.480	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
467.400	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
472.320	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
477.240	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

482.160	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
487.080	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000
492.000	0.000	0.0000	0.0000	0.0000	11904.7619	0.0000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.04095461
Maximum bending moment	=	3402504.739 lbs-in
Maximum shear force	=	320327.591 lbs
Depth of maximum bending moment	=	19.680 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	10
Number of zero deflection points	=	38

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .100000	M= 0.000	2.000E+05	.100000	3.937E+05	55124.8231
4	y= .200000	M= 0.000	2.000E+05	.2000	7.875E+05	1.102E+05
4	y= .300000	M= 0.000	2.000E+05	.3000	1.178E+06	1.591E+05
4	y= .400000	M= 0.000	2.000E+05	.4000	1.557E+06	2.014E+05
4	y= .500000	M= 0.000	2.000E+05	.5000	1.925E+06	2.345E+05
4	y= .600000	M= 0.000	2.000E+05	.6000	2.263E+06	2.578E+05
4	y= .700000	M= 0.000	2.000E+05	.7000	2.584E+06	2.773E+05
4	y= .800000	M= 0.000	2.000E+05	.8000	2.879E+06	2.936E+05
4	y= .900000	M= 0.000	2.000E+05	.9000	3.156E+06	3.084E+05
4	y= 1.000	M= 0.000	2.000E+05	1.0000	3.403E+06	3.203E+05

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = .10000 in
Moment = 0. in-lbs
Axial Load = 200000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
492.000	.10000000	393741.917	55124.823
467.400	.10000000	396755.097	55064.022
442.800	.10000000	398321.721	55006.421
418.200	.10000000	398303.883	54951.998
393.600	.10000000	396557.458	54900.751
369.000	.10000000	398062.958	54852.663
344.400	.10000000	399184.028	54807.726
319.800	.10000000	397722.852	54765.931
295.200	.10000000	399415.051	54727.267
270.600	.10000000	398550.212	54691.733

The analysis ended normally.

FOR CONTRACT NO. 297614

MATERIALS INFORMATION

FOUNDATION REPORT
RETAINING WALLS 246, 391, 400N, 400S, AND 403

DATED 10/19/2010

ROUTE: 04-Ala-84-25.5/27.1 **11/17/2011**

04-ALA-84, PM 22.9/27.1

OCTOBER 19, 2010

FOUNDATION REPORT

RETAINING WALLS 246, 391, 400N, 400S AND 403
ROUTE 84 EXPRESSWAY WIDENING
LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Improvement Authority
1333 Broadway, Suite 300
Oakland, CA 94612

URS

100 West San Fernando Street, Suite 200
San Jose, California 95113

URS

October 19, 2010
Project 28649640

File No.04-ALA-84-PM 22.9/27.1
EA297600

Ms. Stefan Garcia
Project Coordinator
Alameda County Transportation Improvement Authority (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

Subject: **Foundation Report**
Retaining Walls 246, 391, 400N, 400S and 403
Route 84 Expressway Widening
Pleasanton and Livermore, California

Dear Ms. Garcia:

URS has completed the accompanying Foundation Report for Retaining Walls 246, 391, 400N, 400S and 403 in Pleasanton and Livermore, California. The report was prepared in accordance with Caltrans Guidelines for Foundation Investigation Reports, Version 2.0, dated March 2006. We also prepared a Geotechnical Design and Materials Report dated August 6, 2010 for the SR84 widening and upgrade.

The Foundation Report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed retaining walls. The opinions and recommendations have been based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Mr. Selvendran Manoharan, Staff Geotechnical Engineer, performed the engineering analysis and assisted with the preparation of this report. Mr. Mark Schmoll, C.E.G, prepared the earthquake analysis, geology and geologic hazards portions of this report. Mr. Michael Larson, G.E., provided review, consultation and guidelines for the project.

Our responses to comments received from Caltrans are incorporated into this report.

If any questions should arise, or if we can be of further service, please contact the undersigned at (408) 297-9585.

Sincerely,

Stephen Huang, G.E. 2150
Geotechnical Task Leader

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The project proposes to widen and upgrade State Route (SR) 84 to expressway standards (55 mph) from Ruby Hill Drive to Jack London Boulevard for the purpose of reducing congestion along SR 84 and improving local traffic circulation; reducing impacts of regional traffic diverting to local streets; and improving safety and operations on SR 84.

SR 84 will be widened from two to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment, with some alternative potential changes in roadway curvature at the southern limit in the section between Ruby Hill Drive and Vallecitos Road. To accommodate the proposed improvements and widening, five non-standard (special) retaining walls are proposed at the following locations:

- Ruby Hill Drive to Vallecitos Road Improvements - a retaining wall (RW246) would be required on the west side of SR 84 to retain cut adjacent to the Ruby Hill development.
- Stanley Boulevard Interchange Improvements - roadway widening section excavations are expected to be a maximum of 15 feet deep. Retaining walls (RW391, RW400N, RW400S and RW403) will be required at both abutments of the undercrossing.

This foundation report (FR) presents feasible foundation systems for the proposed retaining walls for the project.

1.1 PURPOSE AND SCOPE OF THIS STUDY

The purpose of this FR is to document existing foundation conditions and make foundation recommendations. The scope of work for this study includes:

- Review of as-built bridge drawings, logs of test borings (LOTBs), geologic maps, and other existing information
- Preparation of this FR, which includes:
  - Development of seismic design criteria;
  - Description of site geology and evaluation of geologic hazards;
  - Assessment of subsurface conditions based on existing information and new field exploration;
  - Foundation recommendations; and
  - Construction considerations.

1.2 CALTRANS' REVIEW COMMENTS

We reviewed comments prepared by Caltrans for the retaining walls for the Preliminary Foundation Report dated April 15, 2008, and for the Foundation Report (65% submittal) dated May 15, 2009. Our responses to these comments are incorporated into this report. Our responses to these comments are incorporated into this report. We also reviewed comments prepared by Caltrans (dated April 27, 2010) for the 95% PS&E submittal dated March 16, 2010. The Log of Test Boring sheets (Appendix B) are revised to show the new boring identification numbers consistent with Caltrans Logging, Classification, and Presentation Manual, dated June

2007. The following table shows the new boring identification numbers that correspond to the boring numbers referenced in this report.

Boring Number (Old)	Boring Number (New)*
NB03	R-07-003
NB04	A-07-004
NB05	R-07-005
NB05A	A-08-005
NB06	R-07-006
NB19	A-07-019
NB20	A-07-020
NB21	A-07-021
NB22	A-07-022
NB22A	A-07-023
NB23	R-08-023
RB32	A-07-132
RB33	A-07-133

* As described in Caltrans Logging, Classification, and Presentation Manual, dated June 2007

Copies of the review comments and our responses are presented in Appendix A.

2.1 GENERAL

A total of five non-standard retaining wall locations are planned, as described below and shown on Figure 2-1. The preliminary 65 percent drawings of profile, elevation, and typical section of the planned retaining walls are shown in Figures 2-2 through 2-13.

2.2 RETAINING WALL 246

RW246 is located at the west side of SR 84 between Ruby Hill Drive and Vallecitos Road and is required as a result of roadway widening between "A1" Stations 246+00 and 258+26. Due to the close proximity of this 1,100 foot long wall to East Ruby Hill Drive, the use of a conventional cantilever wall is not feasible. The proposed retaining wall (Figures 2-2, 2-3 and 2-4) will consist of a soil nail wall utilizing top-down construction techniques. The wall will be constructed with an initial shotcrete facing and a final cast-in-place reinforced concrete facing with architectural treatment. Maximum wall height is about 34 feet (top of wall minus bottom of wall, i.e. TOW-BOW).

2.3 RETAINING WALL 391

RW391 will be located at the west side of SR 84 immediately south of Stanley Boulevard as a result of widening of SR 84 between "A2" Station 391+16 and "A3" Station 400+14. Total length is approximately 901 feet and maximum wall height is about 19 feet (TOW-BOW). This wall (Figures 2-5 and 2-6) will also be a soil nail wall utilizing top-down construction techniques. It will be constructed with an initial shotcrete facing and a final cast-in-place reinforced concrete facing with architectural treatment.

2.4 RETAINING WALL 400N

RW400N at Stanley Boulevard (northbound elevation) will be located along northbound (east side) SR 84 between "A3" Stations 399+55 to 411+80 for a total length of 1,225 feet (Figures 2-7, 2-8, 2-9 and 2-10). Maximum wall height (TOW-BOW) is about 17 feet. One segment of RW400N (Wall Type A) will be retained with tiebacks; whereas another segment (Wall Type B) will be supported on 24-inch CIDH piles. A third segment will be a Caltrans Type 7 retaining wall (Figures 2-9 and 2-10).

A fourth segment will be located between "A3" Stations 403+26 and 411+80. Total length is approximately 852 feet and maximum wall height is about 17 feet. This fourth segment wall will be a soil nail wall utilizing top-down construction techniques. It will be constructed with an initial shotcrete facing and a final cast-in-place reinforced concrete facing with architectural treatment.

2.5 RETAINING WALL 400S

RW400S (Figure 2-11) at Stanley Boulevard (southbound elevation) is planned along southbound (west side) SR 84 between "A3" Stations 400+14 to 402+58 for a total length of 243 feet. Maximum wall height is about 20 feet. All of RW400S will be retained with tiebacks.

2.6 RETAINING WALL 403

RW403 will be located at the west side of SR 84 immediately north of the existing Union Pacific Railroad Underpass (UPRR) as a result of widening of SR 84 between "A3" Stations 402+99 and 411+80 (Figures 2-12 and 2-13). Total length is approximately 881 feet and maximum wall height (TOW-BOW) is about 23 feet. This wall will also be a soil nail wall utilizing top-down construction techniques. It will be constructed with an initial shotcrete facing and a final cast-in-place reinforced concrete facing with architectural treatment.

Pertinent project information provided by Caltrans includes the following as-built plans:

- Isabel Avenue Pumping Plant, 1999, General Plan
- Isabel Avenue Undercrossing, 1999, 18 sheets, including one Log of Test Boring (LOTB) (Borings B-9 and B-10)
- Isabel Avenue Underpass, 1999, 13 sheets, including one LOTB (Borings B-11, B-12 and B-13)

4.1 SITE CONDITIONS

RW246 will support a cut slope on the northwest side of southbound SR 84. Based on topographic information provided, the existing ground surface at the top of most of the wall ranges from approximately Elevation 540 to 555. East Ruby Hill Drive roughly parallels RW246 and is located to the northwest of the wall; it is located as close as 20 feet. A residential area is located on the northwest side of East Ruby Hill Drive.

4.2 SUBSURFACE CONDITIONS

4.2.1 Field Exploration

The locations of borings along the proposed alignment of RW246 are presented in Figures 4-1a and 4-1b. Borings NB03, NB05 and NB06 were drilled in December 2007 using a rotary wash drill rig, whereas NB04 was drilled in November 2007 with a hollow-stem auger. Boring NB05A was drilled in March 2008 using a solid-stem auger mounted on a steep hillside portable rig. These borings extended to depths ranging from 25 to 80 feet. During drilling, visual classifications of the soils encountered were made from cuttings and soil samples. The subsurface conditions encountered are presented in the LOTBs in Appendix B.

Consistent with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June, 2007), the Unified Soil Classification System, as well as guidelines summarizing soil consistency and relative density, were used in preparation of the Logs of Test Borings (LOTBs) for RW246, and in later sections in this report for RW391, RW400N, RW400S and RW403. The Caltrans Soil Legend is presented in Appendix B.

A representative of URS supervised the drilling operations and soil sampling. The soil samples collected were labeled and sealed immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. Descriptions of individual laboratory tests and their results are presented in Appendix C, "Laboratory Tests," and on the LOTBs.

4.2.2 Soil Conditions

4.2.2.1 Fill

A structural pavement section was encountered in Boring NB05 in the shoulder consisting of 9 inches of asphalt concrete overlying 9 inches of aggregate base.

Fill was encountered in Borings NB03, NB04 and NB05 to depths of 3 to 3½ feet bgs. It consisted of gravelly silt, sandy silt, silty sand and chunks of asphalt concrete. Fill was not encountered in NB05A and NB06.

4.2.2.2 Native Soils

The native soils encountered below fill in Borings NB03, NB04 and NB05, and beginning at ground surface in Boring NB05A consist of stiff to hard lean clay to a depth of about 5 to 6 feet.

Underlying these lean clays are numerous alternating non homogeneous granular and cohesive layers to the terminal depths of borings. The granular deposits include mostly dense to very dense clayey sand with gravel, poorly graded sand, silty sand with gravel and clayey gravel. Cohesive layers consist of very stiff to hard silt, sandy silt, lean clay and sandy lean clay.

Granular soils were encountered in Boring NB06, except for hard lean clay between depths of 39 to 60½ feet bgs. The granular deposits are very dense clayey sand with gravel, poorly graded gravel and clayey gravel.

Cobbles were encountered in Borings NB03 (depth of 7 feet) and NB06 (depth of 31 feet).

4.2.3 Groundwater

Free groundwater was not encountered in Borings NB04 and NB05A to the maximum depth explored of 25 and 35 feet, respectively. Since the rotary wash drilling method was used in the other 3 borings, groundwater was not measured in these locations. Seasonal fluctuations in the groundwater level should be anticipated throughout the year with fluctuations in precipitation, evaporation, and surface runoff.

5.1 SITE CONDITIONS

RW391 will support a cut slope for widening of the west side of southbound SR 84. Based on topographic information provided, the existing ground surface at the top of most of the wall ranges from approximately Elevation 415 to 420. The area west of the wall is undeveloped. The north end of this wall terminates at the existing abutment of Isabel Avenue undercrossing (Stanley Boulevard).

5.2 SUBSURFACE CONDITIONS

5.2.1 Field Exploration

The locations of borings along the proposed alignment of RW391 are presented in Figure 5-1. Previous 1996 Boring B-10 was drilled using a truck mounted rotary wash drill rig to a depth of 80 feet. More recent December, 2007 Borings NB19 and NB20 were drilled by the hollow stem auger; these borings extended to depths ranging from 30 to 40 feet. During 2007 drilling, visual classifications of the soils encountered were made form cuttings and soil samples. The subsurface conditions encountered are presented in the Log of Test Boring Sheets in Appendix B.

A representative of URS supervised the drilling operations and soil sampling. The soil samples collected were labeled and sealed immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. Descriptions of individual laboratory tests and their results are presented in Appendix C, "Laboratory Tests," and on the LOTBs.

5.2.2 Soil Conditions

5.2.2.1 Fill

A structural pavement section was encountered in Boring B-10 in 1996 consisting of 6 inches of asphalt concrete overlying 17½ inches of aggregate base. Since then, an excavation was made for Stanley Boulevard, resulting in removal of the pavement section.

5.2.2.2 Native Soils

The native soils encountered below fill in Boring B-10, and beginning at ground surface in Borings NB19 and NB20 consist of medium stiff to hard lean clay and silty clay (with trace gravel) to a depth of about 13 to 31 feet. Underlying these lean clays are numerous alternating non homogeneous granular and cohesive layers to the terminal depths of borings. The granular deposits include mostly dense to very dense clayey sand with gravel, silty sand with gravel, clayey gravel and silty gravel. Cohesive layers consist of stiff to hard silt, lean clay and silty lean clay.

5.2.3 Groundwater

Free groundwater was not encountered in Borings NB19 and NB20 for RW391 to the terminal depths explored of 30 and 40 feet, respectively. Since the rotary wash drilling method was used in Boring B-10, groundwater was not measured in this location. Seasonal fluctuations in the groundwater level should be anticipated throughout the year with fluctuations in precipitation, evaporation, and surface runoff.

6.1 SITE CONDITIONS

RW400N will support a cut slope on the east side of northbound SR 84. Based on topographic information provided, the ground at most of the top of the new wall ranges from approximately Elevation 403 to 418. There are several existing structures in close proximity to this proposed wall including;

- Isabel Avenue Undercrossing near south end of RW400N; the UC abutment just east of RW400N is supported on steel piles.
- Pump station about 40 feet wide located near Station 402+00 on east side of roadway.
- An 8-foot diameter reinforced concrete pipe (RCP) buried below the existing sloped ground, however the RCP is planned to be below the proposed roadway shoulder; the centerline of the RCP is offset 3 feet 10 inches west of planned face of RW400N.
- Isabel Avenue Underpass (railroad) located in vicinity of Station 403+00.

The Arroyo Mocho waterway is located north of Stanley Boulevard and parallel to SR 84. A residential area is located just east of this water channel.

6.2 SUBSURFACE CONDITIONS

6.2.1 Field Exploration

The locations of borings along the proposed alignment of RW 400N are presented in Figures 5-1, 6-1a, and 6-1b. Previous 1996 Borings B-9, B-12, B-13 and B-18 were drilled using a truck mounted rotary wash drill rig to depths of 80 to 100 feet. More recent December, 2007 Borings NB22A and NB23 were drilled by the hollow stem auger and rotary wash methods, respectively; these borings extended to depths ranging from 30 to 101½ feet. During 2007 drilling, visual classifications of the soils encountered were made from cuttings and soil samples. The subsurface conditions encountered are presented in the Log of Test Boring Sheets in Appendix B.

A representative of URS supervised the drilling operations and soil sampling. The soil samples collected were labeled and sealed immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. Descriptions of individual laboratory tests and their results are presented in Appendix C, "Laboratory Tests," and on the LOTBs.

6.2.2 Soil Conditions

6.2.2.1 Fill

A structural pavement section was encountered in Borings B-9 (7 inches of asphalt concrete over 19½ inches of aggregate base), NB22 (5 inches of asphalt concrete over 7 inches of aggregate base), NB22A (3 inches of asphalt concrete), RB32 (8 inches of asphalt concrete over 6 inches of aggregate base), and RB33 (6½ inches asphalt concrete over 11½ inches of aggregate base).

Boring B-9 was drilled in 1996; since then, an excavation was made for Stanley Boulevard, resulting in removal of the pavement section.

6.2.2.2 Native Soil

The native soils encountered below fill in Borings B-9, NB22 and NB22A and beginning at ground surface in Borings B-12, B-13 and B-18 are primarily stiff to very stiff lean clays, silty clay or sandy silt to depths of 5 to 23 feet bgs. An exception to this is mostly dense to very dense silty sand in Borings RB32 and RB33 to a depth of 10 feet. Below the surficial clay deposits are predominately granular layers with fine-grained interbeds which extend to terminal boring depths. The granular layers range from generally dense to very dense clayey sand with gravel, silty sand, clayey gravel with sand to silty gravel with sand. The fine-grained interbeds are mostly stiff to hard lean clay, silt or clayey silt. Cobbles were encountered in Borings B-12 (depths of 16, 39 and 66 feet) and B-18 (depth of 95 feet).

6.2.3 Groundwater

Free groundwater was not encountered during drilling in Borings B-9, B-12, B-13 and B-18 since the rotary wash method was used. However, groundwater was encountered at a depth of 24.7 feet bgs (hollow stem auger in Boring NB22A) and 42 feet bgs (piezometer in B-9). Groundwater was not encountered in Borings RB32 and RB33 to the terminal depth of 10 feet. Seasonal fluctuations in the groundwater level should be anticipated throughout the year with fluctuations in precipitation, evaporation and surface runoff, as well as fluctuations in the water level of nearby Arroyo Mocho.

7.1 SITE CONDITIONS

RW400S will support a cut slope on west side of southbound SR 84. Based on topographic information provided, the ground at the top of the wall is about Elevation 410. There are two existing structures in close proximity to this proposed wall, including:

- Isabel Avenue Undercrossing (UC) near southbound end of RW400S in the vicinity of Station 401+00. West abutment of the UC is supported on steel piles and parallels RW400S; distance between new wall and abutment face is less than 15 feet.
- Isabel Avenue (railroad) Underpass is located just beyond north end of RW400S.

7.2 SUBSURFACE CONDITIONS

7.2.1 Field Exploration

The locations of borings along the proposed alignment of RW400S are presented in Figures 5-1 and 6-1a. Previous 1996 Borings B-10, B-11 and B-13 were drilled using a truck mounted rotary wash drill rig to depths ranging from 80 to 100 feet. The subsurface conditions encountered are presented in the Log of Test Borings Sheet in Appendix B.

7.2.2 Soil Conditions

7.2.2.1 Fill

A structural pavement section was encountered in Boring B-10 in 1996 consisting of 6 inches of asphalt concrete overlying 17¾ inches of aggregate base. Since then, an excavation was made for Stanley Boulevard, resulting in removal of the pavement section.

7.2.2.2 Native Fill

The native soils encountered below fill in B-10 and beginning at ground surface in Borings B-11 and B-13 generally consist of very stiff silty clay and stiff sandy lean clay to depths of 10 to 13 feet. Below the surficial clay layers are predominately granular layers with fine-grained interbeds which extend to terminal boring depths. The granular layers vary from silty sand, clayey sand, well graded gravel, clayey gravel to poorly graded gravel; relative density ranges from medium dense to very dense. Fine-grained interbeds consist of stiff to hard silty clay, lean clay, clayey silt and sandy silt. Cobbles were encountered in Boring B-11 at depths of 49 and 57 feet bgs.

7.2.3 Groundwater

Free groundwater was not encountered during drilling in Borings B-10, B-11 and B-13 since the rotary wash method was used. Seasonal fluctuations in the groundwater level should be anticipated throughout the year with fluctuations in precipitation, evaporation, and surface runoff, as well as fluctuations in the water level of nearby Arroyo Mocho.

8.1 SITE CONDITIONS

RW403 will support a cut slope for widening of the west side of southbound SR 84. Based on topographic information provided, the existing ground surface at the top of the wall ranges from approximately Elevation 410 to 422. The adjacent area to the west is undeveloped.

8.2 SUBSURFACE CONDITIONS

8.2.1 Field Exploration

The locations of borings along the proposed alignment of RW403 are presented in Figures 5-1, 6-1a and 6-1b. Previous 1996 Borings B-11 and B-13 were drilled using a truck mounted rotary wash drill rig to depths of 80 to 100 feet. More recent November and December, 2007 Borings including NB21, NB23 and RB32 were drilled to depths ranging from 10 to 101½ feet. Borings NB21 and RB32 were drilled by the hollow stem auger method, whereas NB23 was advanced by the rotary wash method. During 2007 drilling, visual classifications of the soils encountered were made from cuttings and soil samples. The subsurface conditions encountered are presented in the Log of Test Boring Sheets in Appendix B.

A representative of URS supervised the drilling operations and soil sampling. The soil samples collected were labeled and sealed immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. Descriptions of individual laboratory tests and their results are presented in Appendix C, "Laboratory Tests," and on the LOTB.

8.2.2 Soil Conditions

8.2.2.1 Fill

A structural pavement section was encountered in Boring RB32 in the shoulder consisting of 8 inches of asphalt concrete overlying 6 inches of aggregate base.

Fill was encountered in Boring NB23 to a depth of 6 inches consisting of aggregate base.

8.2.2.2 Native Soils

The native soils encountered below fill in Borings NB23 and RB32, and beginning at ground surface in Borings NB21, B-11 and B-13 consist of numerous alternating non homogeneous granular and cohesive layers to the terminal depths of borings. The granular deposits include mostly dense to very dense clayey sand with gravel, silty sand with gravel, poorly graded sand with silt and gravel, clayey gravel, silty gravel with sand, and poorly graded gravel. Cohesive layers consist of stiff to hard silt, sandy silt, lean clay and sandy lean clay.

Cobbles were encountered in Borings B-11 (depths of 50 and 60 feet) and NB23 (depth of 3 feet).

8.2.3 Groundwater

Free groundwater was not encountered in Borings RB32 and NB21 drilled to the maximum depth explored of 10 and 40 feet, respectively. Since the rotary wash drilling method was used in the other 3 borings, groundwater was not measured in these locations. In Boring NB23, it was dry to a depth of 8 feet when rotary wash was introduced. Seasonal fluctuations in the groundwater level should be anticipated throughout the year with fluctuations in precipitation, evaporation, and surface runoff.

9.1 REGIONAL GEOLOGY

The SR 84 alignment lies within the Livermore Valley within the central portion of the Coast Ranges geomorphic province of California. Northwest-southeast-trending valleys and ridges characterize the regional morphology of the Coast Ranges province. These topographic features are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent predominantly strike-slip faulting along the San Andreas fault system between the Pacific and North American plates. Regional geologic mapping shows the project alignment to be underlain by Holocene alluvium and channel sand and gravel deposits along the active channel of Arroyo Del Valle (Dibblee, 1980; Gramer et al., 1996). More recent mapping by Witter and others (2006) subdivide the alluvium into latest Holocene alluvial fan deposits extending from about Jack London Boulevard south to Stanley Boulevard, Holocene alluvial fan deposits extending from about Stanley Boulevard to just north of Concannon Boulevard and historic stream channel deposits within the active channels of Arroyo Mocho and Arroyo Del Valle. The geologic map (Figure 9-1) shows the aerial extent of these various geologic units. Witter (2006) also maps a small area of stream terrace deposits and Pleistocene alluvial fan deposits, mostly east of SR 84 and north of Arroyo Del Valle in the vicinity of Concannon Boulevard. South of Arroyo Del Valle the road alignment crosses through Holocene alluvian deposits and alluvial fan deposits as it enters the mouth of a canyon at the south end of the alignment. The surrounding low hills south of the intersection of Vallecitos Road are mapped as older alluvium deposits and the Pleistocene Livermore Gravels Formation. The project alignment does not cross into these older formations.

In this portion of southeastern Alameda County, the underlying “bedrock” is the nonmarine sedimentary Livermore Gravels Formation (Graymer, et al.1996; Dibblee, 1980). The Livermore Gravels Formation is up to about 4,000 feet thick and lies as much as 400 feet in depth below the alluvium in the central Livermore Valley (Hall, 1958). It contains poorly to moderately consolidated cobble conglomerate, conglomeratic sandstone, and coarse-grained sandstone with some siltstone and claystone (Graymer et al., 1996). The Livermore Gravels may have been encountered at depth in some of the deeper borings completed near the southern portion of the project alignment, however it is difficult to distinguish between the gravelly alluvium soils and the older Livermore Gravels Formation in the borings.

10.1 SEISMIC DESIGN METHODOLOGY

The seismic design methodology adopted for this project is based on the following current Caltrans standards:

1) Seismic Design Criteria (SDC), v 1.4, June 2006
2) Guidelines for Foundation Investigations and Reports, v 2.0, dated March 2006
3) California Seismic Hazard Map (Mualchin, 1996)

10.2 PEAK BEDROCK ACCELERATION

The active faults close to the SR 84 alignment between Ruby Hill Drive and Jack London Boulevard are the Greenville, Calaveras, and Verona Williams faults (Figure 10-1). The Greenville fault, Calaveras fault, and Verona Williams fault are designated with Maximum Credible Earthquake (MCE) magnitudes of 7.25, 7.5 and 6.0, respectively, by the California Seismic Hazard Map (Mualchin, 1996). The locations of these faults and associated peak bedrock acceleration (PBA) contours were obtained from the California Seismic Hazard Map and transferred to a topographical map showing the SR 84 structure. Three faults contribute the same level of ground shaking at the site (0.5g) even though the Verona Williams fault is closest to the site. The MCE, nevertheless, is the earthquake on the Calaveras fault since it potentially releases the highest energy (M=7.5). The SR 84 alignment is roughly parallel to the Calaveras fault, and the distance from the site to the Calaveras fault is approximately 7.3 km.

Table 10-1
Seismic Source Parameters

Fault	Type	MCE	Distance (km)	Near Field Effects?	Design PBA (g)
Greenville	strike-slip	7.25	8.3	Y	0.5
Calaveras	strike-slip	7.5	7.3	Y	0.5
Verona Williams	Unknown	6	2.8	Y	0.5

10.3 SITE SOIL PROFILE

As-built LOTBs for SR 84 between Ruby Hill Drive and Jack London Boulevard indicate a soil profile consisting of dense to very dense and stiff to hard alluvial deposits that extend to a depth of at least 100 feet, with the weighted average of the recorded SPT blow counts over the depth of exploration ranging between 30 and 80 or more (uncorrected). Exploratory borings drilled for the proposed retaining walls reveal similar conditions. Although the maximum depth of exploration did not extend much beyond 100 feet, the regional geology suggests the soils become stiffer and denser with increasing depth.

The standard penetration resistance was used to classify the soil profile based on the guidelines given in SDC Table B.1. No potentially liquefiable soils along the retaining wall sites were identified based on the current information. Accordingly, the project site is divided into two segments. The segment south of East Vineyard Avenue is classified as Soil Profile Type C and the segment north of East Vineyard Avenue, which includes the Arroyo Del Valle Trail Bridge, is classified as Soil Profile Type D. Therefore, RW246 is classified as Soil Type C, whereas RW391, RW400N, RW400S and RW403 are classified as Soil Profile D.

10.4 FAULT TYPE AND NEAR FIELD SPECTRAL ACCELERATION INCREASES

The technical report that accompanies the California Seismic Hazard Map (Mualchin, 1996) indicates that the controlling fault (San Andreas) has strike-slip displacement. Therefore, in accordance with Caltrans design procedures referenced above, an increase in design spectral accelerations is not required for fault type. However, since the project site is less than 15 km from the nearest active fault, design spectral accelerations should be modified to account for near-fault effects as follows:

Table 10-2
Near – Fault Effects

Period (sec)	Increase in Spectral Acceleration (%)
< 0.5	0
0.5 – 1.0	0 – 20 (determined by linear interpolation)
≥1	20

At the time of this study, no retaining wall structures with fundamental period of vibration greater than 1.5 seconds are anticipated, and therefore no adjustments are required for long period effects.

10.5 DESIGN ACCELERATION RESPONSE SPECTRUM

Based on Caltrans SDC (Version 1.4), the design seismic response spectra for the two segments of the project alignment can be estimated with spectral acceleration values generated by:

- Soil Profile Type C (RW246, South of East Vineyard Avenue); Soil Profile Type D (RW391, RW400N, RW400S and RW403, North of East Vineyard Avenue)
- Maximum Credible Earthquake (MCE) Magnitude 7.25 ± 0.25
- Peak bedrock acceleration 0.5 g
- No ARS increase for fault-type or long period structure
- ARS increase for near-field effect

The Design Acceleration Response Spectra (ARS) corresponding to Soil Profile Types C and D, magnitude of controlling event 7.25 $\pm$ 0.25, and a PBA of 0.5 g were obtained from SDC Figure B.8 and modified to account for near field effects as described above. Spectral values are provided in Table 10-3.

Table 10-3
Spectral Acceleration Values
(PBA = 0.5 g, M = 7.5, Soil Type D and Type C)

Period	Soil Type D		Soil Type C	
	Sa (g)	Sa* (g)	Sa (g)	Sa* (g)
0.010	0.50	0.50	0.50	0.50
0.020	0.50	0.50	0.50	0.50
0.030	0.50	0.50	0.50	0.50
0.050	0.50	0.50	0.50	0.50
0.075	0.72	0.72	0.72	0.72
0.100	0.92	0.92	0.92	0.92
0.120	1.04	1.04	1.04	1.04
0.150	1.16	1.16	1.16	1.16
0.170	1.21	1.21	1.21	1.21
0.200	1.26	1.26	1.26	1.26
0.240	1.27	1.27	1.26	1.26
0.300	1.25	1.25	1.24	1.24
0.400	1.19	1.19	1.17	1.17
0.500	1.12	1.12	1.07	1.07
0.750	0.94	1.04	0.85	0.93
1.000	0.77	0.93	0.67	0.81
1.500	0.48	0.58	0.42	0.50
2.000	0.32	0.39	0.28	0.33
3.000	0.17	0.20	0.15	0.18
4.000	0.11	0.13	0.10	0.12

*Modified for near-field effects

11.1 REGIONAL TECTONIC SETTING AND SEISMICITY

The project alignment lies between known active and potentially active geologic faults. In general, earthquakes occur as a result of movement along active faults. For the purpose of activity classification, faults are generally grouped into the following categories by the California Division of Mines and Geology (renamed the California Geological Survey, CGS) (Jennings, 1994):

- Holocene: displacement has occurred within the last 10,000 to 11,000 years.
- Late Quaternary: displacement has occurred within the last 700,000 years, but evidence of Holocene activity is lacking.
- Quaternary: evidence of displacement within the last 1.6 million years, but evidence of Holocene activity is lacking.
- Pre-quaternary: no recognized evidence of displacement in the last 1.6 million years.

Generally, faults with Holocene movement are considered to be "active" while faults with late Quaternary to Quaternary movement are considered to be "potentially active".

The closest active faults to the project alignment are the Greenville, Calaveras, and Verona Williams faults (Mualchin, 1996). The California Geological Survey (2000) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. All three of these faults are included as Alquist-Priolo (A-P) zoned faults. The Greenville fault is located about 5.2 miles (8.3 km) east of the project site. The Calaveras fault is located about 4.5 miles (7.3 km) west of the site and the Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. More distant active faults include the Hayward fault located 10.5 miles (16.9 km) southwest of the southern end of the project alignment, and the San Andreas fault located 29 miles (46.7 km) southwest of the southern end of the project alignment. Figure 10-1 shows active faults within the site region relative to the project. The project alignment does not cross any mapped A-P zoned faults.

Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1 mile (1.6 km) southeast of the southern end of the project alignment, and the Livermore fault, located about 1,000 feet northeast of the intersection of SR 84 and Jack London Boulevard. The geologic map (Figure 9-1) shows the location of the Livermore fault as mapped by Dibblee (1980) and Alamdea County Seismic Safety Element (1982). The California Geological Survey (2000) includes a portion of the Las Positas fault as an A-P zoned fault south of the Lawrence Livermore complex, but does not extend the A-P zone as far west as Dibblee (1980) and Wagner et al. (1990) map the fault. Both Dibblee and Wagner also map the Livermore fault as a concealed fault trending northwesterly. The Alameda County Seismic Safety Element (1982) also shows this fault on hazard maps, indicating its location is based on a groundwater barrier. They classify the fault as "potentially uncertain" meaning the activity of the fault has insufficient evidence to give it an activity classification. Wagner et al. (1990) maps the Livermore fault as an early Quaternary fault (2,000,000 to 700,000 years old). The project alignment does not cross either the Los Positas fault or the Livermore fault.

The following is a brief description of the nearby active faults.

11.1.1 Calaveras Fault

The Calaveras fault is dextral strike-slip fault that is part of the larger San Andreas fault system and is located along the eastern side of the East Bay Hills. The fault is located about 4.5 miles (7.3 km) west of the project alignment and is predominantly a vertical fault with a slip rate of 12 to 18 mm/year (WGCEP, 2003). Active seismicity, including a moderate magnitude earthquake in 1856, has been recorded along the Calaveras fault resulting in surface ruptures and large earthquakes (Kelson and others, 1996; Simpson and others, 1999). In addition to seismic events, fault creep continues to be present along the Calaveras fault as indicated by a seismic surficial fault rupture in numerous localities.

11.1.2 Greenville Fault

The Greenville fault lies 5.2 miles (8.3 km) east of the project alignment. Recent investigations of the Greenville fault and Mount Diablo thrust indicate that these two structures are geometrically linked, with the Mount Diablo thrust acting to transfer strain from the Greenville fault to the Concord-Green Valley fault (Unruh and Sawyer, 1997). This suggests that the Greenville fault does not continue to the north as previously mapped, but dies out near Morgan Territory Road. Two earthquakes during January 1980 on this fault measured Richter magnitudes of 5.9 and 5.8.

Available data on the late Quaternary slip rate of the Greenville fault are sparse and have significant uncertainties. The Working Group on California Earthquake Probabilities estimates the slip rate on the Greenville fault to be about 2 mm/yr (WGCEP, 2003). Based on correlation of terraces south of Livermore Valley offset by the Greenville fault, Wright et al. (1982) documented approximately 90 m of Pleistocene displacement. The deformed terraces were estimated to be 125,000 to 180,000 years old, based on soil profile development, thus implying a slip rate of 0.5 to 0.7 mm/yr (Wright et al., 1982). Paleoseismic trench investigations across one of the strands of the northern Greenville fault documented evidence for Holocene surface-rupturing events. Wright et al. (1982) estimated a horizontal slip rate of approximately 0.1 to 0.3 mm/yr with a recurrence interval estimated to be on the order of 550 years. Recent investigations by Unruh and Sawyer (1998) and Sawyer and Unruh (2002) indicate a 70-km length for the active Greenville fault. Preliminary Holocene slip rate estimates from a site at the northern end of the Livermore Valley are 4.1 ± 1.8 mm/yr (Sawyer and Unruh, 2002). However, Unruh cites strong geomorphic and structural evidence to support a more limited rupture length for a MCE on the Greenville fault. Detailed geomorphic and preliminary paleoseismic investigations support a maximum rupture length of 43 km along the northern part of the Greenville fault; equivalent to rupture of the Livermore and Arroyo Mocho sections of Unruh and Sawyer (1998). A rupture of this length would generate a MCE of **M** 7.

11.1.3 Verona Williams Fault

The Verona Williams fault is located about 1.7 miles (2.8 km) southwest of the southern end of the project alignment. This fault is shown as an uncertain trace over a curving length of about 4 miles (6½ km) along the base of the hills on the north side of the Vallecitos Valley (CGS, 2000). Because the CGS believes that there is insufficient evidence to indicate that this fault is inactive

and that there is sufficient evidence to indicate that this fault is potentially active, it is included within an Alquist-Priolo Earthquake Fault Zone (Hart, 1975; CDMG, 1982a).

11.1.4 Las Positas Fault

The Las Positas fault was originally mapped in 1975 and 1977 by Herd as a northeast-trending, 15-km long zone of left-lateral strike slip faults. Herd showed the southwest end of the fault (the end closest to the project alignment) covered by alluvium and landslides. Herd cites geomorphic features including scarps and several drainages that have been deflected as evidence for recent movement along the fault. Radiometric dating of buried charcoal from a faulted stream terrace indicated that faulting has occurred 17,400 ± 250 years ago (Carpenter et al., 1980). Bonilla et al. (1980) described several en echelon fractures that they attributed to tectonic movement along the Las Positas fault following the two1980 Livermore earthquakes on the Greenville fault. An analysis of seismicity in the Livermore Valley area following these two earthquakes showed that the movement along the Las Positas fault was left lateral and that this fault is "probably seismically active", although the analysis of the limited data set compiled for this study could not prove seismic activity (Ellsworth and Marks, 1980).

California Division of Mines and Geology Fault Evaluation Report 112 by Smith (1981) summarizes the exploratory work and mapping that were performed by numerous authors to evaluate the activity of the Las Positas fault and this document was used to justify the delineation of the Earthquake Fault Zone along a portion of this fault. The Alquist-Priolo Earthquake Fault Zone delineated along the Las Positas fault is located about 3.5 miles (5.6 km) northeast of the end of the project alignment (CGS, 2000).

11.2 SURFACE FAULT DISPLACEMENT AND GROUND SHAKING

The project alignment does not cross any Alquist-Priolo Earthquake Fault Zones. Surface rupture due to faulting along the alignment, therefore, is not expected to occur. However, the short distance to the Earthquake Fault Zones along the Calaveras, Verona Williams, Greenville and Hayward faults, does create a high risk for ground shaking from fault movement. The intensity of the ground shaking is dependent upon the size of the earthquake, the distance of the epicenter from the site, the direction that the earthquake propagates along the fault, and the site geologic conditions. Section 10.2 "Peak Bedrock Acceleration" discusses the anticipated seismic shaking from these more distant faults.

11.2.1 Landslides

With the exception of the southern portion of the project alignment where it enters the mouth of a canyon, the roadway is on relatively flat ground and is not subject to landsliding. Our reconnaissance mapping along the alignment indicates that there are two small landslides that extend into the existing right-of-way. These landslides are both about 150 feet in width and 220 to 240 feet in length and occur on the slopes located east of SR 84, opposite Station 247+00 and 250+00. These are both old rotational slump type landslides that are overgrown with trees and brush. Both of the landslides toe out in a small drainage channel that parallels the eastern edge of the roadway. Boring NB04 was drilled about 100 feet west and northwest of the toe of these landslides for a proposed retaining wall. Although the toes of these old landslides extend into

the existing right-of-way, they do not impact the proposed retaining wall improvements. No other landslides were noted in the vicinity of the project alignment and a review of the U.S. Geological Survey landslide map for the Livermore quadrangle (Nilsen, 1975) does not show any other landslides.

11.2.2 Liquefaction

Liquefaction is a phenomenon whereby sediments temporarily lose shear strength and collapse. This condition is caused by cyclic loading during earthquake shaking that generates high pore water pressures within the sediments. The soil type most susceptible to liquefaction is loose, cohesionless, granular soil below the water table and within about 50 feet of the ground surface. Liquefaction can result in loss of foundation support and settlement of overlying structures, ground subsidence and translation due to lateral spreading, lurch cracking, and differential settlement of affected deposits. Lateral spreading occurs when a layer liquefies at depth and causes horizontal movement or displacement of the overburden mass towards a free face such as a stream bank or excavation, or towards an open body of water.

In a regional study of the nine-county San Francisco Bay region for the U.S. Geological Survey, Witter et al. (2006) mapped the liquefaction susceptibility of the site soils along the project alignment. The alluvium between Jack London Boulevard and Stanley Boulevard (Station 401+00) is mapped as having "high" liquefaction susceptibility. Between Stanley Boulevard and Arroyo Del Valle (Station 321+00) the alluvium is mapped as having "moderate" liquefaction susceptibility. From Arroyo Del Valle extending south about 1,500 feet to Station 304+00 the alluvium is mapped as having "high" liquefaction susceptibility and south of this point to the southern end of the project alignment the soils have a "moderate" liquefaction susceptibility. The historic channel deposits in the active channel of both Arroyo Del Valle and Arroyo Mocho are mapped as having "very high" liquefaction susceptibility.

Based on a review of the borings completed along the alignment, a few thin layers of medium dense sand and silty sand were encountered in the upper 20 feet, primarily north of Arroyo Del Valle. These upper granular soils could be subject to liquefaction if saturated, however the depth to groundwater is at least 20 feet or greater based on the borings drilled in this area. More specifically, groundwater was observed in Borings NB01 (20 feet bgs), NB10 (23.5 feet bgs) and NB22A (24.7 feet bgs). At and below these depths the soils encountered were mostly dense to very dense sands and gravels and therefore the potential for liquefaction of these materials to occur is also considered to be low, including the retaining wall alignments.

Based on review of the borings completed at or near the five non-standard retaining walls, we estimated the potential post-liquefaction settlement at a number of borings using an assessment spreadsheet with formula that are based on the NCERR Workshop on Evaluation of Liquefaction Resistance of Soils (January 1996) and DMG Special Publication 117 (SP117) Guidelines for Analyzing and Mitigating Liquefaction in California (March 1999). In our analysis we used a peak ground acceleration of 0.5g and design earthquake moment magnitude of 7.5. The results of these analyses are presented in Appendix D. At each wall we estimated the potential post-liquefaction ground surface settlement at one or two of the weakest borings; these include Borings NB03 and NB06 for RW246, NB20 for RW391, B-12 for RW400N, B-10 for RW400S, and NB-21 and NB-23 for RW403. We estimate liquefaction induced settlement of less than ¼ inch at each of the 5 retaining walls (RW246, RW391, RW400N, RW400S and RW403).

11.2.3 Subsidence and Settlement

Subsidence typically occurs as a result of subsurface fluid extraction (e.g. groundwater, petroleum) or compression of soft, geologically young sediments. Groundwater extraction for high volume municipal and agricultural use has the potential to cause future ground subsidence in the region. However, we are not aware of subsidence in the area. No active petroleum wells are present within many miles of the site (California Division of Oil, Gas, and Geothermal Resources, 2001).

Settlement can occur quickly when soil is loaded by a structure or by the placement of fill on top of soil and it can also occur gradually when soil pore pressures, increased by vertical loading, gradually dissipate over time. This second type is termed consolidation settlement. It is unlikely that the load imposed by the proposed project improvements will cause settlement.

Compaction settlement, or seismic densification, occurs when loose granular soils above the water table increase in density as a result of earthquake shaking. The soil densification can result in differential settlement because of variations in soil composition, thickness, and initial density. For design, we estimated the potential post-earthquake settlement at a number of borings (NB03, NB06, NB17, NB20, B12 at Stanley Boulevard, and NB26) ranging in depth from 20 to 80 feet and using the NCERR Workshop spreadsheet. In our analyses we used a peak ground acceleration of 0.5 g and design earthquake moment magnitude of 7.5. The results of these studies are presented in Appendix D. As previously mentioned, occasional layers of medium dense granular soils were encountered in a few of the borings, mostly located north of Arroyo Del Valle. These granular layers may be subject to cyclic densification during strong ground shaking. Based on our analyses, we estimate compaction settlement of less than ¼ inch of the retaining walls (RW246, RW391, RW400N, RW400S and RW403).

11.2.4 Flooding

With the exception of the active channels of Arroyo Del Valle and Arroyo Mocho, the project alignment is located outside of the 100-year flood zone as shown on the FEMA flood hazard zone maps (ABAG, 2007).

11.3 SCOUR

The nearest creek from any of the proposed retaining walls is more than 50 feet away; therefore, scouring is unlikely.

Based on as-built plans of existing structures along the SR 84 alignment, the pile and spread footing foundation loadings are summarized as follows:

Table 12-1
Foundation Loadings of Existing Structures Along SR84

Bridge Number	Name	Abutment / Bent / Foundation Type	Pile Loading [2] (tons)	Allowable Bearing Pressure (pounds per square foot) [1]
-	Arroyo Del Valle Creek Bridge Structures (widen)	Abutments (spread footings)	-	8,000
		Bents (spread footings)	-	11,000
33C-0405	Isabel Avenue Underpass[3]	Abutments (spread footings)	-	6,000
		Bents (spread footings)	-	6,000
33C-0406	Isabel Avenue Undercrossing[4]	Abutments (piles)	140	-
		Bents (piles)	140	-
33C-0407	Arroyo Mocho Creek Bridge (widen)	Abutments (piles)	80	-
		Bents (piles)	140	-

[1] All loads including wind and seismic
[2] Nominal resistance
[3] Union Pacific Railroad (UPRR)
[4] Stanley Boulevard

13.1 INTRODUCTION

For the SR 84 project there are five non Standard Plan (special) retaining walls. These special retaining walls include RW246, RW391, RW400N, RW400S and RW403. A summary of the wall type is presented in the following table.

Table 13-1
Retaining Wall Type/Description

Wall No.	Soil Nail	Tieback	Type B	Type 7
246	✓			
391	✓			
400N	✓(1)	✓(2)	✓	✓(3)
400S		✓		
403	✓			

(1) Type D for RW400N (2) Type A for RW400N (3) Type C for RW400N

The following discussion in this section is divided into four wall types: soil nail, tieback (Type A), Type B and Type 7.

13.2 SOIL NAIL WALL DESIGN RECOMMENDATIONS

13.2.1 Anticipated Soil Conditions

13.2.1.1 RW246

The exposed face of the excavation for RW246 is anticipated to range from layers of stiff to hard clays and silts, as well as layers of dense to very dense silty sand, clayey sand, clayey sand with gravel and clayey gravel. The top of RW246 will be located as close as 20 feet from East Ruby Hill Drive. As shown on Figure 2-2, maximum wall height is 34 feet and wall length is 1,100 feet.

13.2.1.2 RW391

The exposed face of this excavation is expected to reveal primarily medium-stiff to hard silty clay (with trace gravel) and very stiff to hard lean clay.

13.2.1.3 RW400N

The face of this exposed excavation is anticipated to reveal stiff sandy lean clay (with gravel) and stiff lean clay (trace gravel), as well as medium dense silty sand and medium dense to very dense clayey sand. Occasional cobbles were also encountered.

13.2.1.4 RW403

The exposed face of this excavation is expected to reveal very stiff to hard sandy lean clay (with gravel) and medium dense clayey sand with gravel. Occasional cobbles were also encountered.

13.2.2 Considerations

Soil nailing is a specialized process in which excavation walls and slopes are stabilized insitu by installing relatively short, fully bonded steel bars, according to a regular and relatively closely spaced pattern. Where excavations are made, the wall is constructed incrementally from the top down. For example, an excavation might be made to a first stage depth of order 3 feet, holes drilled in the middle of the exposed vertical soil face and nails inserted into the holes. The holes are then grouted in place. Steel reinforcement or wire mesh is then placed on the exposed vertical (or sloped) face and the face is shotcreted on the same day. In the second stage, the excavation is extended from a depth of 3 to 6 feet below grade and the above procedure repeated to achieve a wall from grade to 6 feet. This procedure is repeated in increments until full wall height is achieved. According to FHWA (1998), typical nail spacings are 3 to 6 feet both vertically and horizontally, and nail inclinations are generally on the order of 15 degrees below horizontal to facilitate grouting. A level working bench on the order of 30 feet wide is preferable to accommodate drilling equipment used for nail installation. Smaller tracked drills are available that can work on bench widths as narrow as 15 feet. A percentage of the soil nails are proof tested to verify their load-carrying capacity.

FHWA (1990, 1998) lists the following soils as not suitable for soil nailing:

- Loose granular soils with SPT below count number (N) less than 10, or relative density less than 30 percent or a uniformity coefficient less than 2.
- Soft cohesive soils with S_u less than ½ ton per square foot (tsf).
- Organic soils.
- Fat (high plasticity) clays with liquid limit greater than 50 and liquidity index greater than 0.2.
- Clay soils with plasticity index greater than 20.
- Soils containing excessive moisture or wet pockets and soil nailing below the water table.

Since the soils in borings drilled along RW246, RW391, RW400N and RW403 do not fall within these categories, in our opinion, this type of wall is feasible at the subject sites.

A Type 1 wall is not considered to be feasible at RW246 (1) since the cut will extend into East Ruby Hill Drive and (2) alternatively, temporary shoring would be cost prohibitive. For these reasons, a top down construction method of soil nail wall is considered advisable for RW246. There is an existing 24-inch gas line in close proximity of proposed RW246. The Designer

should confirm that the soil nails have sufficient clearance below the gas line. As part of final design, soil nails and the existing gas line should be located in cross-section. If there is interference, the soil nails may be steepened in excess of 15 degrees from horizontal.

For RW391, RW403 and a portion of RW400N, a top down construction method of soil nail wall is also considered advisable based on relatively strong soil.

13.2.3 Geotechnical Design Parameters

Lateral earth pressure on the soil wall (face loadings) are estimated based on published case histories of other soil nail walls (FHWA, 1998). Based on this information, we recommend a nail head service load t_F as follows:

$$t_F = 0.5\ k_a\ \gamma H\ S_H\ S_V \quad \text{(pounds)}$$

Where:

t_F = Nail head service load, pounds

K_a = Coefficient of active earth pressure based on the Coulomb theory

γ = Effective unit weight of retained soil, pcf

H = Wall height, taken from ground surface, feet

S_H = Horizontal spacing of nails, feet

S_V = Vertical spacing of nails, feet

For each of the four soil nail retaining walls, we recommend the following geotechnical design parameters.

Table 13-2
Soil Nail Wall Design Parameters

Retaining Wall No.	Moist Unit Weight (pcf)	Ultimate Ground Grout Bond Stress (psf)		Ultimate Nail Resistance (kips/foot)		Effective Friction Angle (degrees)		Effective Cohesion (psf)		Ka
		Cohesive	Granular	6 inch hole	8 inch hole	Cohesive[1]	Granular	Cohesive[1]	Granular	
246	130	1,000	1,000	1.57	2.09	32	36	0	0	0.42
391	130	800	-[2]	1.25	1.67	34	-[2]	0	0	0.43
400N	130	1,000	1,000	1.57	2.09	34	34	0	0	0.29
403	130	1,000	1,000	1.57	2.09	34	34	0	0	0.43

(1) Assume drained conditions for long term cohesive parameters
(2) Wall is in cohesive soil

As shown in Table 13-2, most design parameters are provided for both cohesive and granular soils. The values shown are ultimate values, i.e. the factor of safety is 1.0.

We recommend the new soil-nail wall be designed for earthquake loading. Based on Section 10.2 "Peak Bedrock Acceleration" (PBA), the recommended design PBA is 0.5g. Since this site is alluvium, the estimated peak ground acceleration (PGA) is 0.50g. Consistent with Caltrans Guidelines for Structures Foundation Reports (March 2006), a seismic factor equal to one third of the horizontal force and not exceeding 0.2g should be used. Therefore a horizontal force equal to the element weight times 0.17 is recommended.

The new soil nail system should be designed to be relatively rigid.

Factors of safety should be selected by the Structural Engineer for long-term static loading conditions, seismic conditions, and proof testing conditions. Furthermore, we recommend that the soil/grout bond strength be verified by field testing. The design at RW246 should also include surcharge load imposed by traffic on East Ruby Hill Drive equivalent to 2 feet of soil, i.e. 250 pounds per square foot vertical pressure.

13.2.4 Earthquake Loading

The effects of an earthquake should be considered according to Bridge Design Specification (BDS) 5.5.4 (Effect of Earthquake). In general, earthquake shaking can be considered as an increase in dynamic forces on walls. The additional force to simulate earthquake loads is dependent upon the magnitude of ground surface acceleration and the height of the wall. To estimate the seismically induced force, we recommend that the magnitude of the dynamic lateral force developed during seismic loading be computed using the following equation:

$$\Delta P_{ae} = 12H^2$$

The units of the dynamic lateral force (ΔP_{ae}) are pounds per linear foot of wall. H is the wall height in units of feet. The dynamic lateral force should be assumed to act at 0.6H from the bottom of the wall and represents the resultant of a triangular pressure distribution.

13.2.5 Caltrans Specifications

Based on a discussion with Caltrans staff, we understand recent changes have been made to the soil nail wall Standard Special Provisions (SSP) specifications. These specification sections include "Soil Nail Wall Earthwork" and "Soil Nail Assembly". These latest revisions will be included in Appendix H and the project specifications and drawings.

13.3 SOIL NAIL WALL CONSTRUCTION CONSIDERATIONS

13.3.1 Associated Ground Movements

13.3.1.1 RW246

During construction of a soil nail wall from the top-down, the reinforced soil zone tends to rotate outwards about the toe of the wall as part of the process of mobilizing tensile loads within the nails. Hence, maximum horizontal movements occur at the top of the wall and decrease

progressively towards the toe of the wall. Settlements at the facing also occur, and these tend to be on the same order of magnitude as the horizontal movements at the top of the wall. Displacements of the facing depend on the following factors (FHWA, 1998):

- Construction rate;
- Nail spacing and excavation lift heights;
- Nail and soil stiffness;
- Global factor of safety;
- Nail inclination (greater displacements for greater inclinations because of less efficient reinforcing action);
- Bearing capacity of the foundation soils; and
- Magnitude of any surcharge loadings.

For vertical soil nail walls with typical nail-length-to-wall-height ratios, negligible surcharge loadings, and designed with reasonable factors of safety, the peak wall displacements at the top of the wall (vertical and horizontal) tend to vary from 0.1%H or less for weathered rocks and very competent and dense soils (e.g., glacial tills), to 0.2%H for granular soils, and up to 0.4%H for fine-grained clay type soils. These movements are considered to be relatively small and generally correspond to those expected for well braced systems and for tieback walls. For RW246 we estimate vertical and lateral displacements will occur behind the wall on the ground surface between approximately Stations 246+50 and 258+00; maximum movements of order ¾ to 1 inch are estimated between Stations 247+50 and 255+00.

The construction displacements tend to decrease in magnitude with distance back from the wall facing. Based on FHWA (1998) recommended procedures, we have estimated the manner in which surface displacements decrease with distance from the facing for soil nail walls in various soil types. For example, we have estimated the zone of ground surface movement to be negligible beyond a distance of 35 to 42 feet between approximately Stations 247+80 and 255+80; this line is shown on Figure 13-1. As shown, this line extends onto the roadway (East Ruby Hill Drive). Consequently, we expect some settlement and cracking of the roadway during construction. Therefore, a bid item should be included to repair/repave East Ruby Hill Drive.

In addition, the effect of ground movement of existing underground utilities that might be located within or adjacent to East Ruby Hill Drive should be considered. For example, the existing gas line just off the roadway lies within the estimated zone of ground surface settlement (Figure 13-1) and will undergo estimated settlement on the order of ½ inch; the Owner should be made aware of this. Furthermore, the locations of existing buried utilities should be verified in advance of construction by the City of Pleasanton so that the nails can be installed at the design locations. If unknown obstructions (such as a sanitary sewer) are encountered, this could result in delays and claims by the Contractor. In particular, an existing gas line is shown on the east side of East Ruby Hill Drive on Figure 13-1. The Designer should verify that the soil nails have sufficient clearance below the gas line.

We believe it would be prudent to require the Contractor to perform a preconstruction and postconstruction condition survey of Ruby Hill Drive pavement surface, buried utilities and nearby houses abutting Ruby Hill Drive. This survey should extend for the full length of RW246

and be performed by a California Registered Professional Engineer retained by the Contractor. The videotaped survey should include a verbal narrative of these items. The preconstruction survey will serve as a baseline, in the event that the utility owners and/or adjacent homeowners make a claim for structural damage.

The Contractor should be required to submit a shop drawing of the proposed design prepared and signed by a Registered Civil Engineer (or Registered Structural Engineer). The shop drawing should present the Contractor's proposed construction plan and design of the system, including supporting design calculations, earth pressure diagrams and anticipated deflections. Assuming the Contractor's Engineer designs the wall, we would be pleased to review their design for appropriateness of geotechnical design parameters.

13.3.1.2 RW391, RW400N and RW403

These three (3) walls have maximum heights of order 17 to 20 feet or less (about ½ the height of RW246). Furthermore, the land immediately behind these three (3) walls is relatively undeveloped. Therefore, the potential for damage of adjacent property is relatively low at these three (3) wall locations.

13.3.1.3 Construction Dewatering

Based on field explorations conducted along proposed RW246, we estimate the groundwater to be below Elevations 503 and 511 at Borings NB04 and NB05A, respectively. Since bottom of wall (BOW) ranges from about Elevation 519 to 537, it appears the groundwater level will be at least 8 feet below the bottom of the wall.

Based on field explorations conducted along proposed RW391, we estimate the groundwater to be below Elevations 391 and 381 at Borings NB19 and NB20, respectively. Since BOW ranges from about Elevation 393 to 409, it appears the groundwater level will be at least 2 feet below BOW.

Based on field explorations conducted along proposed RW400N, we estimate the groundwater to be about Elevations 396 and 374 at Boring NB22A and piezometer in B-9, respectively. Since BOW ranges from about Elevation 394 to 414, it appears the groundwater level will be as high as 2 feet above BOW. Dewatering portions of this excavation during construction is anticipated.

Based on field explorations conducted along proposed RW403, we estimate the groundwater to be below Elevations 393 and 378 at Borings RB32 and NB21, respectively. Since BOW ranges from Elevation 394 to 414, it appears the groundwater level will be at least 1 foot below BOW.

Although most soil nail wall locations are expected to be dry, surface runoff could accumulate at the bottom of the wall trenches during the rainy season. Normal sumping procedures are anticipated to lower groundwater inside the trench to provide a dry excavation.

13.3.1.4 Overbreak

Some of the borings indicate silty sand and localized cobbles may be encountered during installation of soil nails. Where silty sands are encountered, some localized overbreak is expected; additional shotcrete will be required in those areas. The Contractor should be aware of encountering localized cobbles during drilling of soil nail holes.

13.4 TIEBACK WALL DESIGN RECOMMENDATIONS

13.4.1 Anticipated Soil Conditions

13.4.1.1 RW400N

A typical section is shown in Figure 2-8, including the proposed wall location relative to the existing Isabel Avenue UC abutment pile cap footing. As shown the bottom of the existing pile cap footing is positioned at Elevation 389.15±. Based on a review of Borings B-9 and B-12, we infer that the new Wall Type A and tiebacks are placed primarily in strong native soils consisting of stiff to hard lean clay and medium dense to dense sandy silt, clayey sand, sandy gravel, clayey gravel, and gravelly sand.

13.4.1.2 RW400S

A typical section is shown in Figure 2-11, including the proposed wall location relative to the existing Isabel Avenue UC abutment pile cap footing. As shown, the bottom of the existing pile cap footing is positioned at Elevation 406.21±. Based on a review of Borings B-10, B-11 and B-13, we infer that the new RW400S wall and tiebacks are placed primarily in strong native soils consisting of stiff to very stiff silty clay and sandy lean clay underlain by deposits of medium dense to very dense silty sand, clayey sand, well graded gravel and clayey gravel.

13.4.2 Considerations

An existing buried 8-foot diameter RCP parallels some of the proposed RW400N (Figure 2-7). A Type 1 wall would (1) result in additional load (from footing) on the pipe and (2) prevent access for maintenance of the RCP. For that reason a tieback wall is advisable in the area of the Isabel Avenue Undercrossing (UC), assuming there is sufficient clearance of tiebacks between existing UC abutment steel piles. This is shown as Wall Type A between "A3" Stations 399+55 and 401+65 on Figure 2-7 (length of about 209 feet). The relatively horizontal tiebacks should be positioned to avoid interference with the existing steel piles and abutment concrete.

At RW400S, the new wall parallels the existing abutment of the Undercrossing at Stanley Boulevard; this distance is about 14 feet. Considering the close proximity to the existing abutment which is supported on piles, a tieback wall is advisable in this area. A typical section is shown in Figure 2-11.

The tieback walls at both RW400N and RW400S will be placed in close proximity to the existing abutment; to minimize ground movement during construction, a tieback wall has been selected. Furthermore, to minimize movement of the existing pile cap at the adjacent abutments, the construction of the tieback wall could proceed in short sections limited in both vertical and horizontal extent. A "notched" excavation could be made, tieback installed, face shotcreted and the tieback load tested. This notching could then be repeated in an alternating manner along the abutment. Once the initial panels are in place, remaining soil blocks between them could be removed until all the tiebacks and shotcrete face has been completed.

13.4.3 Protection of Abutment Foundation

We understand that the proposed tieback wall at RW400N and RW400S will consist of tieback anchors with bearing plates embedded in a structural concrete panel. The structural concrete panel will be formed by shotcreting an initial section and then finished with a cast-in-place panel. Reinforcement cages will include cross ties to facilitate this type of composite shotcrete/concrete panel construction.

To minimize lateral movement of the steel piles and pile cap at the abutments, we recommend that each slope excavation "notch" be limited to a panel width of 10 feet and maximum height of 5 feet at any one time. The existing fill and native soils encountered in the borings behind the proposed walls consist of stiff to hard lean clayey soils and granular materials ranging from gravelly sand, clayey sand, clayey gravel to poorly graded gravel with sand. Granular fill, if temporarily unsupported during construction will have a tendency to ravel. To minimize potential for raveling when excavating each panel, the Contractor should take measures to minimize this occurrence. For example, he might pre-grout the abutment slope within the proposed wall limits to stabilize the granular fill prior to excavating the panel. There may be other methods to minimize raveling. This should be brought to the Contractor's attention in the specifications.

Installation of the tieback anchors, concrete wall reinforcement and shotcrete wall panel should immediately follow the excavation and should be completed the same day. No exposed face of the excavation should be left unsupported overnight. In addition, movement of the existing abutment should be monitored closely as the excavation operation proceeds. If movement exceeds tolerable limits, excavation should be stopped immediately and mitigation or alteration of the construction methods should be implemented. We assume the tolerable movement is 1 inch horizontally and 1 inch vertically; this should be confirmed with the Structural Engineer and/or Caltrans.

13.4.4 Tieback Wall Design Earth Pressures

Lateral earth pressures of the new abutment retaining walls are anticipated to be high due to the relative stiffness of the tieback system. We have estimated the lateral design earth pressure for both walls using the following equation (Bridge Design Specification, August 2004, Section 5.5.5.7):

$$p_a = \frac{0.72 K_a \gamma H^2}{\left(H - \frac{1}{3} H_1 - \frac{1}{3} H_{n+1} \right)}$$

Where:

p_a	=	Maximum ordinate of pressure diagram , psf
K_a	=	Coefficient of active earth pressure based on the Coulomb theory
γ	=	Effective unit weight of retained soil, pcf
H	=	Wall design height, ft.

H_1 = Distance from ground surface at top of wall to upper most level of anchors, ft.

H_{n+1} = Distance from design grade at bottom of wall to lowermost level of anchors, ft.

Please refer to Figure 13-2 for geometric illustration of the terms in this equation. The soil behind the new retaining walls generally consists of stiff to hard lean clay and dense to very dense granular layers at RW400N and RW400S. To determine K_a, we first estimated ϕ' (angle of internal friction) for the clay and granular deposits. For the clay layer, the long-term cohesion approaches a small value, and ϕ' approaches a value ranging between 26 and 34 degrees for clay soils. Based on the plasticity index value and unit weights for the clay encountered, as well as corrected blow count and relative density of sands, we estimate the long-term $\phi' = 34$ degrees and unit weight $\gamma = 130$ pcf for both walls. For the various backfill slope (β), and $\phi' = 34$ degrees, we estimated the following K_a.

Table 13-3
Coefficient of Active Earth Pressure for Tieback Wall RW400N and RW400S

Backfill Slope (β), deg.	K_a
0	0.28
18	0.36
26	0.43

The wall pressure recommended above is based on the assumption that no differential hydrostatic pressures will develop behind the retaining wall. The buildup of hydrostatic pressure behind the wall should be prevented by the inclusion of a positive drainage system. A manufactured prefabricated drainage membrane, such as Miradrain 6000, could be used on the wall face. Positive drainage for water collected in the drainage membrane or backfill should be provided by means of perforated drainpipe leading to a free draining outlet or by weep holes extending though the wall.

13.4.5 Earthquake Loading

The effects of an earthquake should be considered according to BDS 5.5.4 (Effect of Earthquake). In general, earthquake shaking can be considered as an increase in dynamic forces on walls. The additional force to simulate earthquake loads is dependent upon the magnitude of ground surface acceleration and the height of the wall. To estimate the seismically induced force, we recommend that the magnitude of the dynamic lateral force developed during seismic loading be computed using the following equation:

$$\Delta P_{ae} = 32H^2$$

The units of the dynamic lateral force (ΔP_{ae}) are pounds per linear foot of wall. H is the wall height in units of feet. The dynamic lateral force should be assumed to act at 0.6H from the bottom of the wall and represents the resultant of a triangular pressure distribution.

13.4.6 Effect of Existing Battered Piles

As shown in Figure 2-8, the two outside rows of existing steel piles are battered at Isabel UC east abutment, whereas only the outside row of existing steel piles at Isabel UC west abutment (Figure 2-11) is battered. If this is a seat type abutment, the tieback walls should also be designed for a lateral load of 5 kips per pile (both vertical and battered), as required by Caltrans; the location of the horizontal load of 5 kips should be 4 feet below bottom of existing pile cap.

13.4.7 Soil Grout Bond

For estimating purposes, we assume the tiebacks will be grouted within the hard clay and dense sand and will have an ultimate soil/grout adhesion value of order 500 to 1,000 psf; an average of 700 psf is recommended for design, assuming one cycle of grouting at low pressure. Since the adhesion value and the strength of the soil/grout bond are influenced by the construction method, anchor capacities should be verified by proof testing each anchor following installation. Performance tests for the anchors should be at a minimum of 2.0 times the design loads and should not exceed 80 percent of the specified minimum tensile strength of the anchor rod. We also recommend that all production anchors be tested at 1.5 times the design loads, and should not exceed 70 percent of the specified minimum tensile strength of the anchor rod.

Tiebacks can be grouted several times in order to increase the desired tieback tensile load capacity, i.e. soil-grout adhesion. Pregrout means that grout has been injected during one or more stages before the tieback is load tested. The above recommended soil adhesion value of 700 psf is based on the assumption that there will be only one pregrout stage with no postgrouting. Based on our experience with tieback walls, soil-grout adhesion values from 1,800 to as high as 2,900 psf can be achieved with up to 3 pregrouts before testing, followed by postgrouting. Postgrout means that additional grout has been injected after the initial tieback load test has been performed, but the desired tensile load may not have been obtained. The above mentioned soil-grout adhesion values were obtained by using a pressure in the range of 200 to 400 psi for first pregrout followed by increased pressures of 400 to 700 psi for the second and third pregrout cycles. If the Structural Engineer uses the soil grout adhesion value of 2,900 psf, it should be expected this will require several cycles of grouting with associated construction schedule implications, along with close monitoring to avoid potential uplift of the existing abutments. Factors of safety should be selected by the Structural Engineer for long-term static loading conditions, seismic conditions, and proof testing conditions.

The maximum recommended soil grout (bond) length is 40 feet.

13.4.8 Free Length (Unbonded)

The tieback wall anchors should be designed such that the bond zone is located behind the minimum free length plane as shown on Figure 13-3. The free length should be the greatest of the following quantities:

- 15 feet (typical minimum free length)
- 5 feet beyond active wedge projected upward behind toe of wall
- 5 feet beyond existing bridge piles

13.4.9 Minimum Spacing of Tiebacks

The recommended minimum tieback spacing within the grouted (anchor bond) zone, centerline to centerline, is 3-hole diameters, or 5 feet, whichever is larger.

13.5 TIEBACK WALL CONSTRUCTION CONSIDERATIONS

Potential construction considerations at RW400N and RW400S are expected to include:

- Physical conflicts: resolve potential conflicts with locations of new wall supports and tiebacks with all existing facilities such as utilities, piles, and abutment.
- Groundwater: although groundwater was not encountered at these sites, runoff from rainfall or seepage though the pavement aggregate base might require some dewatering during construction using normal sumping procedures.
- Exposed soil face: based on soil conditions in new borings, the tieback walls will be excavated in very stiff to hard clayey soils above groundwater, which will creep with time. Dense to very dense sands are also anticipated. If vertical tieback piles are spaced relatively close, sloughing and/or creeping may be minimized. Depending on the spacing of the tiebacks, and the time intervals between installation of tiebacks and the tieback wall, temporary wooden lagging may be required. The Contractor should be prepared to install lagging to prevent ground loss.
- Tiebacks: Tiebacks will likely be above groundwater. Nevertheless, the Contractor should be prepared to install tiebacks within the thin sand interbeds, which contain variable amounts of gravel. To minimize interference of existing abutment piles, casing should be required until the last row of existing piles is cleared.
- Bridge abutment pile cap footing foundations: monitoring of horizontal and vertical movements of existing foundations will be required before, during, and after excavation and construction of tieback wall. We recommend that the lateral movement and settlement of the top of the existing footings at abutments be measured at points spaced about every 10 feet before, during, and after excavation until all tiebacks have been installed and loaded. These movements should be measured by a Registered Land Surveyor retained by the Contractor. Movements should be plotted with respect to time by the Surveyor and promptly submitted to URS for review. As a minimum, readings should be taken:
  - Two weeks and one week before excavation commences
  - Daily during excavation of tieback wall
  - Weekly during tieback installation
  - Weekly after tiebacks are installed until movement has ceased

Confirm monitored movements are less than tolerable movements established by Structural Engineer.

13.6 WALL TYPE B DESIGN RECOMMENDATIONS

13.6.1 Design Considerations

A typical section of Wall Type B in RW400N is shown in Figure 2-8, including the proposed wall location relative to the existing 8–foot reinforced concrete pile (RCP). As shown the wall face overhangs the RCP. Bottom of wall appears to be about Elevation 394±. Wall length is approximately 109 feet. Based on a review of Borings B-12 and B-13, we infer that a portion of the new Wall Type B is placed primarily in strong native soils consisting of stiff to hard lean clay and medium dense to dense sandy silt, clayey sand, sandy gravel, clayey gravel, and gravelly sand. However, based on our review of the cross section shown in Figure 2-8, we infer that a portion of Wall Type B will be placed on backfill for the RCP. There are no records available documenting the compaction of the backfill.

Free groundwater was not encountered in Borings B-12 and B-13 since the rotary wash method was used. The closest 2006 borings were RB-30 and RB-32 which were dry to the terminal depth of 10 feet, corresponding to about Elevations 390 and 392, respectively. A piezometer was installed in nearby 1996 Boring B-9 and groundwater was measured at Elevation 373.6 feet on February 28, 1997. We selected a design groundwater level at Elevation 375.0 feet for Wall Type B.

13.6.2 Lateral Earth Pressure

These retaining walls should be designed for lateral earth pressures imposed by the adjacent backfill using an equivalent fluid pressure of 36 pounds per square foot per foot for horizontal backfill and 2 feet of surcharge. These lateral earth pressures are based on non-expansive wall backfill, i.e. soil with a plasticity index of less than 12. Surcharge loads such as vehicular traffic would apply additional loads to the walls as indicated on Caltrans Standard Plan B3-8.

The recommended pressures assume that no hydrostatic pressures will develop behind the retaining wall. The buildup of hydrostatic pressure behind the walls should be prevented by the inclusion of a positive drainage system. It is recommended that such a system consist of Pervious Backfill Material conforming to the requirements of Section 19-3 of the Caltrans Standard Specifications, latest edition, to a width of at least 1.0 foot behind the retaining wall in accordance with Caltrans Standard Detail Sheets (Retaining Wall Details No. 1, Sheet B3-8 and Bridge Details, Sheet B0-3). Positive drainage for water collected in the backfill should be provided by means of weep holes or drain pipes leading to a free draining outlet.

13.6.3 Earthquake Loading

The effects of an earthquake should be considered according to Bridge Design Specification (BDS) 5.5.4 (Effect of Earthquake). In general, earthquake shaking can be considered as an increase in dynamic forces on walls. The additional force to simulate earthquake loads is dependent upon the magnitude of ground surface acceleration and the height of the wall. To estimate the seismically induced force, we recommend that the magnitude of the dynamic lateral force developed during seismic loading be computed using the following equation:

$$\Delta P_{ae} = 12H^2$$

The units of the dynamic lateral force (ΔP_{ae}) are pounds per linear foot of wall. H is the wall height in units of feet. The dynamic lateral force should be assumed to act at 0.6H from the bottom of the wall and represents the resultant of a triangular pressure distribution.

13.6.4 CIDH Piles

Wall Type B will be placed in close proximity to an existing buried 8-foot RCP. To prevent additional loading from the new wall onto the RCP with attendant settlement of the RCP, the new wall will be supported on CIDH piles which will derive their support from soils below the invert of the RCP. Borings B-12 and B-13 located in close proximity to this wall below the RCP invert (Elevation 382.6 ±) reveal very dense clayey gravel and gravelly sand with cobbles down to about Elevation 367.5 (or about 15 feet below pipe invert). Underlying these granular layers are mostly stiff to hard fine-grained layers (silt and lean clay) to the terminal depth of Boring B-13 and to about Elevation 347.7 in Boring B-12. Cobbles were encountered in these layers. From Elevation 347.7 in Boring B-12 to the terminal depth is a layer of very dense clayey gravel with cobbles. The closest nearby boring where groundwater was measured was Boring B-9 on February 28, 1997; groundwater was recorded at Elevation 373.6, or about 9 feet below RCP invert. The vertical supporting capacity of the portion of the CIDH pile located above Elevation 382.6 should be reduced because of pipe backfill.

In calculating the axial and lateral pile capacity, we:

- Developed the native soil parameters from B-12 and B-13 below the bottom of the RCP trench, i.e, Elevation 381 feet; and
- Estimated backfill soil parameters above Elevation 381, assuming backfill is weaker than native soils.

Table 13-4a presents a summary of the foundation design data provided by the Structural Engineer, and Table 13-4b presents the pile data for the proposed CIDH pile foundation.

Table 13-4a
Foundation Design Data for RW400N, Wall Type B

Location	Design Method	Pile Type	Finished Grade Elevation (ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	No. of Piles per Support
					B	L		
RW400N –Type B	WSD	24 inch CIDH	405.0	394.25	13.0	see Note	1.0	see wall general plan

Note: The wall is continuous and max spacing of piles is 40 at pump building, and then varies between 10’ to 20’ elsewhere

Table 13-4b
Pile Data for RW400N, Wall Type B

Location	Pile Class	Cut-off Elevation (feet)	Nominal Resistance (Kips)		Design Tip Elevation (feet)	Specified Tip Elevation (feet)
			Compression	Tension		
Pile Cap	24 inch CIDH	394.25	580	0	347.0[(1)] 373.0[(2)]	347.0

Design tip elevation is controlled by following demands: (1) Compression (2) Lateral

A CIDH-pile design spreadsheet is included in Appendix E; as shown the pile length is estimated to be 47 feet, with a corresponding design pile tip at Elevation 347.0 for a 24-inch CIDH pile.

Evaluation of lateral load capacity of CIDH piles at this location was made using the computer program LPILE (version 5.0). The results of this analysis are also presented in Appendix E and in Figure 13-4. This figure presents results for both free head and fixed head conditions. In addition, Figure 13-5 presents the estimated lateral pressure due to the CIDH pile lateral loading imposed on the existing RCP. We recommend the Civil Engineer assess the effect of this new lateral load on the existing RCP.

13.6.5 Settlement Estimate

Wall Type B (RW400N) will be placed on 24-inch drilled shafts. We estimate settlement to be less than ¼ inch for these drilled shafts.

13.7 WALL TYPE B CONSTRUCTION CONSIDERATIONS

13.7.1 Temporary Wall Excavation

13.7.1.1 Open Cuts with Side Slopes

Excavation for the proposed retaining wall is anticipated to be more than 12 feet deep. Open cut methods with sloping sides can be used where shoring is not required, as described below. This is predicated on the assumption that dewatering, when necessary, is accomplished in advance of the excavation. Safety standards set by OSHA limit the height of unshored vertical excavations to 5 feet if construction personnel will be working in the excavations. The 1989 set of guidelines published by OSHA classify soils in detail as either Type A, B or C. In general, strength of Type A soils is greatest, Type B soils is intermediate, and strength of Type C soils is smallest. Based on the soil type, depth, duration the excavation is open, and the sequence of soils exposed in the excavation, OSHA recommends maximum allowable slopes. For example, for excavations in homogeneous soils 20 feet or less in depth, they state that maximum allowable slopes (horizontal to vertical) should be ¾ to 1, 1 to 1 and 1½ to 1 for Type A, B and C soils, respectively. The soils encountered at the site generally correspond to OSHA Type B. On this basis it is recommended that temporary slopes in soils should be cut at a slope no steeper than 1 to 1, corresponding to Type B soil.

13.7.1.2 Dewatering

The depth of groundwater is inferred to be about 20 feet (394-373.6) below bottom of excavation. Therefore, groundwater is not anticipated during excavation of the wall. However, dewatering may become necessary during rainy seasons and normal sumping procedures with a sump may be required.

13.7.2 CIDH Piles

CIDH piles will be installed in close proximity to the RCP; to minimize disturbance of the ground surrounding the RCP, permanent casing should be installed to at least the pipe invert.

Groundwater was inferred to be about 9 feet (382.6-373.6) below the RCP invert. While the cohesive deposits will help keep the CIDH pile holes open during construction, some sloughing and caving can be expected in the cohesionless deposits. Therefore, we recommend that the Contractor have casing on site, should it be needed to minimize the risk of caving in either clay or sand soils. If casing is used, the casing should be withdrawn from the hole slowly as the concrete is being placed; a minimum head of concrete of 3 feet should be maintained in the casing at all times. All CIDH piles should be installed under the direct observation of the Geotechnical Engineer.

Cobbles were revealed in Boring B-12 at various depths. For that reason, the Contractor should anticipate some difficulty during augering and casing installation.

We recommend that a preconstruction and post-construction condition video survey be performed of the interior of the 8-foot RCP for the length of Wall Type B. With this information, potential damage claims can be readily resolved, should they occur.

13.8 TYPE 7 WALL DESIGN RECOMMENDATIONS

13.8.1 Anticipated Soil Conditions

A typical section is shown in Figures 2-8 and 2-10, including the proposed 55-foot long wall location relative to the existing bridge abutment (Figure 2-8) footing positioned at Elevation 389.15±. Based on a review of Boring B-13, we infer that the new Type 7 retaining wall footing is positioned at Elevation 392.50 (Figure 2-9) in mostly very stiff lean clay and very dense clayey gravel.

Free groundwater was not encountered in Boring B-13 since the rotary wash method was used. A piezometer was installed in B-9, which was the closest 1996 boring, and groundwater was measured at Elevation 373.6 feet on February 28, 1997. This measured groundwater depth is about 19 feet below bottom of the Type 7 retaining wall. We selected a design groundwater level at Elevation 375.0 feet at Type 7 retaining wall.

13.8.2 Lateral Earth Pressures for Caltrans Type 7 Wall

Caltrans Type 7 retaining walls (Figure 2-10) are designed to resist toe pressures resulting from lateral earth pressures imposed by the adjacent backfill using an equivalent fluid pressure of 36 pcf for horizontal backfill. This lateral earth pressure is based on non-expansive wall backfill,

i.e. soil with a plasticity index of less than 12. Surcharge loads (2 feet of soil, or 2x12=240 psf) such as vehicular traffic would apply additional loads to the walls as indicated on Caltrans Standard Plan B3-8.

The recommended pressures assume that no hydrostatic pressures will develop behind the retaining wall. The buildup of hydrostatic pressure behind the walls should be prevented by the inclusion of a positive drainage system. It is recommended that such a system consist of Pervious Backfill Material conforming to the requirements of Section 19-3 of the Caltrans Standard Specifications, latest edition, to a width of at least 1 foot behind the retaining wall in accordance with Caltrans Standard Detail Sheets (Retaining Wall Details No. 1, Sheet B3-8 and Bridge Details, Sheet B0-3). Positive drainage for water collected in the backfill should be provided by means of weep holes or drain pipe leading to a free draining outlet.

13.8.3 Bearing Capacity

The maximum wall height is 12 feet; this results in a maximum allowable bearing pressure of 2 ksf (General Notes on Figure 2-10). Based on our review of the available cross section (Figure 2-8) and soil boring information, in our opinion, most of the soils encountered below the anticipated bottom of proposed footing elevation in the vicinity of RW400N Type 7 wall are capable of supporting the toe pressure presented in "General Notes" on Figure 2-10 and as shown below in Table 13-5.

Table 13-5
Foundation Design Recommendations for Spread Footing for Wall Type 7

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination) [1]		LRFD[2]		
							Service	Strength ϕ_b = ?	Extreme Event ϕ_b = 1.00
	B	L			Permissible Gross Contact Stress[3] (ksf)	Allowable Gross Bearing Capacity[4] (ksf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance (ksf)	Factored Gross Nominal Bearing Resistance (ksf)
Type 7	12	54	392.5	3.25	7.5	6	N/A	N/A	N/A

1. WSD = Working Stress Design
2. LRFD = Load and Resistance Factor Design
3. Permissible settlement is 1 inch.
4. Assume existing fill is removed and replaced with new engineered fill.

However, it should be noted from Figure 2-8 (Wall Type C – Typical Section) that the Type 7 wall is higher than the existing UPRR underpass bridge abutment. It is likely that the sides of the original excavation for the UPRR bridge abutment were sloped; consequently backfill was placed in this wedge which might have extended underneath the proposed Type 7 wall footing.

Records are not available which document the extent, type, relative compaction and quality of backfill in this area. Therefore, we recommend that during construction the exposed subgrade of the Type 7 wall footing be observed by a URS Geotechnical Engineer Representative; if weak existing fill is observed it should be removed and replaced with new compacted engineered fill. The permissible gross contact stress and allowable gross bearing capacity listed in Table 13-5 assumes all existing fill is removed and replaced with new engineered fill.

13.8.4 Earthquake Loading

The effects of an earthquake should be considered according to Bridge Design Specification (BDS) 5.5.4 (Effect of Earthquake). In general, earthquake shaking can be considered as an increase in dynamic forces on walls. The additional force to simulate earthquake loads is dependent upon the magnitude of ground surface acceleration and the height of the wall. To estimate the seismically induced force, we recommend that the magnitude of the dynamic lateral force developed during seismic loading be computed using the following equation:

$$\Delta P_{ae} = 12H^2$$

The units of the dynamic lateral force (ΔP_{ae}) are pounds per linear foot of wall. H is the wall height in units of feet. The dynamic lateral force should be assumed to act at 0.6H from the bottom of the wall and represents the resultant of a triangular pressure distribution.

13.8.5 Settlement Estimate

As shown on Figure 2-8, an excavation will be required to install Retaining Wall Type 7, with minimal backfill. Therefore, consolidation settlement is not expected at this location. However, we assume that any loose or weak existing subgrade fill will be removed and replaced with engineered fill during construction. Liquefaction settlement at this wall location is expected to be nil.

13.9 TYPE 7 CONSTRUCTION CONSIDERATIONS

13.9.1 Construction Dewatering

The depth of groundwater is inferred to be about 19 feet (392.5-373.6) below bottom of excavation. Therefore, groundwater is not anticipated during excavation of the wall. However, dewatering may become necessary during rainy seasons and normal sumping procedures with a sump may be required.

13.9.2 Open Cuts with Side Slopes

Excavation for the proposed retaining wall is anticipated to be more than 14 feet deep. Open cut methods with slope sides can be used where shoring is not required, as described below. This is predicated on the assumption that dewatering, when necessary, is accomplished in advance of the excavation. Safety standards set by OSHA limit the height of unshored vertical excavations to 5 feet if construction personnel will be working in the excavations. The 1989 set of guidelines published by OSHA classify soils in detail as either Type A, B or C. In general, strength of Type A soils is greatest, Type B soils is intermediate, and strength of Type C soils is smallest. Based

on the soil type, depth, duration the excavation is open, and the sequence of soils exposed in the excavation, OSHA recommends maximum allowable slopes. For example, for excavations in homogeneous soils 20 feet or less in depth, they state that maximum allowable slopes (horizontal to vertical) should be ¾ to 1, 1 to 1 and 1½ to 1 for Type A, B and C soils, respectively. The soils encountered near the site generally correspond to OSHA Type B. On this basis, it is recommended that temporary slopes in soils should be cut at a slope no steeper than 1 to 1 (horizontal to vertical), corresponding to Type B soil.

13.10 GLOBAL STABILITY

The global stability of RW246, RW391, RW400N, RW400S and RW403 was evaluated using a limit equilibrium method based on Spencer's procedure of slices as coded in the program SLOPE/W (Version 4). In Spencer's procedure, all forces are assumed to have the same inclination, and all requirements for static equilibrium are satisfied. We performed the analyses using the maximum wall heights, which in our opinion, represents the critical section for each retaining wall. On this basis, the cross sections were selected at Stations "A1" 251+80 (RW246), "A3" 396+16 (RW391), "A3" 401+60 (Type A Tieback RW400N), "A3" 405+77 (soil nail, RW400N), "A3" 401+00 (RW400S) and "A3" 405+00 (RW403). A design groundwater at Elevation 503 was selected for RW246, whereas at the other walls (RW391, RW400S, RW400N and RW403) a design groundwater at Elevation 375 was selected.

Caltrans requires minimum factors of safety of 1.3 for retaining walls under static loading conditions (Bridge Design Specifications, Section 5.2.2.3, August 2004). The results of our analyses are summarized in the following paragraphs and include the following cases: (1) end of construction, (2) long term, and (3) pseudo-static condition. A copy of our global slope stability calculations is presented in Appendix F.

13.10.1 End of Construction Conditions

The end of construction case represents the condition immediately following construction when excess pore pressures have been induced by the placement of fill loads, and insufficient time has passed for dissipation to occur. For this reason, undrained conditions were assumed for impervious clay soils, whereas drained strengths were used for granular soils. Soil strength parameters from laboratory unconfined compressive strength tests were used for the fine grained soils and the estimated friction angle was used for the granular soils.

13.10.2 Long Term Conditions

For the long term condition, the soil strengths typically increase over time with pore pressure dissipation. Therefore, we used both cohesion and friction angle to determine the strength of fine grained soils and formational deposits. Friction angle only was used for determining strength of granular soils.

13.10.3 Pseudo-Static Condition

For the earthquake (or pseudo static) loading, drained shear strengths for pervious materials and reduced undrained shear strengths for impervious materials were selected to evaluate the stability of the embankments during the potential earthquake. Undrained strengths for impervious

materials were used because no significant dissipation of pore pressures is expected during the rapid earthquake loading. A reduction of undrained shear strengths on the order of 20 percent of the static undrained shear strengths was used to account for the strength loss of cohesive soils during cyclical loading. This reduction in strength is recommended in the report, "A Simplified Procedure for Estimating Earthquake Induced Deformations in Dams and Embankments" by Makdisi and Seed (1978). This is a conservative approach as soil strengths typically increase over time with pore pressure dissipation. To compute the factor of safety of the slope during earthquake loading, we applied a pseudo-static seismic coefficient of 0.17g to the center of the slice for the slip surface having the minimum computed static factor of safety. This pseudo-static seismic coefficient is equal to approximately one-third of the peak horizontal ground acceleration, 0.5 g, anticipated at the site. The seismic stability screening approach is consistent with Section 3.10 of the March 2006 Guidelines for Structure Foundation Reports.

13.10.4 Results

The results of our analyses for the five retaining walls are summarized in the following table.

Table 13-6
Results of Global Slope Stability Calculations

Loading Conditions	Minimum Calculated Factor of Safety						Minimum Required Factor of Safety
	RW246*	RW391*	RW400N*		RW400S	RW403*	
	Case 1	Case 1	Case 1	Case 2 Tieback	Case 2 Tieback	Case 1	
End of Construction	2.6	4.3	3.5	1.8	2.8	3.4	1.3
Long Term Steady State	2.4	2.6	3.4	2.2	2.8	3.0	1.3
Pseudo Static Seismic	1.7	2.3	2.2	1.1	1.8	2.0	1.1

*Soil nail wall

In the analysis of RW246, RW391, RW400N and RW403, soil nail walls were used; we assumed the critical circle falls outside the terminal ends of the soil nails (Case 1). For this analysis, we have assumed soil nails extend to 25 feet from the wall face; we define this as Case 1.

In the analysis of a portion of RW400N and all of RW400S, tiebacks are planned; we assumed the critical circle falls outside the terminal ends of the tiebacks. For this analysis, we have assumed tiebacks extend to 30 feet from the wall face; we define this as Case 2.

Based on our analyses, the computed minimum (critical) factor of safety for end of construction for the five walls ranges from 1.8 to 4.3, all of which exceed the minimum required value of 1.3.

Based on our analysis, the computed minimum (critical) factor of safety for long term steady state for the five walls ranges from 2.2 to 3.4, all of which exceed the minimum required value of 1.3.

Based on our analyses, the computed minimum (critical) factor of safety for the pseudo-static condition for the five walls ranges from 1.1 to 2.3, all of which exceed or equal the minimum required value of 1.1 (See guidelines for Structures Foundation Reports, March 2006, Version 2.0, Section 3.10).

An assessment of the potential for corrosion of various buried foundation and pipe structures was performed by V&A Consulting Engineers (V&A). The results of their investigation are presented in Appendix G. The following paragraphs include their summary and recommendations.

14.1 SUMMARY

V&A was retained by URS Corporation to perform a corrosion survey on State Highway 84, from Ruby Hill Drive to Jack London Boulevard, in Livermore, California. The objective of the investigation was to measure various soil parameters and evaluate the results with respect to possible levels of corrosion along the highway. The soil was tested at depths ranging from 0 to 62 feet below existing grade. This report provides recommendations for corrosion control of structural foundation materials under consideration for a proposed retaining wall between the Ruby Hill Drive and Vallecitos Road intersections and modifications to existing retaining structures at the Stanley Boulevard Underpass. The materials being considered as part of this investigation include buried reinforced concrete.

The investigation was conducted in accordance with California Department of Transportation's Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch "Corrosion Guidelines" (Guidelines) dated September 2003. These Guidelines consider representative soil or water samples to be corrosive to structural elements if one or more of the following conditions exist:

1. The chloride concentration is 500 ppm or greater,
2. The sulfate concentration is 2000 ppm or greater,
3. The pH is 5.5 or less.

Evaluation of the soil environment was made in terms of potential corrosion damage to concrete and metal structures. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, soil samples taken during a geotechnical investigation were provided to V&A for laboratory testing. The soil samples were analyzed for minimum (saturated) resistivity, as well as for pH, chloride and sulfate ion concentrations. All of these affect the corrosion rate of buried structures.

Soil samples were selected from two borings taken between the Ruby Hill Drive and Vallecitos Road intersections at the southern end of the Highway 84 project alignment. The minimum (saturated) resistivity of the samples ranged from 3,302 ohm-cm to 7,312 ohm-cm. The soil pH ranged from 7.5 to 8.6 and the water-soluble chloride concentrations ranged from below the detection limit of 2 mg/kg to 9 mg/kg. The water-soluble sulfate concentrations ranged from below the detection limit of 5 mg/kg to 7 mg/kg. The pH, chloride and sulfate ion concentrations all indicate the sampled soils are *non-corrosive* to metallic and reinforced concrete structures, as defined by the Guidelines.

14.2 CONCLUSIONS

The soil boring chemical analyses gave pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg, and soluble sulfate concentrations less than 2,000 mg/kg. According to the Guidelines, the soils at the proposed retaining wall site near the Vallecitos Road intersection and sites at the Stanley Boulevard Underpass are considered *non-corrosive.*

14.3 RECOMMENDATIONS

The test data and a review of the project requirements were used to make recommendations for the structural foundation material listed below.

14.3.1 Buried Reinforced Concrete Structures

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following for installations in *non-corrosive* soil:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 2 inches should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should also have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Based on sulfate ion concentrations, Type I-P (MS) modified or Type II modified cement should be used.

This study is intended for design purposes only. The opinions, conclusions and recommendations presented herein are based on available subsurface information developed by others and supplementary new borings. The recommendations presented in this report are based on the assumption that the soil and geologic conditions do not deviate substantially from those anticipated by the information contained in the logs of test borings.

Existing facilities, utilities, soils/bedrock conditions, road/structure distress, slope distress or groundwater/seepage conditions other than those noted herein have not been considered in the preparation of this report. Locating utilities and evaluating potential utility interference is outside the scope of this report. Individuals utilizing this report shall inform URS Corporation if they are aware of any additional facilities or site conditions so that their presence and impact upon the project (or vice-versa) can be properly evaluated and recommendations modified to address geotechnical issues as necessary.

The Geotechnical Engineer should be given the opportunity to review the final specifications and drawings to verify that those documents are consistent with the intent of the geotechnical recommendations.

Geotechnical issues may arise during construction that were not apparent at the time this report was prepared. The Geotechnical Engineer should be retained during construction to review the soil conditions encountered and the construction procedures used. All earthwork and wall construction and testing should be completed under the direct observation of the Geotechnical Engineer.

Specific review and investigation for environmental issues and subsurface environmental contamination were beyond the scope of our services.

The opinions and recommendations presented in this report were developed with the standard of care commonly used by other professionals practicing at the same time, within the same locality and under the same limitations. No other warranties are included, either express or implied, as to the professional advice included in this report.

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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Oakland, CA 94612

INDEX TO PLANS

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2-2	RETAINING WALL No. 246 - RETAINING WALL PLAN No. 1 OF 3
2-3	RETAINING WALL No. 246 - RETAINING WALL PLAN No. 2 OF 3
2-4	RETAINING WALL No. 246 - RETAINING WALL PLAN No. 3 OF 3
2-5	RETAINING WALL No. 391 - RETAINING WALL PLAN No. 1 OF 2
2-6	RETAINING WALL No. 391 - RETAINING WALL PLAN No. 1 OF 2
2-7	RETAINING WALL No. 400N - RETAINING WALL PLAN No. 1 OF 4
2-8	RETAINING WALL No. 400N - RETAINING WALL PLAN No. 2 OF 4
2-9	RETAINING WALL No. 400N - RETAINING WALL PLAN No. 3 OF 4
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2-12	RETAINING WALL No. 403 - RETAINING WALL PLAN No. 1 OF 2
2-13	RETAINING WALL No. 403 - RETAINING WALL PLAN No. 2 OF 2

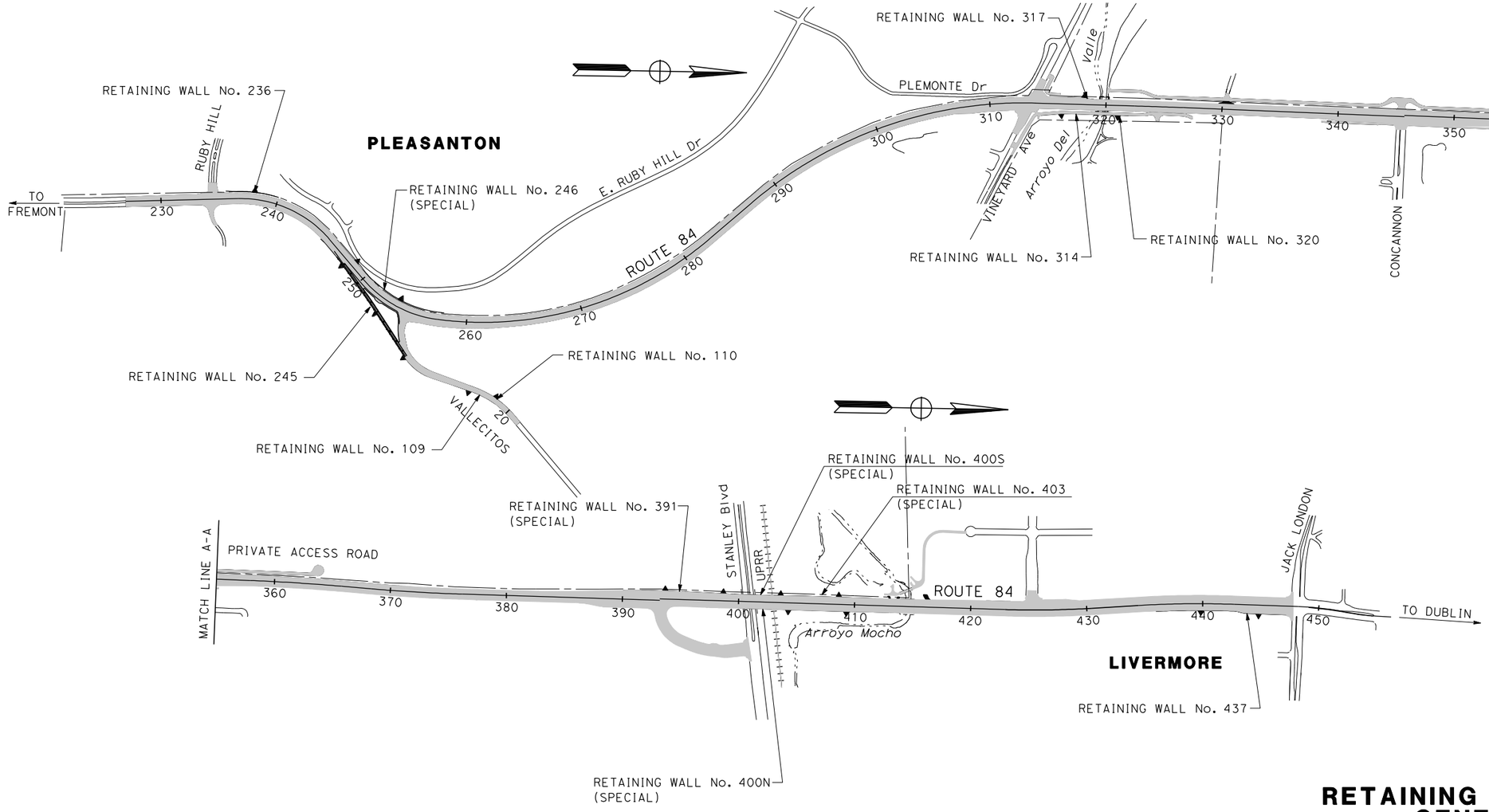

FIGURE 2-1

RETAINING WALL KEY MAP GENERAL PLAN

SCALE: 1" = 500'

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR
CALCULATED-DESIGNED BY
CHECKED BY
DRAWN BY
REVISED BY
DATE REVISED

LAST REVISION 00-00-00
DATE PLOTTED => 12/16/2009
TIME PLOTTED => 8:51:59 AM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

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DGN FILE => ...\Figures_Special RW\Fig 2-1.dgn

CU 04256

EA 297601

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

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MGE ENGINEERING, INC.
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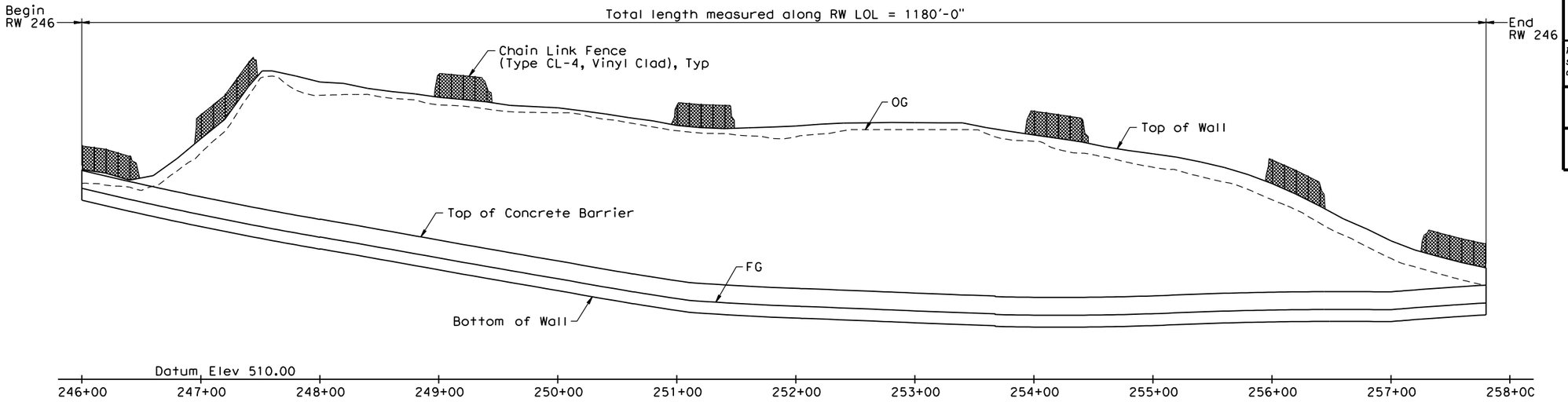
SACRAMENTO, CALIFORNIA 95831



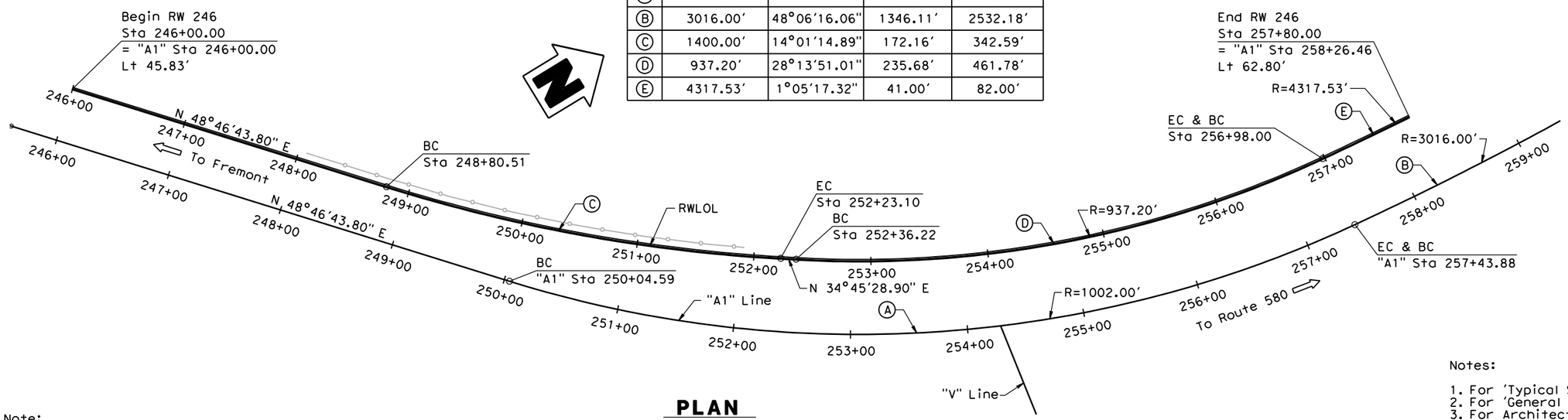
DEVELOPED ELEVATION

1" = 50'-0" (H); 1" = 10'-0" (V)

(Architectural Treatment not shown, see Note 3)

CURVE DATA TABLE

NO	R	Δ	T	L
(A)	1002.00'	42°16'25.03"	387.38'	739.29'
(B)	3016.00'	48°06'16.06"	1346.11'	2532.18'
(C)	1400.00'	14°01'14.89"	172.16'	342.59'
(D)	937.20'	28°13'51.01"	235.68'	461.78'
(E)	4317.53'	1°05'17.32"	41.00'	82.00'



PLAN

1" = 50'-0"

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

FIGURE 2-2

Notes:

1. For 'Typical Section', see "General Plan No. 2" sheet.
2. For 'General Notes', see "Index to Plan" sheet.
3. For Architectural Treatment, see "Soil Nail Wall Details No. 14" sheet.

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED E. Tang	LOAD FACTOR DESIGN	LIVE LOADING: SURCHARGE 240 PSF	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu PROJECT ENGINEER
SIGN OFF DATE	DETAILS	BY X. Sun	CHECKED G. Xu	LAYOUT BY G. Xu	CHECKED E. Tang		
	QUANTITIES	BY D. Vang	CHECKED R. Huang	SPECIFICATIONS BY K. Chen	PLANS AND SPECS COMPARED G. Xu		

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

BRIDGE NO.	RETAINING WALL 246
33E0075	
POST MILES	GENERAL PLAN No. 1
22.9	

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 02/05/09 05/01/09 01/22/10 08/16/10

SHEET 1 OF 21

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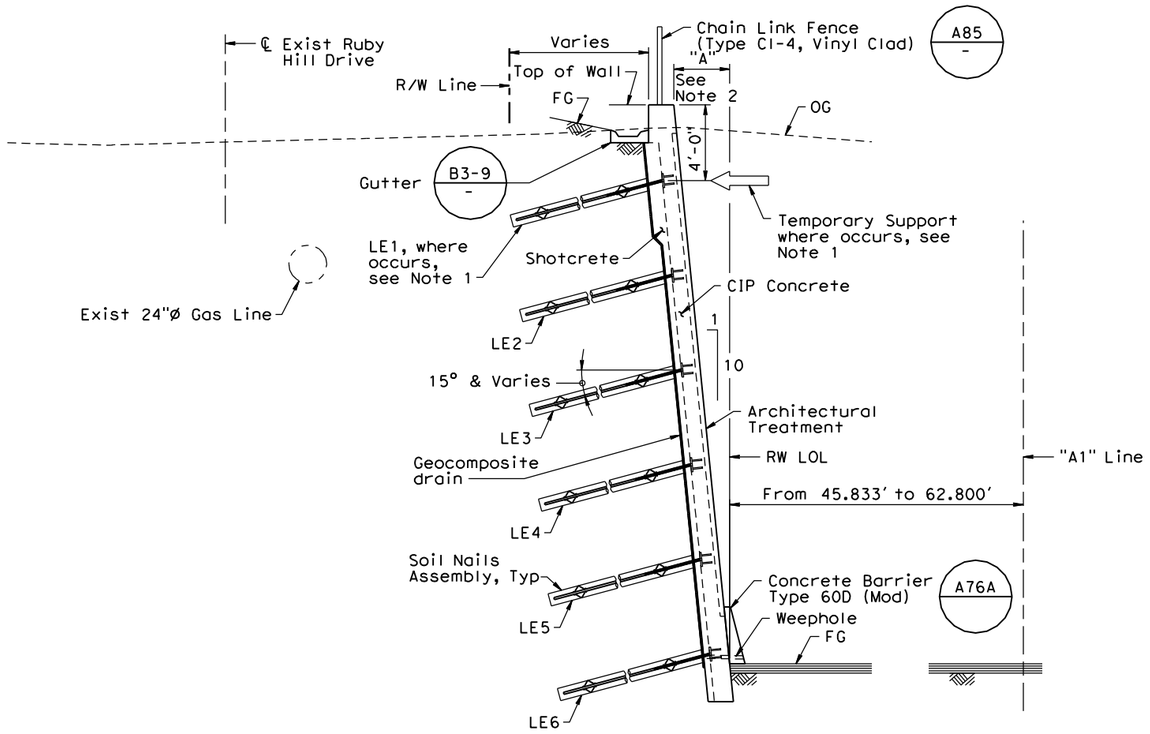
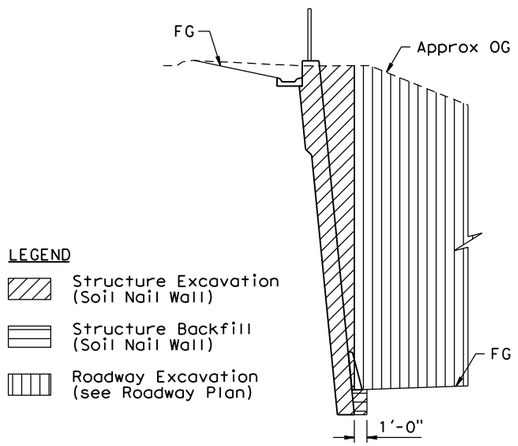


TYPICAL SECTION

1/4" = 1'-0"



SOIL NAIL WALL EXCAVATION AND BACKFILL PAY LIMITS

NO SCALE

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

GENERAL NOTES LOAD FACTOR DESIGN

DESIGN: Bridge Design Specifications April 2000 (LFD) (1996 AASHTO) with interims and revisions by Caltrans

Service Load Design Method per FHWA Manual for Design & Construction-Monitoring of Soil Nail Walls (FHWA-SA-96-069R and FHWAO-IF-03-017)

REINFORCED CONCRETE:
fy = 60,000 psi
f'c = 3,600 psi

SHOTCRETE:
fy = 60,000 psi
f'c = 3,600 psi

SOIL NAILS ASSEMBLY:
ASTM Designation: A615
fy = 60,000 psi
Nail grout f'c = 3,000 psi

STRUCTURAL STEEL:
ASTM Designation: A709
fy = 36,000 psi

DESIGN PARAMETERS: (Soil)
ø = 36°
C = 1,000 psf
γ = 130 pcf
Qd = 2.09 k/ft

PSEUDE-STATIC SEISMIC ACCELERATION: Coefficient = 0.17 g

LIVE LOAD: Surcharge = 240 psf

STANDARD PLANS

Dated May 2006

A10A	Acronyms and Abbreviations (Sheet 1 of 2)
A10B	Acronyms and Abbreviations (Sheet 2 of 2)
A10C	Symbols (Sheet 1 of 2)
A10D	Symbols (Sheet 2 of 2)
A62B	Limits of Payment for Excavation and Backfill Bridge Surcharge and Wall
A76A	Concrete Barrier Type 60D (Mod)
A85	Chain Link Fence
B3-9	Retaining Wall Details No. 2

Standard Plan sheet No.
Detail No.

ABBREVIATION LIST

LE# - Soil Nail Layer No.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

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PLANS APPROVAL DATE

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SACRAMENTO, CALIFORNIA 95831

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2	General Plan No. 2
3	Foundation Plan
4	Soil Nail Wall Details No. 1
5	Soil Nail Wall Details No. 2
6	Soil Nail Wall Details No. 3
7	Soil Nail Wall Details No. 4
8	Soil Nail Wall Details No. 5
9	Soil Nail Wall Details No. 6
10	Soil Nail Wall Details No. 7
11	Soil Nail Wall Details No. 8
12	Soil Nail Wall Details No. 9
13	Soil Nail Wall Details No. 10
14	Soil Nail Wall Details No. 11
15	Soil Nail Wall Details No. 12
16	Soil Nail Wall Details No. 13
17	Soil Nail Wall Details No. 14
18	Log of Test Borings (1 of 4)
19	Log of Test Borings (2 of 4)
20	Log of Test Borings (3 of 4)
21	Log of Test Borings (4 of 4)

FIGURE 2-3

Notes:

1. Top row of nails shall be replaced by temporary support from Sta 247+60 to Sta 252+20 in order to clear existing gas line. See "Soil Nail Wall Details No. 11" sheets for design information of temporary support.
2. For offset dimension "A", see 'Soil Nail Wall Profile' table on "Soil Nail Wall Details" sheets.

DESIGN OVERSIGHT
SIGN OFF DATE

	BY	CHECKED
DESIGN	G. Xu	E. Tang
DETAILS	X. Sun	G. Xu
QUANTITIES	D. Vang	R. Huang

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

BRIDGE NO. 33E0075
POST MILE 22.9

RETAINING WALL 246
GENERAL PLAN No. 2

DESIGN DETAIL SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

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SHEET 2 OF 21

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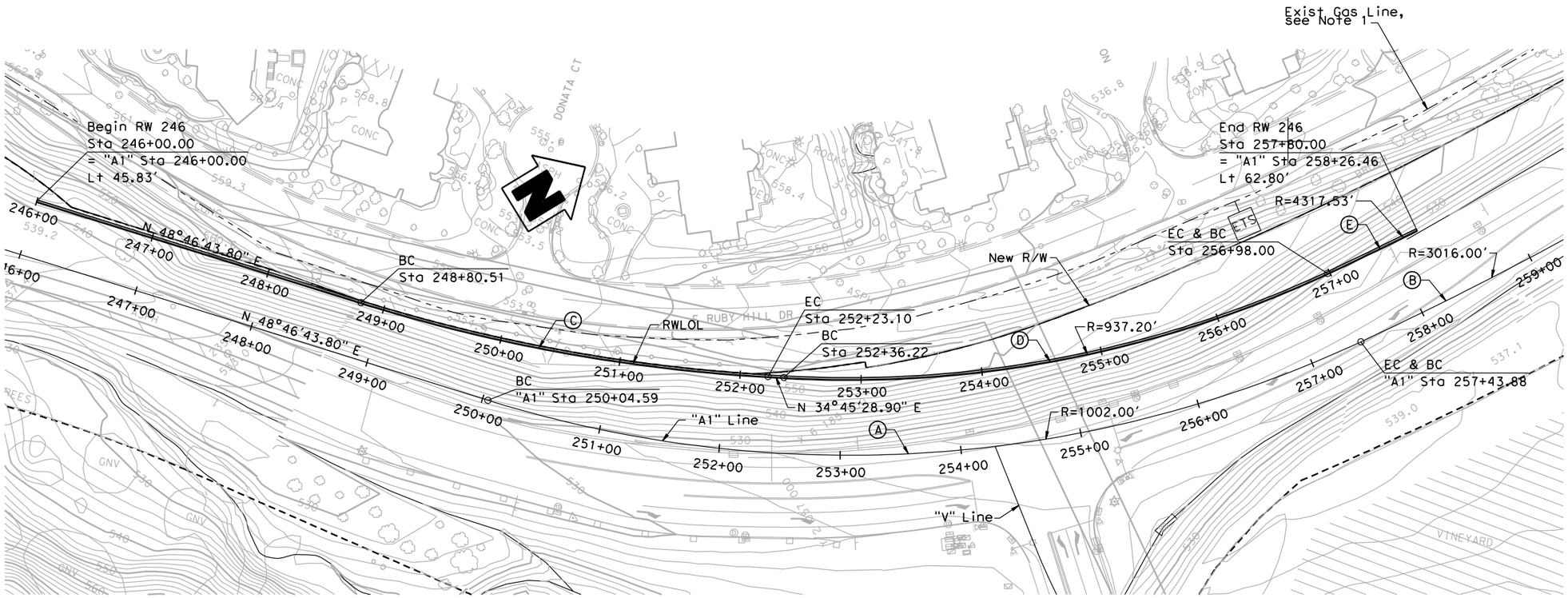

FOUNDATION PLAN

1" = 50'-0"

CURVE DATA TABLE

NO	R	Δ	T	L
Ⓐ	1002.00'	42°16'25.03"	387.38'	739.29'
Ⓑ	3016.00'	48°06'16.06"	1346.11'	2532.18'
Ⓒ	1400.00'	14°01'14.89"	172.16'	342.59'
Ⓓ	937.20'	28°13'51.01"	235.68'	461.78'
Ⓔ	4317.53'	1°05'17.32"	41.00'	82.00'

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

Note:

1. For elevation of existing Gas Line, see 'Civil Plans'.

FIGURE 2-4

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84			

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PLANS APPROVAL DATE _____

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Stephen Huang 08/18/2010
GEOTECHNICAL PROFESSIONAL APPROVAL DATE

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SIGN OFF DATE

SCALE:	VERT.DATUM NAVD 88	HORZ.DATUM NAD 83			
PHOTOGRAMMETRY AS OF: 11/10/2005		ALIGNMENT TIES Dist. Traverse Sheet			
SURVEYED	BY Dan Scott	DRAFTED	BY Abhijeet Bhoi		
FIELD CHECKED	BY Dan Scott	CHECKED	BY		

DESIGN	BY G. Xu	CHECKED E. Tang	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
DETAILS	BY X. Sun	CHECKED G. Xu	
QUANTITIES	BY D. Vang	CHECKED R. Huang	

Guoping Xu
PROJECT ENGINEER

BRIDGE NO.	RETAINING WALL 246
33E0075	
POST MILE	FOUNDATION PLAN
22.9	

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SHEET 3 OF 21

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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04	Ala	84			

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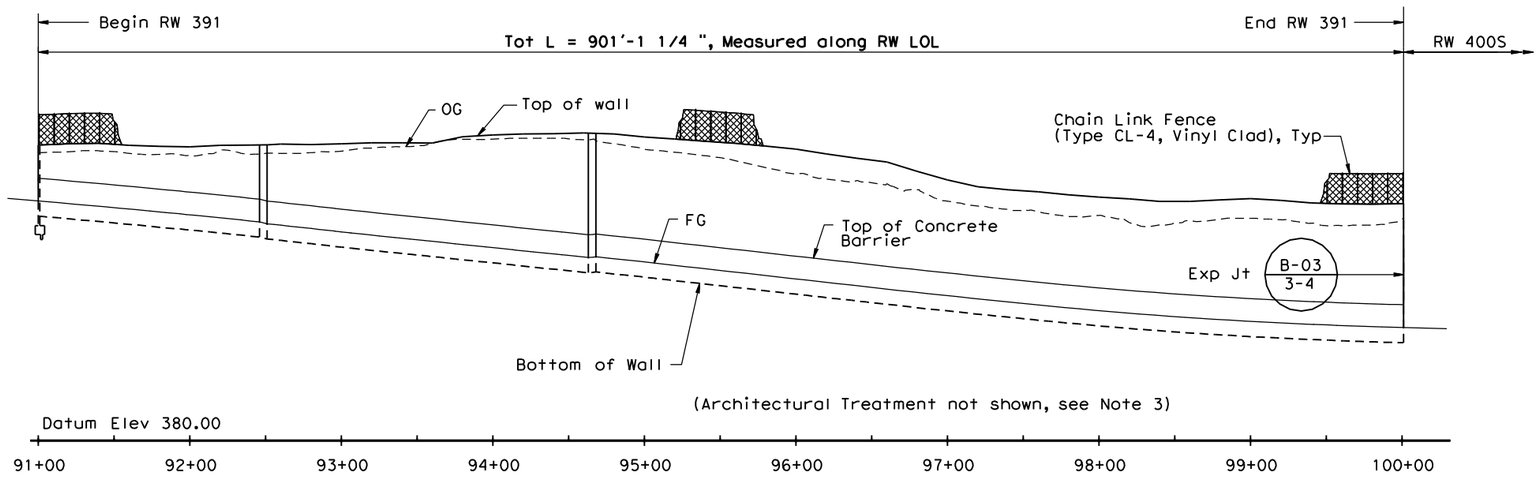
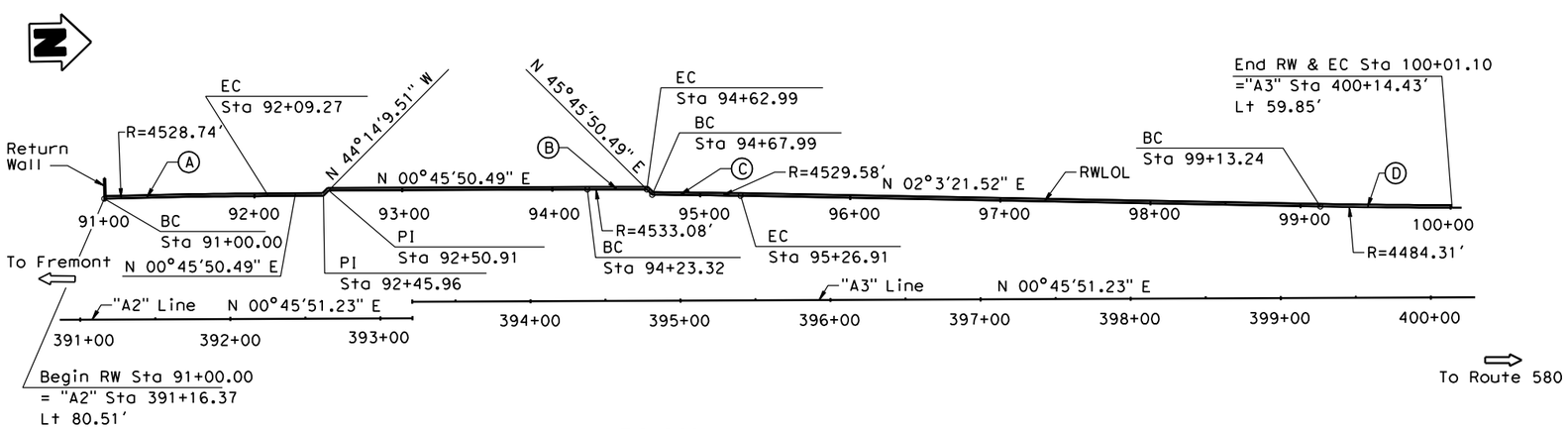
QUANTITIES

FIGURE 2-5



DEVELOPED ELEVATION

SCALE: 1" = 50'-0" (H)
1" = 10'-0" (V)

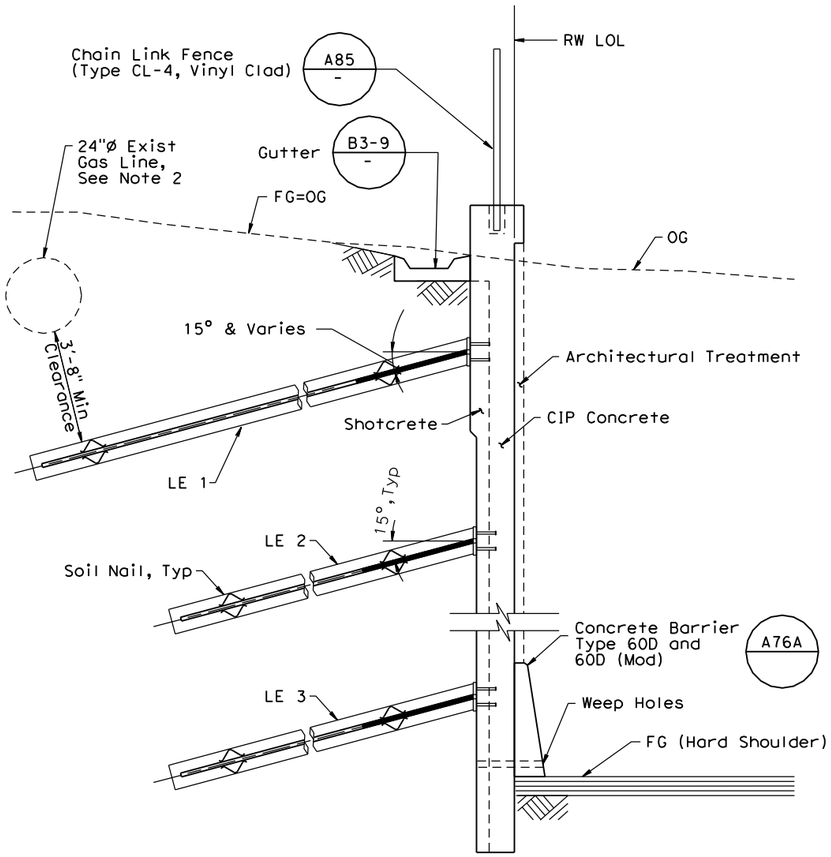


PLAN

SCALE: 1" = 50'-0"

CURVE DATA TABLE

NO	R	Δ	T	L
Ⓐ	4528.74'	1°22'56.79"	54.64'	109.27'
Ⓑ	4533.08'	0°30'5.06"	19.84'	39.67'
Ⓒ	4529.58'	0°44'43.01"	29.46'	58.92'
Ⓓ	4484.31'	1°7'21.39"	43.93'	87.86'



TYPICAL SECTION

1/2" = 1'-0"

Notes:

1. For 'General Notes', see "Foundation Plan" sheet.
2. See Utility Plans for location of existing gas line.
3. For Architectural Treatment, see "Architectural Treatment Layout" sheet.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED E. Tang	LOAD FACTOR DESIGN	LIVE LOAD: SURCHARGE 240 PSF		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu, PROJECT ENGINEER	BRIDGE NO. 33E0076	RETAINING WALL 391
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED E. Tang	LAYOUT	BY G. Xu	CHECKED E. Tang			POST MILES 27.00	GENERAL PLAN
	QUANTITIES	BY D. Yang	CHECKED R. Huang	SPECIFICATIONS	BY K. Chen	PLANS AND SPECS COMPARED G. Xu				

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

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SHEET 1 OF 16

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04	Ala	84			

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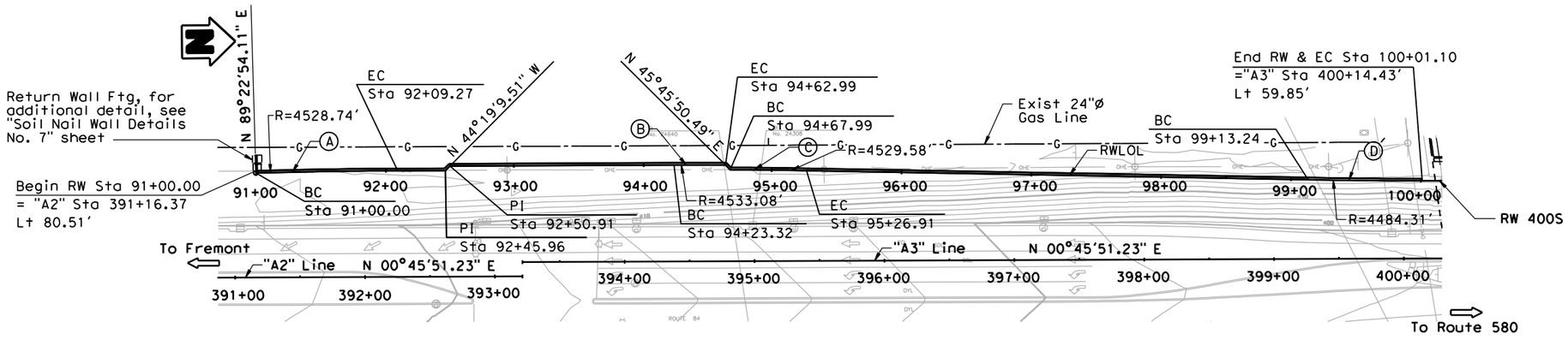

FOUNDATION PLAN

SCALE: 1" = 50'-0"

GENERAL NOTES
LOAD FACTOR DESIGN

DESIGN:	Bridge Design Specifications April 2000 (LFD) (1996 AASHTO) with interims and revisions by Caltrans Service Load Design Method per FHWA Manual for Design & Construction Monitoring of Soil Nail Walls (FHWA-SA-96-069R and FHWA O-IF-03-017)
REINFORCED CONCRETE:	fy = 60,000 psi f'c = 3,600 psi
SHOTCRETE:	fy = 60,000 psi f'c = 3,600 psi
SOIL NAILS ASSEMBLY:	ASTM Designation: A615 fy = 60,000 psi
STRUCTURAL STEEL:	ASTM Designation: A709 fy = 36,000 psi
DESIGN SOIL PARAMETERS:	ø = 34° (Effective) C = 800 psf γ = 130 pcf Qd = 1.67 k/ft
LIVE LOAD SURCHARGE:	240 psf (Vertical)
SEISMIC LOAD:	Pseudo-static Seismic Coefficient = 0.17g

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

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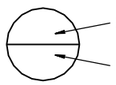
7	Soil Nail Wall Details No. 5
8	Soil Nail Wall Details No. 6
9	Soil Nail Wall Details No. 7
10	Soil Nail Wall Details No. 8
11	Soil Nail Wall Details No. 9
12	Architectural Treatment Layout
13	Log of Test Borings (1 of 4)
14	Log of Test Borings (2 of 4)
15	Log of Test Borings (3 of 4)
16	Log of Test Borings (4 of 4)

STANDARD PLANS
Dated May 2006

A10A	Acronyms and Abbreviations (Sheet 1 of 2)
A10B	Acronyms and Abbreviations (Sheet 2 of 2)
A10C	Symbols (Sheet 1 of 2)
A10D	Symbols (Sheet 2 of 2)
A62B	Limits of Payment for Excavation and Backfill Bridge Surcharge and Wall
A76A	Concrete Barrier Type 60D and 60D (Modified)
A85	Chain Link Fence
B0-1	Bridge Details
B0-3	Bridge Details
B3-3	Regaining Wall Type 1A
B3-8	Retaining Wall Details No. 1
B3-9	Retaining Wall Details No. 2



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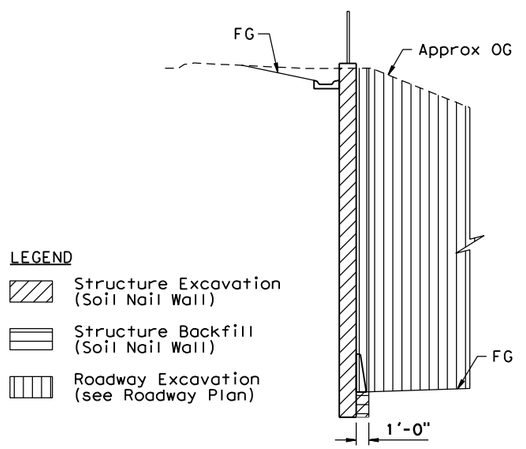

LEGEND

- Structure Excavation (Soil Nail Wall)
- Structure Backfill (Soil Nail Wall)
- Roadway Excavation (see Roadway Plan)

SOIL NAIL WALL EXCAVATION AND BACKFILL

NO SCALE

FIGURE 2-6

Stephen Huang — GEOTECHNICAL PROFESSIONAL — 08/18/2010 — APPROVAL DATE

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	PHOTOGRAMMETRY AS OF: 11/10/2005	ALIGNMENT TIES Dist. Traverse Sheet		DETAILS	BY K. Wang	CHECKED E. Tang	
SIGN OFF DATE	SURVEYED BY Dan Scott	DRAFTED BY Abhijeet Bhoi		QUANTITIES	BY D. Vang	CHECKED R. Huang	
FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)	FIELD CHECKED BY Dan Scott	CHECKED BY		ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO.	RETAINING WALL 391
33E0076	FOUNDATION PLAN
POST MILE 27.00	

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 12/05/08 01/27/10 08/16/10

SHEET 2 OF 16

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DATE PLOTTED => 8/20/2010 TIME PLOTTED => 11:49:05 AM USERNAME => Peter

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — DUAN WANG — No. C61943 — Exp. 06/30/11 — CIVIL — STATE OF CALIFORNIA

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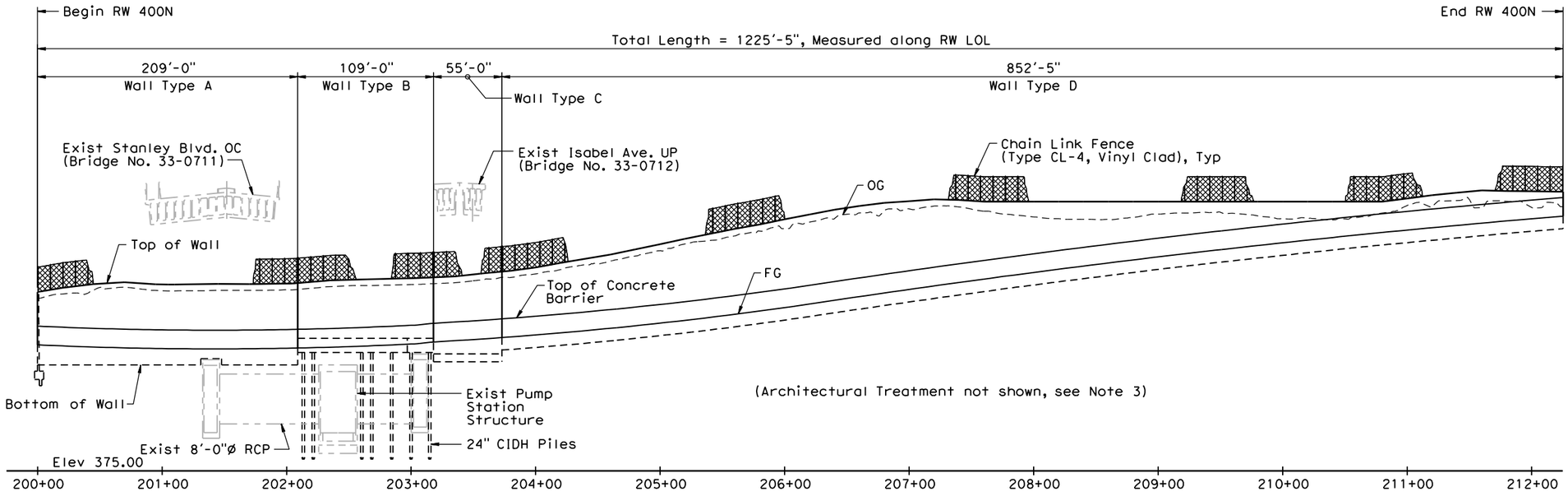
MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



MIRROR DEVELOPED ELEVATION

1" = 50'-0" (H); 1" = 10'-0" (V)

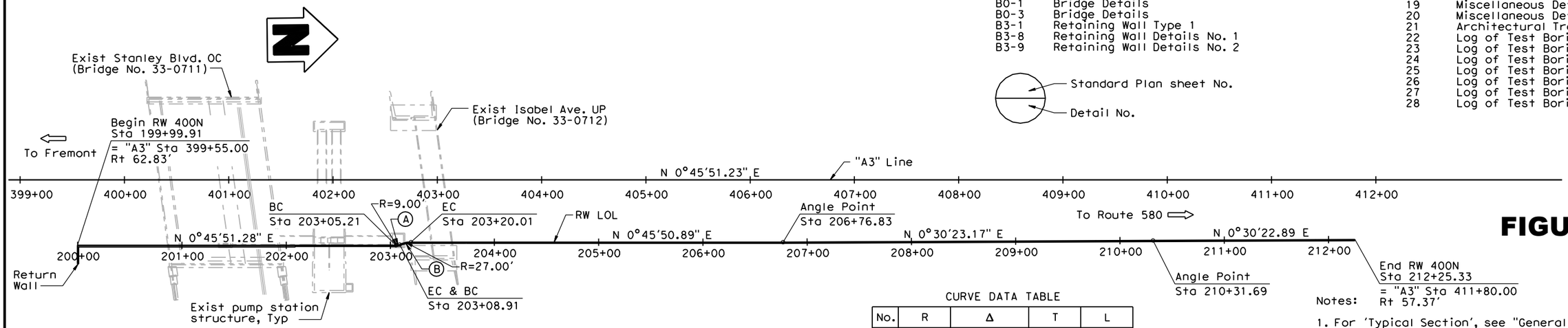
STANDARD PLANS

Dated May 2006

A10A	Acronyms and Abbreviations (Sheet 1 of 2)
A10B	Acronyms and Abbreviations (Sheet 2 of 2)
A10C	Symbols (Sheet 1 of 2)
A10D	Symbols (Sheet 2 of 2)
A62B	Limits of Payment for Excavation and Backfill Bridge Surcharge and Wall
A76A	Concrete Barrier Type 60
A85	Chain Link Fence
B0-1	Bridge Details
B0-3	Bridge Details
B3-1	Retaining Wall Type 1
B3-8	Retaining Wall Details No. 1
B3-9	Retaining Wall Details No. 2

INDEX TO PLANS

Sheet No.	Title
1	General Plan No. 1
2	General Plan No. 2
3	Foundation Plan
4	Wall Type A Details No. 1
5	Wall Type A Details No. 2
6	Wall Type A Details No. 3
7	Wall Type A Details No. 4
8	Wall Type B Details No. 1
9	Wall Type B Details No. 2
10	Wall Type B Details No. 3
11	Wall Type C Details No. 1
12	Wall Type C Details No. 2
13	Wall Type D Details No. 1
14	Wall Type D Details No. 2
15	Wall Type D Details No. 3
16	Wall Type D Details No. 4
17	Wall Type D Details No. 5
18	Wall Type D Details No. 6
19	Miscellaneous Details No. 1
20	Miscellaneous Details No. 2
21	Architectural Treatment Layout
22	Log of Test Borings (1 of 7)
23	Log of Test Borings (2 of 7)
24	Log of Test Borings (3 of 7)
25	Log of Test Borings (4 of 7)
26	Log of Test Borings (5 of 7)
27	Log of Test Borings (6 of 7)
28	Log of Test Borings (7 of 7)



PLAN

1" = 50'-0"

CURVE DATA TABLE

No.	R	Δ	T	L
(A)	9.00'	23°33'04.6"	1.88'	3.70'
(B)	27.00'	23°33'04.2"	5.63'	11.10'

Notes:

1. For 'Typical Section', see "General Plan No. 2" sheet.
2. For 'General Notes', see "Foundation Plan" sheet.
3. For Architectural Treatment, see "Architectural Treatment Layout" sheet.
4. For 'Pile Data Table', see "Wall Type B Details No. 1" sheet.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

FIGURE 2-7

DESIGN OVERSIGHT	DESIGN	BY D. Wang / E. Tang	CHECKED G. Xu / R. Huang	LOAD FACTOR DESIGN	LIVE LOADING: SURCHARGE 240 PSF	
SIGN OFF DATE	DETAILS	BY X. Sun	CHECKED G. Xu	LAYOUT	BY D. Wang	CHECKED G. Xu
	QUANTITIES	BY D. Wang / D. Vang	CHECKED W. Sennett	SPECIFICATIONS	BY K. Chen	PLANS AND SPECS COMPARED G. Xu

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO.	33E0079
POST MILES	27.00

RETAINING WALL 400N

GENERAL PLAN No. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 05/01/09 | 01/22/10 | 08/16/10

SHEET 1 OF 28

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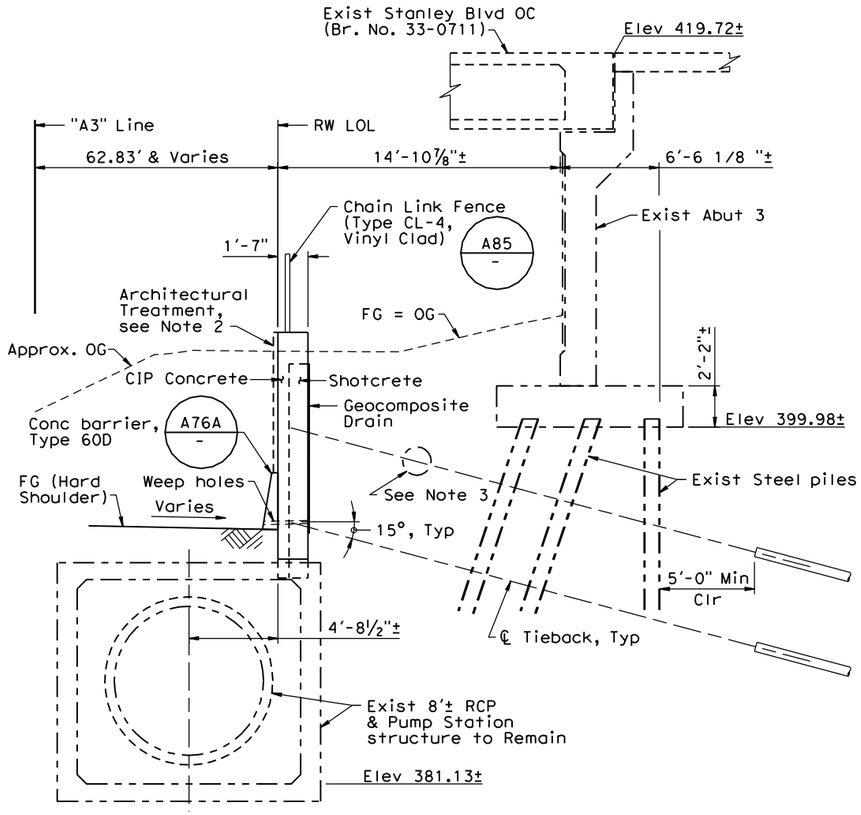
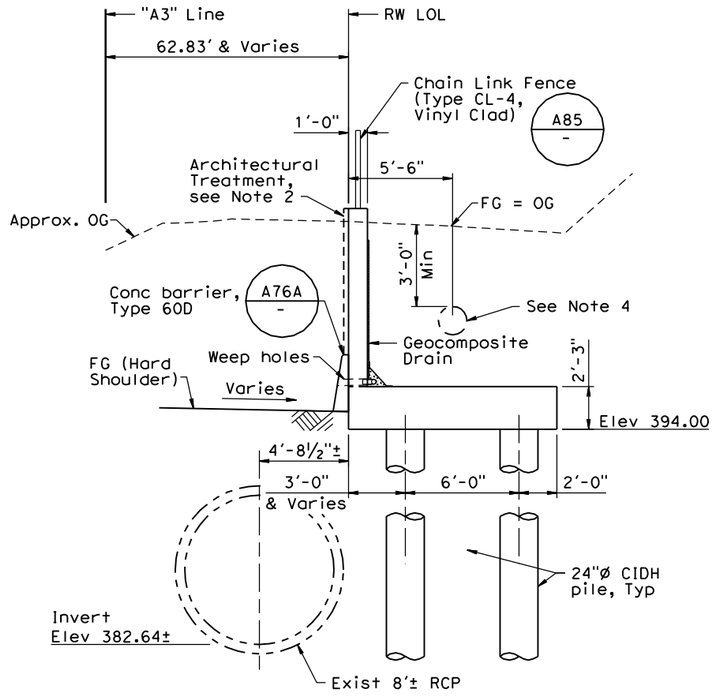
USERNAME => Peter DATE PLOTTED => 8/13/2010 TIME PLOTTED => 10:18:58 AM



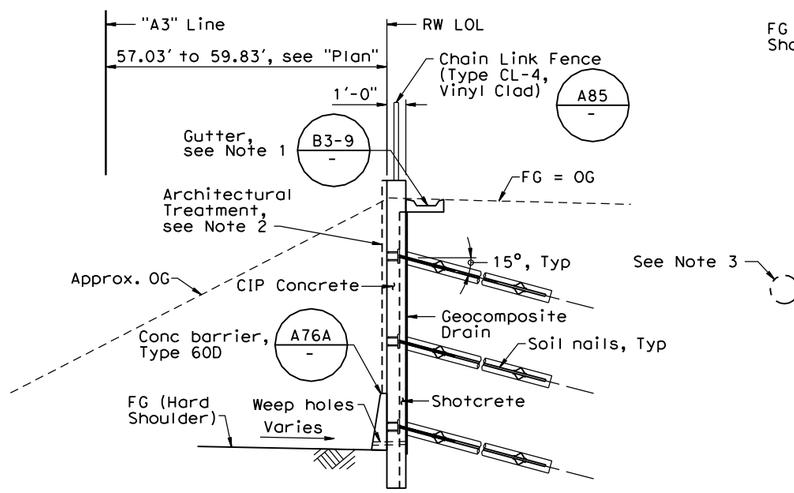
WALL TYPE A TYPICAL SECTION

1/4" = 1'-0"



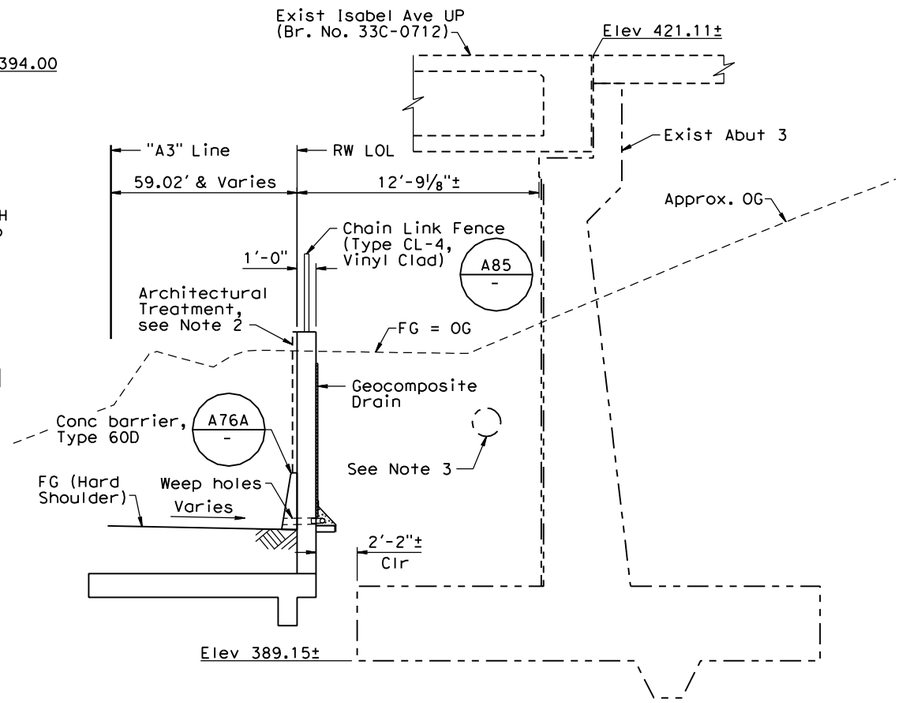
WALL TYPE B TYPICAL SECTION

1/4" = 1'-0"



WALL TYPE D TYPICAL SECTION

1/4" = 1'-0"



WALL TYPE C TYPICAL SECTION

1/4" = 1'-0"

Notes:

1. Gutter is present only at Type D Wall, See "Civil Plans".
2. For architectural treatment, see "Architectural Treatment Details" sheet.
3. Exist 18"ø Reclaimed Water Line to remain. See "Utility Plans" for exact locations. Adjust soil nail / tieback angle or height locally as necessary to clear existing water line with minimum clearance of 1'-0".
4. Exist 18"ø Reclaimed Water Line to be temporarily removed prior to constuction of Wall Type B and replaced afterwards. See Civil Plan sheet "W-5" for details.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

FIGURE 2-8

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — DUAN WANG — No. C61943 — Exp. 06/30/11 — CIVIL — STATE OF CALIFORNIA

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MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN	BY D. Wang / E. Tang	CHECKED G. Xu / R. Huang	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
DETAILS	BY X. Sun	CHECKED G. Xu	
QUANTITIES	BY D. Wang / D. Vang	CHECKED W. Sennett	

DESIGN OVERSIGHT

SIGN OFF DATE

Guoping Xu
PROJECT ENGINEER

BRIDGE NO.	RETAINING WALL 400N
33E0079	
POST MILE	GENERAL PLAN No. 2
27.00	

DESIGN DETAIL SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

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SHEET 2 OF 28

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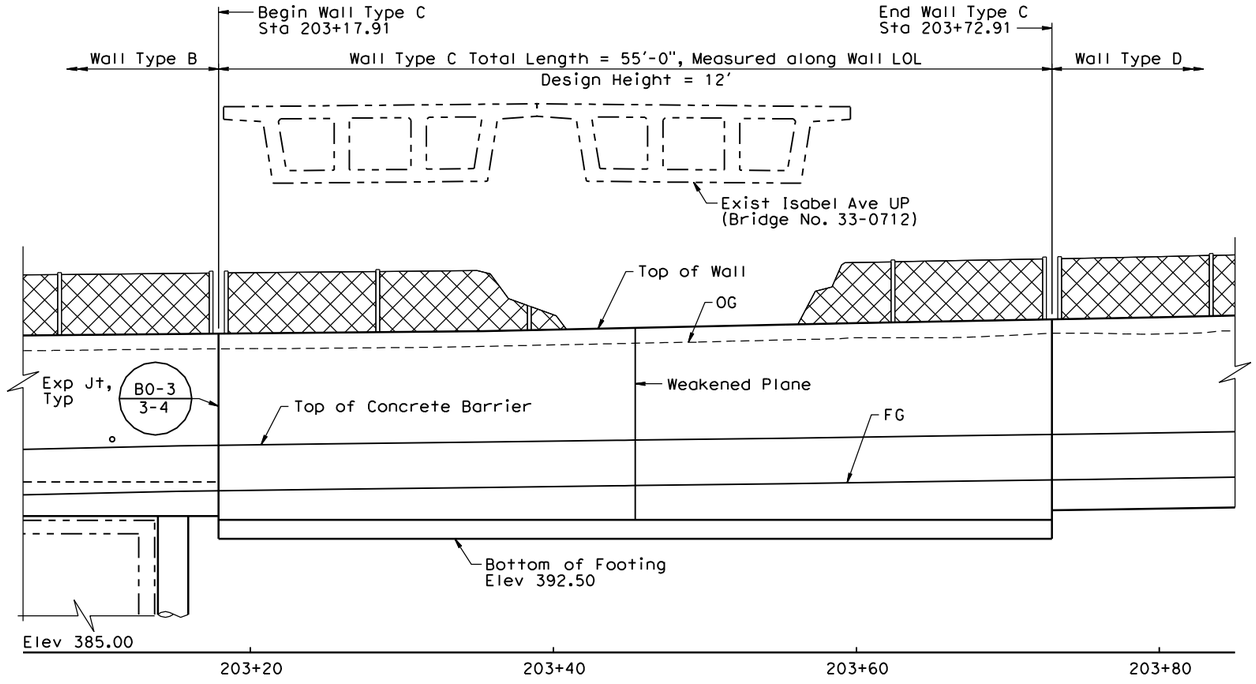


WALL TYPE C MIRROR DEVELOPED ELEVATION

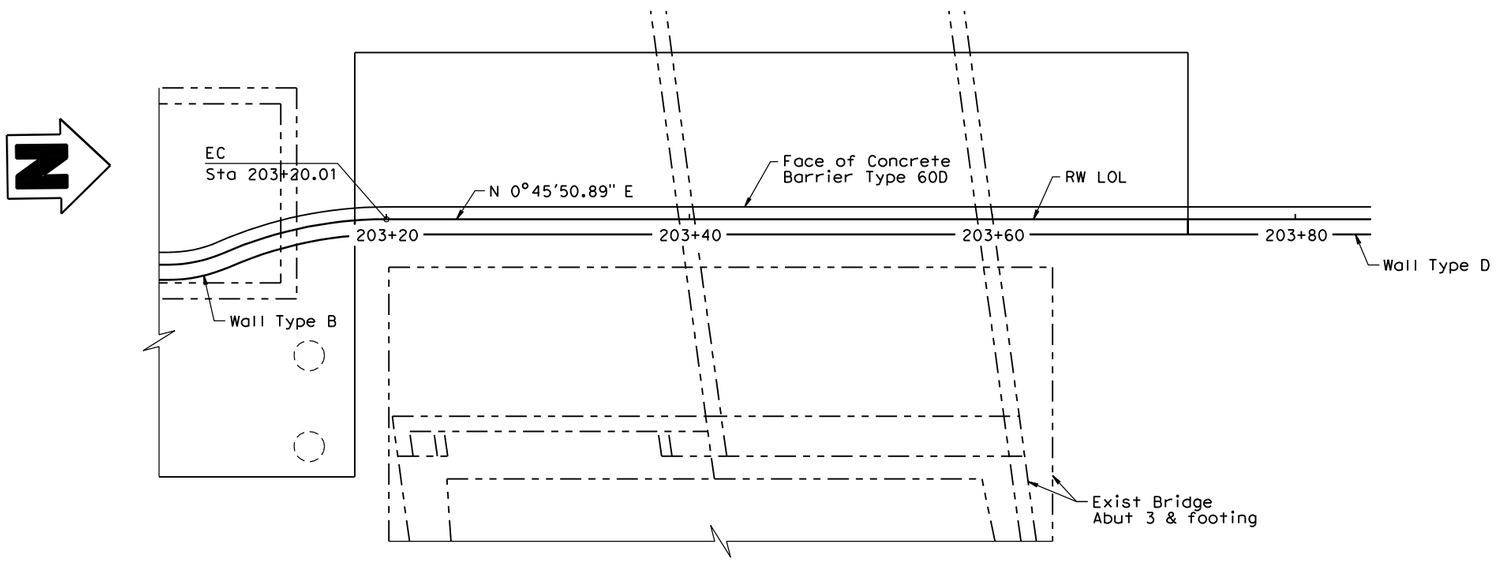
1" = 5'-0"

WALL TYPE C PROFILE

Station	Bottom of Footing Elev	Top of Wall Elev
203+17.91	392.50	406.03
203+35.32	392.50	406.20
203+55.32	392.50	406.66
203+60.00	392.50	406.73
203+72.91	392.50	406.97

WALL TYPE C DESIGN NOTES:

Minimum Allowable Bearing Pressure = 6 psf



WALL TYPE C PLAN VIEW

1" = 5'-0"

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

FIGURE 2-9

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT

SIGN OFF DATE

	BY	CHECKED
DESIGN	D. Wang / E. Tang	G. Xu / R. Huang
DETAILS	X. Sun	G. Xu
QUANTITIES	D. Wang / D. Vang	W. Sennett

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO. 33E0079
POST MILE 27.00

RETAINING WALL 400N

WALL TYPE C DETAILS No. 1

DESIGN DETAIL SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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SHEET 11 OF 28

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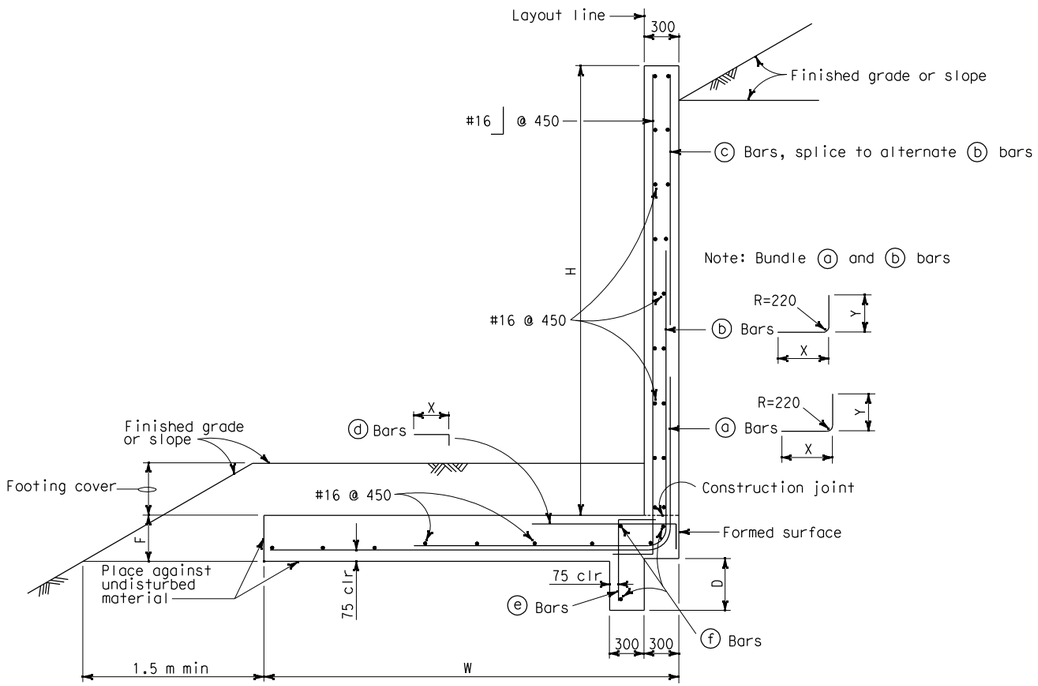
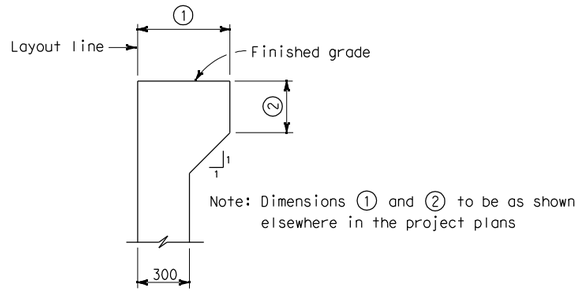


TYPICAL SECTION

Note: For details not shown, see B3-8



HAUNCH FOR CONCRETE BARRIER

TABLE OF DIMENSIONS AND REINFORCING STEEL

DESIGN H (m)	1.2	1.82	2.4	3.0	3.6
W (m)	1.2	1.6	2.2	2.8	3.6
F (m)	.30	.30	.38	.38	.38
D (m)	.22	.22	.22	.45	.45
FOOTING COVER (m)	.30 min	.30 min	.45 min	.45 min	.45 min
ⓐ Bars	#16 @ 450	#16 @ 300	#19 @ 300	#19 @ 300	#19 @ 230
X	Cont	Cont	Cont	Cont	Cont
Y	Cont	Cont	Cont	1.5 m	1.5 m
ⓑ Bars	———	———	———	#19 @ 300	#19 @ 230
X	———	———	———	1.6 m	2.2
Y	———	———	———	Cont	2.5
ⓒ Bars	———	———	———	———	#16 @ 450
ⓓ Bars	———	———	———	#16 @ 300	#16 @ 300
X	———	———	———	1.2	1.2
ⓔ Bars	———	———	———	#16 @ 300	#16 @ 300
ⓕ Bars	———	———	———	3-#16	3-#16

Cont = Continuous

GENERAL NOTES

Design: Service load design
Loading case:
1. Level slope with 240 psf surcharge
2. 2:1 unlimited slope

Concrete: n=9, f'_c =3250 psi, f_c= 1300 psi
Reinforcing steel: fy=60,000 psi f_s=24,000 psi
Soil:
Backfill: Ø=34°, γ=120 pcf
Foundation: Ø=34°, c=200 psf, γ=120 pcf
Minimum allowable bearing pressure=2.0 ksf

Lateral earth pressure: Coulomb's theory with δ=0°
Seismic:
1. Level slope, k_h=0.3g
2. 2:1 unlimited slope, k_h=0.1g

FIGURE 2-10

NO SCALE

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Caltrans Metric

REGISTERED ENGINEER - CIVIL

PLANS APPROVAL DATE

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STANDARD DRAWING

RELEASE DATE	9/22/93	DESIGN	BY J.C. MOESE	CHECKED O. HOR	RELEASED BY
FILE NO.	xs14-010	DETAILS	BY R. YEE	CHECKED O. HOR	
		SUBMITTED	BY J.C. MOESE	DRAWING DATE 10/92	OFFICE CHIEF

DS OSD 2147A (METRIC) (REV. 2/25/97)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

CU
EA

BRIDGE NO.

KILOMETER POST

RETAINING WALL TYPE 7, H = 1.2-3.6 m

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USERNAME => madhu_thummaluru

...\Fig 2-10.dgn

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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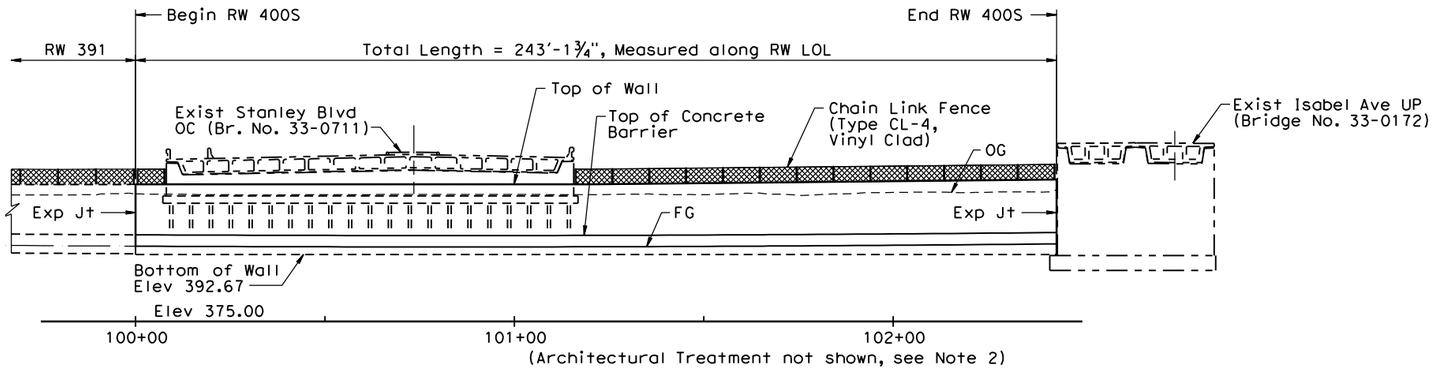


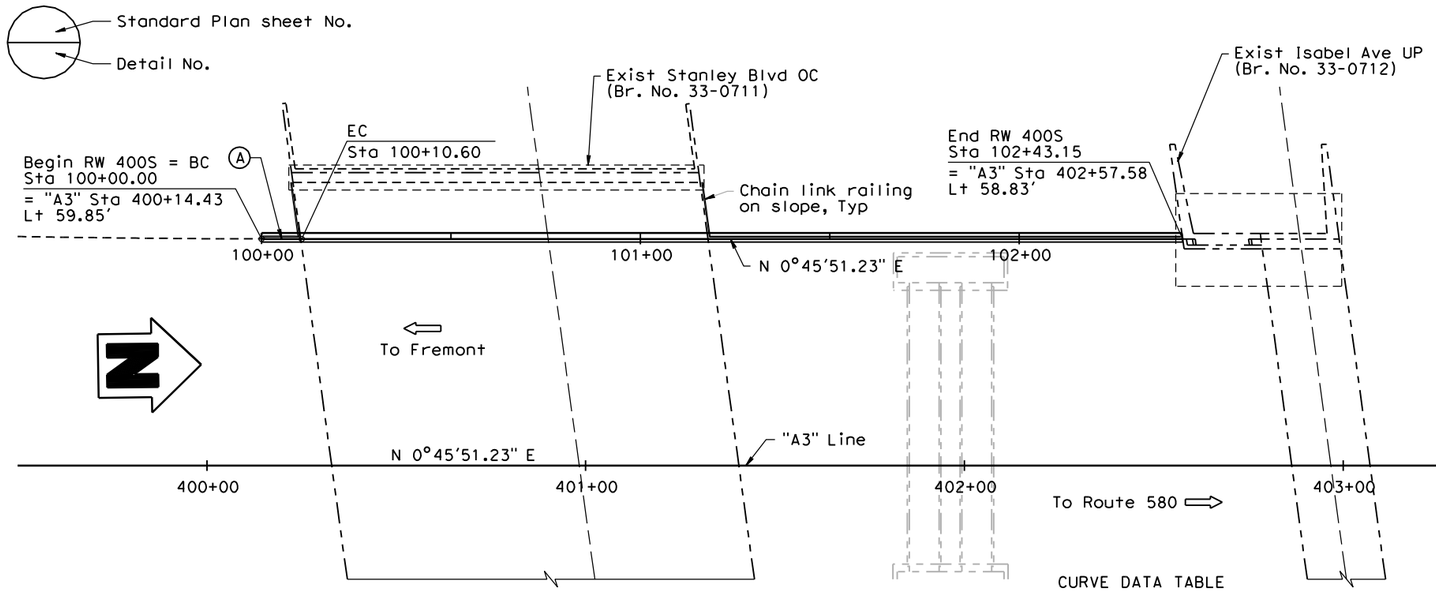
DEVELOPED ELEVATION
1" = 20'-0"

STANDARD PLANS
Dated May 2006

A10A	Acronyms and Abbreviations (Sheet 1 of 2)
A10B	Acronyms and Abbreviations (Sheet 2 of 2)
A10C	Symbols (Sheet 1 of 2)
A10D	Symbols (Sheet 2 of 2)
A76A	Concrete Barrier Type 60
A85	Chain Link Fence
B3-9	Retaining Wall Details No. 2

INDEX TO PLANS

Sheet No.	Title
1	General Plan
2	Foundation Plan
3	Tieback Wall Details No. 1
4	Tieback Wall Details No. 2
5	Tieback Wall Details No. 3
6	Exist Log of Test Borings (1 of 2)
7	Exist Log of Test Borings (2 of 2)

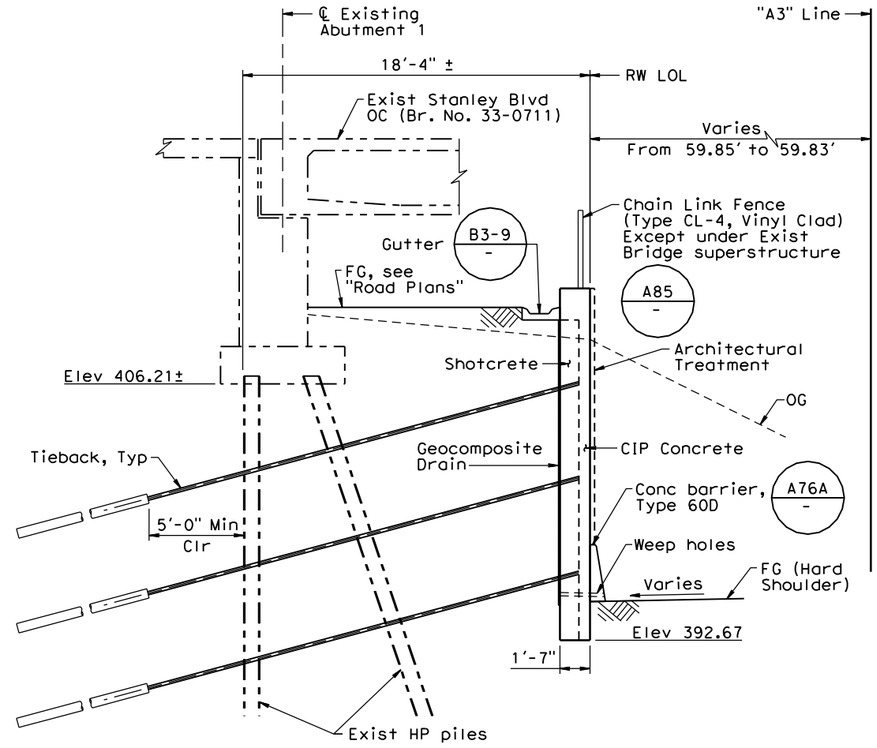


PLAN
1" = 20'-0"

CURVE DATA TABLE

No.	R	Δ	T	L
Ⓐ	4484.32'	0°08'07.5"	5.30'	10.60'

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.



TYPICAL SECTION
1/4" = 1'-0"

Notes:
1. For 'General Notes', see "Foundation Plan" sheet.
2. For Architectural Treatment, see "Tieback Wall Details No. 2" sheet.

FIGURE 2-11

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED D. Wang	LOAD FACTOR DESIGN	LIVE LOADING: SURCHANGE 240 PSF		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	DETAILS	BY X. Sun	CHECKED D. Wang	LAYOUT	BY G. Xu	CHECKED D. Wang	
SIGN OFF DATE	QUANTITIES	BY E. Tang	CHECKED W. Sennett	SPECIFICATIONS	BY K. Chen	PLANS AND SPECS COMPARED G. Xu	

Guoping Xu
PROJECT ENGINEER

BRIDGE NO. 33E0078
POST MILES 27.00

RETAINING WALL 400S
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04254
EA 297601

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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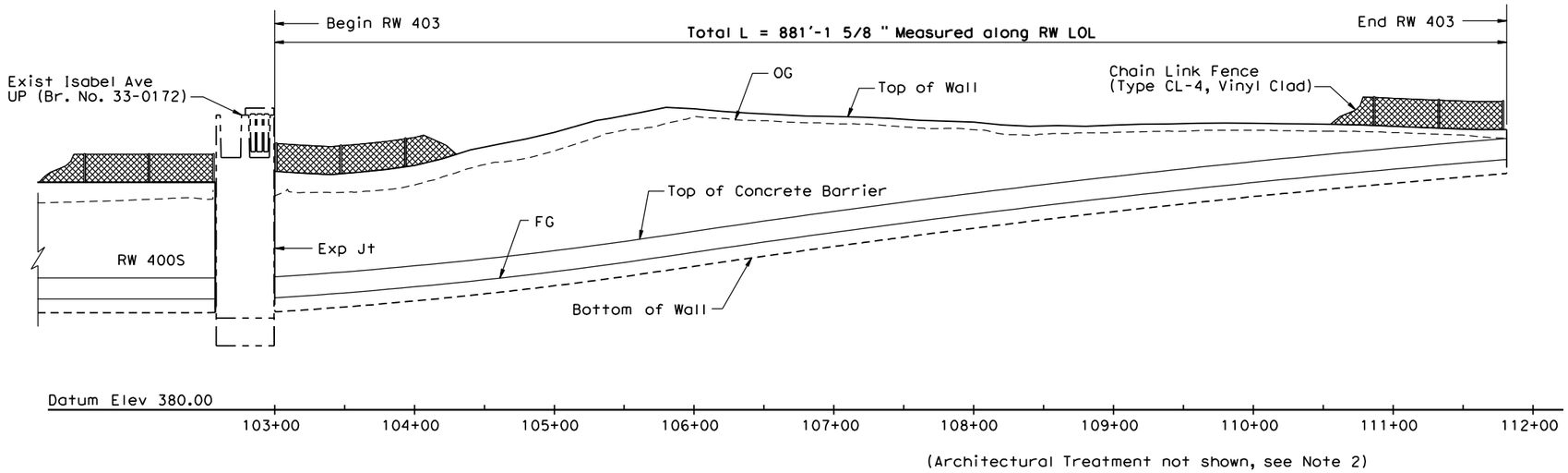
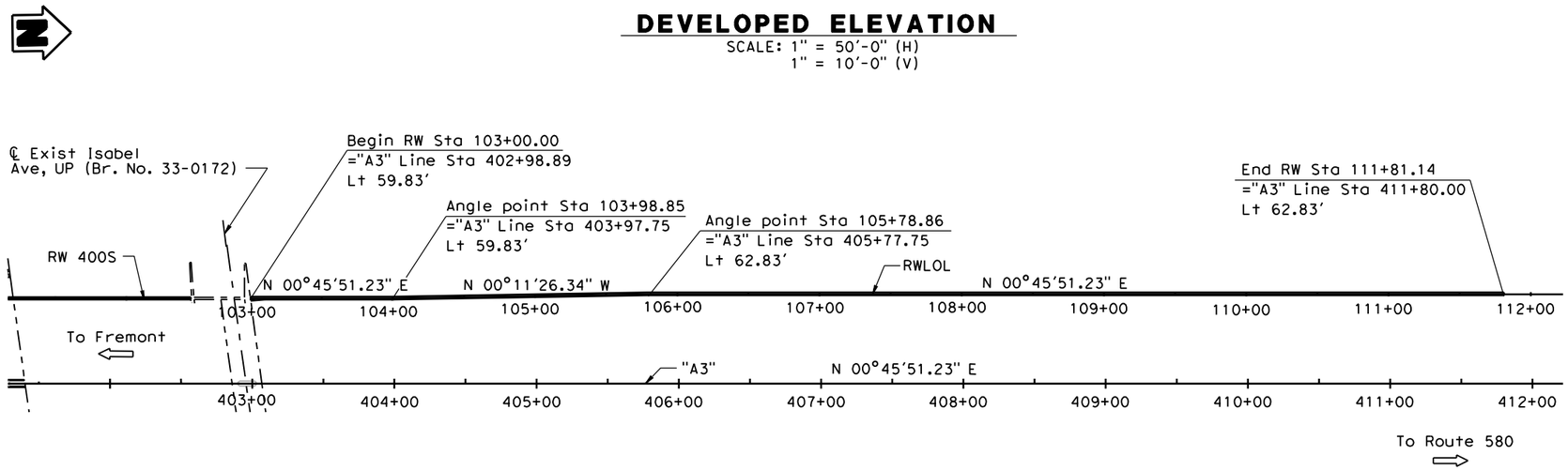
SACRAMENTO, CALIFORNIA 95831



(Architectural Treatment not shown, see Note 2)

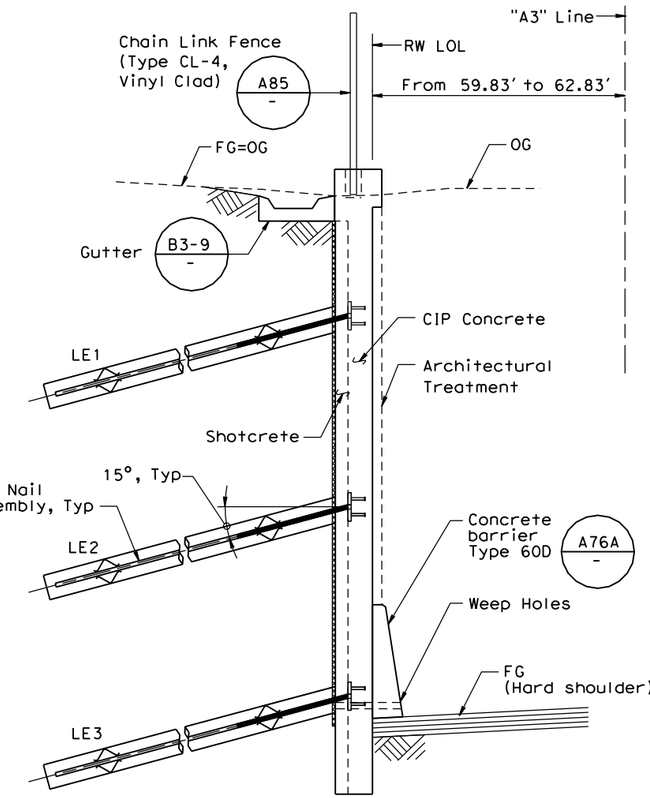
DEVELOPED ELEVATION

SCALE: 1" = 50'-0" (H)
1" = 10'-0" (V)



PLAN

SCALE: 1" = 50'-0"



TYPICAL SECTION

SCALE: 1/2" = 1'-0"

Notes:

1. For "General Notes", see "Foundation Plan" sheet.
2. For Architectural Treatment, see "Architectural Treatment Layout" sheet.
3. For expansion joint details, see "Soil Nail Wall Details No. 7" sheet.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

FIGURE 2-12

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED E. Tang	LOAD FACTOR DESIGN	LIVE LOAD: SURCHARGE 240 PSF	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu PROJECT ENGINEER
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED E. Tang	LAYOUT	BY G. Xu / CHECKED E. Tang		
	QUANTITIES	BY D. Vang	CHECKED W. Sennett	SPECIFICATIONS	BY K. Chen / PLANS AND SPECS COMPARED G. Xu		

CU 04254
EA 297601

BRIDGE NO. 33E0077
POST MILES 27.00

RETAINING WALL 403
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GUOPING XU — No. C 63977 — Exp. 09/30/10 — CIVIL — STATE OF CALIFORNIA

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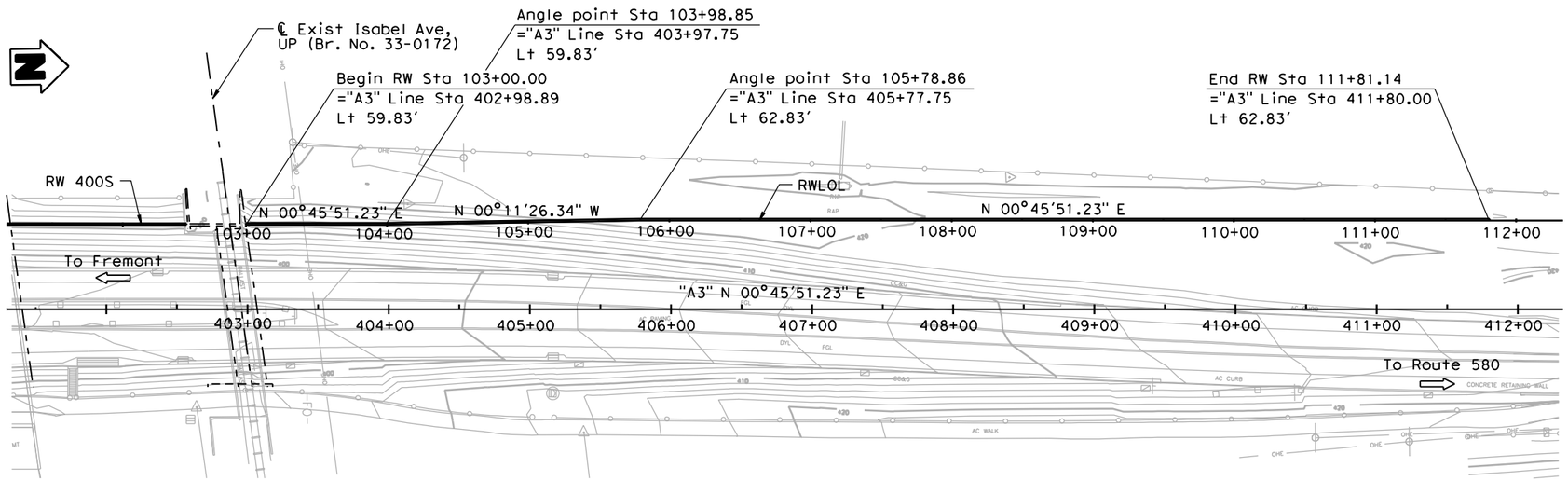
OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



FOUNDATION PLAN

SCALE: 1" = 50'-0"

GENERAL NOTES
LOAD FACTOR DESIGN

DESIGN:	Bridge Design Specifications April 2000 (LFD) (1996 AASHTO) with interims and revisions by Caltrans
	Service Load Design Method per FHWA Manual for Design & Construction Monitoring of Soil Nail Walls (FHWA-SA-96-069R and FHWA O-IF-03-017)
REINFORCED CONCRETE:	fy = 60,000 psi f'c = 3,600 psi
SHOTCRETE:	fy = 60,000 psi f'c = 3,600 psi
SOIL NAILS ASSEMBLY:	ASTM Designation: A615 fy = 60,000 psi
STRUCTURAL STEEL:	ASTM Designation: A709 fy = 36,000 psi
DESIGN PARAMETERS: (Soil)	ø = 34° C = 1,000 pfs γ = 130 pcf Qd = 2.09 k/ft
LIVE LOAD SURCHARGE:	240 psf (Vertical)
SEISMIC LOAD:	Pseudo-static seismic Coefficient = 0.17g

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

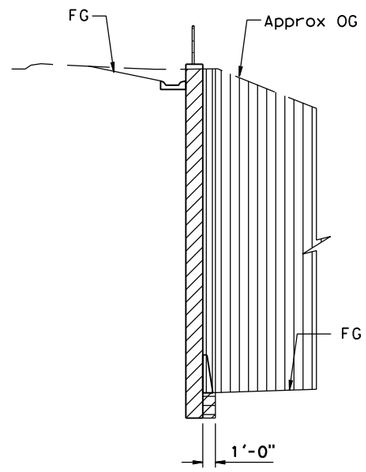
STANDARD PLANS
Dated May 2006

A10A	Acronyms and Abbreviations (Sheet 1 of 2)
A10B	Acronyms and Abbreviations (Sheet 2 of 2)
A10C	Symbols (Sheet 1 of 2)
A10D	Symbols (Sheet 2 of 2)
A62B	Limits of Payment for Excavation and Backfill Bridge Surcharge and Wall
A76A	Concrete Barrier Type 60D
A85	Chain Link Fence
B3-9	Retaining Wall Details No. 2

Standard Plan sheet No.
Detail No.

INDEX TO PLANS

Sheet No.	Title
1	General Plan
2	Foundation Plan
3	Soil Nail Wall Details No. 1
4	Soil Nail Wall Details No. 2
5	Soil Nail Wall Details No. 3
6	Soil Nail Wall Details No. 4
7	Soil Nail Wall Details No. 5
8	Soil Nail Wall Details No. 6
9	Soil Nail Wall Details No. 7
10	Soil Nail Wall Details No. 8
11	Soil Nail Wall Details No. 9
12	Architectural Treatment Layout
13	Log of Test Borings (1 of 4)
14	Log of Test Borings (2 of 4)
15	Log of Test Borings (3 of 4)
16	Log of Test Borings (4 of 4)



SOIL NAIL WALL
EXCAVATION AND BACKFILL PAY LIMITS

NO SCALE

LEGEND

- Structure Excavation (Soil Nail Wall)
- Structure Backfill (Soil Nail Wall)
- Roadway Excavation (see 'Road Plan')

FIGURE 2-13

Stephen Huang — GEOTECHNICAL PROFESSIONAL — 08/18/2010 APPROVAL DATE

DESIGN OVERSIGHT — SIGN OFF DATE

SCALE:		VERT.DATUM NAVD 88		HORZ.DATUM NAD 83			
PHOTOGRAMMETRY AS OF: 11/10/2005		ALIGNMENT TIES Dist. Traverse Sheet					
SURVEYED	BY Dan Scott	DRAFTED	BY Abhijeet Bhoi	DESIGN	BY G. Xu	CHECKED E. Tang	
FIELD CHECKED	BY Dan Scott	CHECKED	BY	DETAILS	BY K. Wang	CHECKED E. Tang	
				QUANTITIES	BY D. Vang	CHECKED W. Sennett	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

CU 04254
EA 297601

BRIDGE NO. 33E0077
POST MILE 27.00

RETAINING WALL 403
FOUNDATION PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
05/07/09	01/22/10	08/16/10								2	16

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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USERNAME => Peter DATE PLOTTED => 8/20/2010 TIME PLOTTED => 12:03:28 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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. FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1.

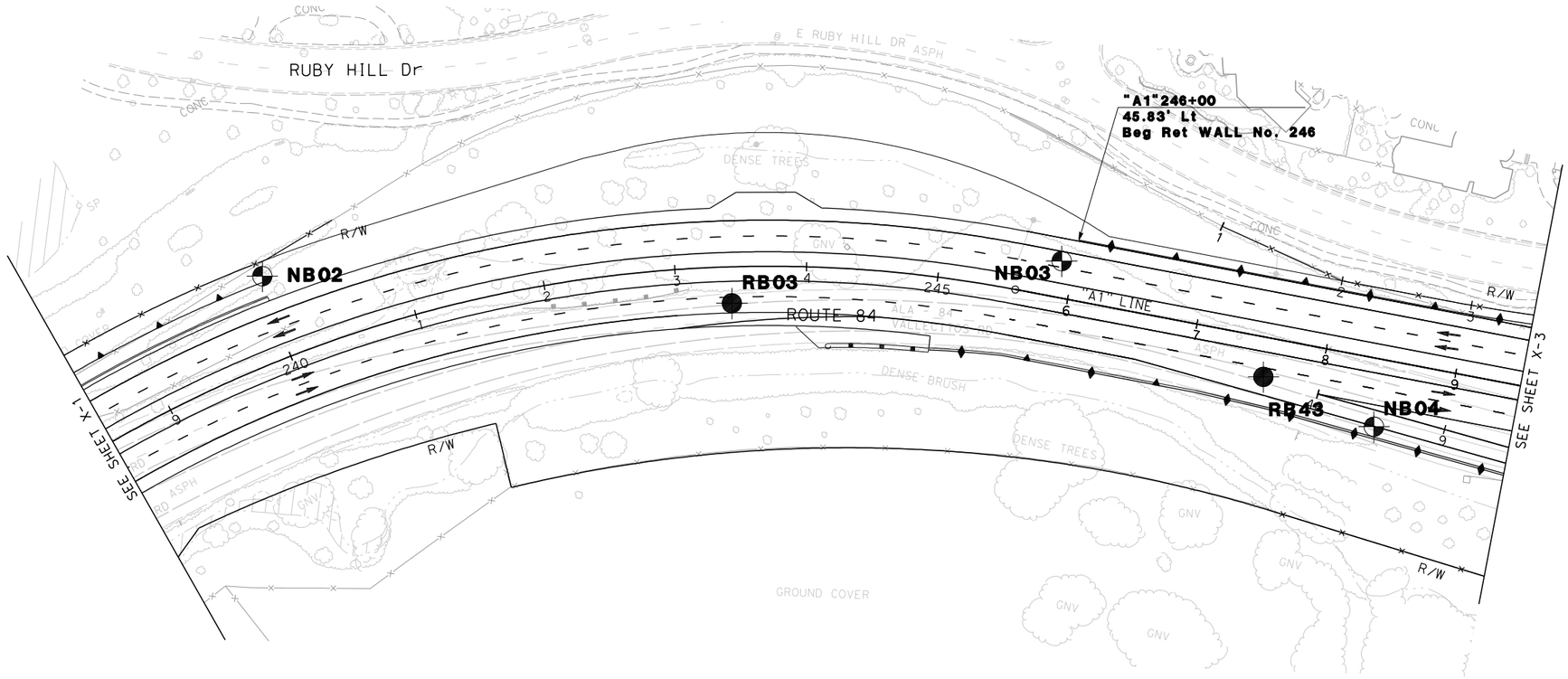

FIGURE 4-1a

FIELD EXPLORATION LOCATION PLAN

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

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FOR NOTES, ABBREVIATIONS
AND LEGEND, SEE SHEET X-1.

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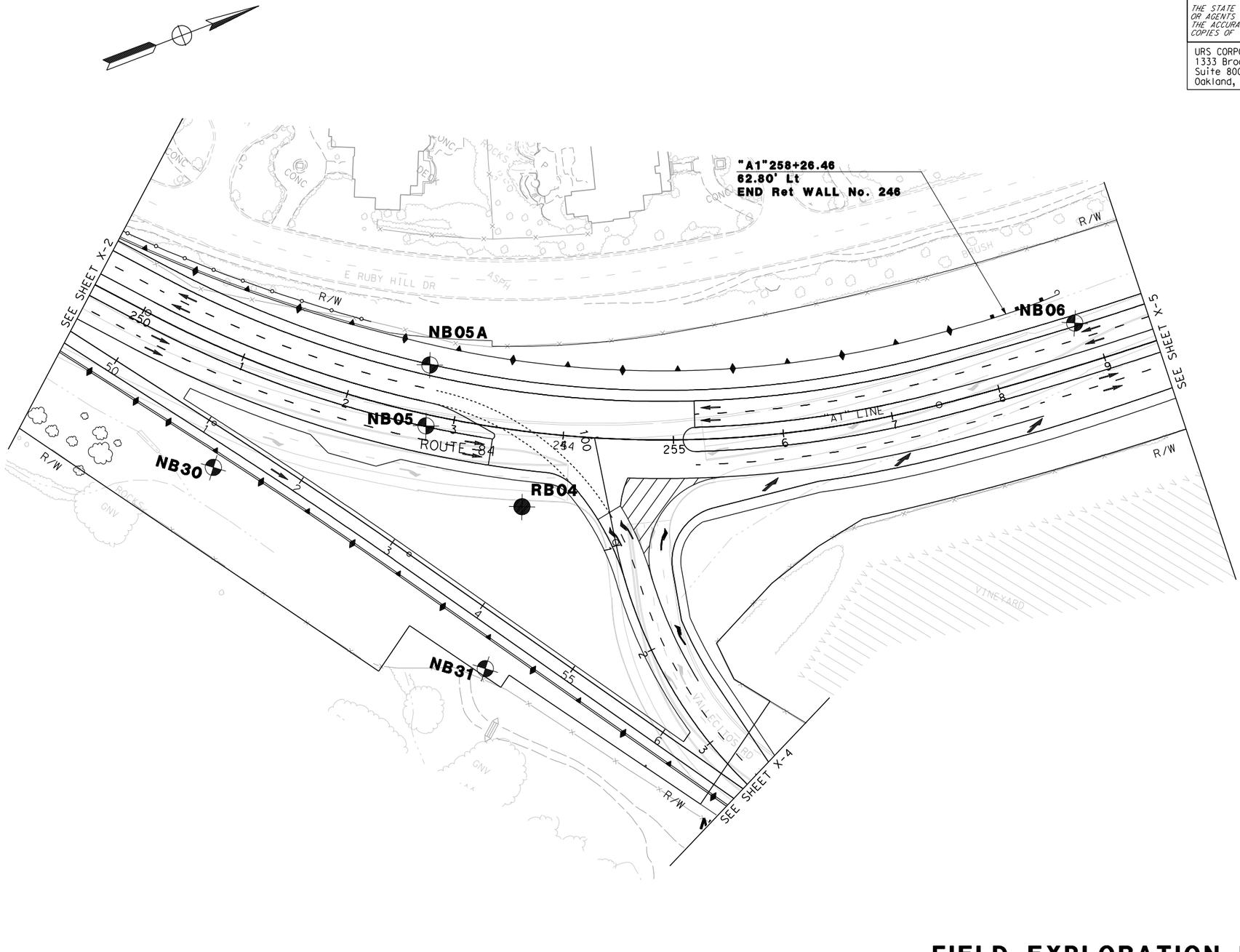

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

FIELD EXPLORATION LOCATION PLAN

SCALE 1"=50'

FIGURE 4-1b

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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04	Ala	84	22.9/27.1		

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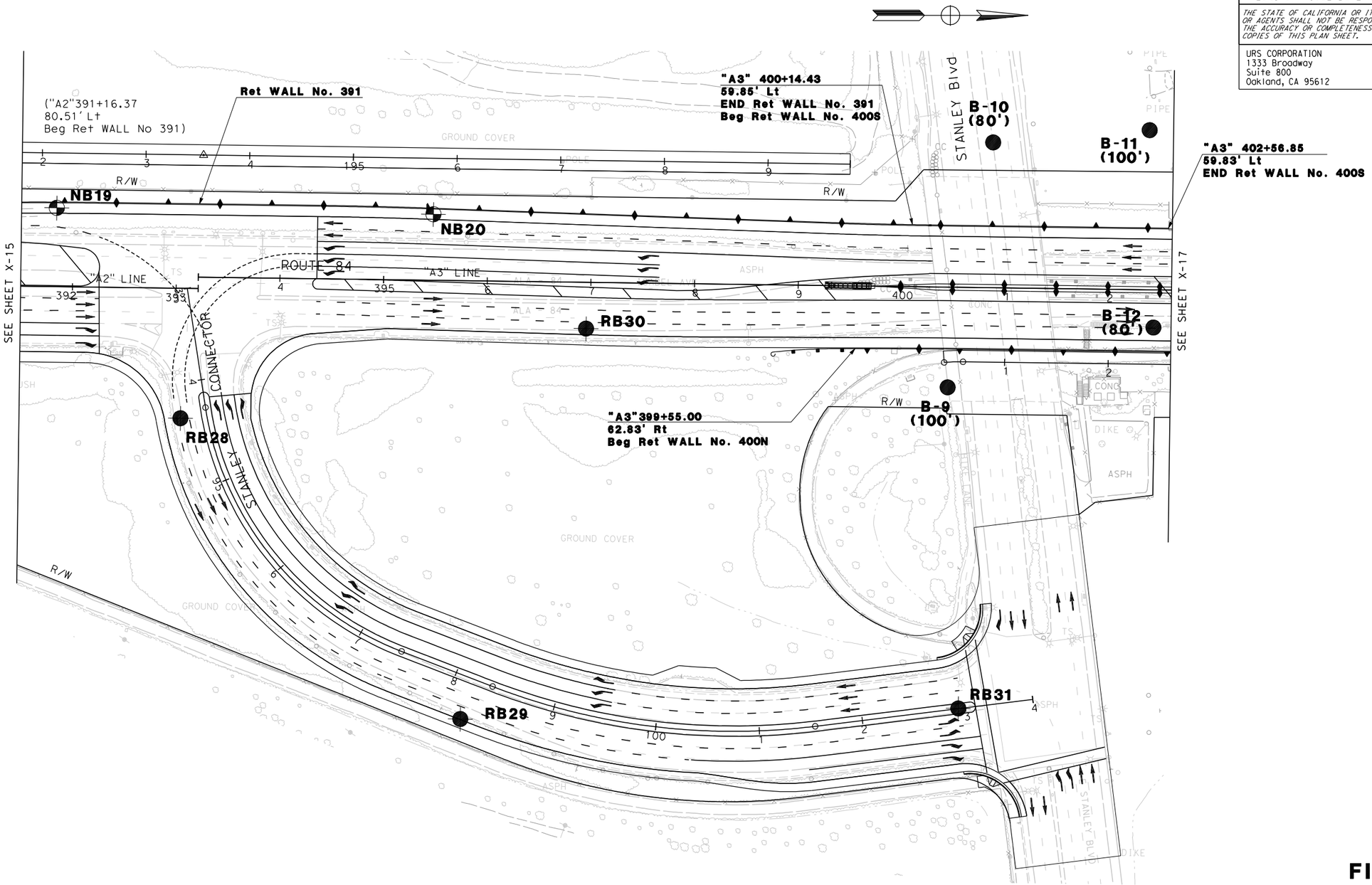

FIGURE 5-1

FIELD EXPLORATION LOCATION PLAN

SCALE 1"=50'

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UNLESS OTHERWISE SHOWN

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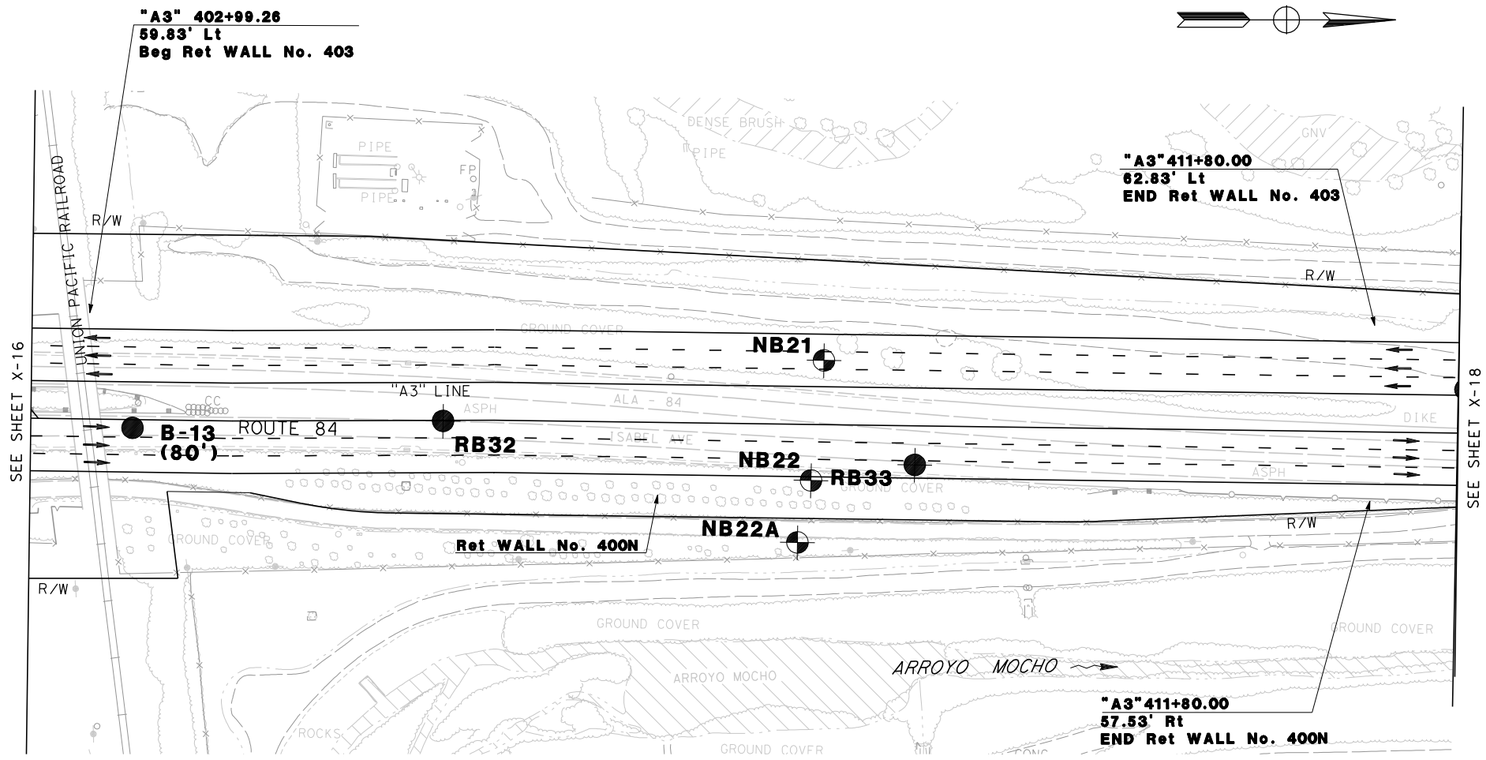

FIGURE 6-1a

FIELD EXPLORATION LOCATION PLAN

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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DGN FILE => ...\Fig 6-1a.dgn

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EA 297601

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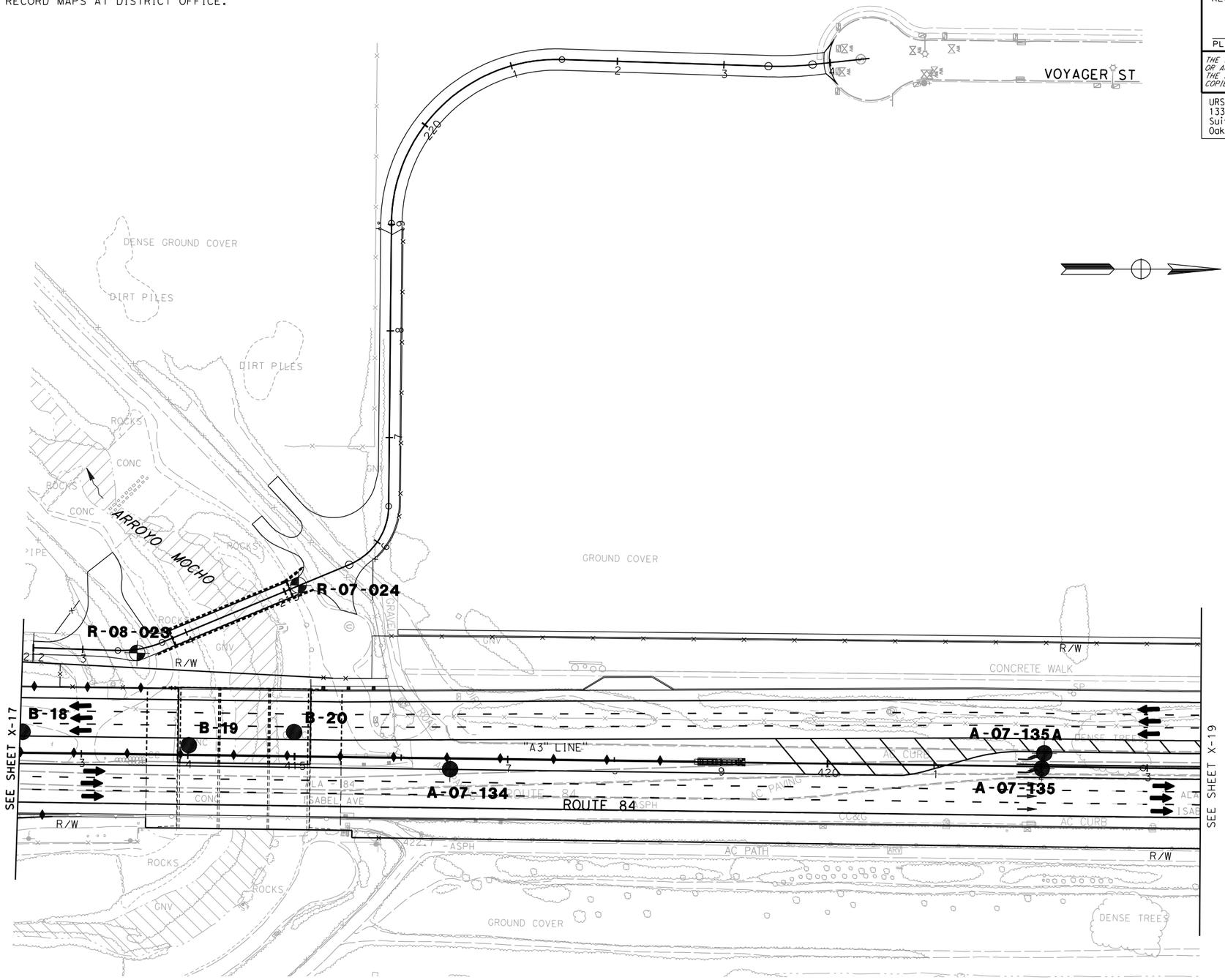

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER

3/12/10
DATE

Abhijeet R. Bhoi
No. 68606
Exp. 09-30-11
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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Oakland, CA 94612

FIGURE 6-1b

FIELD EXPLORATION LOCATION PLAN

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

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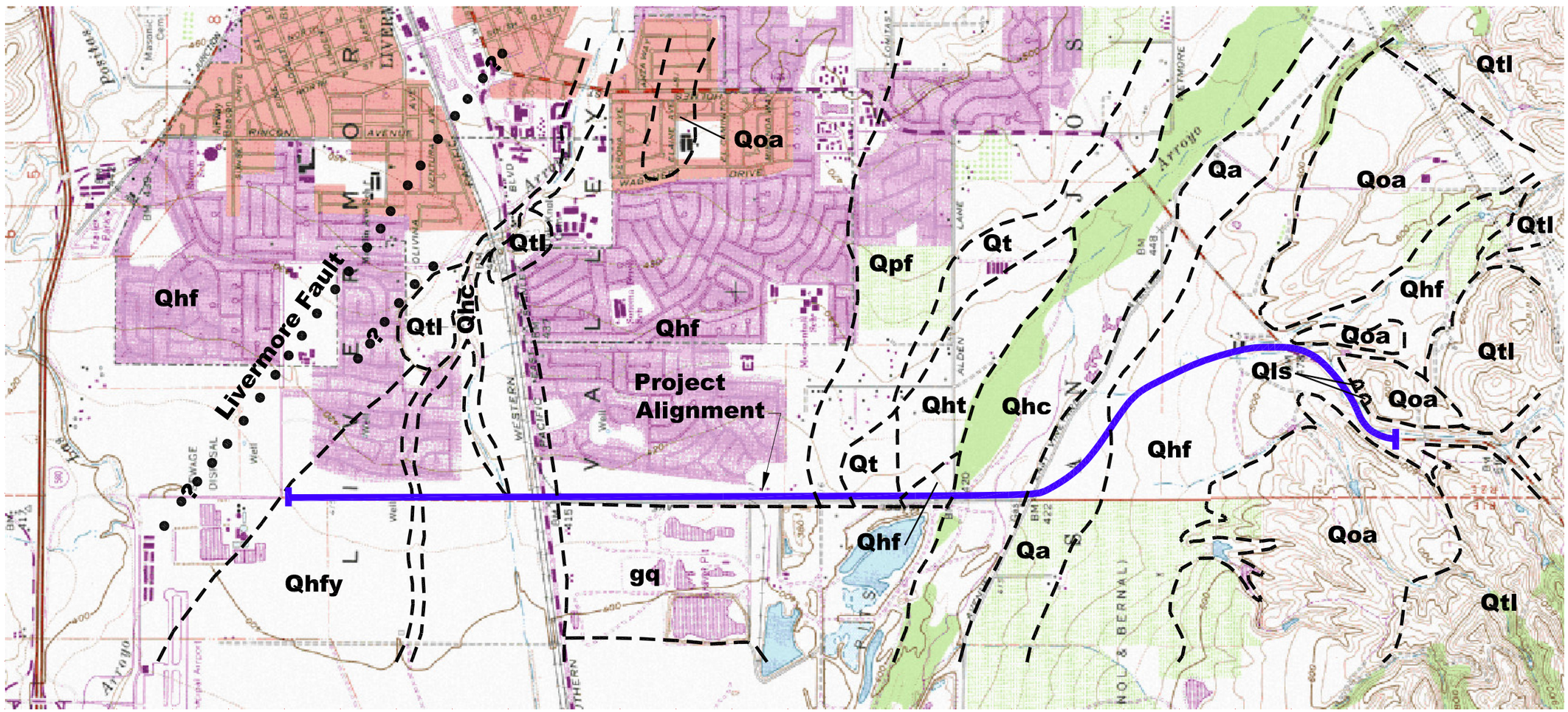
DGN FILE => ...\Fig 6-1b.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 04256

PROJECT NUMBER & PHASE 297601



LEGEND:

-----	Approximate geologic contact
?• • • • •	Concealed fault
gq	Gravel quarries
Qhc	Historical stream channel deposits
Qls	Holocene landslide deposits
Qhfy	Latest Holocene alluvial fan deposits
Qhf	Holocene alluvial fan deposits
Qa	Holocene alluvium deposits, undifferentiated
Qht	Holocene stream terrace deposits
Qt	Holocene to latest Pleistocene stream terrace deposits
Qpf	Latest Pleistocene alluvial fan deposits
Qoa	Early to late Pleistocene older alluvium deposits
Qtl	Pleistocene Livermore Gravels Formation

0 0.2 0.4 0.6 0.8 1.0 mile

Approximate Scale in Mile

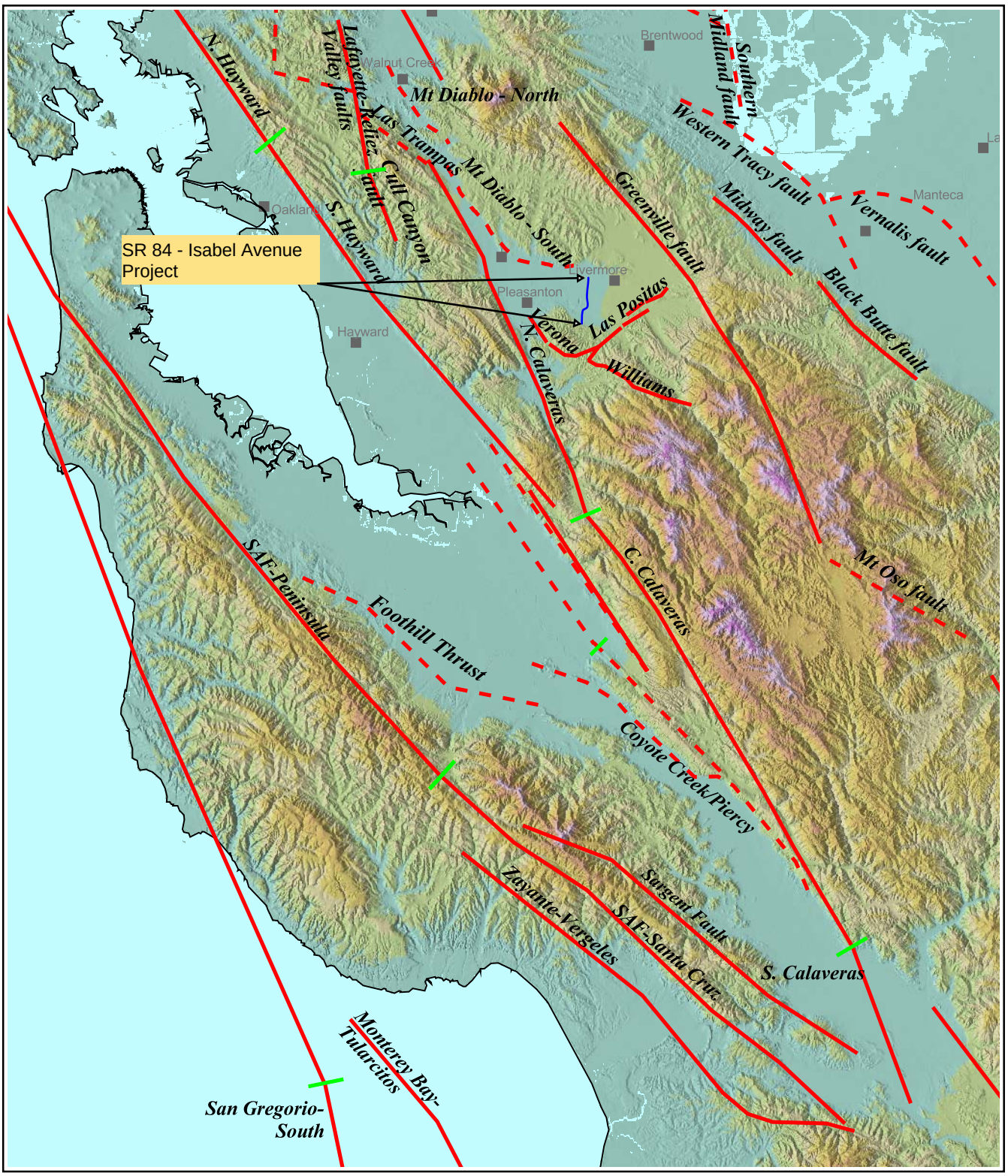
Geologic map modified from Dibblee, T.W., 1980 and Witter, R.C., et al, 2006

URS

SR 84 Isabel Ave
Livermore, California
Alameda County

SITE AND GEOLOGIC MAP

SCALE
Figure **9-1**
April /2008



Fault Sources: URS Seismic Hazard Model

URS	28649640 SR 84 - Isabel Ave Livermore, CA	ACTIVE FAULTS IN THE SITE REGION	Figure 10-1

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1		

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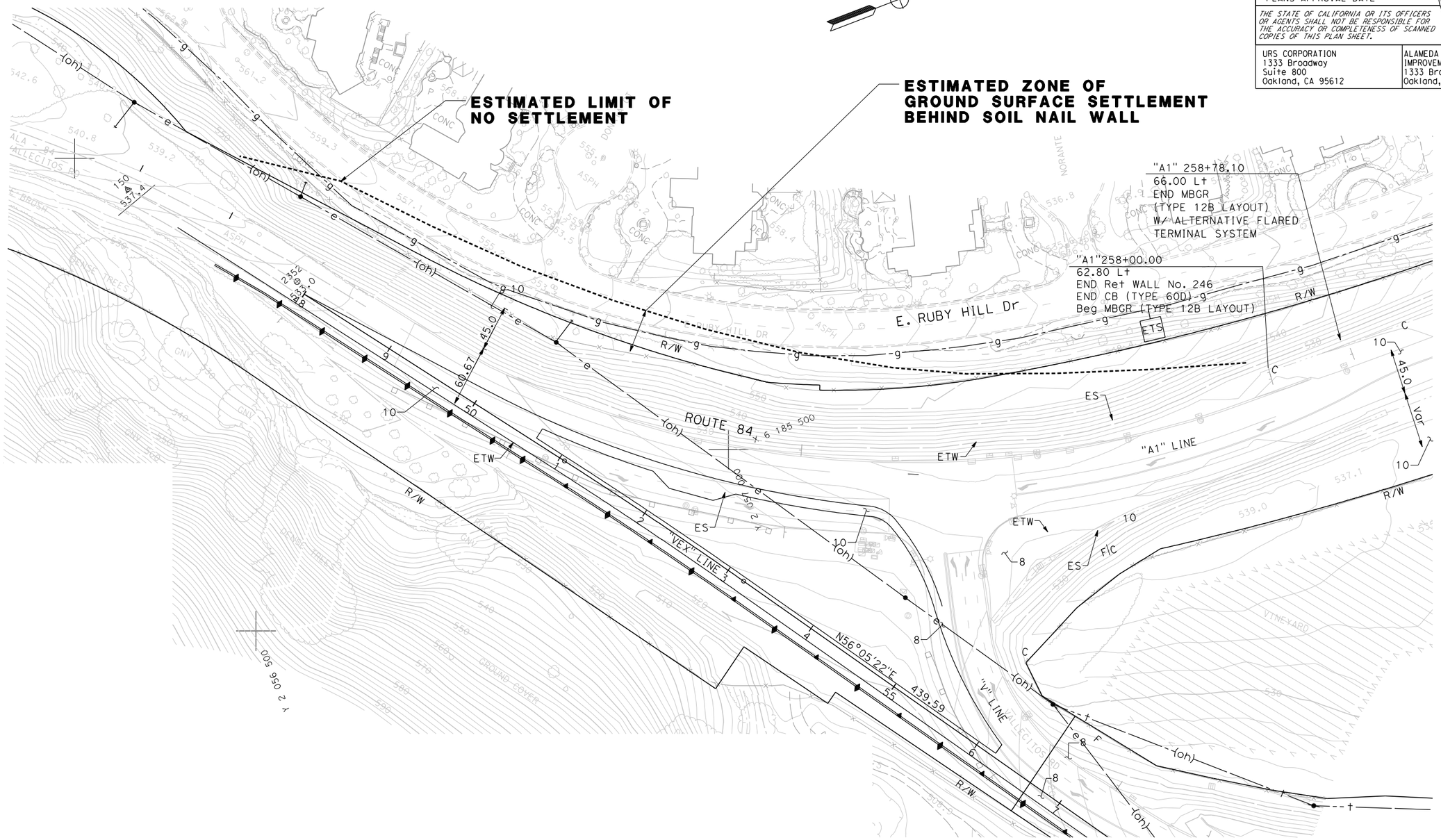

GROUND SURFACE SETTLEMENT
RETAINING WALL 246

SCALE 1"=50'

FIGURE 13-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

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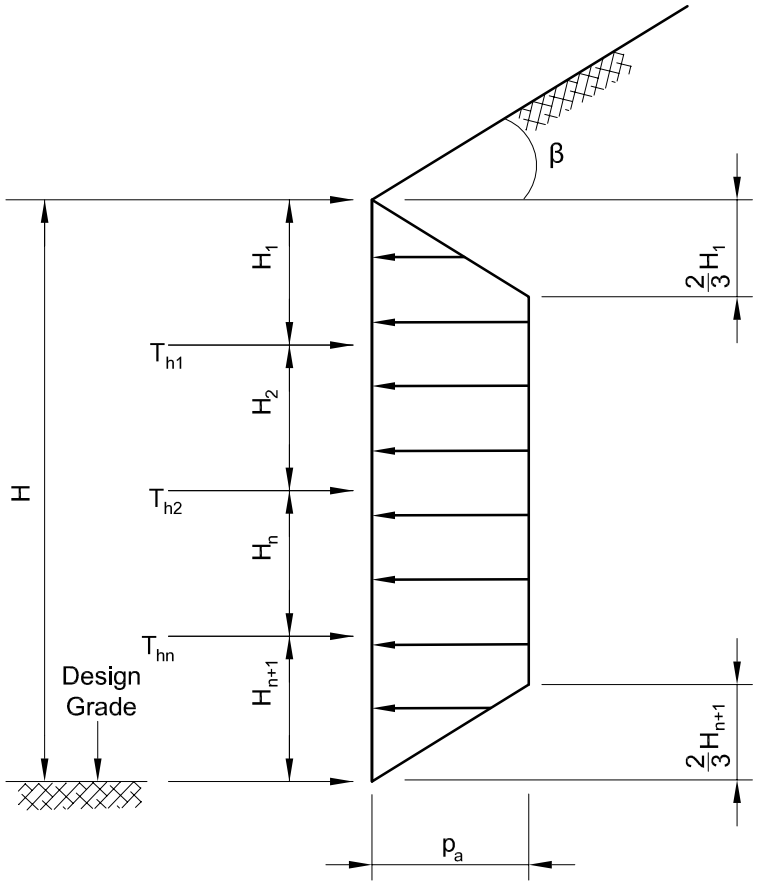
CU 04256

EA 297601



p_a = maximum ordinate of pressure diagram (psf)

P_{Total} = total lateral load required to be applied to the wall face to provide a factor of safety (FS) equal to 1.3 for the retained soil mass when stability is analyzed using an appropriate limiting equilibrium method of analysis. Except that P_{Total} , shall not be less than 1.44 P_a

Pa = active lateral earth pressure resultant acting on the wall height, H, and determined using Coulomb's theory with a wall friction angle, δ, equal to zero. (lbf)

H = wall design height (ft)

H_1 = distance from ground surface at top of wall to uppermost level of anchors (ft)

H_{n+1} = distance from design grade at bottom of a wall to lowermost level of anchors (ft)

T_{hi} = horizontal component of design force in anchor at level i (lbf/ft)

NOTES:

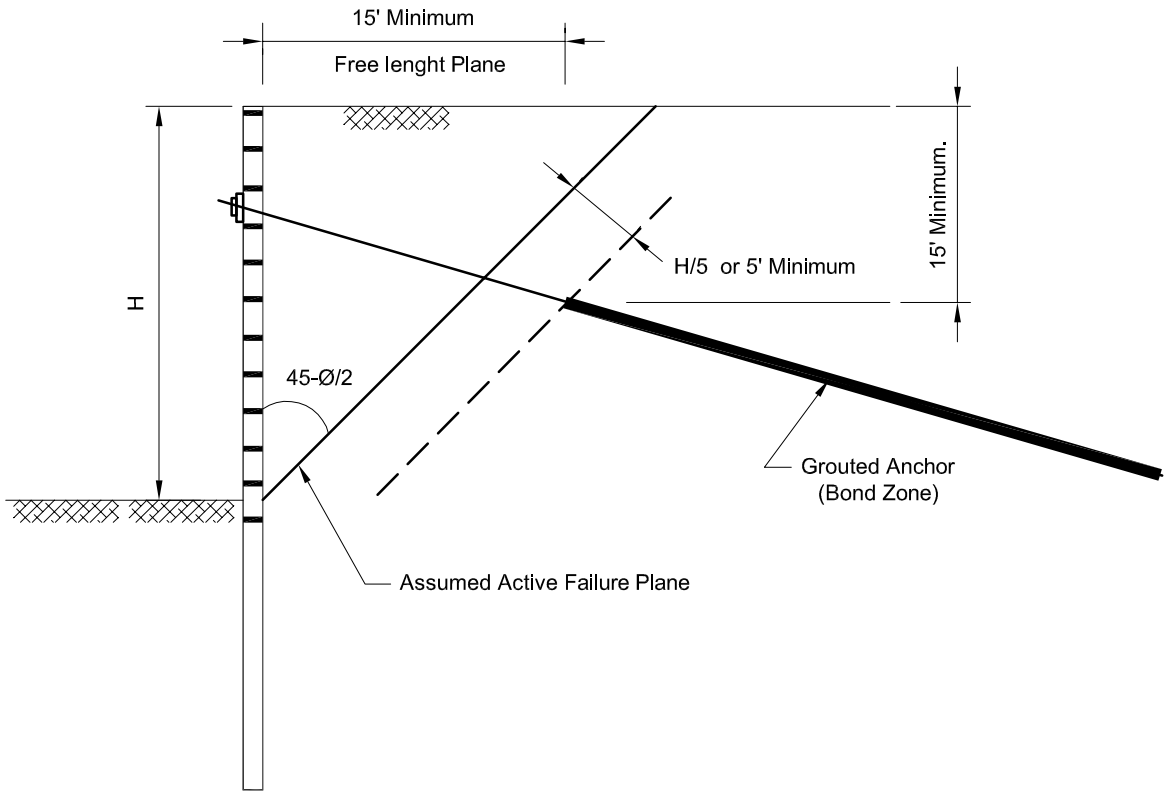
1. $p_a = \dfrac{P_{Total}}{(H - \frac{1}{3}H_1 - \frac{1}{3}H_{n+1})}$

2. $P_{Total} = 1.44$ Pa
   [Based on Spencer limiting equilibrium stability analysis, the required total lateral load is estimated to be less than 1.44 Pa for both walls in order to achieve a FS $\geq$ 1.3

3. Estimated ϕ' = 34 deg.

4. Elev. 375 is estimated design high ground water from 1996 boring B-9

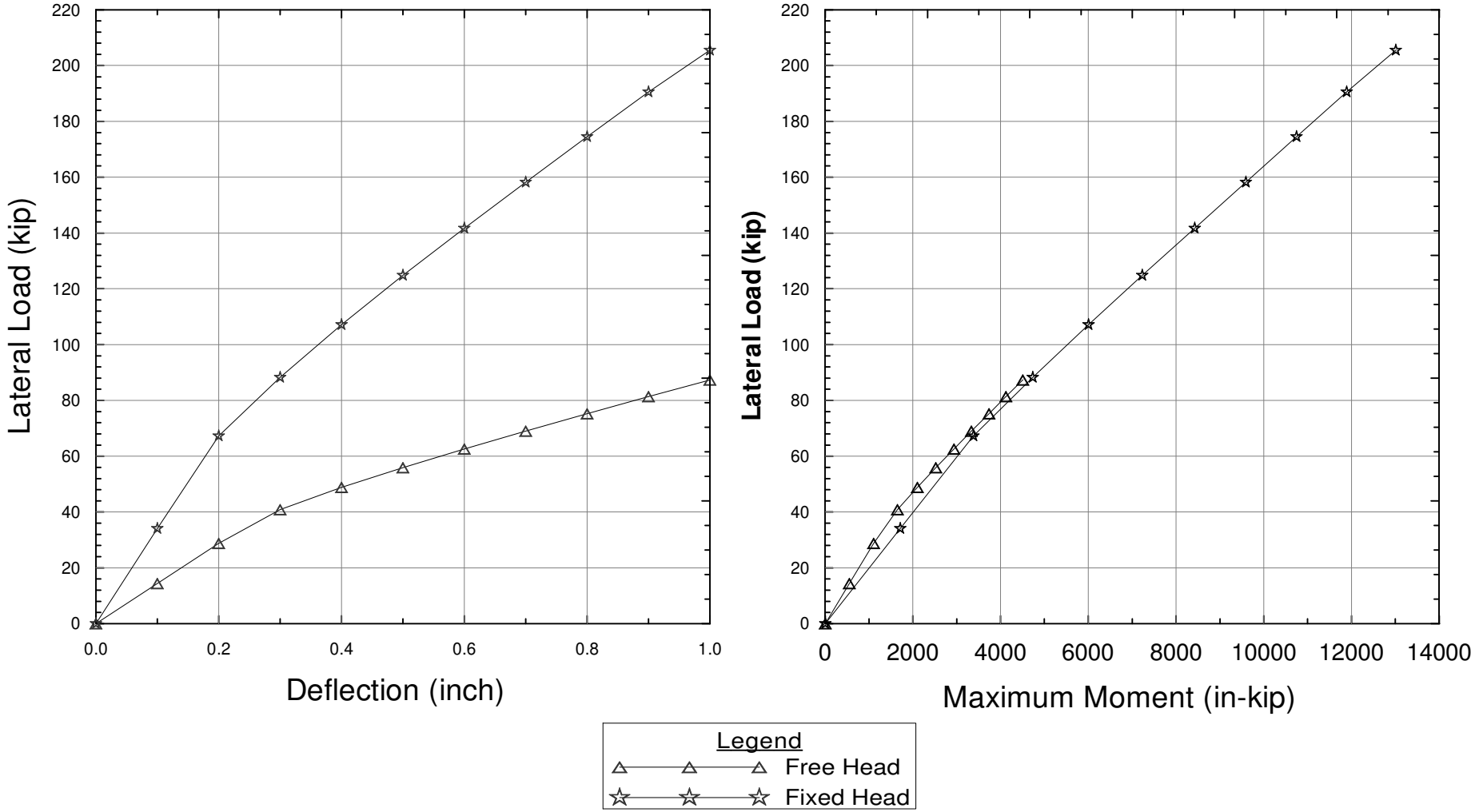
URS	**ROUTE 84 EXPRESSWAY WIDENING** Livermore, CA	**TIEBACK DESIGN STATIC EARTH PRESSURE AT RW 400N AND RW 400S**	Not to Scale Figure **13-2** AUGUST 2010



NOTE:

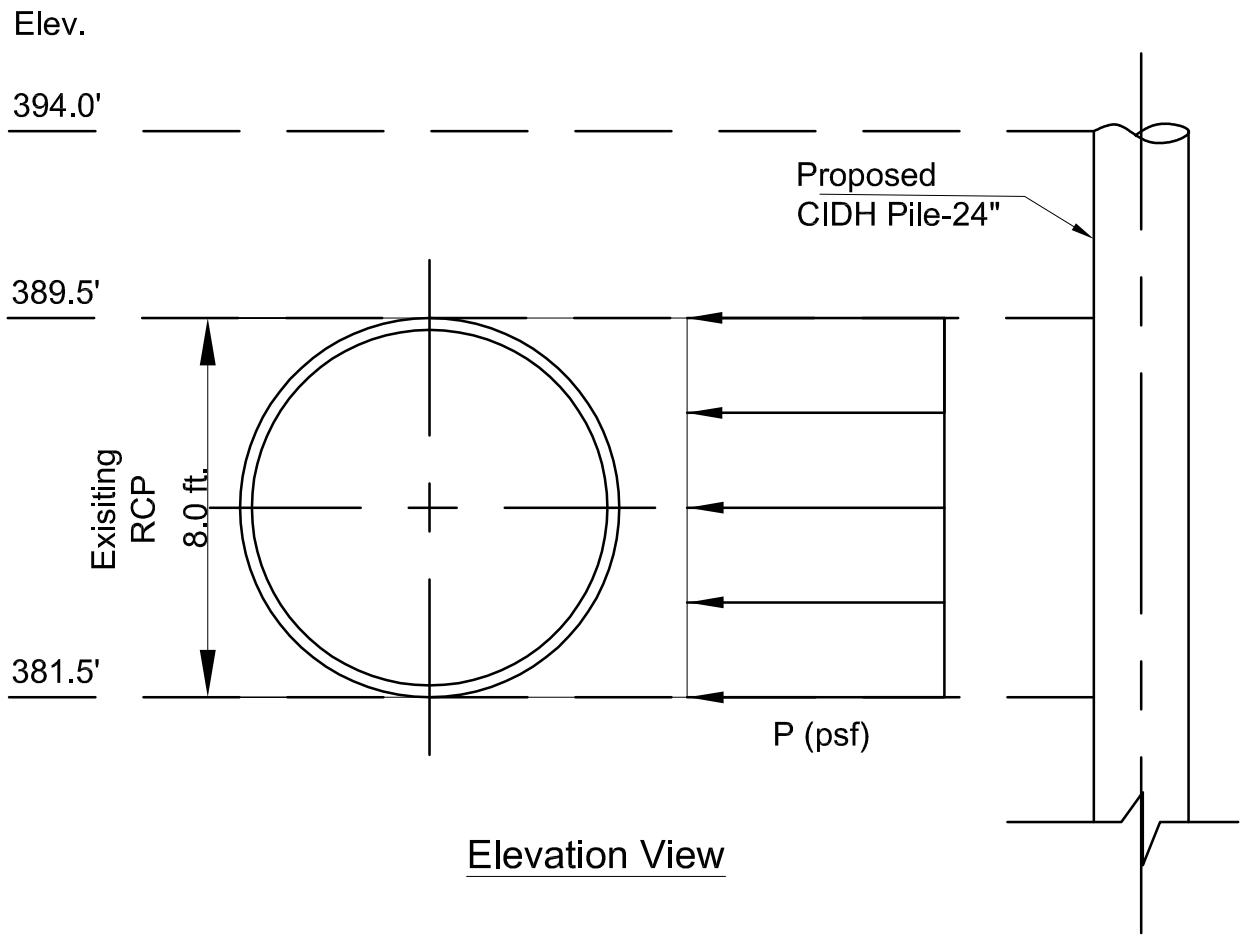
$\Theta = 45 - \frac{\emptyset}{2} = 45° - \frac{34°}{2} = 45° - 17° = 28°$

URS	**ROUTE 84 EXPRESSWAY WIDENING** Livermore, CA	**TYPICAL TIEBACK INSTALLATION AT RW 400N AND RW 400S**	Not to Scale Figure **13-3** FEBRUARY 2009



Project No. 28649640	Rout 84 Widening Livermore, California	**Retaining Wall 400N - Type B Retaining Wall Pile Lateral Resistance CIDH- 24 inch Pile**	Figure 13-4
	URS		

X:/Route 84/geotech/Analysis/Pile Design/Lateral/Arroyo Mocho/Abutments_B20.grf



Elevation View

	Deflection (inch)	Earth Pressure on RCP Wall, P (psf)
Free Head	1/4	500
	1/2	1,000
Fixed Head	1/4	1,200
	1/2	2,100

NOTE: Earth pressure is limited to a distance of 5.5 ft. along RCP.

URS	**ROUTE 84 EXPRESSWAY WIDENING** Livermore, CA	**Additional Earth Pressure on RCP Wall Imposed by CIDH Pile**	Not to Scale Figure **13-5** FEBRUARY 2009

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. OVERCOMER Y. HOR
Liaison Engineer
Office of Special Funded Projects
Structures Design Services & Earthquake Engineering

Date: June 2, 2008

File: 04-ALA-84 PM 22.5/27.3
04-297601
Rte 84 Expressway
Widening Project
Various Structures

From: EDUARDO ORTEGA
Associate Materials and Research Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Type Selection Reports Review

Per your request, we have completed the review of Type Selection Reports prepared by URS and MGE Consultants for the above referenced project. The project site is located in the City of Livermore, Alameda County, California. The Route 84 Expressway Widening Project will require the following structures work:

Existing Bridge Widenings
Arroyo Del Valle Bridge (Widen)
Arroyo Mocho Bridge (Widen)

New Bridges
Arroyo Mocho Access Bridge
Arroyo Del Valle Trail Bridge

Retaining Walls
Retaining Wall 246 at East Ruby Hill Drive
Retaining Walls 400N and 400S at Isabel Avenue Undercrossing

Based in our review, we have the following comments on the project:

1. All shallow and deep pile support foundations for bridge should be designed based on LRFD. Refer to Memo to Designers 3-1 for deep foundations and 4-1 for spread footings.

2. Settlement calculations should be included for the shallow footing support abutments located within clay.

3. Lateral condition bearing capacity of shallow footing should be addressed.

4. Do the shallow footing of bents who are within clay layer should be deepened?

5. In the tieback walls, looks like the soldier beam embedment depth is too shallow, could you please clarify.

6. Typical section for tie back walls does not show walers, could you please clarify.

7. Is there any horizontal boring drilling program for Soil Nail Walls?

8. Note that soil nail wall standard special provisions (SSP) have been revised by Caltrans. Use new SSP in your recommendations for the proposed soil nail walls.

* * * * *

Should you have any questions, please call me at (510) 286-4821.

c: TPokrywka, MMomenzadeh, E☺rtega, Daily File, Route File, Translab File

Eduardo ☺rtega/mm/297601 Type Selection. doc

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES • OFFICE OF SPECIAL FUNDED PROJECTS

Comments

(DRAFT REVISION 01/2008)

Structure:	**Rte 84 Express Way Widening**	Route:	**84**		
Bridge No:	**33-0710, 33-0711, Arroyo Del Valle Trail Bridge, Arroyo Mocho Access Bridge and Retaining wall No. 400N, 400S AND 246.**	EA:	**297601**	Liaison:	**Overcomer Hor**
District	**04**	Reviewer:	**Mahmood Momenzadeh**	Reviewed Date:	**June 2,2008**
Review Level:	**Type Selection Pack.**	Consultant	**URS**	Response Date:	**January 12, 2009**

ABBREVIATIONS: BDA Bridge Design Aids; BDD Bridge Design Details; GP General Plan; IPG OSFP Information and Procedures Guide; MTD Memo to Designers; SDC Seismic Design Criteria; SDS Suctural Detailing Standards

Item	Comment	Response	Notes
	Structure Type Selection Report		
1	All shallow and deep pile support foundations for bridge should be designed based on LRFD. Refer to Memo to Designers 3-1 for deep foundations and 4-1 for spread footings.	Will comply.	
2	Settlement calculations should be included for the shallow footing support abutments located within clay.	Will comply.	
3	Lateral condition bearing capacity of shallow footing should be addressed.	Will include estimate of passive resistance and discuss applicability in the shallow footing design.	
4	Do the shallow footing of bents who are within clay layer should be deepened?	Bent support has been revised to deep pile foundation to address erosion issues and support of shallow footing in fine grained soils such as clays.	
5	In the tieback walls, looks like the soldier beam embedment depth is too shallow, could you please clarify.	The planned tieback wall system uses continuous horizontal support elements (soldier pileless wall) based on Bridge Design Specifications, Section 5, Figure 5.8.1-2b. The embedment depth for the continuous horizontal elements presented on the general plans was a minimum value; the required embedment depth will be based on structural analysis with geotechnical parameters provided in the draft Foundation Report. Will include the relevant parameters in the updated Foundation Report for the walls.	
6	Typcial section for tie back walls does not show walers, could you please clarify.	The planned tieback wall system uses continuous horizontal support elements (soldier pileless wall) based on Bridge Design Specifications, Section 5, Figure 5.8.1-2b. Thus, no	

Item	Comment	Response	Notes
		walers are planned.	
7	Is ther any horizontal boring drilling program for Soil Nail Walls?	Because of site access restrictions from Ruby Hill Property management, it is currently unfeasible to include horizontal borehole in the field exploration program. Will develop an SSP to require Contractor to pre-drill, submit and review results, modify design if necessary, and seek Caltrans approval prior to actual soil nail installation.	
8	Note that soil nail wall standard special provisions (SSP) have been revised by Caltrans. Use new SSp in your recommendations for the proposed soil nail walls.	Will comply.	

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. OVERCOMER Y. HOR
Liaison Engineer
Office of Special Funded Projects
Structures Design Services
& Earthquake Engineering

Date: July 22, 2009

File: 04-ALA-84, PM 22.5/27.3
04-297601
Rte 84 Expressway
Widening Project
Various Structures

From: EDUARDO ORTEGA
Associate Materials and Research Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

CHRIS RISDEN
Engineering Geologist
Office of Geotechnical Design - West
Geotechnical Services
Division of Engineering Services

GRANT WILCOX
Branch Chief, Branch B
Office of Geotechnical Design - West
Geotechnical Services
Division of Engineering Services

Subject: 65% PS&E and Foundation Report Review

Per your request, we have completed the review of 65% PS&E and Foundation Report prepared by URS and MGE Consultants for the above referenced project. The project site is located in the City of Livermore, Alameda County, California. The Route 84 Expressway Widening Project will require the following structures work:

Existing Bridge Widenings
Arroyo Del Valle Bridge (Widen)
Arroyo Mocho Bridge (Widen)

New Bridges
Arroyo Mocho Access Bridge
Arroyo Del Valle Trail Bridge

Retaining Walls
Retaining Wall 246 at East Ruby Hill Drive
Retaining Walls 400N and 400S at Isabel Avenue Undercrossing

Based in our review, we have the following comments on the project:

GENERAL

- Please provide a legend on the General Soil Profiles that identify the values found on either side of the vertical soil profiles.

FIGURES ON FOUNDATION REPORT
(Retaining Walls 246, 391, 400N, 400S, and 403)

1. Figure 2-1: Change index to include Retaining Wall No.'s found in this report

2. Figure 5-2: Horizontal reference line in Profile on LOTBs should be "A2" and "A3", not "A1".

3. Figure 5-2: The north arrow is not correctly aligned.

4. Retaining Wall 400N LOTBs: 400N is referenced on the wrong side of the "A3" line on the plan figure at top of sheet.

5. Retaining Wall 400N LOTBs: Horizontal reference line in Profile should read "A3" instead of "A1".

6. Figure 8-1: Horizontal reference line in Profile should read "A3" and not "A1".

7. Figure 8-1: The north arrow is misaligned.

8. Figure 8-1: Please reference all walls along the "A3" line on the Plan drawing at top of sheet.

RETAINING WALLS

1. Retaining walls No: 109, 110. 236, 245, 314, 317, 320, 400S, and 437 (mentioned on Table 1-1 "Summary of Planned Retaining Walls" on the Foundation Report for Arroyo Mocho Access Bridge dated March 23, 2009) are not part of this submittal. Please clarify.

2. An horizontal drilling program is needed for tie back retaining wall 400N Type A and for soil nail retaining walls No: 246, 391, 403, and 400N Type D. SSP has to be developed for this program to prepare the LOTBs and revise the wall design details, if it is planned to include this work as part of the construction program. Contractor has to submit results of the horizontal drilling and provide calculations and drawings to be reviewed by this Office prior to start of construction.

3. No vertical drilling program reported for pile foundations of retaining wall No 400N Type B. Please clarify.

ARROYO MOCHO BRIDGE (WIDEN)

1. Sheet 2/13 shows Pier 2 & 3 at specified tip elevation of 340.0 ft. Foundation Report Table 7-2 and sheet 2/12 shows the same tip elevation at 336.0 ft. Correct the discrepancy. If it was a round up it should be at a lower elevation (335.0 ft).

2. Provide details and calculations for the retaining wall shown on "Typical Plan" Sheet 11/13.

ARROYO DEL VALLE BRIDGE (WIDEN)

1. Provide details and calculations for the retaining wall shown on "Typical Plan" sheet 13/14.

UTILITY CROSSINGS

Contractor should request a permit for a trenchless construction method based on soil and groundwater conditions to buried proposed utilities, as bore & jack, micro tunneling or other method.

GRAVEL MINING OPERATIONS

There is an ongoing mining operation anticipated for the next 25 years adjacent to the west side of SR 84 Isabel Avenue, between approximately Stanley Boulevard and Arroyo Del Valle by Vulcan Materials Quarry and at both side of SR 84 between Vineyard Avenue and Alden Lane by Cemex Quarry, both up to 50 feet of existing right-of-way line. Is there any program to install slope inclinometers to monitor the stability of the slopes adjacent to SR 84 that could be impacted due to the mining operations? This Office has to review the details of the program.

* * * * *

Should you have any questions, please call me at (510) 286-4821.

c: TPokrywka, MMomenzadeh, GWilcox, CRisden, E©rtega, Daily File, Route File, Translab File

Eduardo ©rtega/mm/297601 65% FR. doc

Office of Special Funded Projects
Comment & Response Form

General Project Information	Review Phase	Reviewer Information
Dist: 04 EA: 297601 **Project Name: Rte 84 Expressway Widening Project** **OSFP Liaison: Overcomer Y. Hor** **Phone: (916) 227-8419** **e-mail: overcomer_hor@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection ☒ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☐ Other:_____ **Structure Information** (Use when necessary to document comments by individual structure) **Structure Name: Retaining Walls** **Br No: _____**	**Reviewer Name: Eduardo Ortega** **Functional Unit: Geotechnical** **Cost Center: 59-327** **Phone Number: (510) 286-4821** **e-mail: eduardo_ortega@dot.ca.gov** **Date of Review: 7-22-09**

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1		Figure 2-1	Change index to include Retaining Wall No.'s found in this report	Will revise index on Figure 2-1 to correspond to retaining walls discussed in the report.	
2		Figure 5-2	Horizontal reference line in Profile on LOTBs should be "A2" and "A3", not "A1".	Will revise.	
3			Retaining Wall 400N LOTBs: 400N is referenced on the wrong side of the "A3" line on the plan figure at top of sheet.	Will revise.	
4			Retaining Wall 400N LOTBs: Horizontal reference line in Profile should read "A3" instead of "A1".	Will revise.	
5		Figure 8-1	Horizontal reference line in Profile should read "A3" and not "A1"	Will revise.	
6		Figure 8-1	The north arrow is misaligned.	Will adjust.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

7		Figure 8-1	Please reference all walls along the "A3" line on the Plan drawing at top of sheet.	Will revise.	
8			Retaining walls No: 109, 110. 236, 245, 314, 317, 320, 400S, and 437 (mentioned on Table 1-1 "Summary of Planned Retaining Walls" on the FR for Arroyo Mocho Access Bridge dated March 23, 2009) are not part of this submittal. Please clarify.	Geotechnical design of Retaining Wall No. 400S was discussed in the report. Retaining walls no. 109, 110, 236, 245, 314, 317, 320, and 437 are standard plan walls and the appropriateness of the geotechnical design parameters are discussed in the project Geotechnical Design Report/Materials Report.	
9			An horizontal drilling program is needed for tie back retaining wall 400N Type A and for soil nail retaining walls No: 246, 391, 403, and 400N Type D. SSP has to be developed for this program to prepare the LOTBs and revise the wall design details, if it is planned to include this work as part of the construction program. Contractor has to submit results of the horizontal drilling and provide calculations and drawings to be reviewed by this Office prior to start of construction.	It is the project plan to develop an SSP to require Contractor to pre-drill, submit and review results, modify design if necessary, and seek Caltrans approval prior to actual tieback installation.	
10			No vertical drilling program reported for pile foundations of retaining wall No 400N Type B. Please clarify.	Previous explorations, B-12 and B-13, were located in close proximity of the wall alignment and are considered applicable to the geotechnical design of the wall foundation.	
11		General	Please provide a legend on the General Soil Profiles that identify the values found on either side of the vertical soil profiles.	Understand that this comment is meant for Foundation Report of Arroyo Mocho Bridge (Widen) and Arroyo Del Valle (Widen). Will include a legend to the corresponding generalized soil profiles.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

Office of Special Funded Projects
Comment & Response Form

General Project Information	Review Phase	Reviewer Information
Dist: 04 EA: 297601 **Project Name: 4-ALA-84 PM 22.9/27.1** **OSFP Liaison: Overcommer Hor** **Phone: 916-227-8419** **e-mail: Overcomer_Hor@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection ☐ 65% PS&E Unchecked Details ☒ PS&E (Review No. _) ☐ Construction Support ☐ Other:_____ **Structure Information** (Use when necessary to document comments by individual structure) **Structure Name: Retaining Walls 246, 391, 400N, 400S & 403** **Br No: _____**	**Reviewer Name: Eduardo Ortega** **Functional Unit: Geotechnical** **Cost Center: 327** **Phone Number: 510-286-4821** **e-mail: Eduardo_Ortega@dot.ca.gov** **Date of Review: 03/22/10**

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	Found. Report	LOTB	Log of Test Boring (LOTB) shall follow the requirements of Caltrans Logging, Classification, and Presentation Manual dated June 2007 or obtain an exception. Holes shall be identified using the following convention: HHH-YY-NNN HHH: Hole type according Figure 2-2 of the Manual YY: 2-digit year NNN: 3-digit number (001-199)	Will comply to modify LOTBs.	
2	Found. Report	Page 4-1	Please provide Soil Nail calculations and show horizontal borings for RW 246.	Will provide relevant SNAILZ results in Structural submittal. Horizontal borings were not drilled because access to property beyond project current right-of-way was denied.	
3	Found.	Page 5-1	Please provide Soil Nail calculations and show horizontal	Will provide relevant SNAILZ results in Structural	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

	Report		borings for RW391	submittal. Horizontal borings were not drilled because access to property beyond project current right-of-way was denied.	
4	Found. Report	Page 6-1 And General Plans Nos 1, 2 & 3	For Retaining Wall 400N: Please show calculations and horizontal borings for : Wall A (Tie Back wall) and for Soil Nail Wall	Will provide relevant calculations in Structural submittal. Horizontal borings were not drilled because access to property beyond project current right-of-way was denied.	
5	Found. Report	Page 7.1	For Retaining Wall 400S: Please show calculations and horizontal borings for Tie Back Wall	Will provide relevant calculations in Structural submittal. Horizontal borings were not drilled because access to property beyond project current right-of-way was denied.	
6	Found. Report	Response to June 2, 2008 comments	Due to site access restrictions from Ruby Hill Property, please submit the SSP requiring the Contractor to pre-drill, submit and review results, modify design if necessary, and seek Caltrans approval prior to actual soil nail installation.	SSP requiring the Contractor to pre-drill, submit and review results, modify design if necessary, and seek Caltrans approval to actual soil nail installation will be included in the Foundation Report (Appendix H) and project specifications and drawings.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

LOG OF TEST BORINGS
RETAINING WALL 246

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/12 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

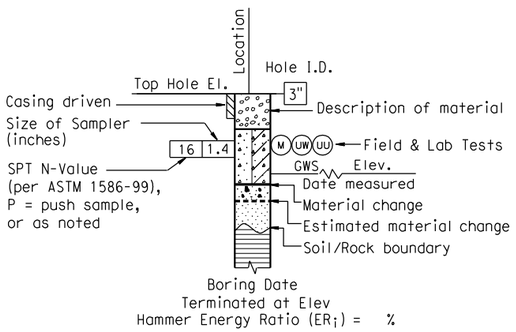
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

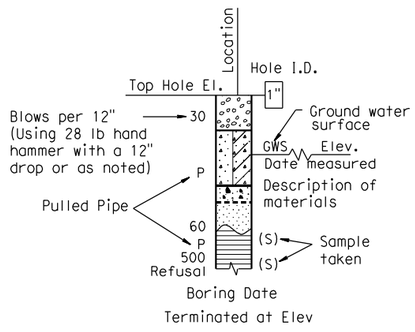
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

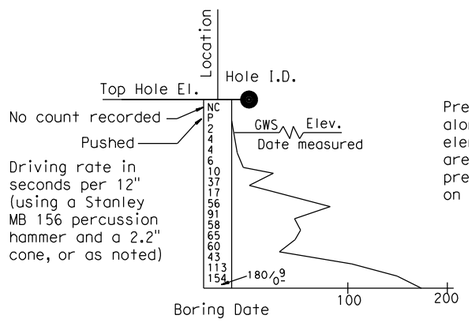
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



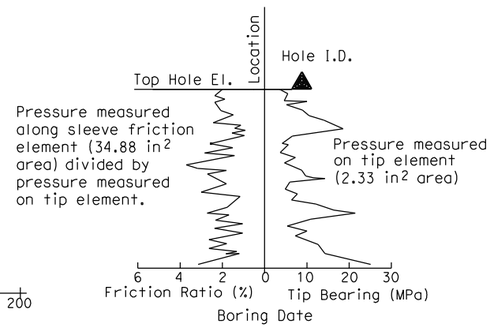
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO.	RETAINING WALL 246
FUNCTIONAL SUPERVISOR	DRAWN BY: ANDREW CHEUNG	FIELD INVESTIGATION BY:		DESIGN BRANCH	33E0075	LOG OF TEST BORINGS (1 OF 4)
NAME: STEPHEN HUANG	CHECKED BY: MADHU THUMMALURU	CHARLES RAMBO			POST MILES	
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU 04256 EA 297601		DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES / SHEET 18 / OF 21

FILE => ...\RW 246 LOTB\LOTB 1 of 4.dgn

USERNAME => mdhu_thummaluru DATE PLOTTED => 9/1/2010 TIME PLOTTED => 11:22:25 AM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/12 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ENGINEERING SERVICES		GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0075	RETAINING WALL 246
FUNCTIONAL SUPERVISOR	DRAWN BY: ANDREW CHEUNG	FIELD INVESTIGATION BY:		DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (2 OF 4)
NAME: STEPHEN HUANG	CHECKED BY: MADHU THUMMALURU	CHARLES RAMBO		CU 04256 EA 297601	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES / SHEET 19 / OF 21

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

FILE => ...\RW 246 LOTB\LOTB 2 of 4.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/1/2010 TIME PLOTTED => 11:23:33 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Stephen Huang
No. C 42289
Exp. 03/31/12
REGISTERED PROFESSIONAL ENGINEER
CIVIL
STATE OF CALIFORNIA

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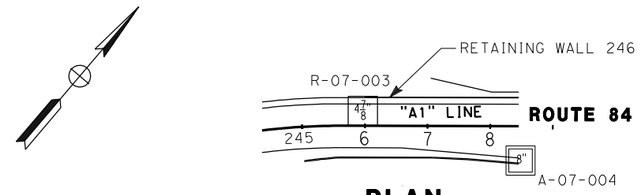
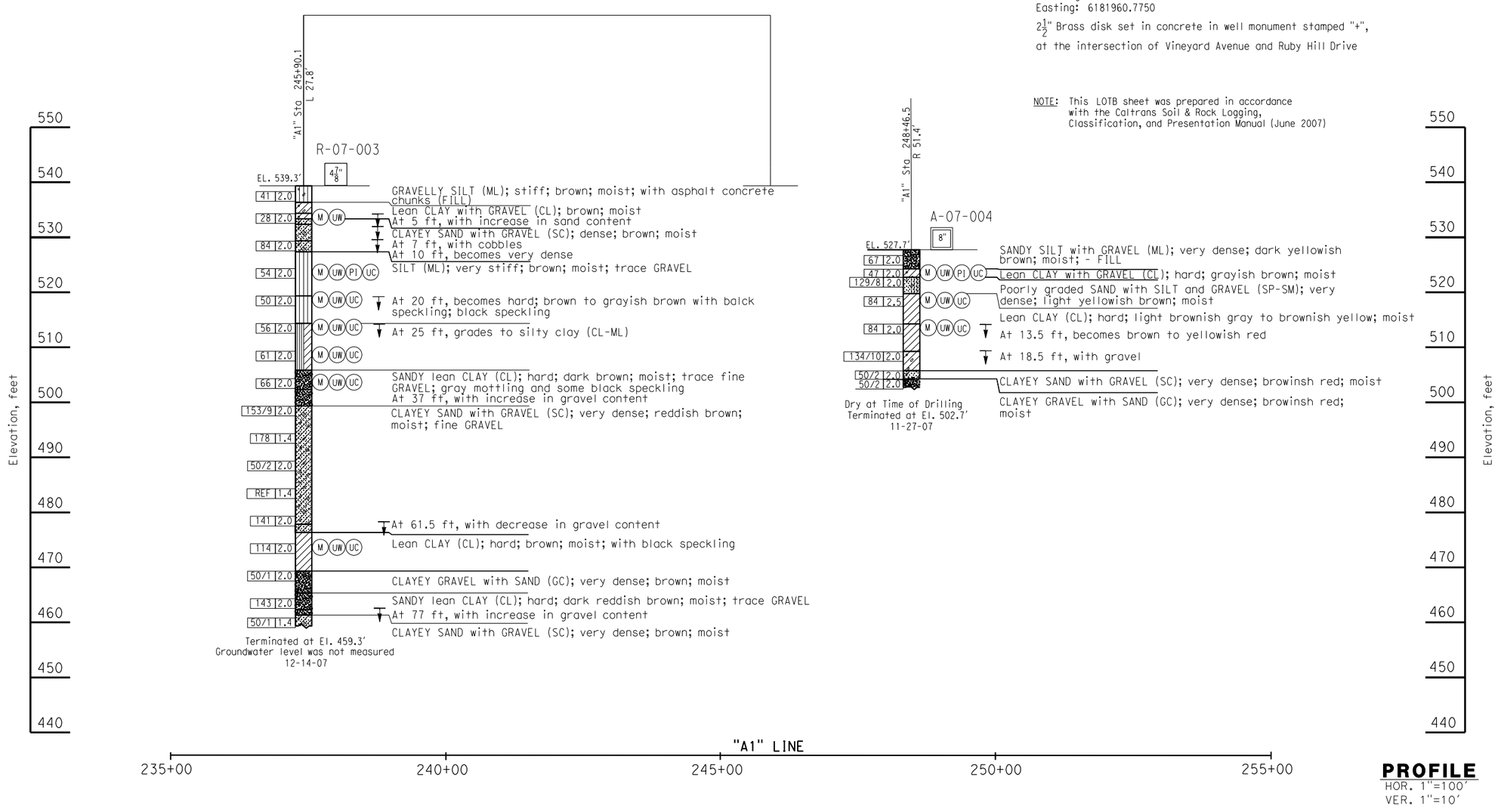


PLAN
Scale: 1"=100'

BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
$2\frac{1}{2}$" Brass disk set in concrete in well monument stamped "+",
at the intersection of Vineyard Avenue and Ruby Hill Drive

NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)



PROFILE
HOR. 1"=100'
VER. 1"=10'

ENGINEERING SERVICES		GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0075	RETAINING WALL 246
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO		DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (3 OF 4)
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU 04256 EA 297601		DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES / SHEET 20 / OF 21

FILE => ...\RW 246 LOTB\LOTB 3 of 4.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/1/2010 TIME PLOTTED => 11:01:25 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/12 — CIVIL — STATE OF CALIFORNIA

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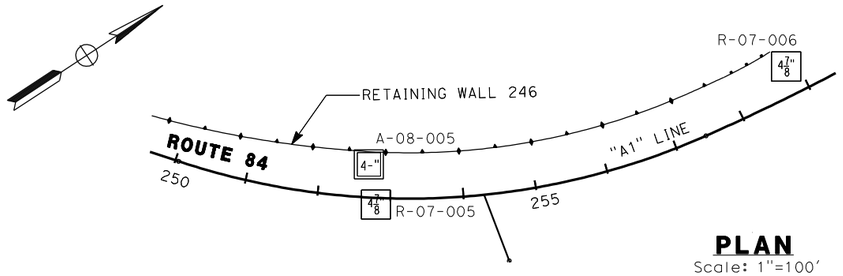

PLAN
Scale: 1"=100'

BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
2½" Brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive

NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

"A1" Sta 252+67.4
L 44.4'

A-08-005

EL. 546.0'

36	2.0	M UW UC PI		Lean CLAY with GRAVEL (CL); hard; brown mottled with dark brown; moist; gravel at the top
56	2.0			SANDY lean CLAY (CL); very stiff; black; moist
				SILTY SAND with GRAVEL (SM); dense; reddish brown; moist; fine GRAVEL
48	2.0	M UW UC PI		SANDY lean CLAY (CL); hard; brown; moist
57	2.0			Gravel layer 3"
				SILTY SAND (SM); dense; brown; fine GRAVEL
				SANDY lean CLAY (CL); very stiff; brown; moist
71	2.0			SILTY SAND with GRAVEL (SM); very dense; reddish brown
				SILTY SAND (SM); very dense; reddish brown; moist
				Gravel
87/10	2.0			SANDY SILT (ML); hard; brown; moist
				SILTY SAND (SM); very dense; moist; coarse SAND
	2.0			SANDY SILT (ML); brown
				SILTY SAND (SM); very dense; reddish brown; fine GRAVEL
50	2.0			SANDY lean CLAY (CL); hard; brown
				CLAYEY SAND (SC); very dense; brown

Dry at Time of Drilling
Terminated at El. 511.0'
03-06-08

"A1" Sta 252+76.0
R 10.2'

R-07-005

EL. 527.3'

73	2.0			9 inches Asphalt Concrete over 9 inches Aggregate Base
				SILTY SAND with GRAVEL (SM); very dense; gray; moist; with asphalt concrete chunks - FILL
61	2.0	M UW		SANDY lean CLAY with GRAVEL (CL); stiff; black; moist
				CLAYEY SILT (CL-ML); stiff; brownish yellow to brown; moist
97	2.0			SILTY, CLAYEY SAND with GRAVEL (SC-SM); very dense; brown; moist
65	1.4			SILTY SAND with GRAVEL (SM); very dense; brown; moist
				CLAYEY SAND with GRAVEL (SC); very dense; brown; moist
72	2.0	M UW UC		Lean CLAY (CL); hard; gray; moist; trace GRAVEL; brown mottling with some black speckling
76	2.0	M UW UC		
77	2.0	M UW UC		
74	2.0	M UW UC		
90	2.0	M UW UC		
99	2.0	M UW UC		
91	2.0	M UW UC		At 50 ft, becomes dark reddish brown
118	2.0			At 54 ft, with gravel

Terminated at El. 470.8'
Groundwater level was not measured
12-13-07

"A1" Sta 258+83.4
L 38'

R-07-006

EL. 527.8'

55	2.0	M UW		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist
69	2.0	M UW		
81	2.0	M UW PA		CLAYEY GRAVEL with SAND (GC); very dense; brown; moist
106	2.0			
126	2.0			
149	2.0			
				At 27 ft, with increase in gravel content
REF	2.0			At 31 ft, with cobbles
				Poorly graded GRAVEL (GP); very dense; with interbedded clayey sand lenses
103	2.0	M UW UC		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist
				At 37.5 ft, with decrease in gravel content
64	2.0	M UW UC		Lean CLAY (CL); hard; reddish brown; moist; with black speckling
96	2.0	M UW UC		At 45 ft, with some fine SAND
100	2.0	M UW UC		At 50 ft, with gray mottling
91	2.0	M UW UC		At 55 ft, with no gray mottling
84	2.0	M UW		CLAYEY SAND with GRAVEL (SC); very dense; reddish brown; moist
169/8	2.0			CLAYEY GRAVEL (GC); very dense; reddish brown; moist
96	1.4			CLAYEY SAND with GRAVEL (SC); very dense; reddish brown; moist
50/2	2.0			
165	2.0			

Terminated at El. 447.8'
Groundwater level was not measured
12-17-07

Elevation, feet: 570, 560, 550, 540, 530, 520, 510, 500, 490, 480, 470, 460, 450, 440

"A1" LINE
245+00 250+00 255+00 260+00 265+00

PROFILE
HOR. 1"=100'
VER. 1"=10'

ENGINEERING SERVICES		GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0075	RETAINING WALL 246
FUNCTIONAL SUPERVISOR	DRAWN BY: ANDREW CHEUNG	FIELD INVESTIGATION BY: CHARLES RAMBO		DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (4 OF 4)
NAME: STEPHEN HUANG	CHECKED BY: MADHU THUMMALURU					

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 21 OF 21

FILE => ...\RW 246 LOTB\LOTB 4 of 4.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/1/2010 TIME PLOTTED => 11:10:45 AM

LOG OF TEST BORINGS
RETAINING WALL 391

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

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Suite 800
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CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size (square)	A	Auger Boring
Size (square)	R P	Rotary drilled boring Rotary percussion boring (air)
Size (diamond)	R	Rotary drilled diamond core
Size (square)	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

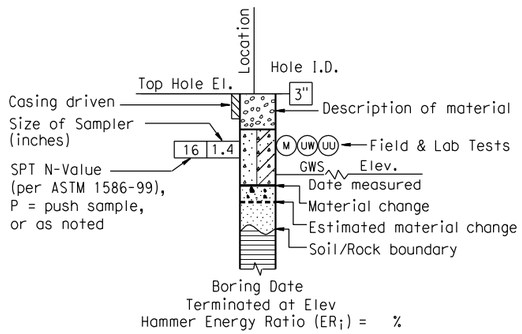
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

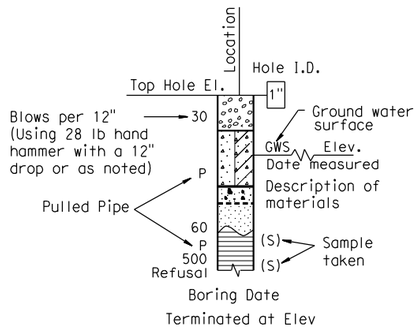
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

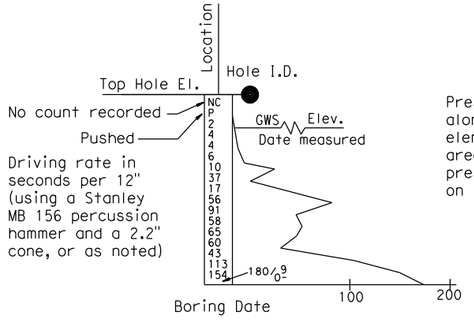
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



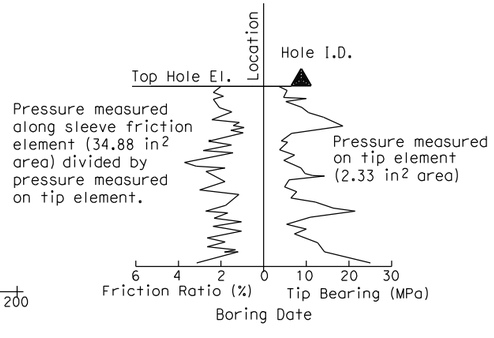
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0076	RETAINING WALL 391
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO	DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (1 OF 4)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 13 OF 16

FILE => ...\RW 391 LOTB 1 of 4.dgn

USERNAME => andrew_cheung DATE PLOTTED => 8/20/2010 TIME PLOTTED => 4:22:25 PM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42789 — Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

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APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ENGINEERING SERVICES
FUNCTIONAL SUPERVISOR
NAME: STEPHEN HUANG

GEOTECHNICAL SERVICES
DRAWN BY: ANDREW CHEUNG
CHECKED BY: MADHU THUMMALURU
FIELD INVESTIGATION BY:
CHARLES RAMBO

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH

BRIDGE NO. 33E0076
POST MILES

RETAINING WALL 391
LOG OF TEST BORINGS (2 OF 4)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 14 OF 16

FILE => ...\RW 391 LOTB 2 of 4.dgn

USERNAME => andrew_cheung DATE PLOTTED => 8/20/2010 TIME PLOTTED => 4:22:43 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
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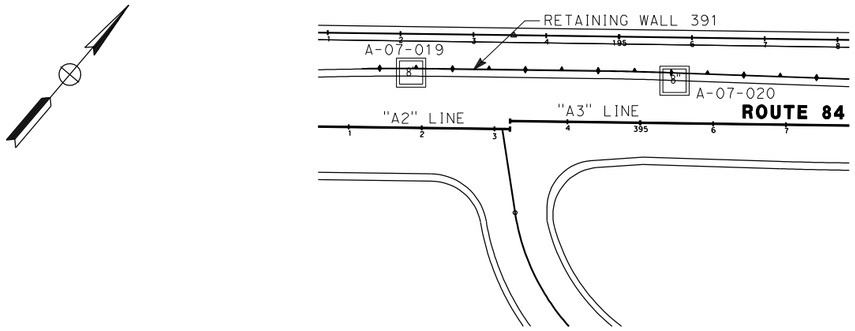
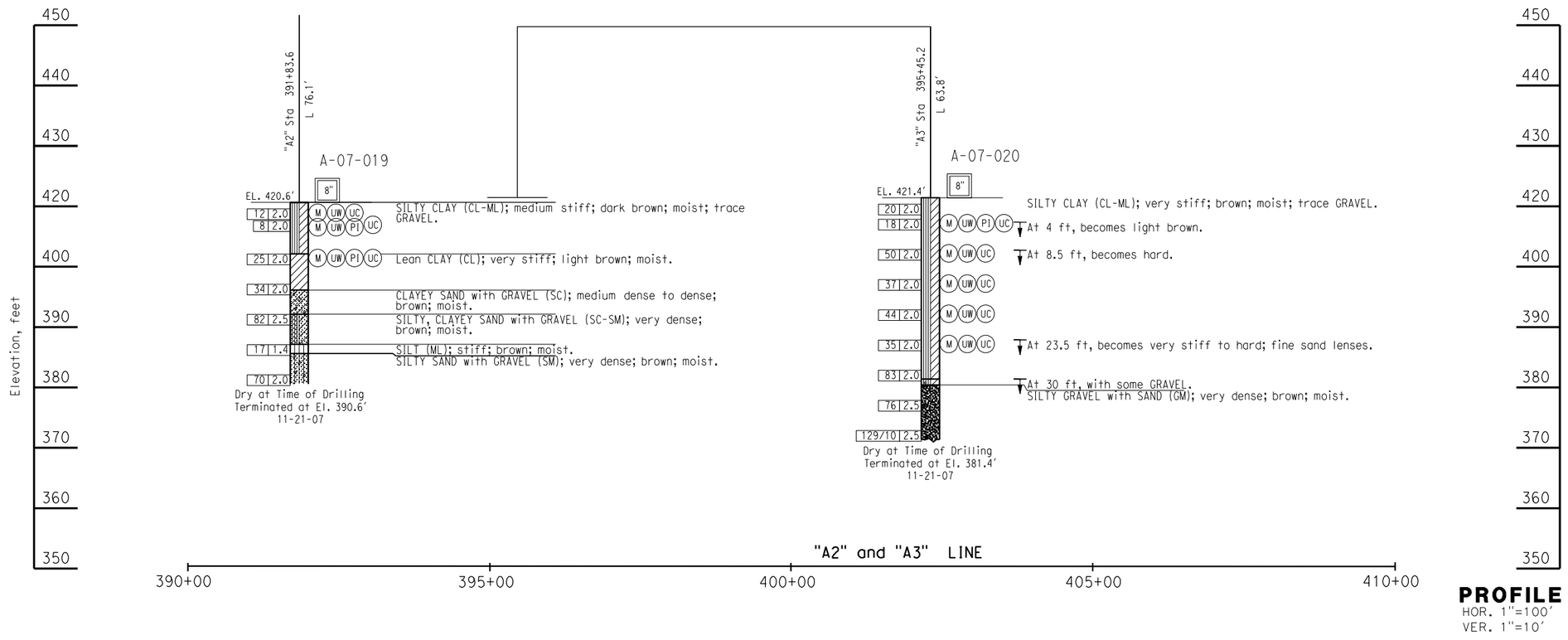


NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

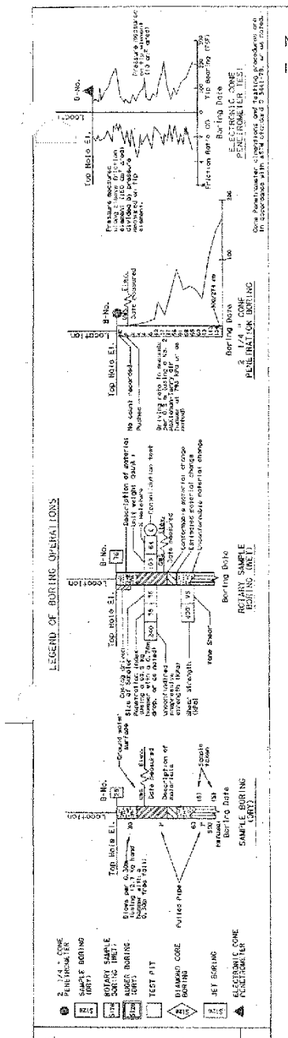
BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
$2\frac{1}{2}$" Brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive



PROFILE
HOR. 1"=100'
VER. 1"=10'

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0076	RETAINING WALL 391
FUNCTIONAL SUPERVISOR	DRAWN BY: ANDREW CHEUNG		DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (3 OF 4)
NAME: STEPHEN HUANG	CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO	CU 04256 EA 297601	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES / SHEET 15 / OF 16
OGS CIVIL LOG OF TEST BORINGS SHEET	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		FILE => ...\RW 391 LOTB 3 of 4.dgn		

USERNAME => madhu_thummaluru DATE PLOTTED => 9/1/2010 TIME PLOTTED => 11:47:47 AM

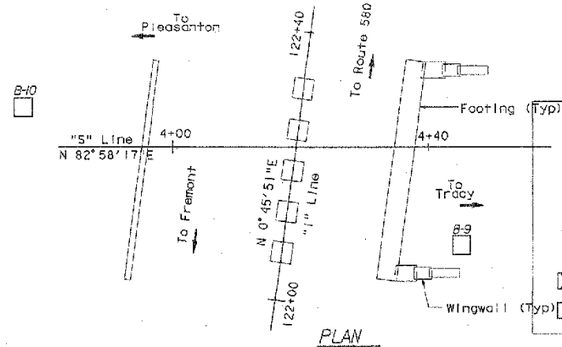


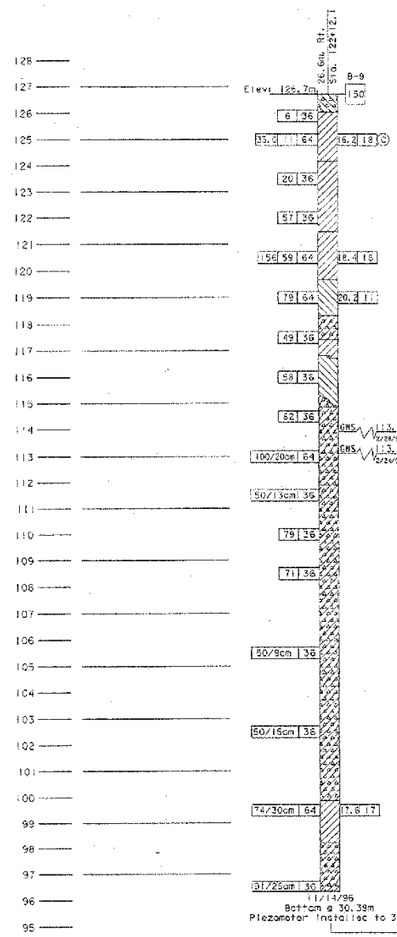
NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

2. Soil classification and description conform to ASTM D2487.

BENCHMARK:
All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).
TBM No. 2: Mon. No. 220
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.004 meters right of Center Line Station "15" 122+19.529. The elevation is 126.311 meters (414.41 feet).





Notes:

1. See the plans dated May 11, 1999 for stationing.
For example | Line Sta 136+62 (Metric) = A3 Line Sta 448+23 (English).

2. Structure Design produced the data presented in the table below. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

Boring	Station	Offset from A3 Line (84)
B-9	400+66	87.3 ft. Rt
B-10	401+02	135.2 ft. Lt

Revisions made to this Log of Test Borings from the original Log of Test Borings are the addition of the following table and notes:

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84			

3/2/09
REGISTERED GEOTECHNICAL ENGINEER — DATE

RETAINING WALL 391

LOG OF TEST BORINGS (4 OF 4)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

Cu: 04256
Ea: 297601

BRIDGE No. 33E0076
Sheet 16 of 16

DATE PLOTTED => 8/20/2010

Stephen Huang
No. C 42289
Exp. 03/31/10
GEOTECHNICAL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		382	407

REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

NEEL KANTAM
No. 2391
Exp. 9/30/01
GEOTECHNICAL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes ☐ Changes As Noted
Revisions by: MPW (Initials)

DESIGN OVERSIGHT	DRAWN BY	J. HULSE	N. Mace	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	O. RODRIGUEZ
SIGN OFF DATE	CHECKED BY	F. HUBER	FIELD INVESTIGATION BY: DATE:		PROJECT ENGINEER

BRIDGE NO. 33C-0406
KILOMETER POST

ISABEL AVENUE UNDERCROSSING
LOG OF TEST BORINGS

REV. DATE: 6-2-97
ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100
CU
EA
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 16 OF 16

FILE => ...\bw 391 LOTB 4 of 4.dgn
TIME PLOTTED => $$$$$$$$TIME$$$$$$

LOG OF TEST BORINGS
RETAINING WALL 400N

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

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1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

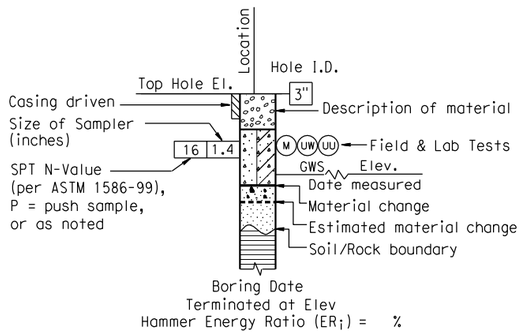
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size (square)	A	Auger Boring
Size (square)	R P	Rotary drilled boring Rotary percussion boring (air)
Size (diamond)	R	Rotary drilled diamond core
Size (square)	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

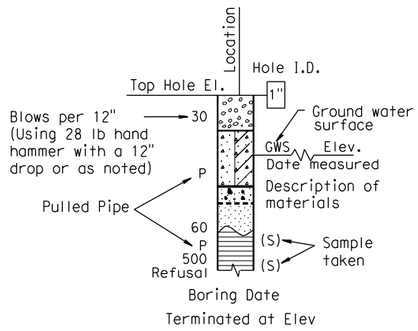
Note: Size in inches.

PLASTICITY OF FINE-GRAINED SOILS

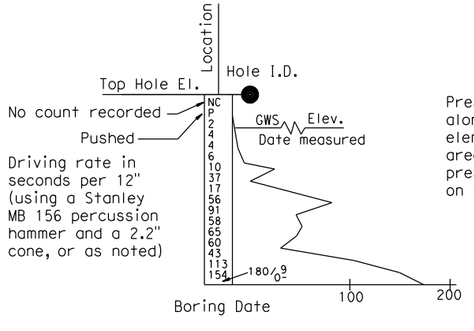
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



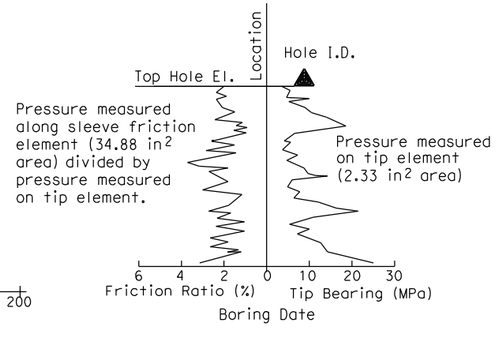
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ENGINEERING SERVICES	GEOTECHNICAL SERVICES		STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0079	RETAINING WALL 400N
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO		DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (1 OF 7)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 21 OF 27

FILE => ...\RW 400N LOTB 1 of 7.dgn

USERNAME => andrew_cheung DATE PLOTTED => 8/20/2010 TIME PLOTTED => 4:26:17 PM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42789 — Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

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APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ENGINEERING SERVICES		GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0079	RETAINING WALL 400N
FUNCTIONAL SUPERVISOR	DRAWN BY: ANDREW CHEUNG	FIELD INVESTIGATION BY:		DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (2 OF 7)
NAME: STEPHEN HUANG	CHECKED BY: MADHU THUMMALURU	CHARLES RAMBO				

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 22 OF 27

FILE => ...\RW 400N LOTB 2 of 7.dgn

USERNAME => andrew_cheung DATE PLOTTED => 8/20/2010 TIME PLOTTED => 4:26:36 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Stephen Huang
No. C 42289
Exp. 03/31/12
REGISTERED PROFESSIONAL ENGINEER
CIVIL
STATE OF CALIFORNIA

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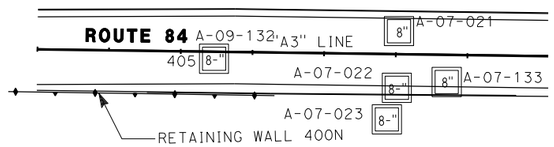
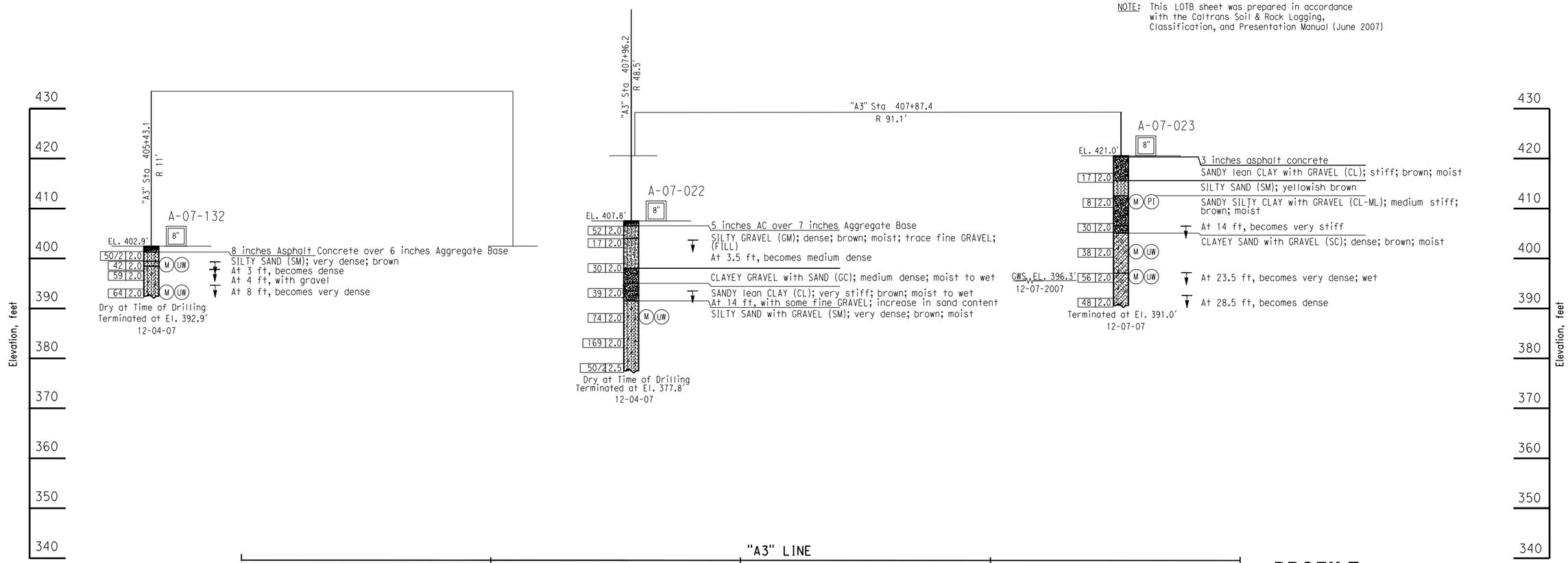


PLAN
Scale: 1"=100'

BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
2½" Brass disk set in concrete in well monument stamped "+",
at the intersection of Vineyard Avenue and Ruby Hill Drive

NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)



PROFILE
HOR. 1"=100'
VER. 1"=10'

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0079	RETAINING WALL 400N
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO	DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (3 OF 7)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 23 OF 27

FILE => ...\RW400N LOTB 3 of 7.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/11/2010 TIME PLOTTED => 12:02:52 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/12 — CIVIL — STATE OF CALIFORNIA

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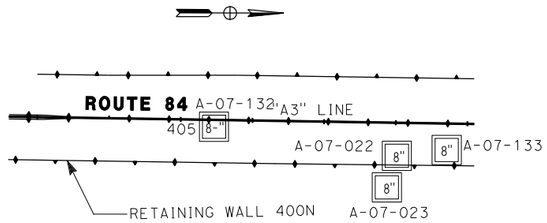
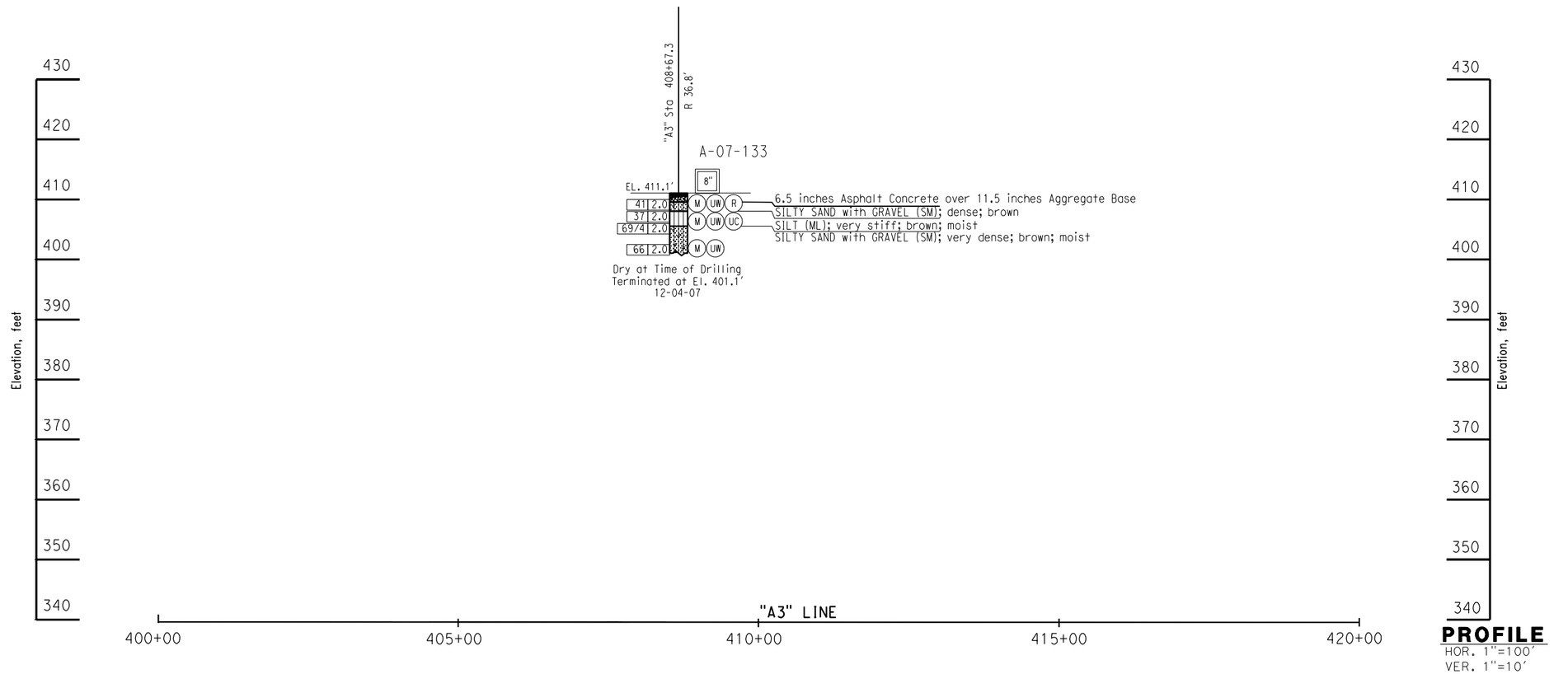


PLAN
Scale: 1"=100'

BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
$2\frac{1}{2}$" Brass disk set in concrete in well monument stamped "+",
at the intersection of Vineyard Avenue and Ruby Hill Drive

NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)



PROFILE
HOR. 1"=100'
VER. 1"=10'

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0079	RETAINING WALL 400N
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG; CHECKED BY: MADHU THUMMALURU; FIELD INVESTIGATION BY: CHARLES RAMBO		DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (4 OF 7)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

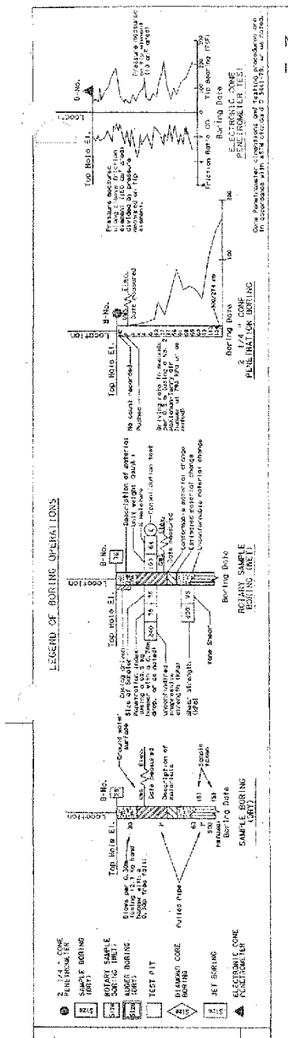
DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 24 OF 27

FILE => ...\RW400N LOTB 4 of 7.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/1/2010 TIME PLOTTED => 12:05:57 PM

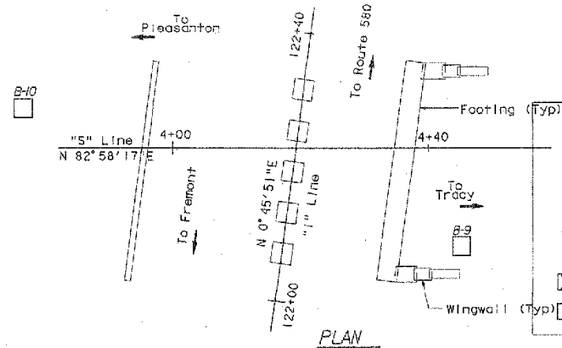


NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

2. Soil classification and description conform to ASTM D2487.

BENCHMARK:
All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).
TBM No. 2: Mon. No. 220
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.004 meters right of Center Line Station "15" 122+19.529. The elevation is 126.311 meters (414.41 feet).



DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		382	407

REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

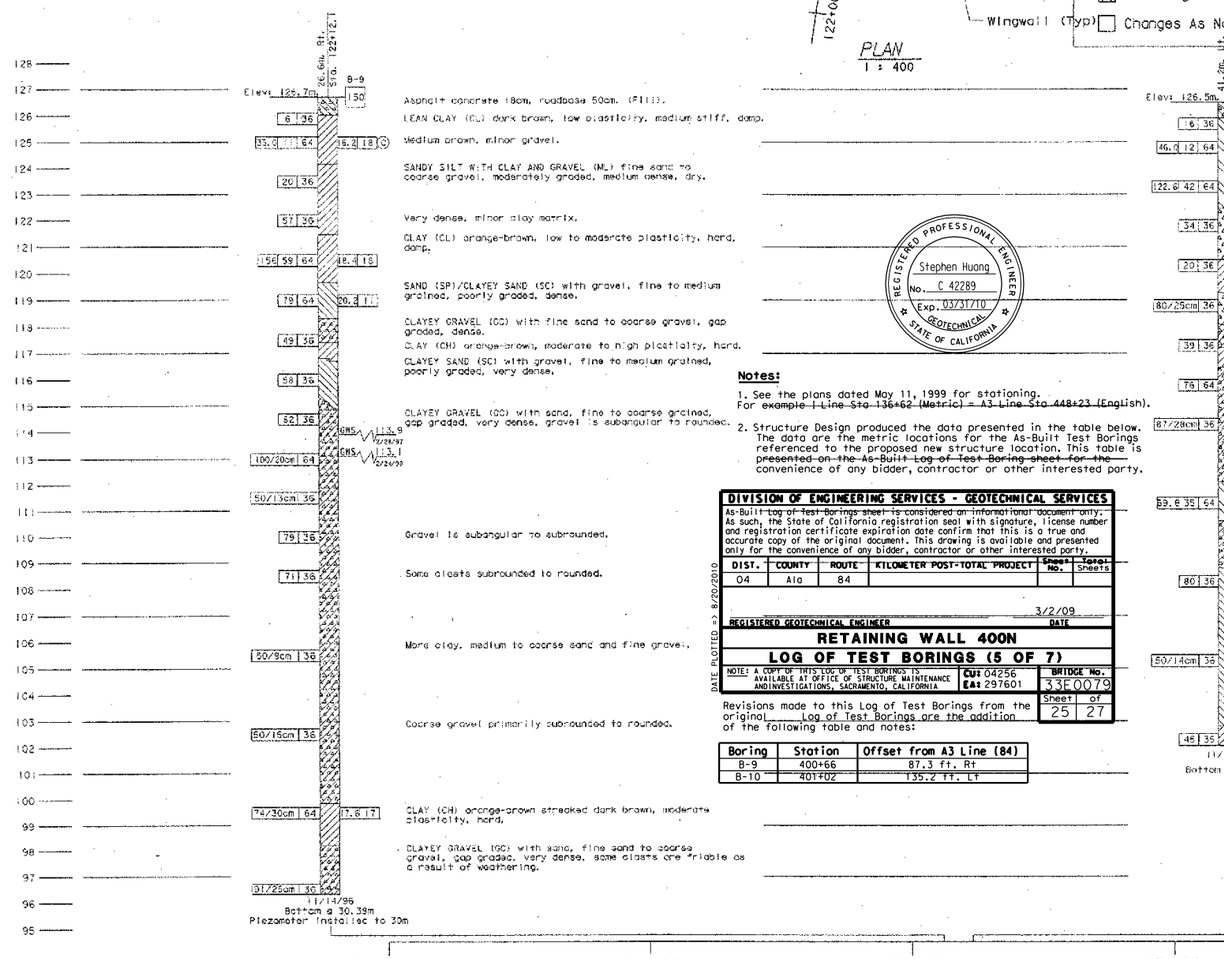
REGISTERED PROFESSIONAL ENGINEER — NEEL KAKNIANI — No. 2391 — Exp. 9/30/01 — GEOTECHNICAL — STATE OF CALIFORNIA

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

☒ No Changes ☐ Changes As Noted Revisions by: MPW (Initials)



Notes:

1. See the plans dated May 11, 1999 for stationing.
For example | Line Sta 136+62 (Metric) = A3 Line Sta 448+23 (English).

2. Structure Design produced the data presented in the table below. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

Boring	Station	Offset from A3 Line (84)
B-9	400+66	87.3 ft. Rt
B-10	401+02	135.2 ft. Lt

STEPHEN HUANG — No. C 42289 — Exp. 03/31/10 — GEOTECHNICAL — STATE OF CALIFORNIA

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84			

3/2/09
REGISTERED GEOTECHNICAL ENGINEER — DATE

RETAINING WALL 400N

LOG OF TEST BORINGS (5 OF 7)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

Cu# 04256
Ea# 297601

BRIDGE No. 33E0079
Sheet 25 of 27

Revisions made to this Log of Test Borings from the original Log of Test Borings are the addition of the following table and notes:

DATE PLOTTED => 8/20/2010

DESIGN OVERSIGHT	DRAWN BY	J. HULSE	N. Mace	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	O. RODRIGUEZ	BRIDGE NO. 33C-0406	ISABEL AVENUE UNDERCROSSING
SIGN OFF DATE	CHECKED BY	T. HUBER	FIELD INVESTIGATION BY: DATE:		PROJECT ENGINEER	KILOMETER POST	LOG OF TEST BORINGS

REV. DATE: 6-2-97 — ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100 — CU EA — DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES (PRELIMINARY STAGE ONLY) — SHEET 16 OF 16

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TIME PLOTTED => $$$$$$$$$TIME$$$$$$

NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

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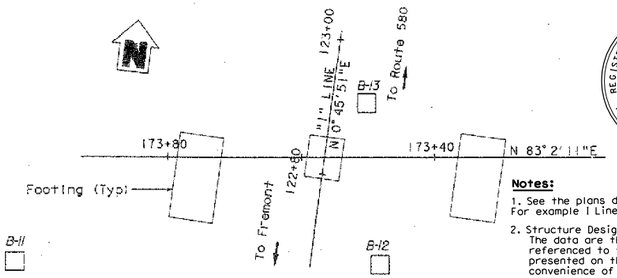
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.004 meters right of Center Line Station "15" 122+19.529. The elevation is 126.311 meters (414.41 feet).



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Stephen Huang
No. C 42289
Exp. 03/31/10
GEOTECHNICAL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

Caltrans Metric

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		395	401

REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3569 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

G. NEELAKANTAN
No. 2791
Exp. 9/30/01
GEOTECHNICAL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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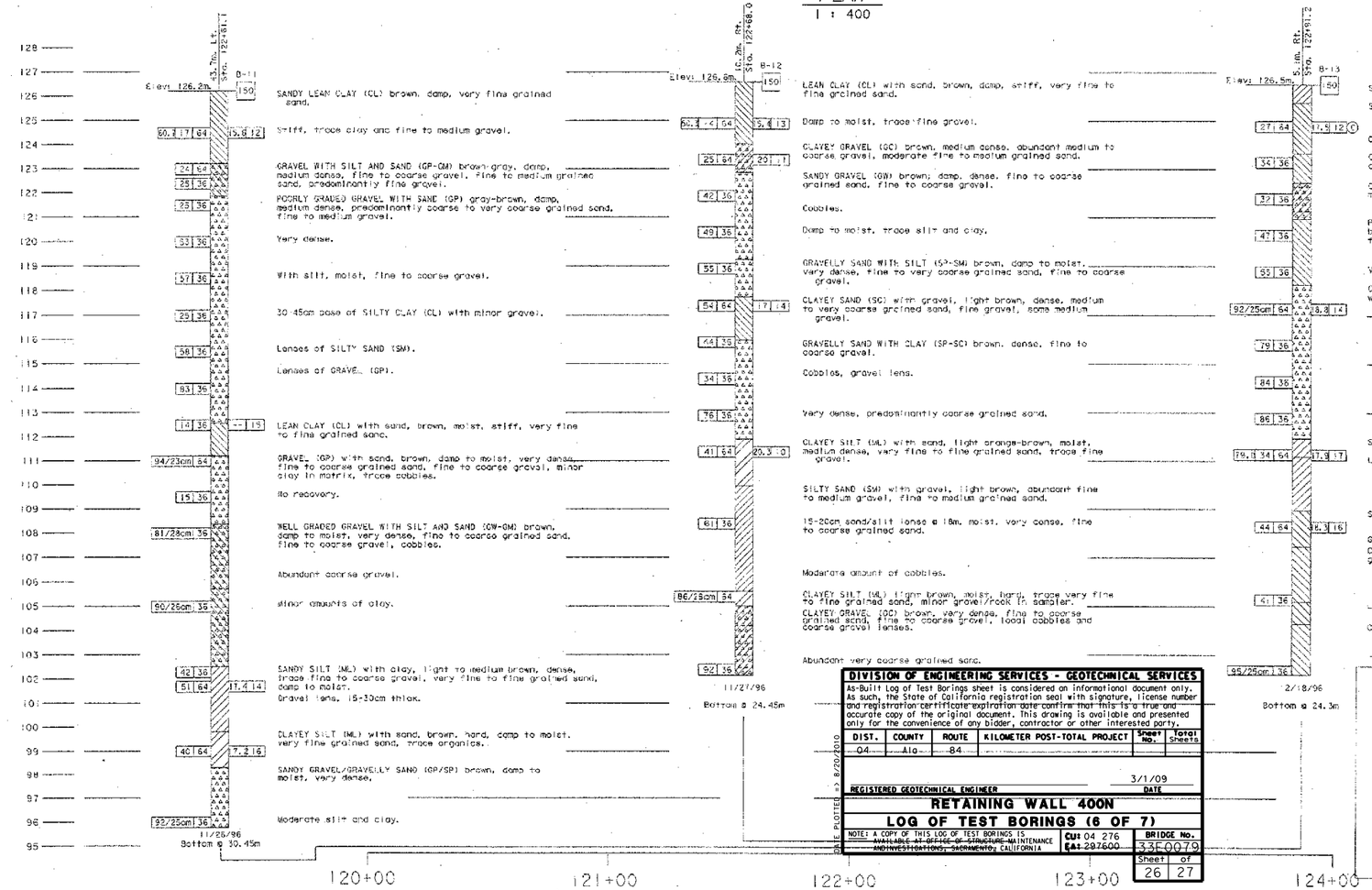
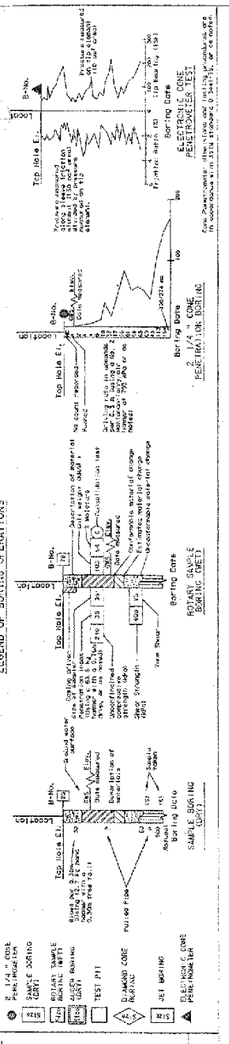
Revisions made to this Log of Test Borings from the original ___ Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from A3 Line (84)
B-11	402+27	143.4 ft. Lt
B-12	402+49	33.5 ft. Rt
B-13	403+25	16.7 ft. Rt

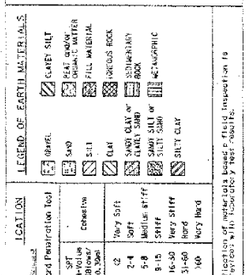
PLAN
1 : 400



LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS U.S.C.S.



CONSISTENCY LOCATION

According to the Standard Penetration Test			
SPT N-Value (blows/0.3m)	Cohesive		Very Soft, Soft, Medium stiff, Stiff, Very stiff, Hard, Very Hard
		0-2	
		2-4	
		4-8	
		8-15	
		15-30	
		31-60	
		60+	
SPT N-Value (blows/0.3m)	Granular		Very Loose, Loose, Medium Dense, Dense, Very Dense
0-4		0-10	
5-10		11-30	
11-30		31-50	
31-50		50+	
50+			

NOTE: Visual classification of materials based on field inspection by contractor or Caltrans with laboratory test results.

DESIGN OVERSIGHT	DRAWN BY J. HULSE	A. PATTERSON, V. THILAKARATNE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY T. HUBER	FIELD INVESTIGATION BY: DATE:	G. RODRIGUEZ PROJECT ENGINEER

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU EA

REV. DATES: 6-2-97

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

BRIDGE NO. 33C-0405
KILOMETER POST:

ISABEL AVENUE UNDERPASS
LOG OF TEST BORINGS

SHEET 13 OF 13

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	KILOMETER POST-TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		396	401

REGISTERED GEOTECHNICAL ENGINEER — 3/1/09 DATE

RETAINING WALL 400N

LOG OF TEST BORINGS (6 OF 7)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04 276
EA: 297600

BRIDGE No. 33E0079

Sheet 26 of 27

DATE PLOTTED => 8/20/2010

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Barry Chu

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates

☒ No Changes
☐ Changes As Noted

Revisions by: MFW (Initials)

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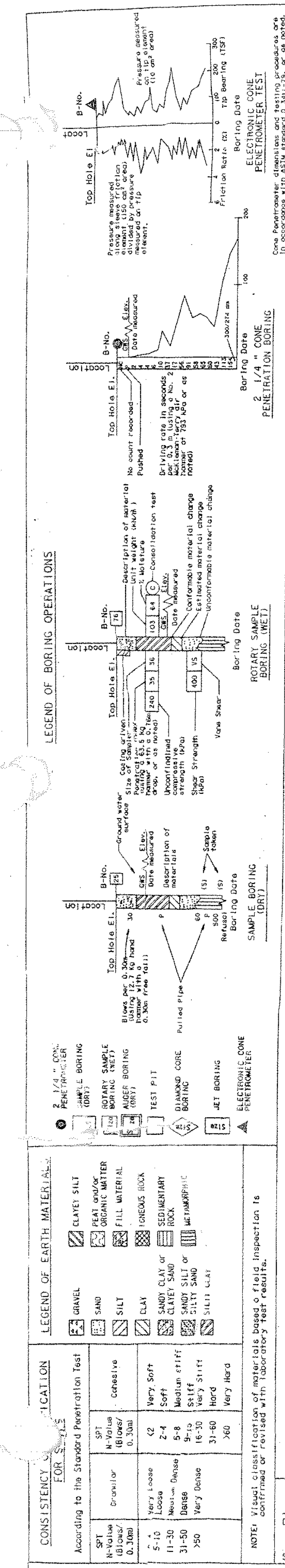

NOTES:

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A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.064 meters right of Center Line Station "I5" 122+19.529. The elevation is 126.311 meters (414.41 feet).

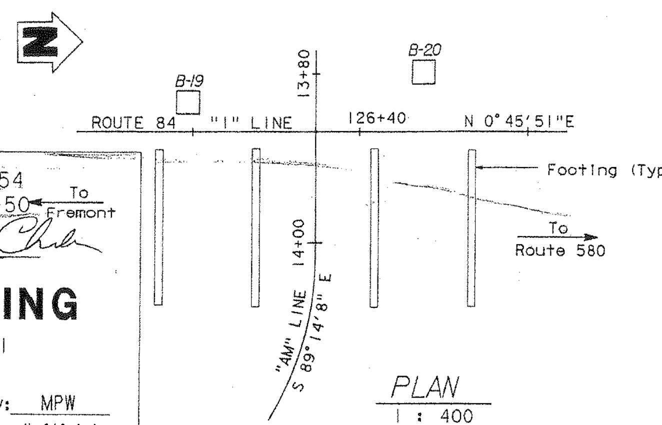
Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

AS-BUILT DRAWING

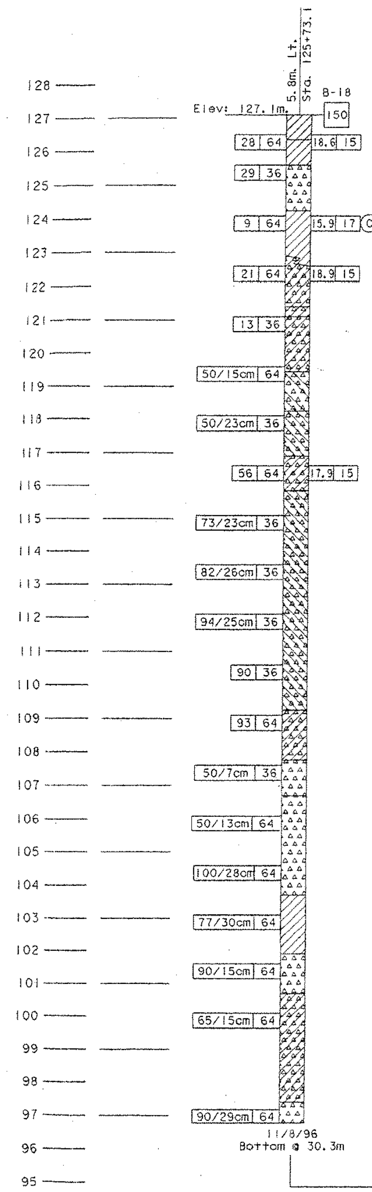
Resident Engineer: Hank Doll
Vali Cooper & Associates

[X] No Changes
[ ] Changes As Noted

Revisions by: MPW (Initials)

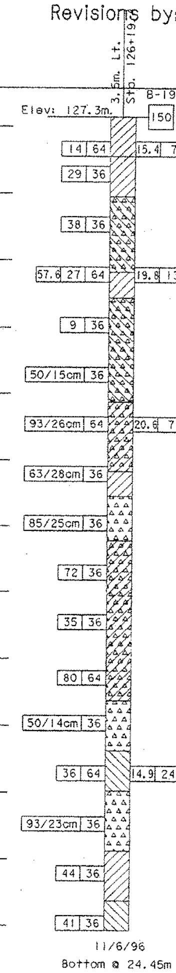


PLAN
1 : 400



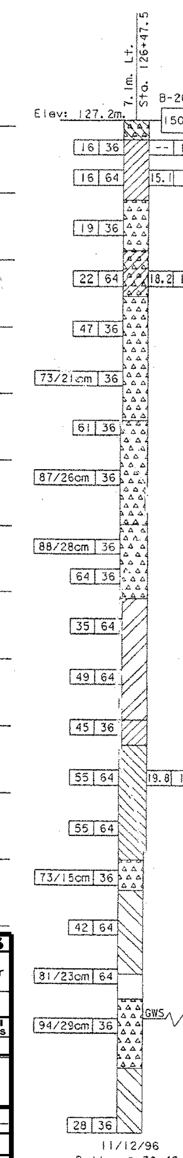
B-18: SILTY SAND (SM) medium brown, very fine grained, poorly graded, medium dense, dry.
SANDY SILT (ML) with gravel, light to medium brown, gap graded, medium dense, moist.
SANDY GRAVEL/GRAVELLY SAND (GP/SP) medium brown to light gray @ 1.65m, gap graded, medium dense, dry, gravel is fine to coarse grained, sand is primarily fine grained.
SANDY SILT (ML) with minor gravel, medium brown, loose, non plastic, moist, grading to CLAY (CL) with minor sand and gravel.
GRAVELLY LEAN CLAY (CL) brown, stiff, low to moderate plasticity, fine to coarse gravel, subrounded to rounded.
CLAYEY GRAVEL (GC) lens.
Local sandy layers.
GRAVEL AND COBBLES (GC) with silty clay matrix, fine to coarse gravel and small cobbles, gap graded, very dense.
SILTY GRAVEL (GM) brown, medium to coarse grained sand, primarily fine gravel, moderately graded, very dense.
CLAYEY GRAVEL (GC) medium brown, coarse grained, poorly graded, dense, subrounded to rounded gravel, clay is low to medium plasticity.
SILTY GRAVEL (GM) with sand, brown to gray, fine to coarse grained, moderately graded, very dense, primarily fine gravel.
Local lenses of fine to coarse grained, very dense, SANDY GRAVEL (GP).
Fine to coarse gravel, moderately gap graded.
CLAYEY GRAVEL (GC) brown, low to moderate plasticity clay matrix, gravel is coarse grained, subrounded to rounded, very dense.
GRAVELLY SAND (SP) fine to coarse sand, fine gravel, moderately graded, very dense.
SANDY GRAVEL (GW) light brown, moist, very dense, sand, silt and minor clay matrix, coarse gravel is subangular.
5-7.5cm layers of Gravelly Sand (SP).
CLAY (CL) brown, hard.
No recovery.
SANDY GRAVEL (GM) with clay, brown, moist to wet, very dense.
CLAYEY GRAVEL (GC) brown, moist, very dense.
Scattered cobbles.
SANDY CLAYEY GRAVEL (GM/GC) brown, damp, very dense, medium to coarse gravel, subangular to angular.

11/8/96
Bottom @ 30.3m



B-19: SANDY SILT (ML) gray-brown, damp, loose.
SILTY SAND (SM) with gravel, gray-brown, damp, medium dense, medium to coarse sand, fine gravel.
WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, damp, dense, fine to coarse gravel.
LEAN CLAY (CL) brown, moist, stiff.
WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) gray-brown, moist, loose, rounded fine to coarse gravel in cuttings at 5.7m.
6m: No recovery, clayey sand to clayey gravel cuttings.
Very dense.
CLAYEY GRAVEL (GC) with sand, brown, moist, very dense, fine to coarse gravel.
LEAN CLAY (CL) yellow-brown, moist, very stiff.
WELL GRADED GRAVEL (GW) with sand, brown, moist to wet, very dense, fine to coarse gravel, medium to coarse sand.
WELL GRADED GRAVEL WITH CLAY AND SAND (GW-GC) brown to yellow-brown, moist, very dense, fine to coarse gravel, medium to coarse grained sand.
Lens of LEAN CLAY (CL) from 15.3 to 15.45m.
No recovery.
GRAVELLY SAND TO SANDY GRAVEL (SW/GW) gray-brown, wet, very dense.
SILT (ML) brown, moist to wet, very stiff, slightly plastic.
POORLY GRADED SAND (SP) with gravel, gray-brown, wet, very dense, coarse sand and gravel.
LEAN CLAY (CL) dark yellow-brown, moist, hard.
SILT (ML) dark yellow-brown, moist, hard.

11/6/96
Bottom @ 24.45m



B-20: SILT (ML) with gravel, dark brown, damp, stiff, minor string, plastic.
SILT (ML) with sand, dark brown, damp, stiff, open-pore structure, gravel at 1m.
SANDY GRAVEL (GM/GP) brown, damp, medium dense, fine to coarse gravel, moderate amount of sand and silt matrix.
LEAN CLAY (CL) with gravel, brown, damp to moist, stiff.
SANDY GRAVEL (GP) gray-brown, moist, dense, minor silt, fine to coarse gravel.
Coarse gravel and cobbles.
Cobble layer, minor caving.
Cobble in sampler.
Coarse gravel and cobbles.
GRAVELLY SAND (SP-SM) moderate sand and silt matrix, dense, scattered cobbles.
Very dense, coarse gravel and cobbles, local clay lens.
SANDY SILTY GRAVEL (GM) brown, damp, very dense.
Very dense.
CLAYEY SILT (ML) brown, damp, very stiff.
CLAYEY SILT (ML) with sand, brown, moist, very stiff, fractured, sand is very fine to fine grained.
SILTY SAND (SM) brown, moist, dense, sand is very fine to medium grained.
SANDY CLAY (CL) with gravel, brown, moist, hard, minor fine to coarse gravel throughout. Layers of Clayey Silt (ML) with fine grained sand.
Increasing sand and gravel.
SANDY GRAVEL (GP/GM) green-brown, moist, very dense.
SILTY CLAY (CL) brown, moist, very stiff.
POORLY GRADED SAND (SP) gray-brown, moist, very dense, sand is coarse to very coarse grained, minor silt.
SANDY GRAVEL (GM/GP) brown, moist to wet, very dense, coarse gravel.
GWS 100.5 11/12/96
SILTY CLAY (CL) brown, moist, very stiff, slightly plastic.

11/12/96
Bottom @ 30.45m

124+00 125+00 126+00 127+00 128+00

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		407	407

REGISTERED GEOTECHNICAL ENGINEER
PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

(Seal: REGISTERED PROFESSIONAL ENGINEER, Stephen Huang, No. C 42289, Exp. 03/31/10, GEOTECHNICAL, STATE OF CALIFORNIA)
(Seal: REGISTERED PROFESSIONAL ENGINEER, G. NEELAKANTAN, No. 2391, Exp. 9/30/01, GEOTECHNICAL, STATE OF CALIFORNIA)

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Revisions made to this Log of Test Borings from the original ____ Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from A3 Line (84)
B-18	412+45	19.0 ft. Lt
B-19	414+00	11.5 ft. Lt
B-20	415+00	23.0 ft. Lt

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84			

REGISTERED GEOTECHNICAL ENGINEER — DATE 3/2/09

RETAINING WALL 400N

LOG OF TEST BORINGS (7 OF 7)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04 276
EA: 297600
BRIDGE No. 33E0079
Sheet 27 of 27

DATE PLOTTED => 8/20/2010

DESIGN OVERSIGHT
SIGN OFF DATE
DRAWN BY: J. HULSE
CHECKED BY: T. HUBER
N. MACE, V. THILAKARATNE, J. THURBER
FIELD INVESTIGATION BY:
DATE:

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

O. RODRIGUEZ
PROJECT ENGINEER

BRIDGE NO. 33C-0407
KILOMETER POST

ARROYO MOCHO BRIDGE

LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 12 OF 12

REV. DATE: 6-2-97

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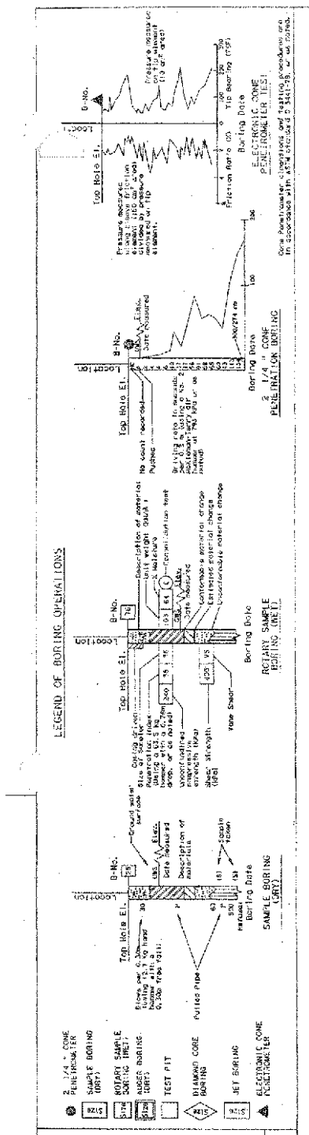
LOG OF TEST BORINGS
RETAINING WALL 400S



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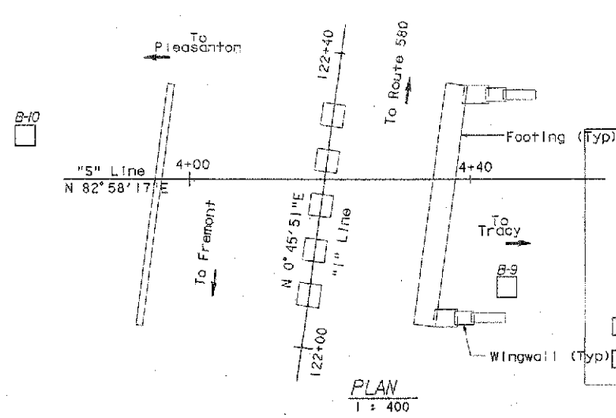

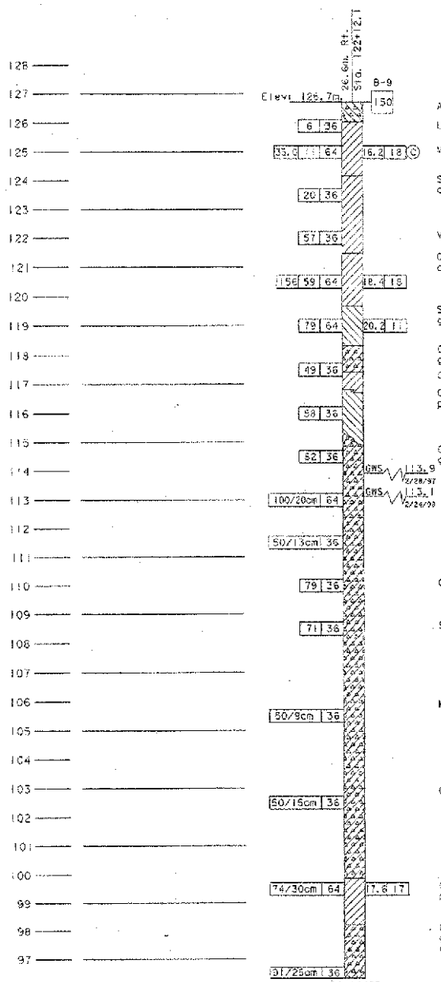

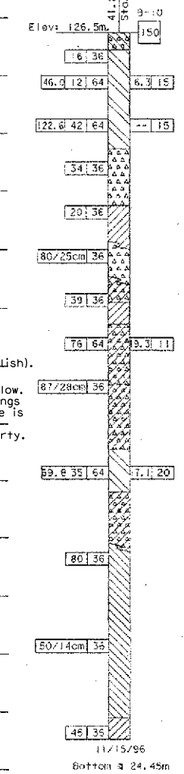

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DIST.	COUNTY	ROUTE	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84			

3/2/09
REGISTERED GEOTECHNICAL ENGINEER — DATE

RETAINING WALL 4008

LOG OF TEST BORINGS (1 OF 2)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04 276
EA: 297600

BRIDGE No. 33E0078
Sheet 6 of 7

Revisions made to this Log of Test Borings from the original Log of Test Borings are the addition of the following table and notes:

DATE PLOTTED => 1/26/2010

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang, No. C 42289, Exp. 03/31/10, GEOTECHNICAL, STATE OF CALIFORNIA

REGISTERED GEOTECHNICAL ENGINEER — NEEL AKANKAN, No. 2391, Exp. 9/30/01, GEOTECHNICAL, STATE OF CALIFORNIA

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vali Cooper & Associates

[X] No Changes [ ] Changes As Noted
Revisions by: MPW (Initials)

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		382	497

REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

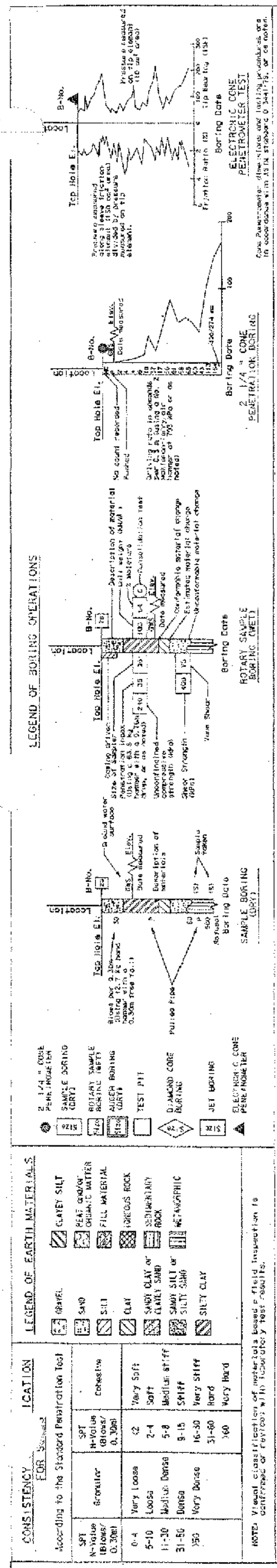
GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste.320
San Francisco, CA 94105

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

DESIGN OVERSIGHT	DRAWN BY	J. HULSE	N. Mode	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	O. RODRIGUEZ	BRIDGE NO. 33C-0405	ISABEL AVENUE UNDERCROSSING
SIGN OFF DATE	CHECKED BY	T. HUBER	FIELD INVESTIGATION BY: DATE:		PROJECT ENGINEER	KILOMETER POST	LOG OF TEST BORINGS

REV. DATE: 6-2-97 — ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100 — CU EA — DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES (PRELIMINARY STAGE ONLY) — SHEET 16 OF 16

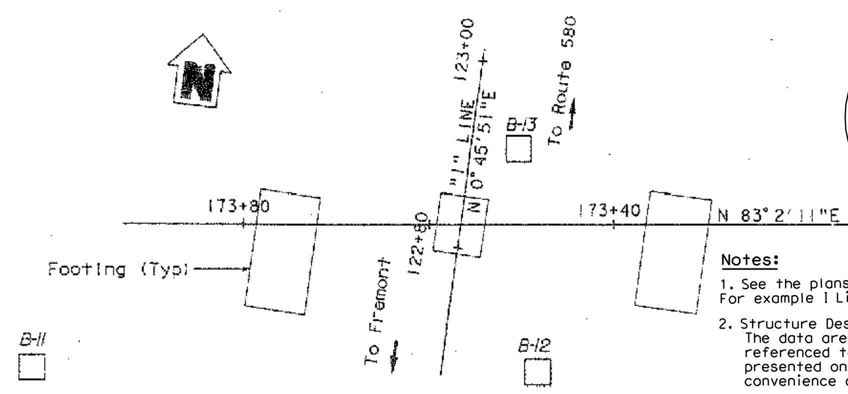
FILE => ...\BW 4005 LOTB 1 of 2.dgn
TIME PLOTTED => $$$$$$$$TIME$$$$$$



NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.
2. Soil classification and description conform to ASTM D2487.

BENCHMARK:
All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).
TBM No. 2: Mon. No. 220
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.004 meters right of Center Line Station "I5" 122+19.529. The elevation is 126.311 meters (414.41 feet).



PLAN
1 : 400

Stephen Huang
No. C 42289
Exp. 03/31/10
GEOTECHNICAL
STATE OF CALIFORNIA

Metric

Notes:

1. See the plans dated May 11, 1999 for stationing.
For example I Line Sta 136+62 (Metric) = A3 Line Sta 448+23 (English).
2. Structure Design produced the data presented in the table below. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		3??	4??

REGISTERED GEOTECHNICAL ENGINEER

G. NEELAKANTAN
No. 2391
Exp. 9/30/01
GEOTECHNICAL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

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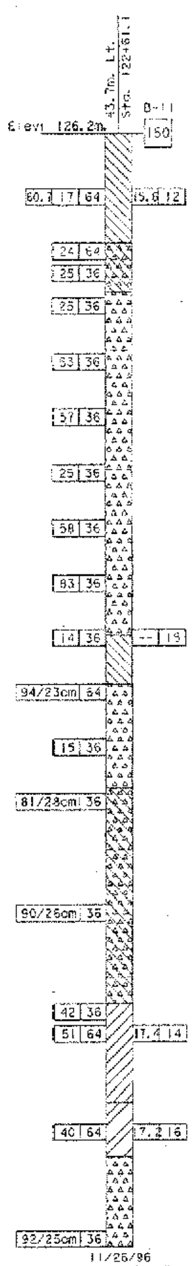
Revisions made to this Log of Test Borings from the original ____ Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from A3 Line (84)
B-11	402+27	143.4 ft. Lt
B-12	402+49	33.5 ft. Rt
B-13	403+25	16.7 ft. Rt

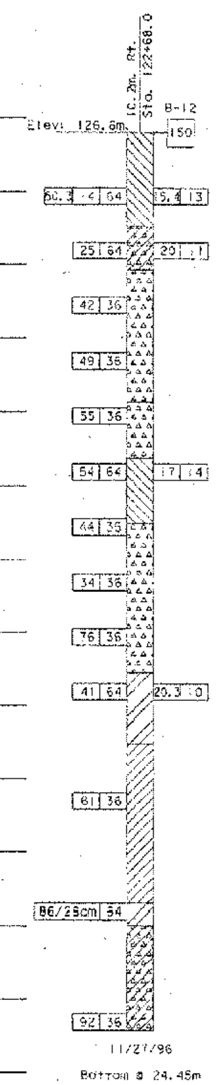
B-11 (3.7m Lt., Sta. 122+61.1), Elev. 126.2m



- SANDY LEAN CLAY (CL) brown, damp, very fine grained sand.
- Stiff, trace clay and fine to medium gravel.
- GRAVEL WITH SILT AND SAND (GP-GM) brown-gray, damp, medium dense, fine to coarse gravel, fine to medium grained sand, predominantly fine gravel.
- POORLY GRADED GRAVEL WITH SAND (GP) gray-brown, damp, medium dense, predominantly coarse to very coarse grained sand, fine to medium gravel.
- Very dense.
- With silt, moist, fine to coarse gravel.
- 30-45cm base of SILTY CLAY (CL) with minor gravel.
- Lenses of SILTY SAND (SM).
- Lenses of GRAVEL (GP).
- LEAN CLAY (CL) with sand, brown, moist, stiff, very fine to fine grained sand.
- GRAVEL (GP) with sand, brown, damp to moist, very dense, fine to coarse grained sand, fine to coarse gravel, minor clay in matrix, trace cobbles.
- No recovery.
- WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) brown, damp to moist, very dense, fine to coarse grained sand, fine to coarse gravel, cobbles.
- Abundant coarse gravel.
- Minor amounts of clay.
- SANDY SILT (ML) with clay, light to medium brown, dense, trace fine to coarse gravel, very fine to fine grained sand, damp to moist.
- Gravel lens, 15-30cm thick.
- CLAYEY SILT (ML) with sand, brown, hard, damp to moist, very fine grained sand, trace organics.
- SANDY GRAVEL/GRAVELLY SAND (GP/SP) brown, damp to moist, very dense.
- Moderate silt and clay.

11/26/96
Bottom @ 30.45m

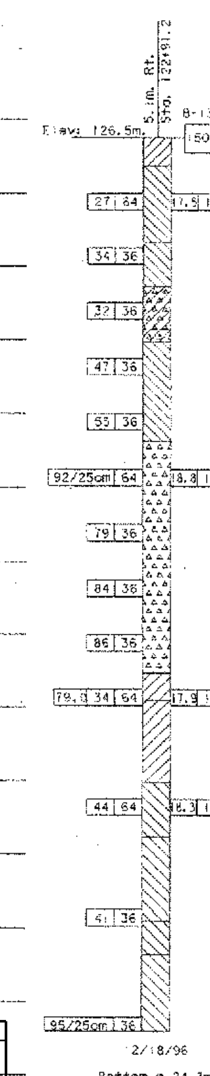
B-12 (16.2m Rt., Sta. 122+68.0), Elev. 126.6m



- LEAN CLAY (CL) with sand, brown, damp, stiff, very fine to fine grained sand.
- Damp to moist, trace fine gravel.
- CLAYEY GRAVEL (GC) brown, medium dense, abundant medium to coarse gravel, moderate fine to medium grained sand.
- SANDY GRAVEL (GW) brown, damp, dense, fine to coarse grained sand, fine to coarse gravel.
- Cobbles.
- Damp to moist, trace silt and clay.
- GRAVELLY SAND WITH SILT (SP-SM) brown, damp to moist, very dense, fine to very coarse grained sand, fine to coarse gravel.
- CLAYEY SAND (SC) with gravel, light brown, dense, medium to very coarse grained sand, fine gravel, some medium gravel.
- GRAVELLY SAND WITH CLAY (SP-SC) brown, dense, fine to coarse gravel.
- Cobbles, gravel lens.
- Very dense, predominantly coarse grained sand.
- CLAYEY SILT (ML) with sand, light orange-brown, moist, medium dense, very fine to fine grained sand, trace fine gravel.
- SILTY SAND (SM) with gravel, light brown, abundant fine to medium gravel, fine to medium grained sand.
- 15-20cm sand/silt lense @ 18m, moist, very dense, fine to coarse grained sand.
- Moderate amount of cobbles.
- CLAYEY SILT (ML) light brown, moist, hard, trace very fine to fine grained sand, minor gravel/rock in sampler.
- CLAYEY GRAVEL (GC) brown, very dense, fine to coarse grained sand, fine to coarse gravel, local cobbles and coarse gravel lenses.
- Abundant very coarse grained sand.

11/27/96
Bottom @ 24.45m

B-13 (5.1m Rt., Sta. 122+91.2), Elev. 126.5m



- SILTY SAND (SM) gray-brown, medium dense.
- SANDY LEAN CLAY (CL) brown, moist, very stiff.
- Occasional gravel from 2.1m to 2.7m.
- CLAYEY SAND TO CLAYEY GRAVEL (SC/GC) brown, moist, dense, medium to coarse sand, fine gravel.
- CLAYEY GRAVEL (GC) with sand, brown, moist, dense, medium to coarse sand, fine gravel.
- POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC) brown, moist, dense, medium to coarse grained sand, fine to coarse gravel.
- Very dense.
- CLAYEY GRAVEL (GC) brown, moist to wet, very dense, with coarse sand, fine to coarse gravel.
- SILTY SAND (SM) brown, moist, dense, fine grained sand.
- LEAN CLAY (CL) yellow-brown, moist, stiff.
- SILT (ML) yellow-brown, moist, very stiff.
- Gravelly at 19m.
- CLAYEY SAND (SC) with gravel, brown, wet, dense, coarse grained sand, fine to coarse gravel.
- LEAN CLAY (CL) with sand, yellow-brown, moist, stiff.
- CLAYEY SAND (SC) with gravel, brown, wet, very dense.

12/18/96
Bottom @ 24.3m

120+00 121+00 122+00 123+00 124+00

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84			

REGISTERED GEOTECHNICAL ENGINEER — DATE 3/1/09

RETAINING WALL 400S

LOG OF TEST BORINGS (2 OF 2)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04 276
EA: 297601
BRIDGE No. 33E0078
Sheet 7 of 7

DATE PLOTTED => 1/26/2010

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

AS-BUILT DRAWING

Resident Engineer: Hank Doll
Vail Cooper & Associates
[X] No Changes — Revisions by: MPW (Initials)
[ ] Changes As Noted

DESIGN OVERSIGHT	DRAWN BY: J. HULSE	A. PATTERSON, V. THILAKARATNE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY: T. HUBER	FIELD INVESTIGATION BY: DATE:	G. RODRIGUEZ, PROJECT ENGINEER

BRIDGE NO. 33C-0405
KILOMETER POST

ISABEL AVENUE UNDERPASS
LOG OF TEST BORINGS

REV. DATE: 6-2-97
ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS
CU
EA
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 13 OF 13

TIME PLOTTED => $$$$$$SYSTIME$$$$$$

LOG OF TEST BORINGS
RETAINING WALL 403

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size (square)	A	Auger Boring
Size (square)	R P	Rotary drilled boring Rotary percussion boring (air)
Size (diamond)	R	Rotary drilled diamond core
Size (square)	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

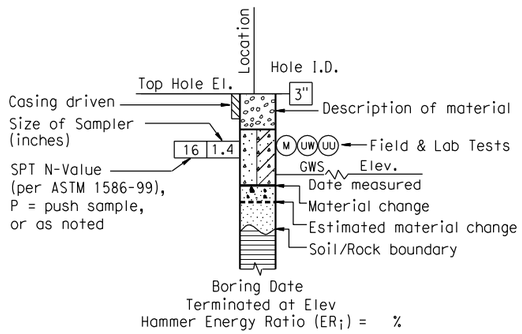
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

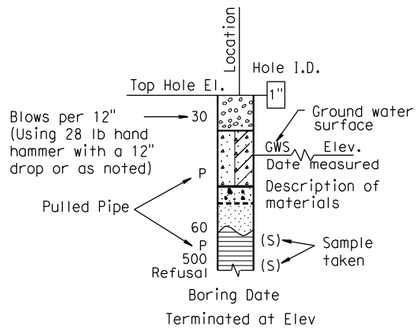
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

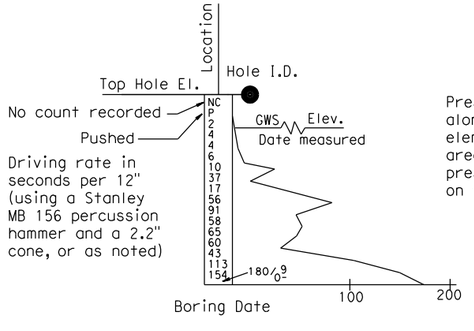
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



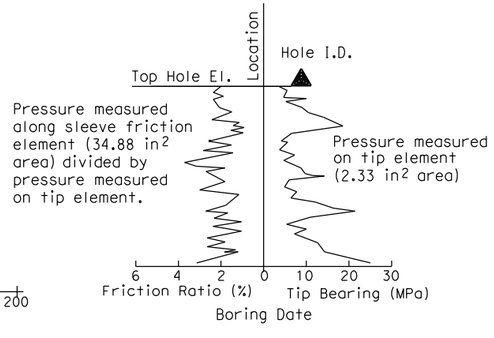
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0077	RETAINING WALL 403
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG CHECKED BY: MADHU THUMMALURU	FIELD INVESTIGATION BY: CHARLES RAMBO	DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (1 OF 4)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 13 OF 16

FILE => ...\RW 403 LOTB\LOTB 1 of 4.dgn

USERNAME => andrew_cheung DATE PLOTTED => 8/20/2010 TIME PLOTTED => 5:38:29 PM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42789 — Exp. 03/31/10 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ENGINEERING SERVICES
FUNCTIONAL SUPERVISOR
NAME: STEPHEN HUANG

GEOTECHNICAL SERVICES
DRAWN BY: ANDREW CHEUNG
CHECKED BY: MADHU THUMMALURU
FIELD INVESTIGATION BY:
CHARLES RAMBO

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH

BRIDGE NO. 33E0077
POST MILES

RETAINING WALL 403
LOG OF TEST BORINGS (2 OF 4)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES

SHEET 14 OF 16

FILE => ...\rw 403 lotb\LOTB 2 of 4.dgn

USERNAME => andrew_cheung DATE PLOTTED => 8/20/2010 TIME PLOTTED => 5:38:47 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

REGISTERED CIVIL ENGINEER DATE

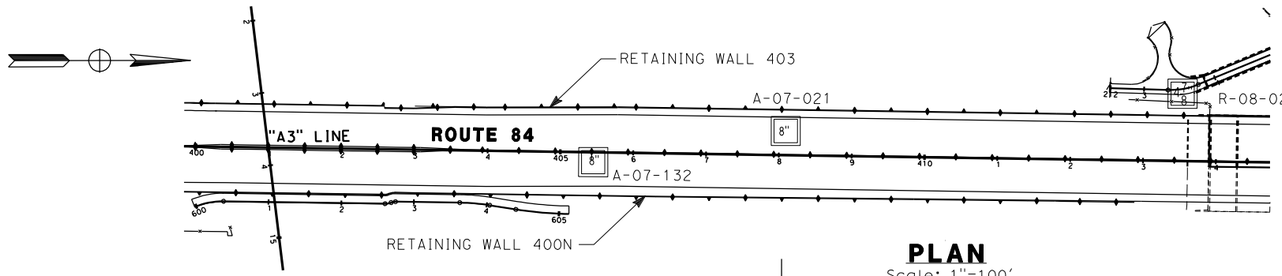
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 03/31/12 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

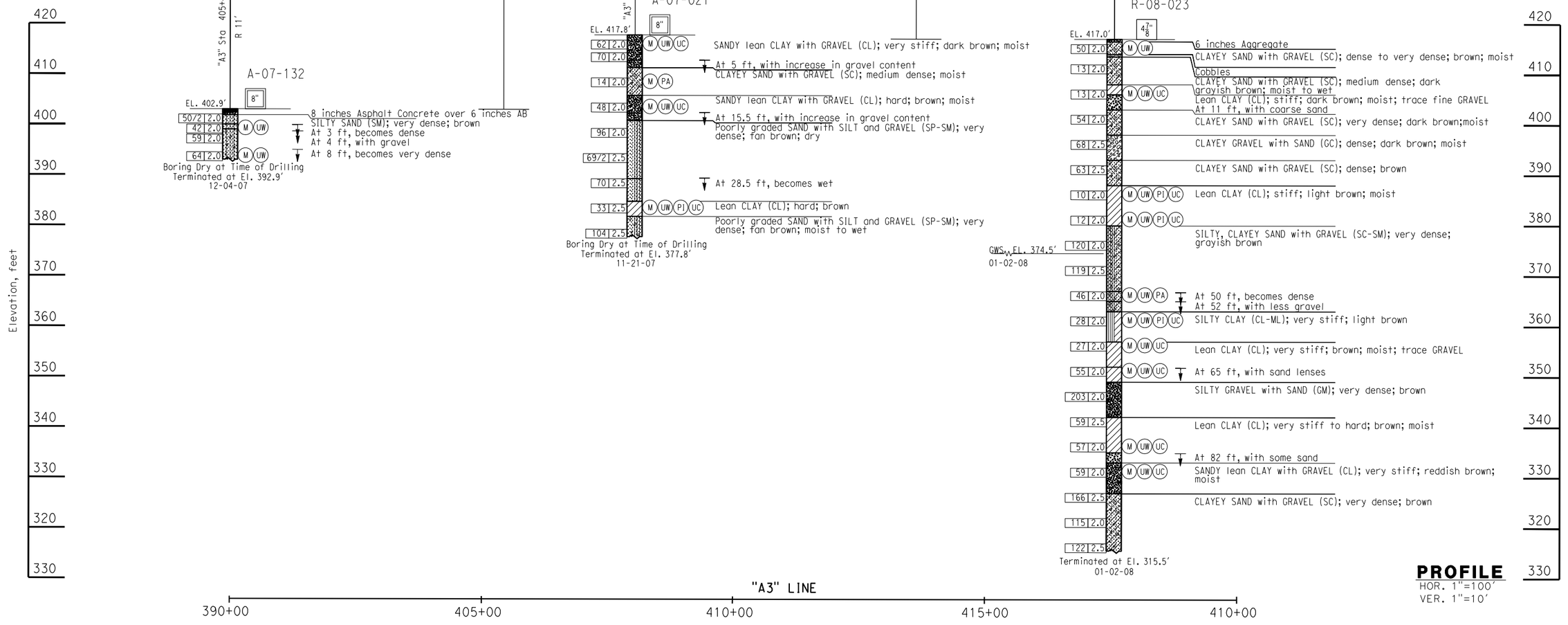
URS CORPORATION
1333 Broadway,
Suite 800
Oakland, CA 94612



NOTE: This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

PLAN
Scale: 1"=100'

BENCH MARK:
B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
2½" Brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive



PROFILE
HOR. 1"=100'
VER. 1"=10'

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN	BRIDGE NO. 33E0077	RETAINING WALL 403
FUNCTIONAL SUPERVISOR NAME: STEPHEN HUANG	DRAWN BY: ANDREW CHEUNG; CHECKED BY: MADHU THUMMALURU; FIELD INVESTIGATION BY: CHARLES RAMBO	DEPARTMENT OF TRANSPORTATION	DESIGN BRANCH	POST MILES	LOG OF TEST BORINGS (3 OF 4)

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04256
EA 297601

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 15 OF 16

FILE => ...\RW 403 LOTB 3 of 4.dgn

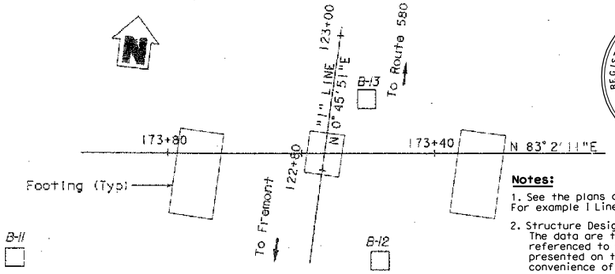
USERNAME => madhu_thummaluru DATE PLOTTED => 9/1/2010 TIME PLOTTED => 12:13:47 PM

NOTES:

1. The 64 mm sampler shown on the logs is a split barrel sampler with 76.2 mm O.D. and 64 mm I.D., with 152.4 mm long brass liners. The sampler is driven using a 63.5 kg hammer with a 0.76 m drop.

2. Soil classification and description conform to ASTM D2487.

BENCHMARK:
All elevations shown hereon are based upon Caltrans Aerial Control Panel No. AB-947 having an elevation of 399.13 feet (121.655 meters) as described in Caltrans Survey Book ALA84-A-5 (pg 2 of 4 - 87-240).
TBM No. 2: Mon. No. 220
A brass pin in Standard City Well Monument Box at the intersection of Stanley Blvd. and Isabel Avenue 19.004 meters right of Center Line Station "15" 122+19.529. The elevation is 126.311 meters (414.41 feet).



Notes:

1. See the plans dated May 11, 1999 for stationing. For example 1 Line Sta 136+62 (Metric) = A3 Line Sta 448+23 (English).
2. Structure Design produced the data presented in the table below. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

Stephen Huang
No. C 42289
Exp. 03/31/10
GEOTECHNICAL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

Caltrans Metric

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		395	401

REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue

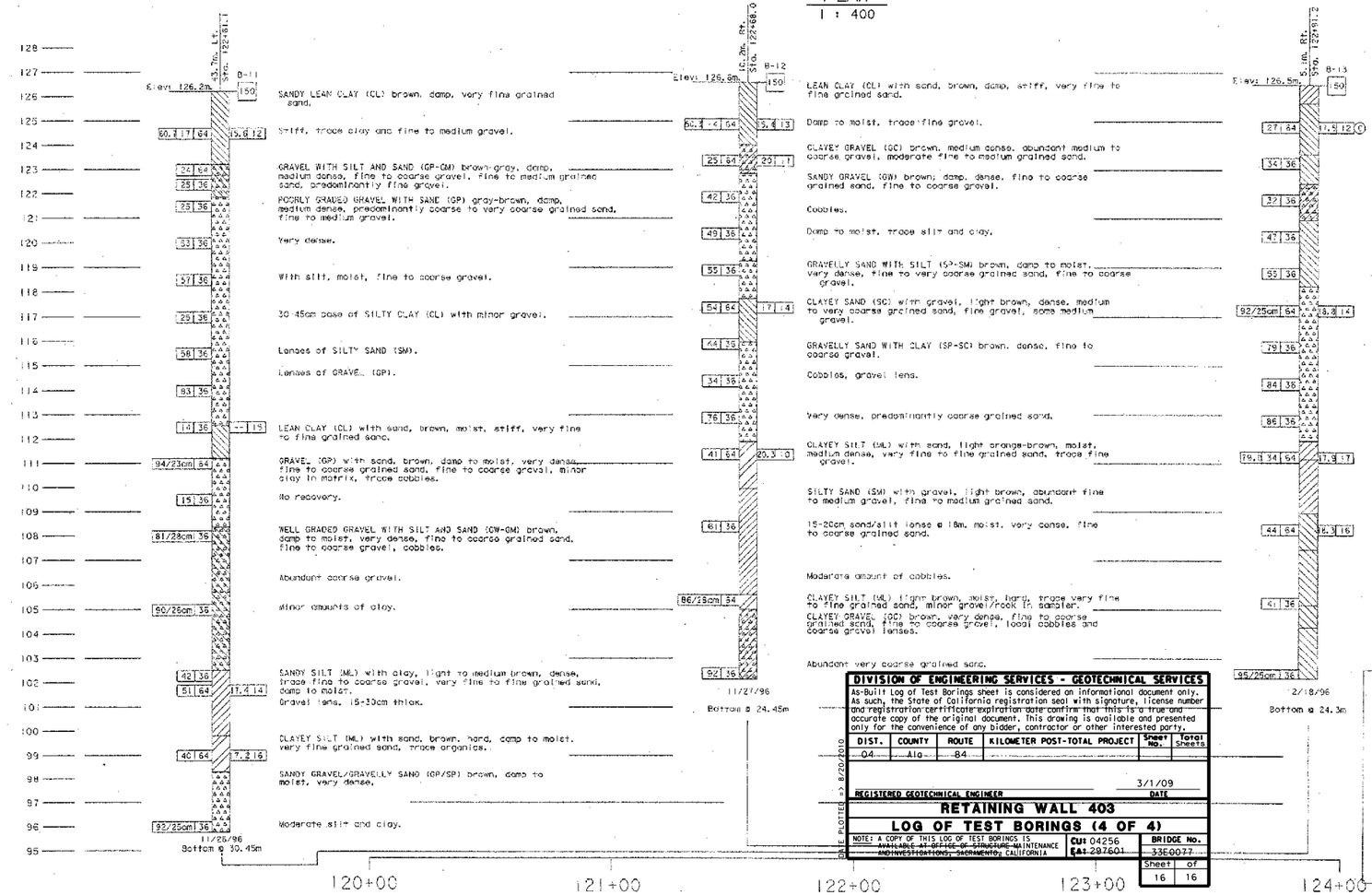
GEOTECHNICAL CONSULTANTS, INC.
631 Howard Street, Ste. 320
San Francisco, CA 94105

G. NEELAKANTAN
No. 2791
Exp. 9/30/01
GEOTECHNICAL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

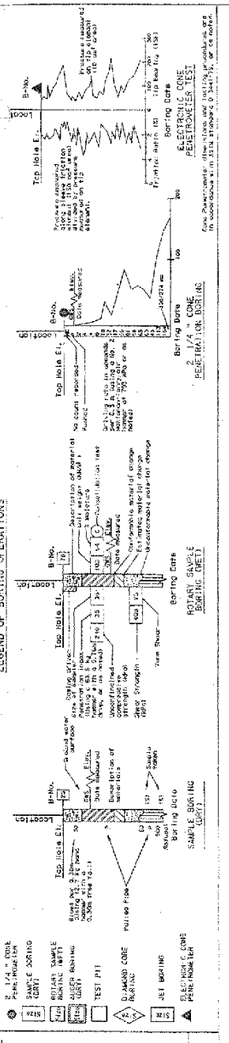
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.
Revisions made to this Log of Test Borings from the original ___ Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from A3 Line (84)
B-11	402+27	143.4 ft. Lt
B-12	402+49	33.5 ft. Rt
B-13	403+25	16.7 ft. Rt

PLAN
1 : 400



LEGEND OF BORING OPERATIONS



DESIGN OVERSIGHT	DRAWN BY	J. HULSE	A. PATTERSON V. THILAKARATNE FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	G. RODRIGUEZ PROJECT ENGINEER	BRIDGE NO. 33C-0405 KILOMETER POST:	ISABEL AVENUE UNDERPASS LOG OF TEST BORINGS
SIGN OFF DATE	CHECKED BY	T. HUBER	DATE:				

REV. DATE: 6-2-97

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 13 OF 13

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	84			

3/1/09
REGISTERED GEOTECHNICAL ENGINEER — DATE

RETAINING WALL 403

LOG OF TEST BORINGS (4 OF 4)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04256
EA: 297601

BRIDGE No. 33E0077

Sheet 16 of 16

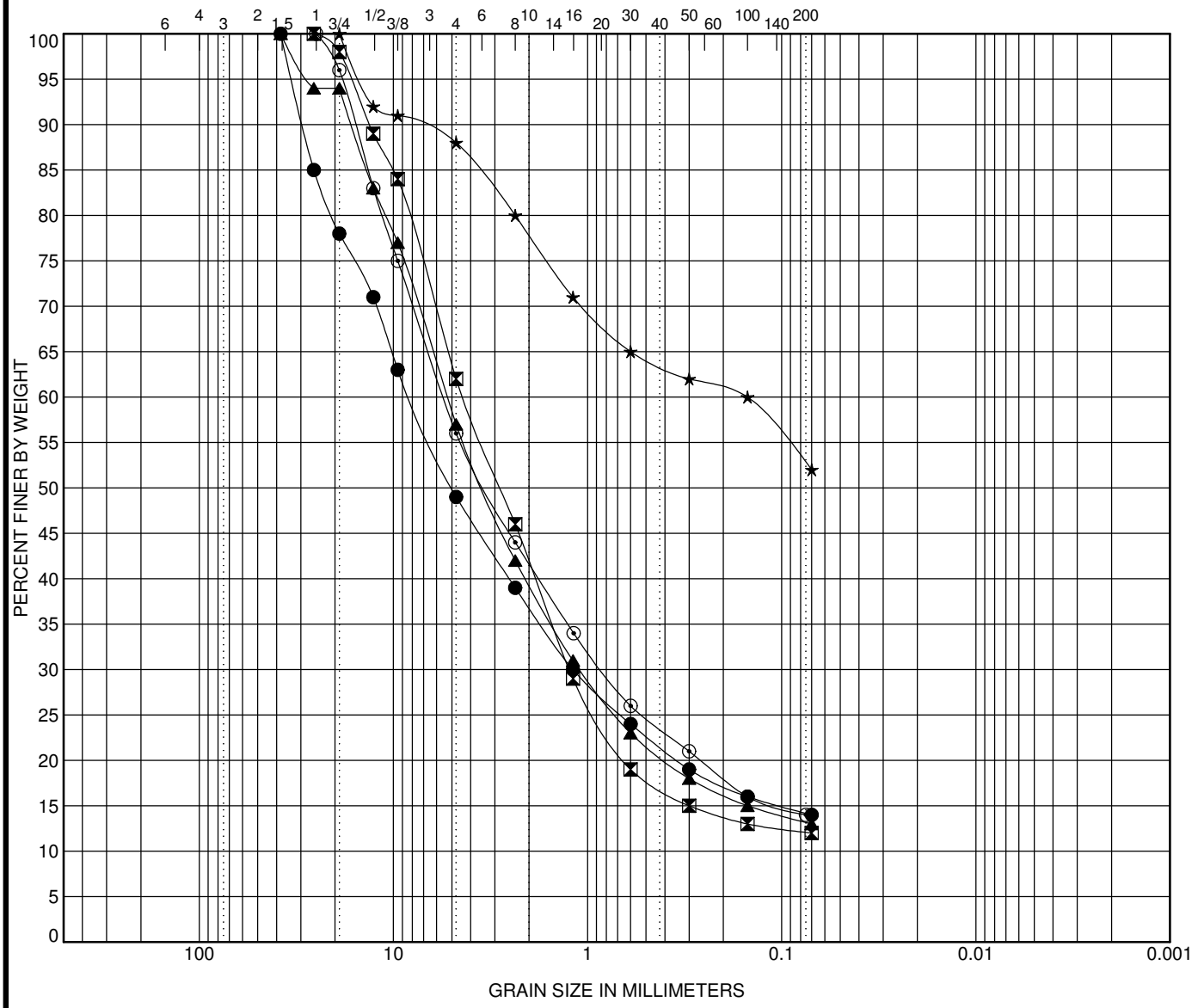
DATE PLOTTED => 8/20/2010

Contract Number: 04-233054
City Project Numbers: 89-50
Date Accepted: 10/1/02

AS-BUILT DRAWING
Resident Engineer: Hank Doll
Vail Cooper & Associates
☒ No Changes
☐ Changes As Noted
Revisions by: MPW (Initials)

TIME PLOTTED => $$$$$$SYSTIME$$$$$$

FILE => ...\BW 403 LOTB 4 of 4.dgn



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	NB06	10.0	Clayey GRAVEL (GC) with sand					
⊠	NB11	5.0	Clayey SAND (SC) with gravel					
▲	NB13	15.0	Clayey SAND (SC) with gravel					
★	NB13	20.0	Sandy fat CLAY (CH)					
⊙	NB14	10.0	Clayey GRAVEL (GC) with sand					

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	NB06	10.0	38.1	8.196	1.19		51.0	34.8	14.2	
⊠	NB11	5.0	25.7	4.352	1.239		38.0	49.9	12.1	
▲	NB13	15.0	38.1	5.271	1.092		43.0	43.8	13.2	
★	NB13	20.0	19	0.15			12.0	35.3	52.7	
⊙	NB14	10.0	25	5.496	0.841		44.0	42.0	14.0	

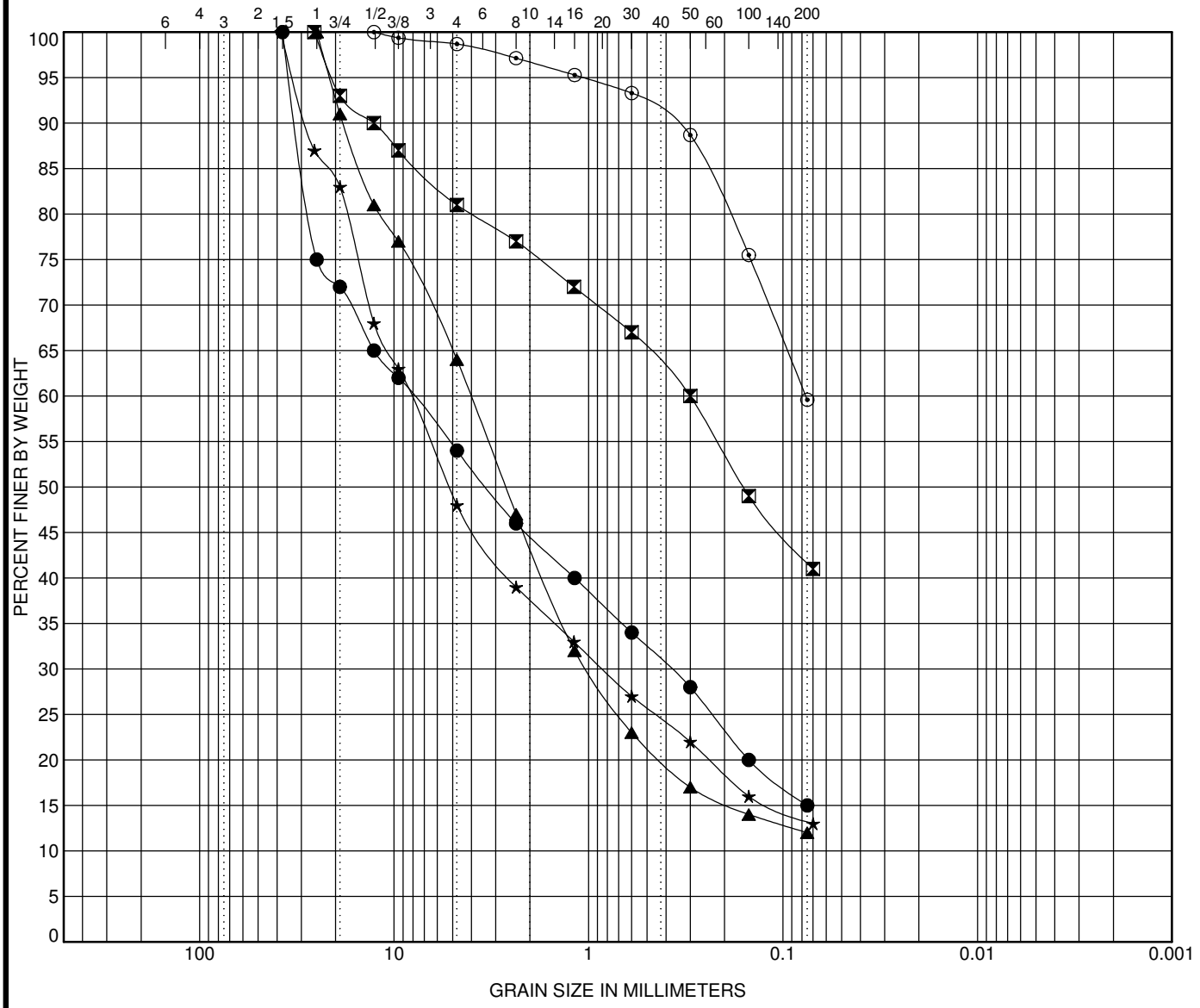
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 12/16/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	NB17	8.5						
⊠	NB21	8.5	Clayey SAND (SC) with gravel					
▲	NB23	50.0	Poorly graded SAND (SP-SC) with clay and gravel				6.82	107.44
★	NB24	15.0	Clayey GRAVEL (GC) with sand					
⊙	NB33	13.5	Sandy lean CLAY (CL)					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	NB17	8.5	37.5	7.989	0.378		46.0	39.0	15.0	
⊠	NB21	8.5	25.7	0.3			19.0	39.3	41.7	
▲	NB23	50.0	25	4.029	1.015		36.0	52.0	12.0	
★	NB24	15.0	38.1	8.277	0.845		52.0	34.7	13.3	
⊙	NB33	13.5	12.7	0.076			1.3	39.1	59.6	

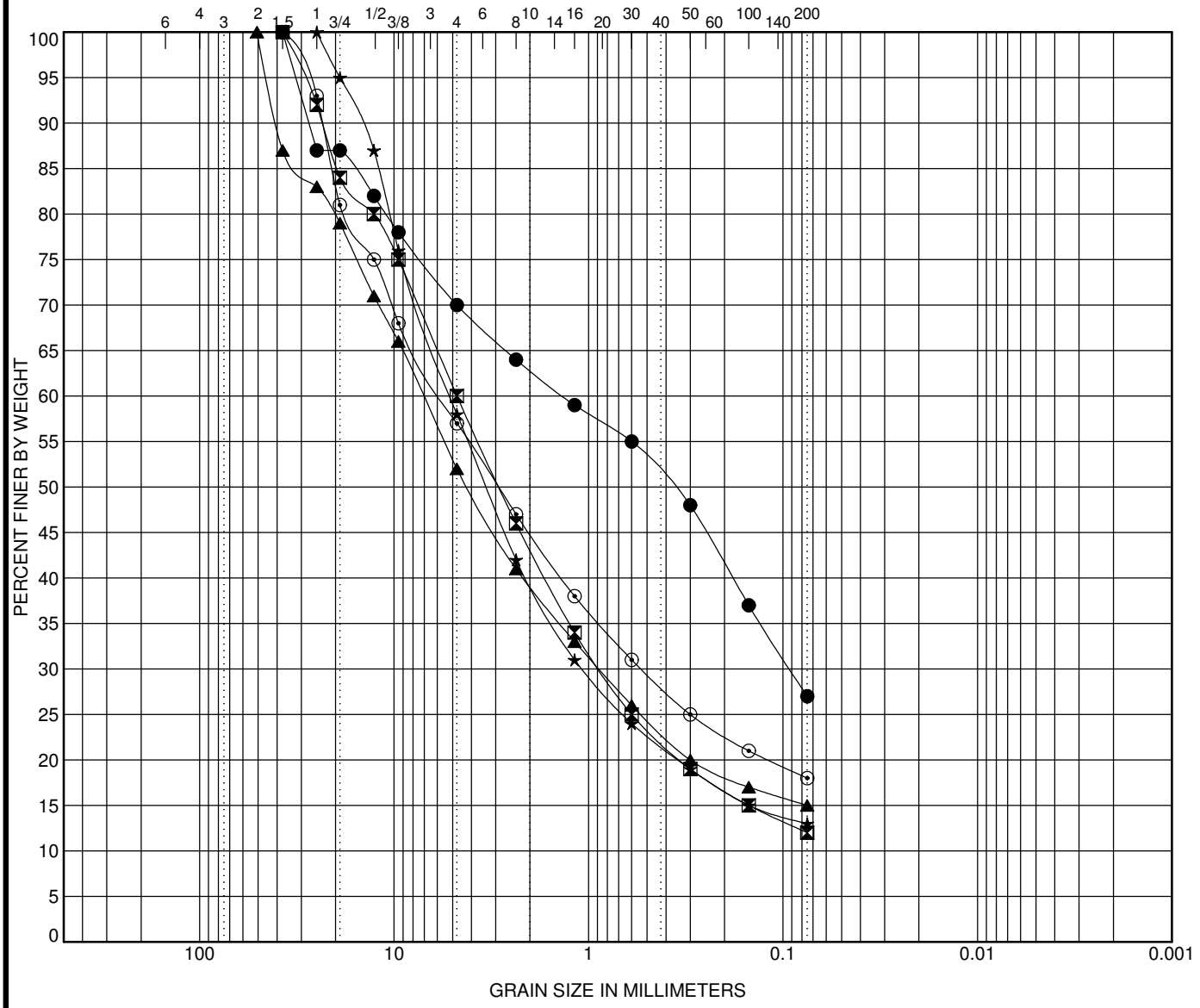
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 12/16/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	NB35	8.5	Clayey SAND (SC) with gravel					
⊠	NB37	30.0	Clayey SAND (SC) with gravel				3.40	100.54
▲	NB37	60.0	Clayey GRAVEL (GC) with sand					
★	NB38	40.0	Clayey SAND (SC) with gravel					
⊙	NB38	65.0	Clayey GRAVEL (GC) with sand					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	NB35	8.5	37.5	1.355	0.092		30.0	43.0	27.0	
⊠	NB37	30.0	37.5	4.75	0.874		40.0	48.0	12.0	
▲	NB37	60.0	50.8	7.058	0.883		48.0	37.0	15.0	
★	NB38	40.0	25	5.13	1.071		42.0	45.0	13.0	
⊙	NB38	65.0	37.5	5.738	0.535		43.0	39.0	18.0	

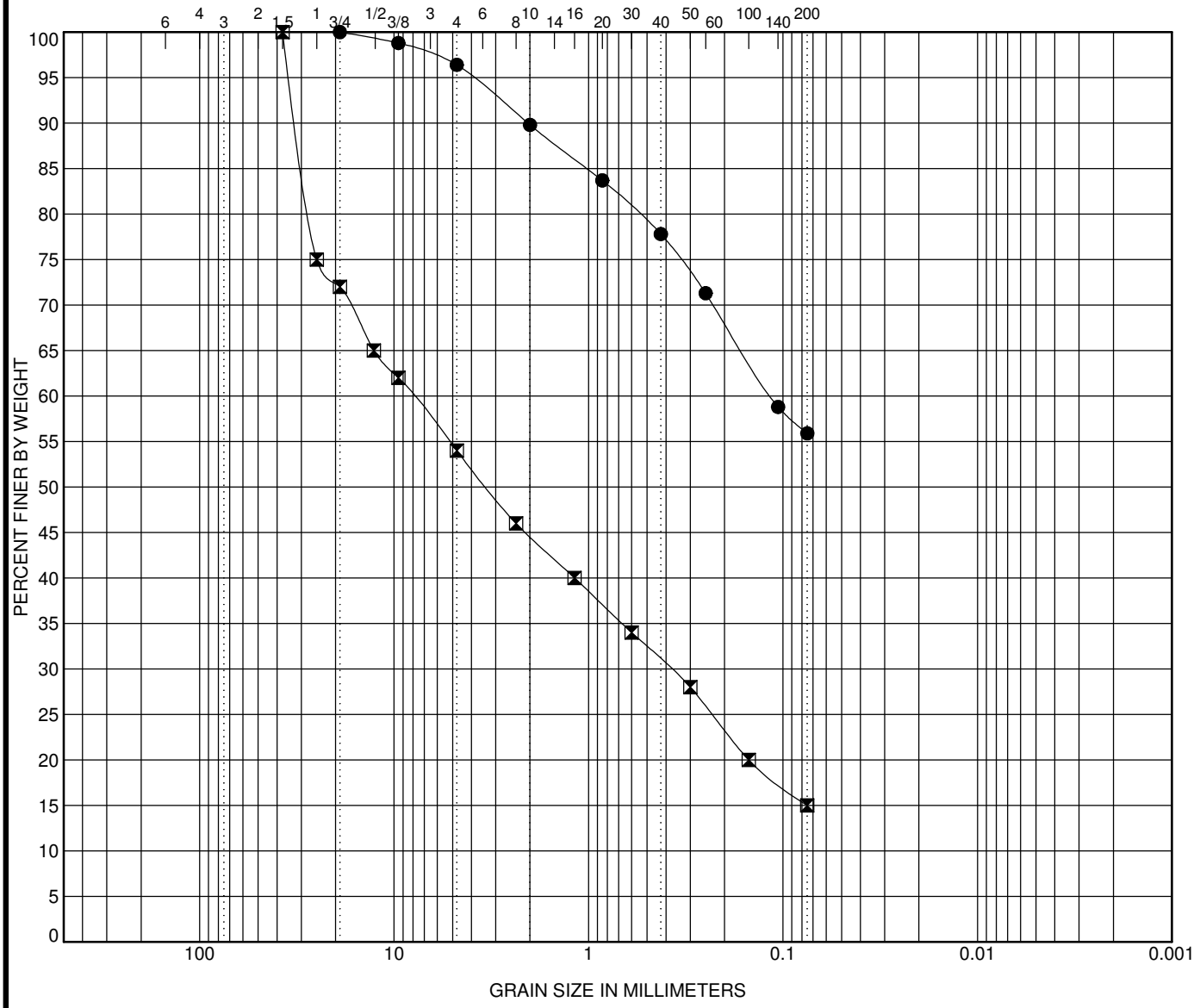
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 12/16/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**RB01**	**1.0**	**Sandy lean CLAY (CL)**	**37**	**16**	**21**		
⊠	**RB17**	**8.5**						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RB01**	**1.0**	**19**	**0.115**			**3.6**	**40.5**	**55.9**	
⊠	**RB17**	**8.5**	**37.5**	**7.989**	**0.378**		**46.0**	**39.0**	**15.0**	

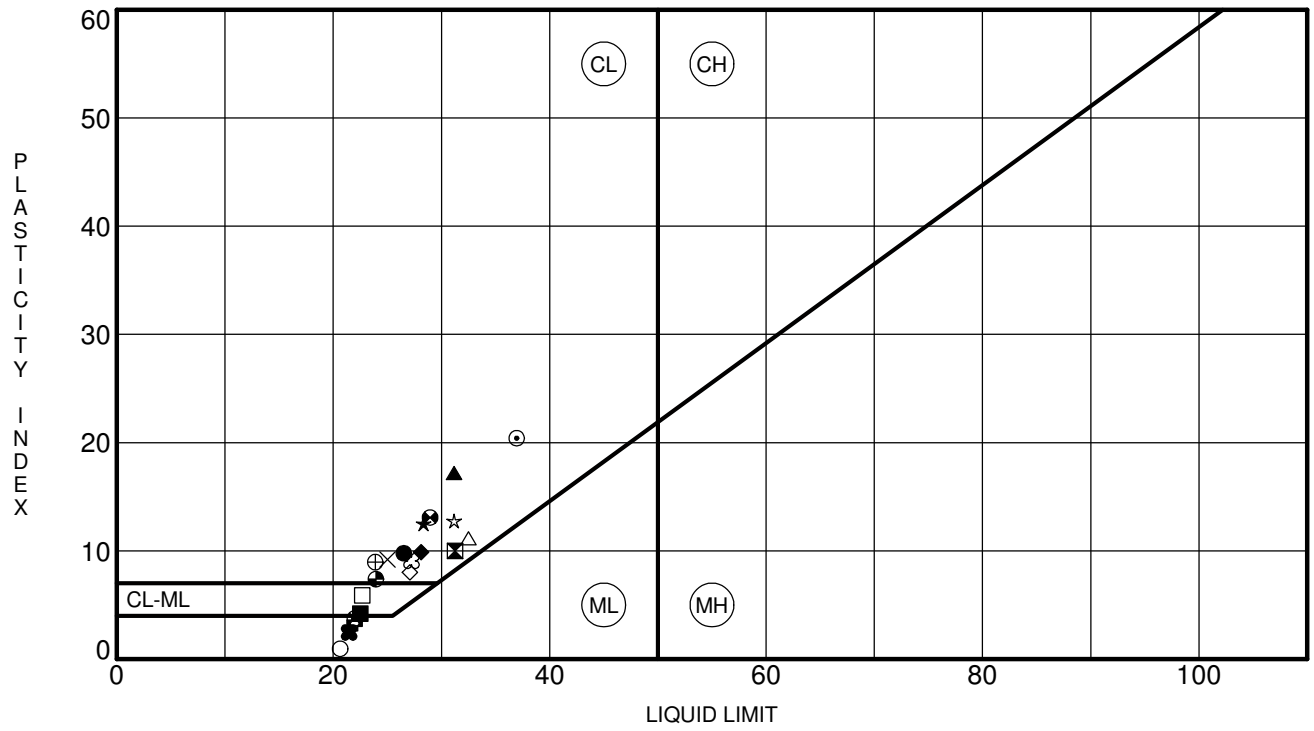
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 12/16/09



Specimen Identification			LL	PL	PI	Fines	Classification
●	NB02	5.0	27	17	10		Clayey SAND (SC) with gravel
⊠	NB03	15.0	31	21	10		Lean CLAY (CL)
▲	NB04	3.5	31	14	17		Sandy lean CLAY (CL) with gravel
★	NB05A	1.0	28	16	12		Lean CLAY (CL) with sand
⊙	NB05A	10.0	37	17	20		Lean CLAY (CL)
✿	NB09	1.0	22	19	3		Silty SAND (SM/GM) with gravel
○	NB14	1.0	21	20	1		Silty SAND (SM) with gravel
△	NB14	15.0	33	21	12		Lean CLAY (CL) with sand
⊗	NB19	3.0	22	18	4		SILT (ML) with sand
⊕	NB19	8.5	24	15	9		Sandy lean CLAY (CL) with gravel
□	NB20	3.5	23	17	6		Silty CLAY (CL-ML)
❁	NB21	33.5	29	16	13		Lean CLAY (CL)
◕	NB22A	8.5	24	17	7		Sandy, silty CLAY (CL-ML) with gravel
☆	NB23	30.0	31	18	13		Lean CLAY (CL)
⊠	NB23	35.0	27	18	9		Lean CLAY (CL)
■	NB23	55.0	23	18	5		Sandy, silty CLAY (CL-ML)
◆	NB24	60.0	28	18	10		Lean CLAY (CL)
◇	NB24	80.0	27	19	8		Lean CLAY (CL)
╳	NB25	13.5	25	16	9		Clayey SAND (SC/GC) with gravel
✖	NB26	18.5	21	19	2		Sandy SILT (ML)

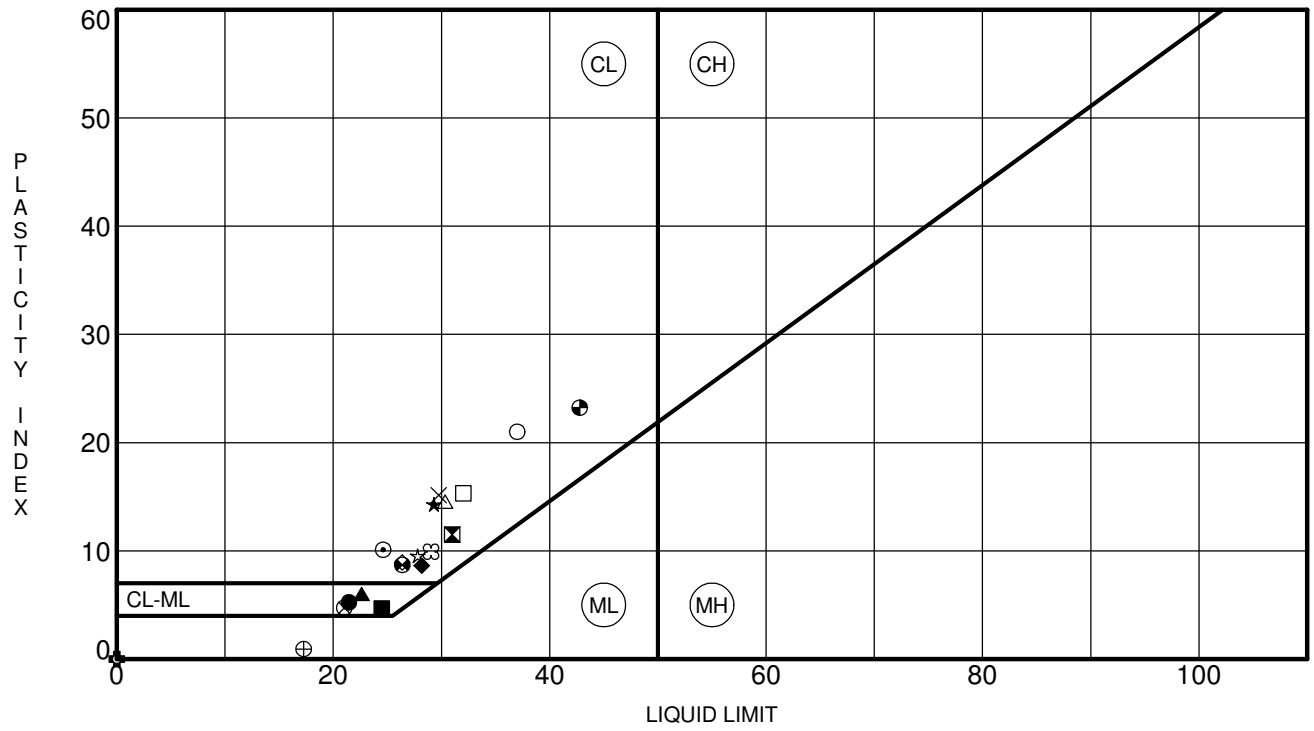
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS ATTERBERG LIMITS 28649640-ROUTE84.GPJ SNJ CT.GLB 12/16/09



	Specimen Identification		LL	PL	PI	Fines	Classification
●	NB30	5.0	21	16	5		Silty, clayey SAND (SC-SM) with gravel
⊠	NB32	18.5	31	20	11		Lean CLAY (CL)
▲	NB33	5.0	23	17	6		Silty, clayey SAND (SC-SM) with gravel
★	NB34	5.0	29	15	14		Clayey SAND (SC) with gravel
⊙	NB35	13.5	25	15	10		Lean CLAY (CL) with sand
✿	NB37	45.0	NP	NP	NP		Sandy SILT (ML)
○	RB01	1.0	37	16	21	56	Sandy lean CLAY (CL)
△	RB02	5.0	30	16	14		Clayey SAND (SC) with gravel
⊗	RB05	1.0	21	16	5		Silty, clayey SAND (SC)
⊕	RB07	8.5	17	16	1		Silty SAND (SM)
□	RB10	3.0	32	17	15		Lean CLAY (CL) with sand
⊛	RB13	3.0	26	18	8		Clayey SAND (SC) with gravel
◕	RB13	5.0	43	20	23		Lean CLAY (CL) with sand
☆	RB29	5.0	28	18	10		Sandy lean CLAY (CL)
⊠	RB31	1.0	29	19	10		Sandy lean CLAY (CL)
■	RB37	1.0	24	20	4		Silty CLAY (CL-ML) with sand
◆	RB37	5.0	28	20	8		Lean CLAY (CL)
◇	RB40	5.0	26	17	9		Lean CLAY (CL/SC) with gravel
×	RB41	2.0	30	15	15		Sandy lean CLAY (CL)

URS

55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

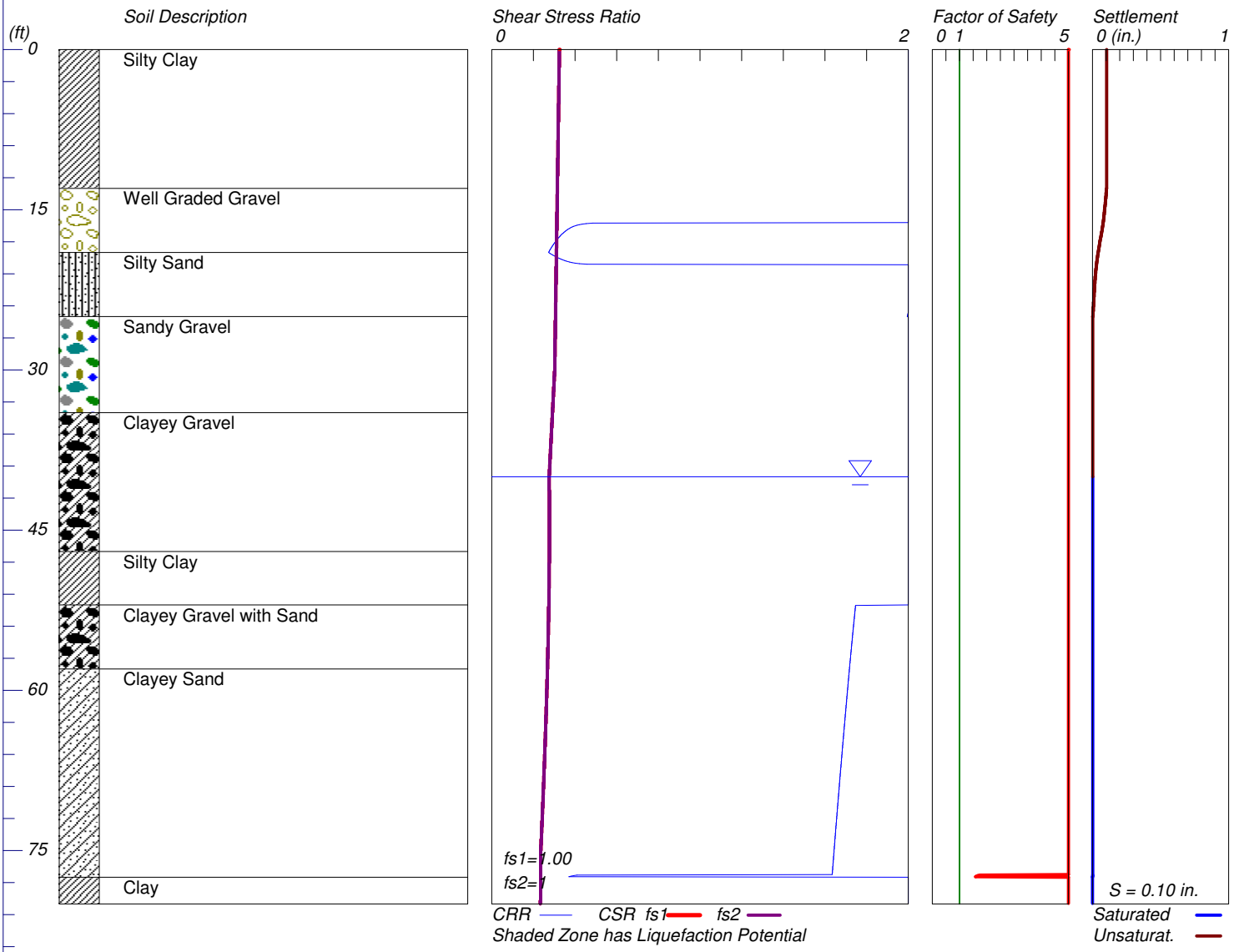
URS ATTERBERG LIMITS 28649640-ROUTE84.GPJ SNJ_CT.GLB 12/16/09

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=B-10 Water Depth=40 ft Surface Elev.=415

Magnitude=7.5
Acceleration=0.5g



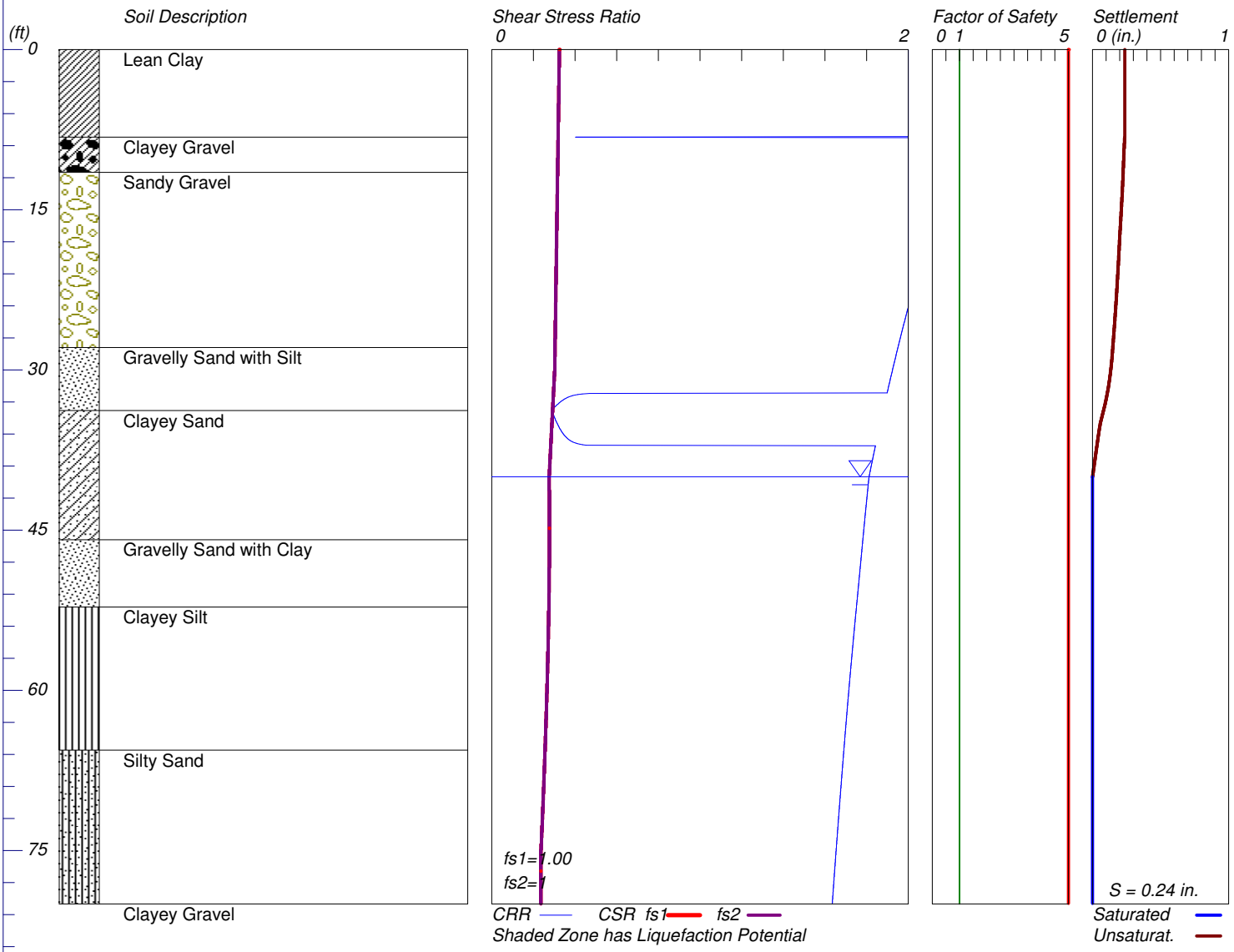
LiquefyPro CivilTech Software USA www.civiltech.com

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=B-12 Water Depth=40 ft Surface Elev.=415

Magnitude=7.5
Acceleration=0.5g



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URS

Alameda County, California

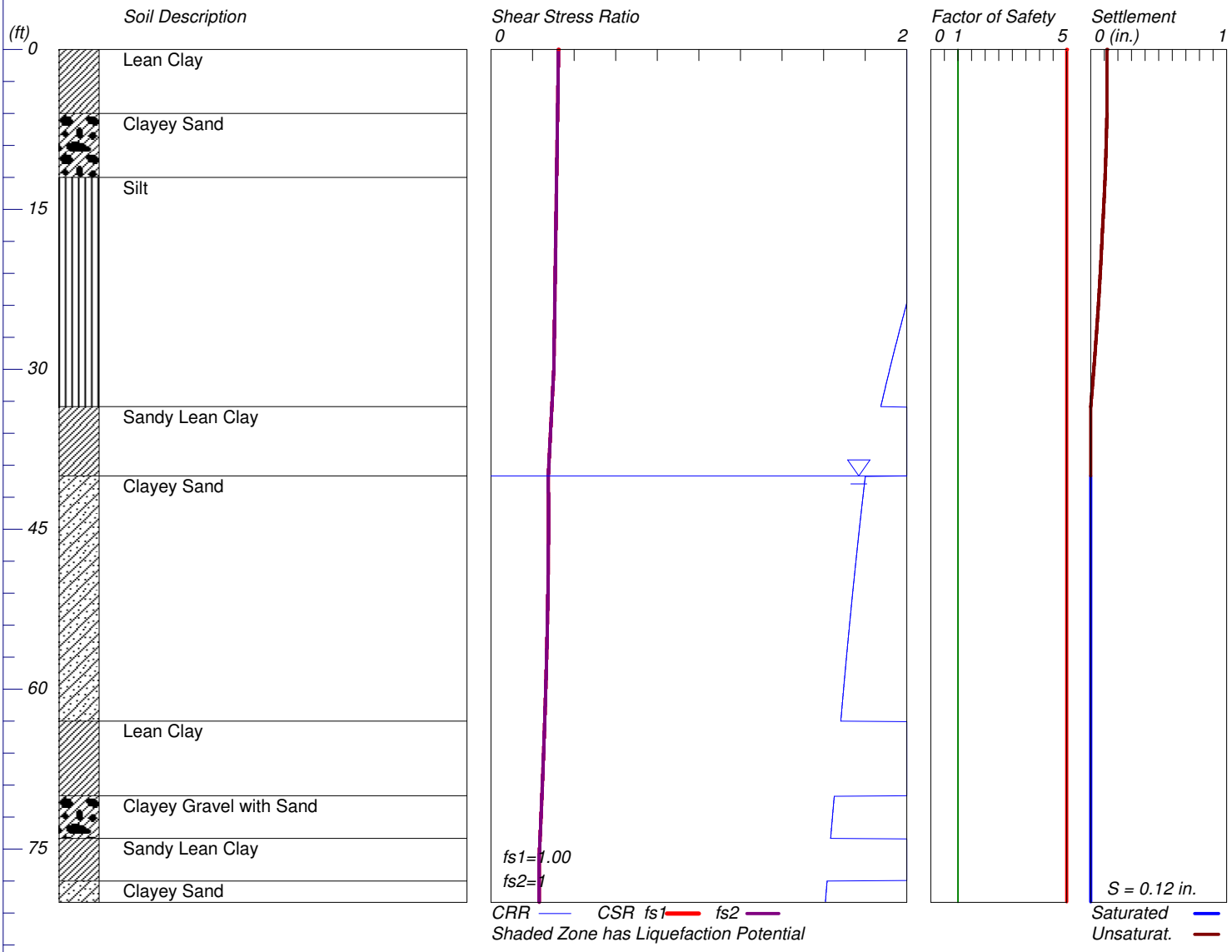
Figure D-2

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB03 Water Depth=40 ft Surface Elev.=539

Magnitude=7.5
Acceleration=0.5g



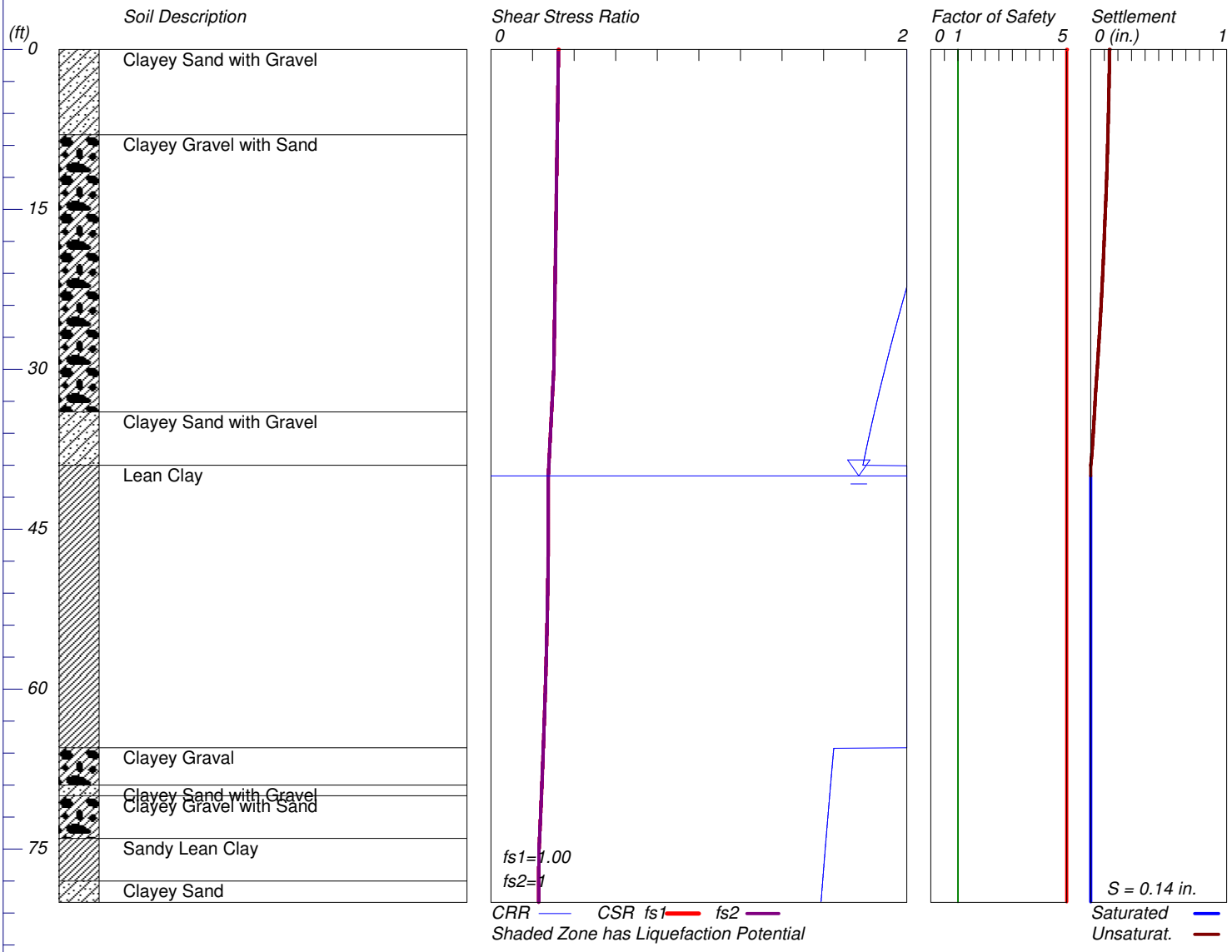
LiquefyPro CivilTech Software USA www.civiltech.com

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB06 Water Depth=40 ft Surface Elev.=528

Magnitude=7.5
Acceleration=0.5g



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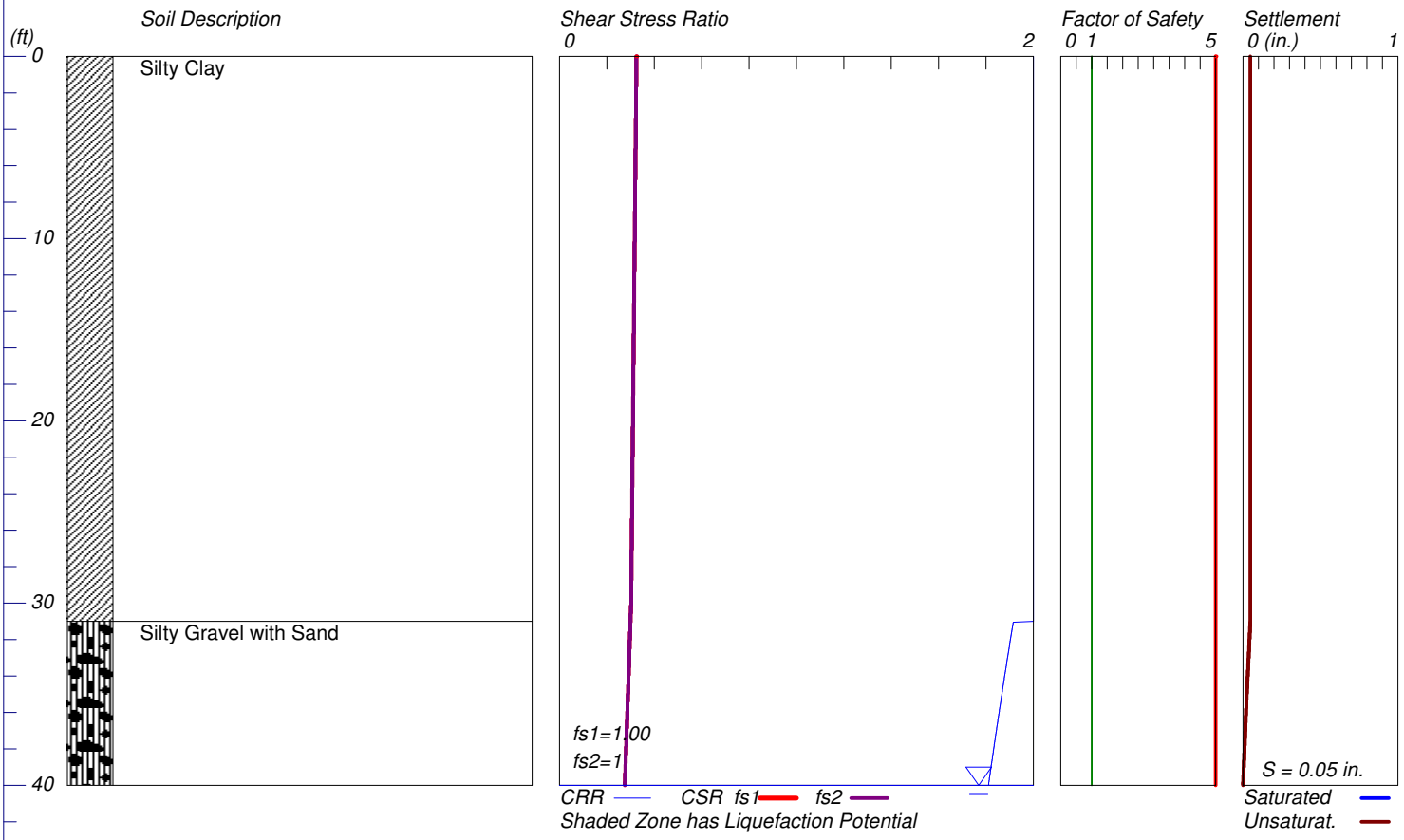
LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB20 Water Depth=40 ft Surface Elev.=421

Magnitude=7.5
Acceleration=0.5g



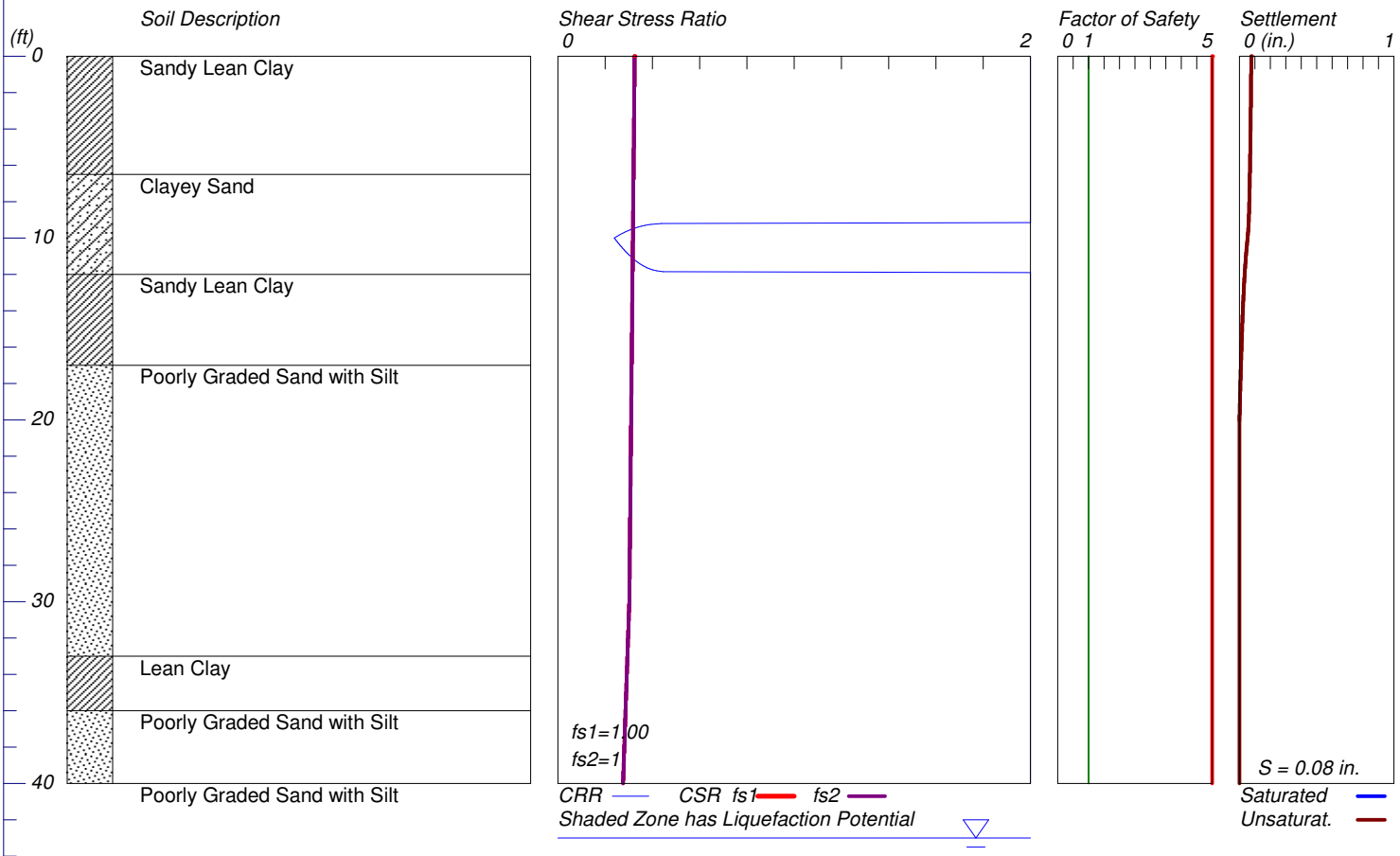
LiquefyPro CivilTech Software USA www.civiltech.com

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB21 Water Depth=43 ft Surface Elev.=418

Magnitude=7.5
Acceleration=0.5g



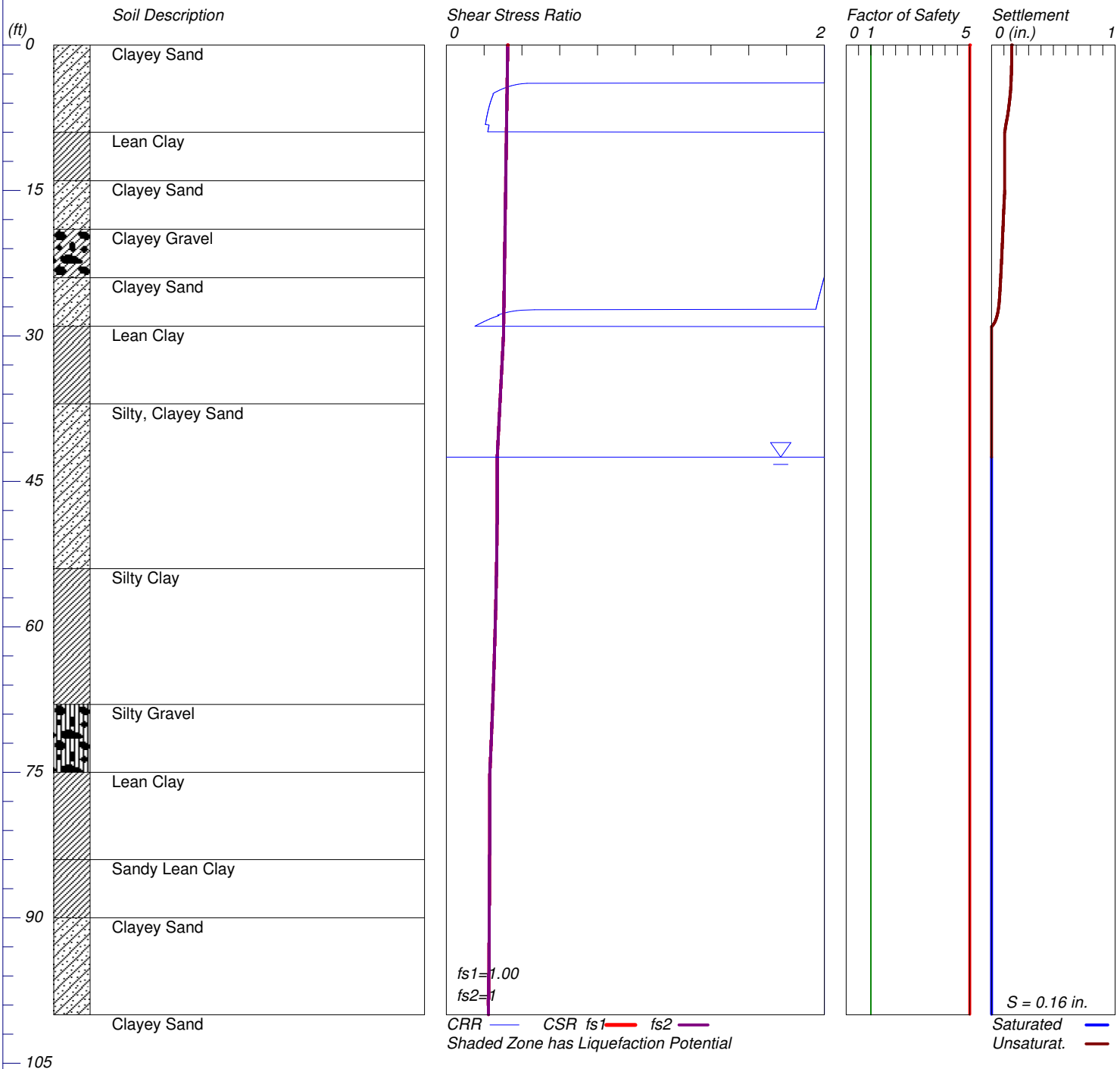
LiquefyPro CivilTech Software USA www.civiltech.com

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB23 Water Depth=42.5 ft Surface Elev.=417

Magnitude=7.5
Acceleration=0.5g



LiquefyPro CivilTech Software USA www.civiltech.com

APPENDIX E

Wall Type B
Pile Design Spreadsheet and
LPile Lateral Load Analysis

Route 84 Widening Retaining Wall 400N - Type B

12/16/2009

Pile Design Spreadsheet

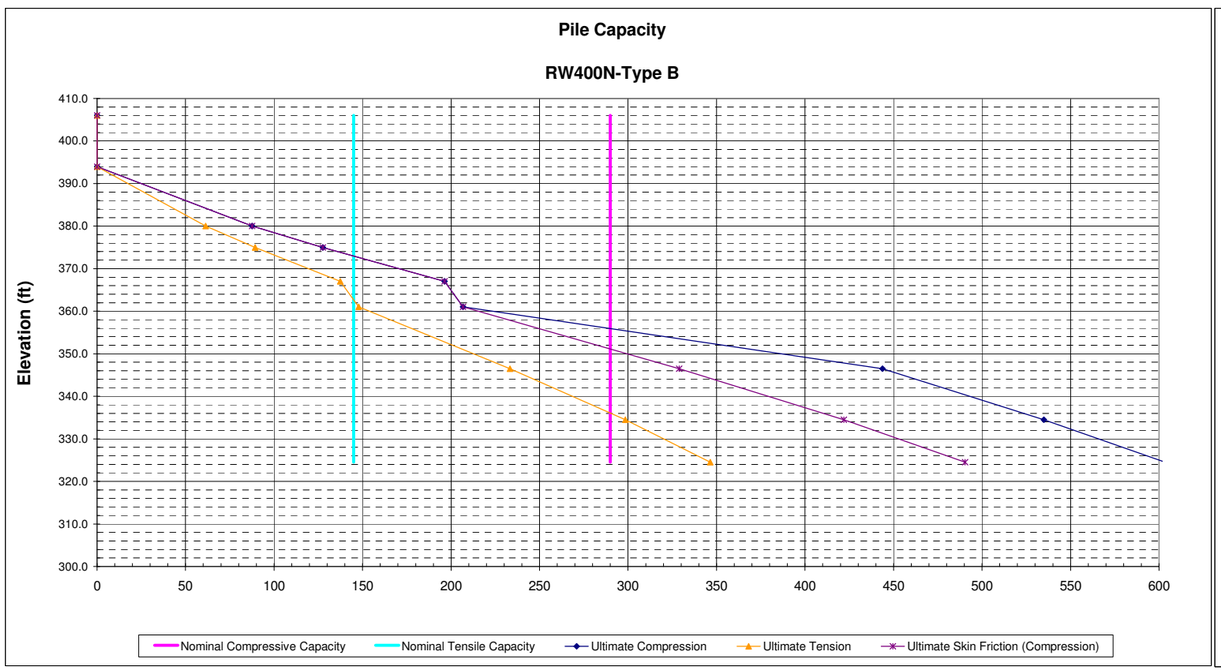
400N-Type B

Caltrans Design Method For CIDH Pile

Project Name:	Route 84 Widening	Nominal axial compress. Capacity (ult.)	290	ton					
Project Number:	28649640	Nominal axial compress. Capacity (ult.)	2581	kN	Pile Type	CIDH			
Retaining Wall Name:	RW400N-Type B Wall_Pile B	Pile Diameter	24	inch	Pile Shape	Circular			
Boring Surface El. (m)	123.7	Pile Diameter	610	mm	Pile Surface Area	1.92	sq. m/m	Pile Tip Area	0.29 sq. m
Boring Surface El. (ft)	406.0	Pile Diameter	2.00	ft	Pile Surface Area	6.28	sq. ft/ft	Pile Tip Area	3.14 sq. ft.
Design GWS El. (ft)	375.0								
Unit Weight of Water (pcf)	62.4								
Depth with no strength									
Convert. Factor	3.281								
Bottom of Pile Cap El. (m)	120.1								
Bottom of Pile Cap El. (ft)	394.0								
Bottom of Fill El. (ft)	N/A								
Scour El. (ft)	N/A								

Soil parameters taken from borings B-12

Layer	Layer Elevation				Lateral	N_{SPT}	Cohesion	Adhesion	Ult. Load	Layer	Depth to	Effective	β	f_{max}	Soil	delta			q_T	z/B	Nc	q_T	Bearing	Include	Elevation	Compression						Tension			
																									Cumulative				Nominal		Cumulative		Nominal	
No.	Top		Bot.		Resists?			Factor	Transfer	Thickness	Layer Center	Vert. Stress			G= gran.	Cohesive	Friction		(granular)		(cohesive)	(cohesive)	Capacity	B.C.?	to	Axial Res.				Axial		Axial Res.		Axial	
							c	α	f_{sl}			(Cen. Lay.)			C=cohes.		(comp)	(tensile)					(B.C.)		midlayer	(skin)		(Tot)		Capacity		(Skin)		Capacity	
(-)	(m)	(feet)	(m)	(feet)		blows/ft	(psf)		(psf)	(feet)	(feet)	(psf)		(psf)		(ton)	(ton)	(ton)	(psf)	(-)	(-)	(psf)	(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			123.74	406.0								0		0	g								0	n	406.0	0	0	0.0	0	290	2581	0	0	145	1291
1	123.74	406.0	120.09	394.0	n	5	0	0.55	0	12.0	6	690.0	1.2	0	g	0.0	0.0	0.0	6000	0.0	6.00	0	9	n	403.0	0.0	0	0.0	0	290	2581	0.0	0	145	1291
2	120.09	394.0	115.82	380.0	Y	30	0	0.55	0	14.0	19	2185.0	0.9	1992	g	0.0	87.6	61.3	36000	7.0	9.00	0	57	n	384.5	87.6	780	87.6	780	290	2581	61.3	546	145	1291
3	115.82	380.0	114.29	375.0	y	35	0	0.55	0	5.0	28.5	3265.0	0.8	2544	g	0.0	40.0	28.0	42000	9.5	9.00	0	66	n	365.8	127.6	1135	127.6	1135	290	2581	89.3	794	145	1291
4	114.29	375.0	111.86	367.0	y	50	0	0.55	0	8.0	35	3902.0	0.7	2737	g	0.0	68.8	48.1	60000	13.5	9.00	0	94	n	357.5	196.3	1747	196.3	1747	290	2581	137.4	1223	145	1291
5	111.86	367.0	110.03	361.0	y	41	1000	0.55	550	6.0	42	4398.6	0.6	2750	c	10.4	0.0	0.0	49200	16.5	9.00	9000	14	n	346.0	206.7	1840	206.7	1840	290	2581	147.8	1315	145	1291
6	110.03	361.0	105.61	346.5	y	61	0	0.55	0	14.5	52.25	5114.6	0.5	2681	g	0.0	122.1	85.5	73200	23.8	9.00	0	115	y	334.9	328.8	2927	443.8	3950	290	2581	233.3	2075	145	1291
7	105.61	346.5	101.95	334.5	Y	60	0	0.55	0	12.0	65.5	6058.4	0.4	2468	g	0.0	93.1	65.1	72000	29.8	9.00	0	113	y	313.8	421.9	3755	535.0	4761	290	2581	298.4	2655	145	1291
8	101.95	334.5	98.9	324.5	Y	60	0	0.55	0	10.0	76.5	6829.5	0.3	2180	g	0.0	68.5	47.9	72000	34.8	9.00	0	113	y	296.3	490.4	4364	603.5	5371	290	2581	346.4	3081	145	1291
Bottom	98.9	324.5																																



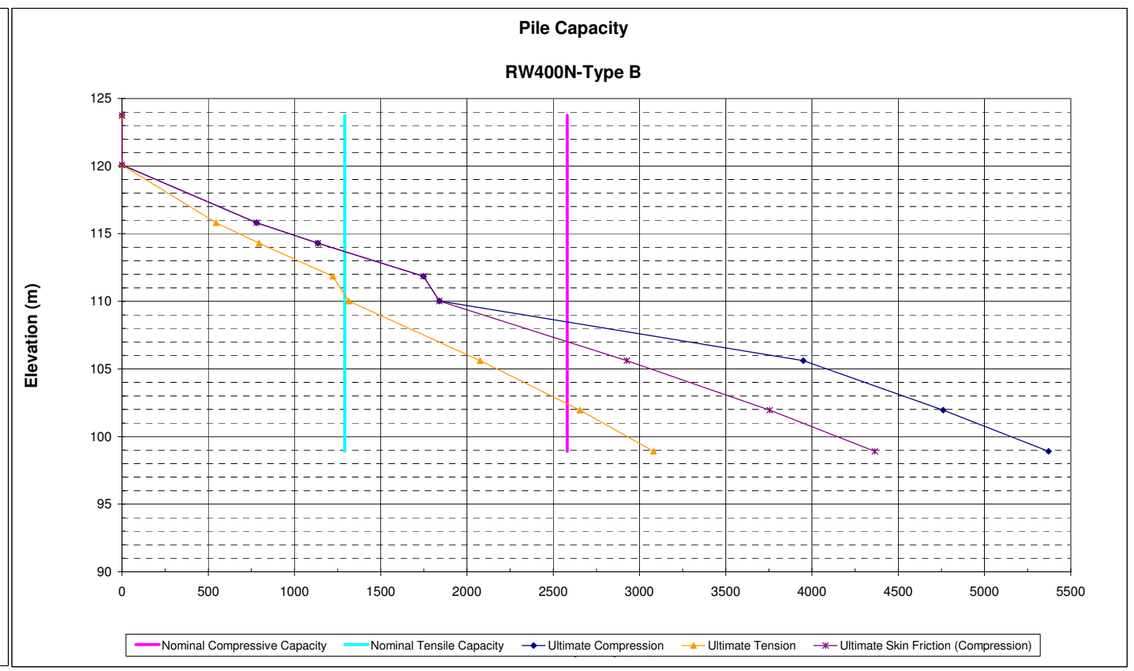


FIGURE E-1

Route 84 Widening Retaining Wall 400N - Type B

12/16/2009

Pile Design Spreadsheet

400N-Type B

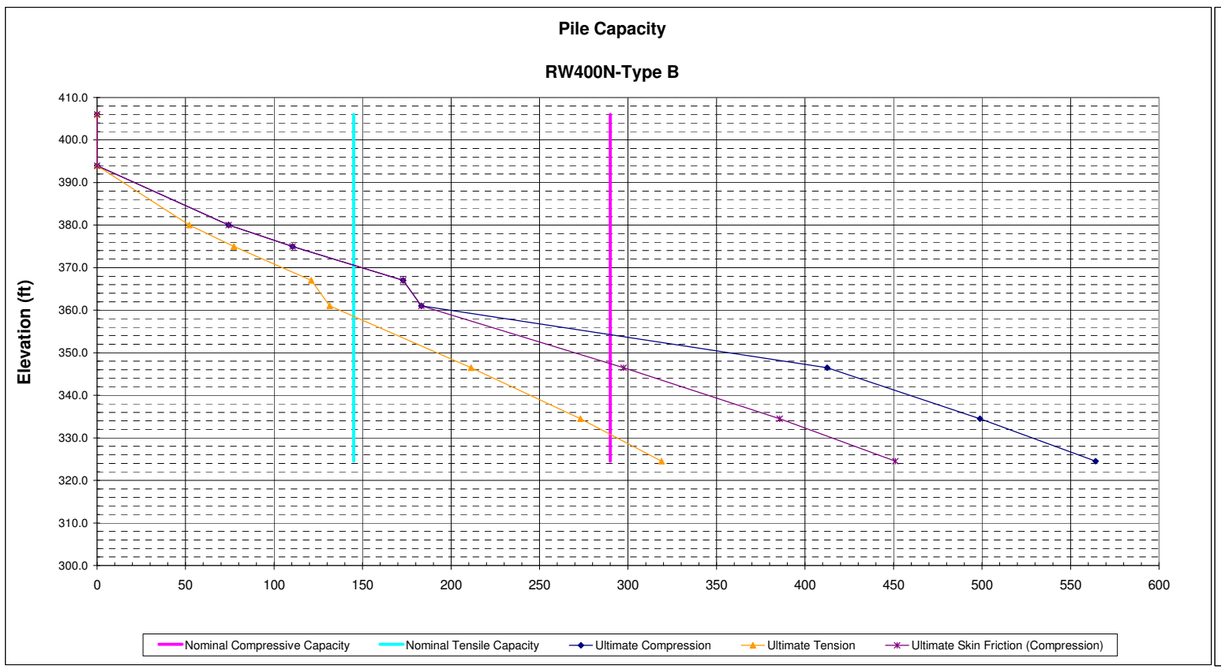
Caltrans Design Method For CIDH Pile

Project Name:	Route 84 Widening	Nominal axial compress. Capacity (ult.)	290	ton					
Project Number:	28649640	Nominal axial compress. Capacity (ult.)	2581	kN	Pile Type	CIDH			
Retaining Wall Name:	RW400N-Type B Wall_Pile A	Pile Diameter	24	inch	Pile Shape	Circular			
Boring Surface El. (m)	123.7	Pile Diameter	610	mm	Pile Surface Area	1.92	sq. m/m	Pile Tip Area	0.29 sq. m
Boring Surface El. (ft)	406.0	Pile Diameter	2.00	ft	Pile Surface Area	6.28	sq. ft/ft	Pile Tip Area	3.14 sq. ft.
Design GWS El. (ft)	375.0								
Unit Weight of Water (pcf)	62.4								
Depth with no strength									
Convert. Factor	3.281								
Bottom of Pile Cap El. (m)	120.1								
Bottom of Pile Cap El. (ft)	394.0								
Bottom of Fill El. (ft)	N/A								
Scour El. (ft)	N/A								

Soil parameters taken from borings B-12

Layer	Layer Elevation				Lateral	N_{SPT}	Cohesion	Adhesion	Ult. Load	Layer	Depth to	Effective	β	f_{max}	Soil	delta			q_T	z/B	Nc	q_T	Bearing	Include	Elevation	Compression						Tension			
																									Cumulative				Nominal		Cumulative		Nominal	
No.	Top		Bot.		Resists?			Factor	Transfer	Thickness	Layer Center	Vert. Stress			G= gran.	Cohesive	Friction		(granular)		(cohesive)	(cohesive)	Capacity	B.C.?	to	Axial Res.				Axial		Axial Res.		Axial	
							c	α	f_{sl}			(Cen. Lay.)			C=cohes.		(comp)**	(tensile)					(B.C.)		midlayer	(skin)		(Tot)		Capacity		(Skin)		Capacity	
(-)	(m)	(feet)	(m)	(feet)		blows/ft	(psf)		(psf)	(feet)	(feet)	(psf)		(psf)		(ton)	(ton)	(ton)	(psf)	(-)	(-)	(psf)	(ton)		(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)
			123.74	406.0								0		0	g								0	n	406.0	0	0	0.0	0	290	2581	0	0	145	1291
1	123.74	406.0	120.09	394.0	n	5	0	0.55	0	12.0	6	690.0	1.2	0	g	0.0	0.0	0.0	6000	0.0	6.00	0	9	n	403.0	0.0	0	0.0	0	290	2581	0.0	0	145	1291
2	120.09	394.0	115.82	380.0	Y	30	0	0.55	0	14.0	19	2185.0	0.9	1992	g	0.0	74.4	52.1	36000	7.0	9.00	0	57	n	384.5	74.4	662	74.4	662	290	2581	52.1	463	145	1291
3	115.82	380.0	114.29	375.0	y	35	0	0.55	0	5.0	28.5	3265.0	0.8	2544	g	0.0	36.1	25.3	42000	9.5	9.00	0	66	n	365.8	110.5	983	110.5	983	290	2581	77.4	688	145	1291
4	114.29	375.0	111.86	367.0	y	50	0	0.55	0	8.0	35	3902.0	0.7	2737	g	0.0	62.4	43.7	60000	13.5	9.00	0	94	n	357.5	172.9	1539	172.9	1539	290	2581	121.0	1077	145	1291
5	111.86	367.0	110.03	361.0	y	41	1000	0.55	550	6.0	42	4398.6	0.6	2750	c	10.4	0.0	0.0	49200	16.5	9.00	9000	14	n	346.0	183.3	1631	183.3	1631	290	2581	131.4	1169	145	1291
6	110.03	361.0	105.61	346.5	y	61	0	0.55	0	14.5	52.25	5114.6	0.5	2681	g	0.0	114.2	79.9	73200	23.8	9.00	0	115	y	334.9	297.5	2647	412.4	3671	290	2581	211.3	1880	145	1291
7	105.61	346.5	101.95	334.5	Y	60	0	0.55	0	12.0	65.5	6058.4	0.4	2468	g	0.0	88.2	61.7	72000	29.8	9.00	0	113	y	313.8	385.7	3432	498.8	4439	290	2581	273.1	2429	145	1291
8	101.95	334.5	98.9	324.5	Y	60	0	0.55	0	10.0	76.5	6829.5	0.3	2180	g	0.0	65.4	45.8	72000	34.8	9.00	0	113	y	296.3	451.1	4014	564.2	5021	290	2581	318.9	2837	145	1291
Bottom	98.9	324.5																																

** Stress reduction was applied (removal of 60 ft wide and 9 ft depth soil from surface)



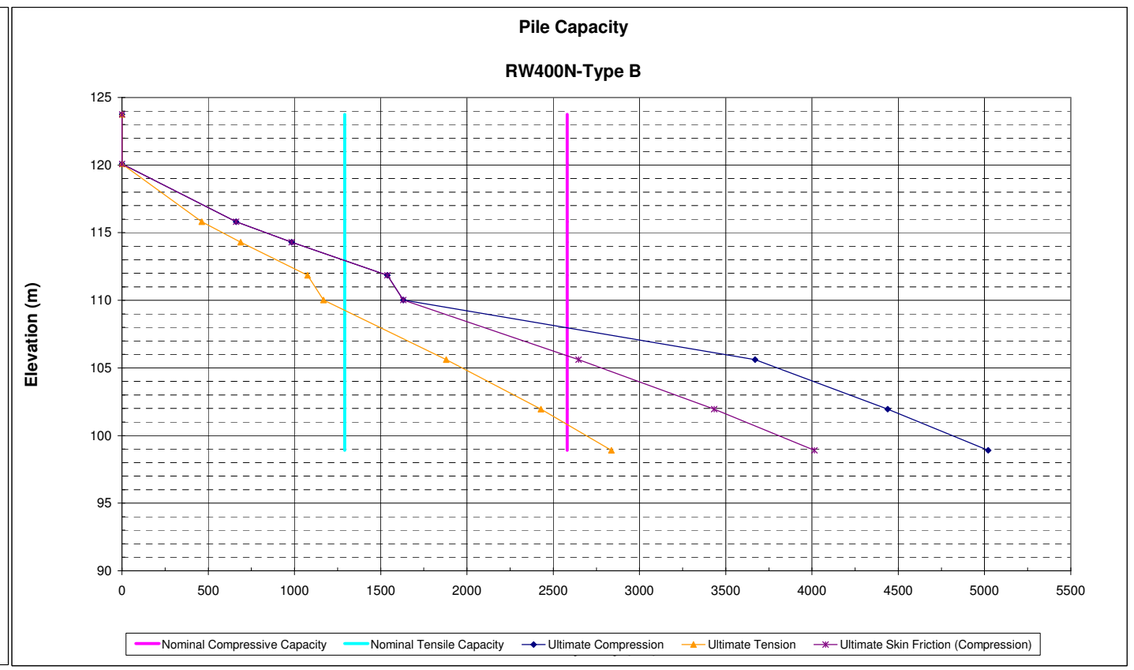


FIGURE E-2

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LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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==========

This program is licensed to:

Mano
URS

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\RW400N-Type B\
Name of input data file: RW400N-Type B_CIDH 24_ Fix.lpd
Name of output file: RW400N-Type B_CIDH 24_ Fix.lpo
Name of plot output file: RW400N-Type B_CIDH 24_ Fix.lpp
Name of runtime file: RW400N-Type B_CIDH 24_ Fix.lpr

Time and Date of Analysis

Date: April 23, 2009 Time: 13:36:59

Problem Title

Route 84 Widening_Retaining Wall 400N-Type B - 24 inch CIDH pile

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 564.00 in
Depth of ground surface below top of pile = -24.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	24.000	16286.0000	452.4000	3600000.000
2	564.0000	24.000	16286.0000	452.4000	3600000.000

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 168.000 in
p-y subgrade modulus k for top of soil layer = 60.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 60.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 168.000 in
Distance from top of pile to bottom of layer = 228.000 in
p-y subgrade modulus k for top of soil layer = 150.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 228.000 in
Distance from top of pile to bottom of layer = 324.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay with water-induced erosion
Distance from top of pile to top of layer = 324.000 in
Distance from top of pile to bottom of layer = 396.000 in
p-y subgrade modulus k for top of soil layer = 750.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 750.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 396.000 in
Distance from top of pile to bottom of layer = 570.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 6 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 570.000 in
Distance from top of pile to bottom of layer = 714.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 714.000 in
Distance from top of pile to bottom of layer = 858.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

(Depth of lowest layer extends 294.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-24.00	.06660
2	168.00	.06660
3	168.00	.07520
4	228.00	.07520
5	228.00	.03910
6	324.00	.03910
7	324.00	.03910
8	396.00	.03910
9	396.00	.04200
10	570.00	.04200
11	570.00	.04200
12	714.00	.04200
13	714.00	.03910
14	858.00	.03910

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-24.000	.00000	34.00	------	------
2	168.000	.00000	34.00	------	------
3	168.000	.00000	36.00	------	------
4	228.000	.00000	36.00	------	------
5	228.000	.00000	36.00	------	------
6	324.000	.00000	36.00	------	------
7	324.000	6.94400	.00	.00500	.0
8	396.000	6.94400	.00	.00500	.0
9	396.000	.00000	36.00	------	------
10	570.000	.00000	36.00	------	------
11	570.000	.00000	38.00	------	------
12	714.000	.00000	38.00	------	------
13	714.000	.00000	36.00	------	------
14	858.000	.00000	36.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .100 in
Slope at pile head = .000 in/in
Axial load at pile head = 290000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .200 in
Slope at pile head = .000 in/in
Axial load at pile head = 290000.000 lbs

Load Case Number 3

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .300 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs

Load Case Number  4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .400 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs

Load Case Number  5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .500 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs

Load Case Number  6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .600 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .700 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .800 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =            .900 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           1.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =      290000.000 lbs
```

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	84.000

Depth of ground surface below top of pile = -24.00 in

p-y Curve in Sand Computed Using Reese Criteria

Soil Layer Number	=	1
Depth below pile head	=	60.000 in
Depth below ground surface	=	84.000 in
Equivalent Depth (see note)	=	84.000 in
Pile Diameter	=	24.000 in
Angle of Friction	=	34.000 deg.
Avg. Eff. Unit Weight	=	.06660 lbs/in**3
k	=	60.000 pci
A (static)	=	.9800
B (static)	=	.6200
Pst	=	1715.339 lbs/in
Psd	=	6357.074 lbs/in
Ps	=	1715.339 lbs/in
pu	=	1681.032 lbs/in
Cbar	=	1627.7632
n	=	2.1528
m	=	1235.0441
yk	=	.1212 in
ym	=	.4000 in
yu	=	.9000 in
p-multiplier	=	1.00000
y-multiplier	=	1.00000

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0333	168.000
.0667	336.000
.1000	504.000
.1333	638.427
.1667	708.154
.2000	770.741
.2333	827.954
.2667	880.936
.3000	930.477

.3333	977.149
.3667	1021.382
.4000	1063.510
.9000	1681.032
24.9000	1681.032
48.9000	1681.032
72.9000	1681.032

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	-1.711E+06	34107.5954	0.0000	1901.7824	-144.0000
5.640	.099536	-1.521E+06	33202.3345	-1.554E-04	1761.6293	-177.0145
11.280	.098247	-1.336E+06	32116.6831	-2.929E-04	1625.4488	-207.9682
16.920	.096232	-1.158E+06	30863.9321	-4.128E-04	1493.9878	-236.2697
22.560	.093590	-9.865E+05	29460.3532	-5.159E-04	1367.9303	-261.4534
28.200	.090413	-8.236E+05	27924.5085	-6.030E-04	1247.8864	-283.1724
33.840	.086788	-6.696E+05	26276.6061	-6.748E-04	1134.3842	-301.1902
39.480	.082801	-5.250E+05	24537.9028	-7.323E-04	1027.8637	-315.3713
45.120	.078528	-3.904E+05	22730.1595	-7.763E-04	928.6740	-325.6724
50.760	.074044	-2.661E+05	20875.1518	-8.079E-04	837.0723	-332.1318
56.400	.069415	-1.523E+05	18994.2354	-8.280E-04	753.2244	-334.8599
62.040	.064704	-49104.5010	17107.9694	-8.377E-04	677.2073	-334.0288
67.680	.059966	43445.7663	15235.7955	-8.380E-04	673.0377	-329.8626
73.320	.055252	1.255E+05	13395.7733	-8.298E-04	733.4950	-322.6275
78.960	.050606	1.973E+05	11604.3686	-8.143E-04	786.3760	-312.6224
84.600	.046067	2.591E+05	9876.2938	-7.924E-04	831.9067	-300.1701
90.240	.041668	3.113E+05	8224.3965	-7.649E-04	870.3720	-285.6091
95.880	.037438	3.543E+05	6659.5931	-7.329E-04	902.1070	-269.2858
101.520	.033401	3.888E+05	5190.8432	-6.972E-04	927.4893	-251.5476
107.160	.029574	4.152E+05	3825.1614	-6.585E-04	946.9307	-232.7367
112.800	.025973	4.341E+05	2567.6624	-6.177E-04	960.8691	-213.1849
118.440	.022607	4.461E+05	1421.6330	-5.753E-04	969.7604	-193.2085
124.080	.019483	4.520E+05	388.6298	-5.321E-04	974.0716	-173.1047
129.720	.016605	4.523E+05	-531.4047	-4.886E-04	974.2730	-153.1486
135.360	.013972	4.476E+05	-1340.0092	-4.453E-04	970.8326	-133.5906
141.000	.011581	4.386E+05	-2040.0606	-4.027E-04	964.2091	-114.6546
146.640	.009429	4.259E+05	-2635.6218	-3.611E-04	954.8474	-96.5373
152.280	.007508	4.101E+05	-3131.7859	-3.209E-04	943.1737	-79.4074
157.920	.005809	3.916E+05	-3534.5186	-2.824E-04	929.5913	-63.4056

163.560	.004323	3.711E+05	-3850.5021	-2.457E-04	914.4774	-48.6453
169.200	.003038	3.490E+05	-4243.6355	-2.110E-04	898.1803	-90.7637
174.840	.001942	3.239E+05	-4667.8636	-1.787E-04	879.7154	-59.6718
180.480	.001022	2.969E+05	-4927.1529	-1.488E-04	859.8143	-32.2748
186.120	2.64E-04	2.689E+05	-5042.2619	-1.216E-04	839.1223	-8.5440
191.760	-3.49E-04	2.405E+05	-5033.5910	-9.710E-05	818.1989	11.6187
197.400	-8.32E-04	2.124E+05	-4920.8268	-7.532E-05	797.5200	28.3686
203.040	-.001199	1.852E+05	-4722.6505	-5.619E-05	777.4814	41.9067
208.680	-.001466	1.593E+05	-4456.5113	-3.962E-05	758.4035	52.4689
214.320	-.001646	1.351E+05	-4138.4606	-2.547E-05	740.5369	60.3150
219.960	-.001753	1.127E+05	-3783.0452	-1.355E-05	724.0683	65.7188
225.600	-.001799	92424.9029	-3403.2526	-3.683E-06	709.1270	68.9594
231.240	-.001794	74326.0965	-3044.8863	4.337E-06	695.7913	58.1208
236.880	-.001750	58064.3965	-2717.6823	1.071E-05	683.8092	57.9090
242.520	-.001674	43635.6216	-2394.8535	1.560E-05	673.1776	56.5693
248.160	-.001574	30999.4289	-2082.1866	1.919E-05	663.8669	54.3055
253.800	-.001457	20085.7936	-1784.3548	2.164E-05	655.8254	51.3087
259.440	-.001330	10801.1058	-1504.9924	2.313E-05	648.9842	47.7560
265.080	-.001196	3033.8187	-1246.7790	2.379E-05	643.2610	43.8090
270.720	-.001061	-3340.3992	-1011.5306	2.378E-05	643.4869	39.6125
276.360	-9.28E-04	-8454.0354	-800.2931	2.321E-05	647.2548	35.2944
282.000	-7.99E-04	-12443.6390	-613.4378	2.221E-05	650.1945	30.9663
287.640	-6.78E-04	-15446.2595	-450.7539	2.087E-05	652.4069	26.7230
293.280	-5.64E-04	-17596.4006	-311.5378	1.928E-05	653.9912	22.6444
298.920	-4.60E-04	-19023.4643	-194.6768	1.752E-05	655.0427	18.7957
304.560	-3.66E-04	-19849.6514	-98.7262	1.565E-05	655.6514	15.2293
310.200	-2.84E-04	-20188.2759	-21.9786	1.372E-05	655.9010	11.9861
315.840	-2.12E-04	-20142.4508	37.4748	1.178E-05	655.8672	9.0966
321.480	-1.51E-04	-19804.0957	81.6915	9.859E-06	655.6179	6.5831
327.120	-1.01E-04	-19253.2203	174.9778	7.980E-06	655.2120	26.4972
332.760	-6.07E-05	-17856.4509	307.7407	6.195E-06	654.1828	20.5818
338.400	-3.06E-05	-15802.1716	406.9392	4.576E-06	652.6691	14.5949
344.040	-9.11E-06	-13281.1467	470.3920	3.177E-06	650.8116	7.9060
349.680	5.21E-06	-10506.5442	475.4010	2.033E-06	648.7672	-6.1298
355.320	1.38E-05	-7925.2744	430.2515	1.147E-06	646.8652	-9.8807
360.960	1.81E-05	-5657.0584	370.5355	4.935E-07	645.1939	-11.2952
366.600	1.94E-05	-3747.2480	305.7902	4.114E-08	643.7867	-11.6641
372.240	1.86E-05	-2207.8793	240.7062	-2.453E-07	642.6525	-11.4153
377.880	1.66E-05	-1031.2793	178.1151	-4.011E-07	641.7855	-10.7802
383.520	1.41E-05	-197.4295	119.7646	-4.602E-07	641.1711	-9.9115
389.160	1.14E-05	321.1712	66.6615	-4.542E-07	641.2623	-8.9194
394.800	8.96E-06	555.9982	19.2796	-4.120E-07	641.4353	-7.8827
400.440	6.79E-06	539.9927	-3.8429	-3.593E-07	641.4235	-.3168
406.080	4.91E-06	513.8259	-5.3919	-3.086E-07	641.4042	-.2325
411.720	3.31E-06	480.1816	-6.4961	-2.608E-07	641.3795	-.1590
417.360	1.97E-06	441.4030	-7.2153	-2.165E-07	641.3509	-.095986
423.000	8.67E-07	399.5017	-7.6069	-1.761E-07	641.3200	-.042894
428.640	-1.75E-08	356.1730	-7.7254	-1.397E-07	641.2881	8.764E-04
434.280	-7.09E-07	312.8163	-7.6212	-1.075E-07	641.2561	.036062
439.920	-1.23E-06	270.5574	-7.3405	-7.947E-08	641.2250	.063469
445.560	-1.61E-06	230.2748	-6.9249	-5.539E-08	641.1953	.083935
451.200	-1.86E-06	192.6260	-6.4109	-3.504E-08	641.1676	.098310
456.840	-2.00E-06	158.0741	-5.8308	-1.818E-08	641.1421	.1074
462.480	-2.06E-06	126.9145	-5.2118	-4.469E-09	641.1192	.1121
468.120	-2.05E-06	99.3001	-4.5770	6.412E-09	641.0988	.1130
473.760	-1.99E-06	75.2653	-3.9454	1.481E-08	641.0811	.1109
479.400	-1.88E-06	54.7479	-3.3322	2.106E-08	641.0660	.1065

485.040	-1.75E-06	37.6089	-2.7495	2.550E-08	641.0534	.1002
490.680	-1.60E-06	23.6498	-2.2063	2.845E-08	641.0431	.092467
496.320	-1.43E-06	12.6284	-1.7092	3.020E-08	641.0349	.083808
501.960	-1.26E-06	4.2709	-1.2628	3.101E-08	641.0288	.074508
507.600	-1.08E-06	-1.7172	-.8699	3.113E-08	641.0269	.064823
513.240	-9.05E-07	-5.6430	-.5321	3.078E-08	641.0298	.054947
518.880	-7.32E-07	-7.8201	-.2502	3.013E-08	641.0314	.045011
524.520	-5.65E-07	-8.5642	-.024329	2.934E-08	641.0320	.035097
530.160	-4.01E-07	-8.1906	.1458	2.854E-08	641.0317	.025239
535.800	-2.43E-07	-7.0128	.2605	2.780E-08	641.0308	.015433
541.440	-8.79E-08	-5.3429	.3200	2.721E-08	641.0296	.005647
547.080	6.41E-08	-3.4926	.3241	2.678E-08	641.0282	-.004168
552.720	2.14E-07	-1.7744	.2727	2.653E-08	641.0269	-.014073
558.360	3.63E-07	-.5035	.1650	2.642E-08	641.0260	-.024127
564.000	5.12E-07	0.0000	0.0000	2.640E-08	641.0256	-.034372

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-1711057.100 lbs-in
Maximum shear force	=	34107.595 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .200000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	-3.382E+06	67212.3567	0.0000	3133.2040	-287.4774
5.640	.199082	-3.008E+06	65403.2542	-3.073E-04	2857.0614	-354.0483
11.280	.196533	-2.644E+06	63231.6577	-5.792E-04	2588.8684	-416.0214
16.920	.192550	-2.292E+06	60725.3281	-8.166E-04	2330.1198	-472.7479
22.560	.187322	-1.956E+06	57916.4625	-.001021	2082.1857	-523.3038
28.200	.181034	-1.636E+06	54841.8108	-.001194	1846.2903	-566.9982
33.840	.173858	-1.333E+06	51541.4097	-.001336	1623.4946	-603.3568
39.480	.165959	-1.050E+06	48057.4123	-.001451	1414.6860	-632.1033

45.120	.157490	-7.865E+05	44467.0757	-.001539	1220.5710	-641.0657
50.760	.148594	-5.434E+05	40842.0425	-.001603	1041.3904	-644.4070
56.400	.139403	-3.206E+05	37203.8276	-.001645	877.2504	-645.7401
62.040	.130039	-1.183E+05	33601.1126	-.001666	728.2084	-631.8184
67.680	.120610	63874.1594	30121.5501	-.001669	688.0900	-602.0690
73.320	.111216	2.269E+05	26809.1218	-.001655	808.2182	-572.5510
78.960	.101945	3.717E+05	23543.1226	-.001626	914.9006	-585.6048
84.600	.092876	4.978E+05	20221.1360	-.001584	1007.8142	-592.4047
90.240	.084077	6.050E+05	16925.4030	-.001531	1086.7853	-576.2950
95.880	.075606	6.937E+05	13766.6885	-.001469	1152.1789	-543.8165
101.520	.067511	7.651E+05	10799.3263	-.001398	1204.7460	-508.4396
107.160	.059832	8.201E+05	8037.7276	-.001322	1245.3074	-470.8507
112.800	.052597	8.601E+05	5492.4879	-.001241	1274.7378	-431.7166
118.440	.045829	8.861E+05	3170.5264	-.001157	1293.9499	-391.6740
124.080	.039542	8.996E+05	1075.2761	-.001071	1303.8791	-351.3225
129.720	.033743	9.018E+05	-793.0867	-9.848E-04	1305.4696	-311.2175
135.360	.028433	8.939E+05	-2437.3813	-8.985E-04	1299.6611	-271.8657
141.000	.023608	8.772E+05	-3863.1373	-8.133E-04	1287.3770	-233.7215
146.640	.019259	8.530E+05	-5078.2924	-7.301E-04	1269.5132	-197.1846
152.280	.015373	8.223E+05	-6092.8822	-6.495E-04	1246.9288	-162.5990
157.920	.011933	7.864E+05	-6918.7253	-5.721E-04	1220.4380	-130.2531
163.560	.008920	7.461E+05	-7569.1113	-4.984E-04	1190.8032	-100.3802
169.200	.006311	7.026E+05	-8383.9671	-4.287E-04	1158.7292	-188.5757
174.840	.004084	6.530E+05	-9269.6048	-3.635E-04	1122.1538	-125.4802
180.480	.002211	5.992E+05	-9820.2975	-3.033E-04	1082.5616	-69.8009
186.120	6.63E-04	5.432E+05	-10077.7422	-2.483E-04	1041.2640	-21.4916
191.760	-5.90E-04	4.864E+05	-10082.9811	-1.988E-04	999.3997	19.6339
197.400	-.001580	4.301E+05	-9875.6749	-1.547E-04	957.9392	53.8790
203.040	-.002336	3.755E+05	-9493.5079	-1.160E-04	917.6917	81.6412
208.680	-.002888	3.234E+05	-8971.7222	-8.237E-05	879.3141	103.3892
214.320	-.003265	2.746E+05	-8342.7752	-5.361E-05	843.3223	119.6416
219.960	-.003493	2.295E+05	-7636.1161	-2.936E-05	810.1029	130.9467
225.600	-.003596	1.885E+05	-6878.0692	-9.260E-06	779.9260	137.8642
231.240	-.003597	1.519E+05	-6160.7358	7.114E-06	752.9586	116.5093
236.880	-.003516	1.190E+05	-5504.0629	2.014E-05	728.7043	116.3534
242.520	-.003370	89759.9480	-4854.7466	3.019E-05	707.1634	113.9006
248.160	-.003175	64134.3111	-4224.5829	3.759E-05	688.2817	109.5617
253.800	-.002946	41983.6968	-3623.1195	4.269E-05	671.9605	103.7232
259.440	-.002694	23125.8702	-3057.8044	4.582E-05	658.0655	96.7432
265.080	-.002429	7341.7666	-2534.1550	4.729E-05	646.4353	88.9481
270.720	-.002160	-5614.0886	-2055.9416	4.737E-05	645.1623	80.6311
276.360	-.001895	-16004.2171	-1625.3778	4.633E-05	652.8180	72.0511
282.000	-.001638	-24099.9112	-1243.3131	4.440E-05	658.7832	63.4328
287.640	-.001394	-30174.0402	-909.4229	4.179E-05	663.2588	54.9680
293.280	-.001166	-34494.9125	-622.3909	3.868E-05	666.4425	46.8164
298.920	-9.57E-04	-37321.1455	-380.0822	3.523E-05	668.5250	39.1086
304.560	-7.69E-04	-38897.4771	-179.7031	3.156E-05	669.6864	31.9478
310.200	-6.01E-04	-39451.4414	-17.9456	2.779E-05	670.0946	25.4130
315.840	-4.55E-04	-39190.8203	108.8833	2.401E-05	669.9026	19.5618
321.480	-3.31E-04	-38301.7810	204.7490	2.028E-05	669.2475	14.4331
327.120	-2.26E-04	-36947.6028	357.6838	1.666E-05	668.2497	39.7991
332.760	-1.43E-04	-34321.6191	558.9025	1.324E-05	666.3148	31.5551
338.400	-7.72E-05	-30686.4803	713.2874	1.011E-05	663.6363	23.1913
344.040	-2.85E-05	-26308.8062	818.2202	7.368E-06	660.4107	14.0189
349.680	5.92E-06	-21481.0585	838.7846	5.069E-06	656.8535	-6.7265
355.320	2.87E-05	-16863.8980	779.4593	3.225E-06	653.4515	-14.3109
360.960	4.23E-05	-12699.3069	690.2188	1.803E-06	650.3829	-17.3347

366.600	4.90E-05	-9084.1272	588.7358	7.552E-07	647.7191	-18.6522
372.240	5.08E-05	-6060.8377	482.5755	2.674E-08	645.4914	-18.9933
377.880	4.93E-05	-3640.7631	376.2213	-4.399E-07	643.7083	-18.7210
383.520	4.59E-05	-1815.6221	272.4906	-7.023E-07	642.3634	-18.0630
389.160	4.14E-05	-564.7722	173.1128	-8.168E-07	641.4418	-17.1773
394.800	3.66E-05	139.7623	79.0625	-8.373E-07	641.1286	-16.1738
400.440	3.20E-05	329.7915	29.2488	-8.147E-07	641.2686	-1.4906
406.080	2.74E-05	472.3537	21.3799	-7.761E-07	641.3737	-1.2998
411.720	2.32E-05	573.4959	14.5704	-7.258E-07	641.4482	-1.1149
417.360	1.93E-05	639.0822	8.7775	-6.675E-07	641.4965	-.9393
423.000	1.57E-05	674.6899	3.9427	-6.043E-07	641.5228	-.7752
428.640	1.24E-05	685.5325	-.004337	-5.389E-07	641.5308	-.6244
434.280	9.59E-06	676.4037	-3.1416	-4.734E-07	641.5240	-.4881
439.920	7.11E-06	651.6437	-5.5517	-4.095E-07	641.5058	-.3666
445.560	4.97E-06	615.1204	-7.3188	-3.485E-07	641.4789	-.2601
451.200	3.18E-06	570.2275	-8.5267	-2.915E-07	641.4458	-.1683
456.840	1.69E-06	519.8927	-9.2564	-2.391E-07	641.4087	-.090507
462.480	4.78E-07	466.5972	-9.5850	-1.917E-07	641.3694	-.026005
468.120	-4.76E-07	412.4010	-9.5843	-1.494E-07	641.3295	.026249
473.760	-1.21E-06	358.9750	-9.3203	-1.123E-07	641.2901	.067361
479.400	-1.74E-06	307.6352	-8.8526	-8.021E-08	641.2523	.098496
485.040	-2.11E-06	259.3801	-8.2341	-5.294E-08	641.2168	.1208
490.680	-2.34E-06	214.9279	-7.5111	-3.012E-08	641.1840	.1355
496.320	-2.45E-06	174.7535	-6.7235	-1.138E-08	641.1544	.1437
501.960	-2.47E-06	139.1237	-5.9052	3.716E-09	641.1282	.1465
507.600	-2.41E-06	108.1309	-5.0842	1.561E-08	641.1053	.1447
513.240	-2.29E-06	81.7231	-4.2835	2.474E-08	641.0859	.1392
518.880	-2.13E-06	59.7318	-3.5216	3.154E-08	641.0697	.1309
524.520	-1.94E-06	41.8957	-2.8130	3.643E-08	641.0565	.1204
530.160	-1.72E-06	27.8817	-2.1688	3.979E-08	641.0462	.1081
535.800	-1.49E-06	17.3016	-1.5973	4.196E-08	641.0384	.094560
541.440	-1.25E-06	9.7268	-1.1048	4.326E-08	641.0328	.080097
547.080	-10.0E-06	4.6983	-.6957	4.396E-08	641.0291	.064950
552.720	-7.50E-07	1.7350	-.3736	4.427E-08	641.0269	.049287
558.360	-5.00E-07	.3393	-.1409	4.437E-08	641.0259	.033211
564.000	-2.50E-07	0.0000	0.0000	4.438E-08	641.0256	.016770

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-3382301.350 lbs-in
Maximum shear force	=	67212.357 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .300000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	-4.733E+06	88298.0984	0.0000	4128.6059	-324.1493
5.640	.298716	-4.240E+06	86240.4983	-4.316E-04	3765.1884	-405.4961
11.280	.295132	-3.759E+06	83745.9437	-8.163E-04	3410.7835	-479.0977
16.920	.289508	-3.293E+06	80843.9507	-.001156	3067.1720	-549.9778
22.560	.282097	-2.843E+06	77572.3769	-.001451	2736.0692	-610.1547
28.200	.273144	-2.413E+06	73982.3883	-.001703	2418.9378	-662.8909
33.840	.262882	-2.003E+06	70130.6729	-.001916	2117.0636	-702.9657
39.480	.251533	-1.616E+06	66079.3812	-.002090	1831.4335	-733.6626
45.120	.239308	-1.251E+06	61890.6931	-.002228	1562.8119	-751.6878
50.760	.226403	-9.102E+05	57612.2680	-.002332	1311.6634	-765.4842
56.400	.213005	-5.935E+05	53257.8689	-.002404	1078.3511	-778.6289
62.040	.199285	-3.016E+05	48876.5944	-.002447	863.2196	-775.0145
67.680	.185401	-34190.3907	44566.7472	-.002463	666.2181	-753.3000
73.320	.171499	2.092E+05	40383.7258	-.002455	795.1826	-730.0409
78.960	.157710	4.294E+05	36205.2194	-.002424	957.3968	-751.6990
84.600	.144155	6.255E+05	31926.0826	-.002373	1101.9428	-765.7254
90.240	.130938	7.973E+05	27590.6052	-.002305	1228.4690	-771.6779
95.880	.118154	9.443E+05	23245.1204	-.002221	1336.8160	-769.2742
101.520	.105883	1.067E+06	18871.5670	-.002124	1427.0231	-781.6313
107.160	.094190	1.164E+06	14577.0749	-.002017	1498.7865	-741.2382
112.800	.083129	1.238E+06	10562.6348	-.001902	1553.0416	-682.3221
118.440	.072739	1.289E+06	6885.4079	-.001780	1591.1608	-621.6591
124.080	.063049	1.321E+06	3552.6209	-.001655	1614.5598	-560.1803
129.720	.054076	1.335E+06	566.4236	-.001527	1624.6761	-498.7549
135.360	.045827	1.333E+06	-2075.7385	-.001398	1622.9476	-438.1820
141.000	.038301	1.316E+06	-4380.7108	-.001271	1610.7945	-379.1841
146.640	.031490	1.287E+06	-6359.1882	-.001146	1589.6013	-322.4037
152.280	.025376	1.248E+06	-8025.2563	-.001024	1560.7023	-268.4006
157.920	.019940	1.200E+06	-9395.9238	-9.061E-04	1525.3678	-217.6517
163.560	.015155	1.145E+06	-10490.6574	-7.933E-04	1484.7928	-170.5517
169.200	.010992	1.084E+06	-11897.7577	-6.861E-04	1440.0875	-328.4201
174.840	.007416	1.013E+06	-13466.4918	-5.852E-04	1387.5590	-227.8686
180.480	.004391	9.345E+05	-14499.9962	-4.915E-04	1329.5722	-138.6223
186.120	.001872	8.512E+05	-15062.0632	-4.056E-04	1268.2279	-60.6922
191.760	-1.85E-04	7.659E+05	-15215.9074	-3.278E-04	1205.3625	6.1375
197.400	-.001826	6.807E+05	-15022.9884	-2.583E-04	1142.5521	62.2735
203.040	-.003098	5.973E+05	-14542.0335	-1.968E-04	1081.1224	108.2779
208.680	-.004045	5.173E+05	-13828.2616	-1.432E-04	1022.1613	144.8327
214.320	-.004713	4.418E+05	-12932.8008	-9.705E-05	966.5349	172.7066
219.960	-.005140	3.717E+05	-11902.2896	-5.792E-05	914.9051	192.7229
225.600	-.005366	3.077E+05	-10778.6497	-2.525E-05	867.7494	205.7309
231.240	-.005425	2.502E+05	-9702.9593	1.588E-06	825.3799	175.7196
236.880	-.005348	1.982E+05	-8708.2858	2.316E-05	787.1001	177.0016
242.520	-.005164	1.519E+05	-7716.9396	4.000E-05	752.9458	174.5396

248.160	-.004897	1.111E+05	-6748.2309	5.265E-05	722.8648	168.9741
253.800	-.004570	75602.0390	-5817.9560	6.163E-05	696.7314	160.9106
259.440	-.004202	45241.2753	-4938.6144	6.744E-05	674.3607	150.9127
265.080	-.003809	19673.8659	-4119.6592	7.056E-05	655.5219	139.4970
270.720	-.003406	-1459.2967	-3367.7735	7.144E-05	642.1009	127.1292
276.360	-.003003	-18548.3008	-2687.1606	7.047E-05	654.6926	114.2229
282.000	-.002611	-32001.0018	-2079.8403	6.804E-05	664.6049	101.1389
287.640	-.002236	-42231.4802	-1545.9433	6.447E-05	672.1430	88.1863
293.280	-.001884	-49650.1427	-1083.9962	6.005E-05	677.6093	75.6247
298.920	-.001559	-54655.4013	-691.1936	5.504E-05	681.2973	63.6670
304.560	-.001263	-57626.8388	-363.6507	4.964E-05	683.4868	52.4830
310.200	-9.99E-04	-58919.7471	-96.6349	4.403E-05	684.4394	42.2035
315.840	-7.66E-04	-58860.9092	115.2269	3.836E-05	684.3961	32.9248
321.480	-5.66E-04	-57745.4854	277.7659	3.276E-05	683.5742	24.7131
327.120	-3.97E-04	-55834.8606	496.1228	2.729E-05	682.1664	52.7184
332.760	-2.58E-04	-52238.4997	764.6695	2.209E-05	679.5165	42.5109
338.400	-1.48E-04	-47281.6646	975.2064	1.731E-05	675.8642	32.1476
344.040	-6.28E-05	-41294.7889	1124.9661	1.305E-05	671.4528	20.9587
349.680	-4.22E-07	-34634.7272	1188.2046	9.395E-06	666.5455	1.4663
355.320	4.32E-05	-27922.5740	1143.1637	6.386E-06	661.5998	-17.4383
360.960	7.16E-05	-21760.7317	1030.6804	3.997E-06	657.0596	-22.4494
366.600	8.83E-05	-16309.5729	897.0893	2.165E-06	653.0430	-24.9233
372.240	9.60E-05	-11648.6484	753.4672	8.207E-07	649.6087	-26.0065
377.880	9.75E-05	-7813.1473	606.2072	-1.154E-07	646.7826	-26.2134
383.520	9.47E-05	-4810.2542	459.3937	-7.226E-07	644.5700	-25.8481
389.160	8.94E-05	-2628.8222	315.6826	-1.080E-06	642.9626	-25.1133
394.800	8.26E-05	-1245.8203	176.7682	-1.267E-06	641.9436	-24.1471
400.440	7.51E-05	-630.7329	98.7983	-1.357E-06	641.4904	-3.5018
406.080	6.72E-05	-126.9368	79.9438	-1.393E-06	641.1192	-3.1842
411.720	5.94E-05	275.5908	62.9208	-1.386E-06	641.2287	-2.8523
417.360	5.16E-05	587.3450	47.7808	-1.345E-06	641.4584	-2.5165
423.000	4.42E-05	818.9570	34.5208	-1.277E-06	641.6291	-2.1856
428.640	3.72E-05	980.9169	23.0938	-1.191E-06	641.7484	-1.8665
434.280	3.08E-05	1083.3492	13.4178	-1.091E-06	641.8239	-1.5647
439.920	2.49E-05	1135.8399	5.3846	-9.845E-07	641.8626	-1.2840
445.560	1.96E-05	1147.3076	-1.1335	-8.747E-07	641.8710	-1.0273
451.200	1.50E-05	1125.9153	-6.2761	-7.654E-07	641.8552	-.7963
456.840	1.10E-05	1079.0171	-10.1895	-6.593E-07	641.8207	-.5915
462.480	7.59E-06	1013.1349	-13.0216	-5.587E-07	641.7721	-.4129
468.120	4.71E-06	933.9606	-14.9182	-4.650E-07	641.7138	-.2597
473.760	2.34E-06	846.3784	-16.0194	-3.794E-07	641.6493	-.1308
479.400	4.33E-07	754.5028	-16.4572	-3.024E-07	641.5816	-.024470
485.040	-1.07E-06	661.7301	-16.3539	-2.343E-07	641.5132	.061110
490.680	-2.21E-06	570.7972	-15.8206	-1.750E-07	641.4462	.1280
496.320	-3.04E-06	483.8465	-14.9566	-1.243E-07	641.3822	.1784
501.960	-3.61E-06	402.4933	-13.8493	-8.165E-08	641.3222	.2143
507.600	-3.96E-06	327.8939	-12.5739	-4.652E-08	641.2672	.2380
513.240	-4.14E-06	260.8121	-11.1942	-1.821E-08	641.2178	.2513
518.880	-4.17E-06	201.6825	-9.7632	4.039E-09	641.1742	.2562
524.520	-4.09E-06	150.6695	-8.3238	2.099E-08	641.1367	.2543
530.160	-3.93E-06	107.7215	-6.9097	3.341E-08	641.1050	.2472
535.800	-3.71E-06	72.6185	-5.5470	4.209E-08	641.0791	.2361
541.440	-3.46E-06	45.0141	-4.2546	4.775E-08	641.0588	.2222
547.080	-3.18E-06	24.4702	-3.0462	5.109E-08	641.0437	.2063
552.720	-2.88E-06	10.4860	-1.9307	5.277E-08	641.0334	.1892
558.360	-2.58E-06	2.5188	-.9141	5.340E-08	641.0275	.1713
564.000	-2.28E-06	0.0000	0.0000	5.352E-08	641.0256	.1529

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	.30000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-4733227.683 lbs-in
Maximum shear force	=	88298.098 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .400000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	-6.007E+06	1.071E+05	0.0000	5066.8608	-352.9717
5.640	.398371	-5.408E+06	1.049E+05	-5.490E-04	4625.4421	-442.2536
11.280	.393807	-4.822E+06	1.022E+05	-.001041	4193.7622	-523.5722
16.920	.386628	-4.252E+06	98989.4040	-.001477	3773.7948	-602.5491
22.560	.377142	-3.700E+06	95399.3293	-.001860	3367.4573	-670.5270
28.200	.365648	-3.170E+06	91448.6029	-.002190	2976.4068	-730.4398
33.840	.352435	-2.662E+06	87198.1850	-.002471	2602.1090	-776.8007
39.480	.337778	-2.178E+06	82709.1623	-.002704	2245.7095	-815.0514
45.120	.321939	-1.720E+06	78037.7074	-.002891	1908.1609	-841.4929
50.760	.305167	-1.288E+06	73225.7701	-.003036	1590.1360	-864.8678
56.400	.287696	-8.838E+05	68279.5498	-.003140	1292.2328	-889.1110
62.040	.269746	-5.076E+05	63246.0134	-.003207	1015.0663	-895.8310
67.680	.251520	-1.599E+05	58229.4496	-.003239	758.8377	-883.0924
73.320	.233208	1.598E+05	53292.9458	-.003239	758.7626	-867.4409
78.960	.214982	4.518E+05	48315.7913	-.003210	973.9618	-897.5075
84.600	.197002	7.153E+05	43193.5936	-.003154	1168.0726	-918.8747
90.240	.179409	9.494E+05	37977.2478	-.003074	1340.5637	-930.8934
95.880	.162332	1.154E+06	32720.8243	-.002972	1491.1263	-933.0866
101.520	.145880	1.328E+06	27411.1637	-.002853	1619.6851	-949.7718
107.160	.130150	1.472E+06	22026.1939	-.002718	1725.8290	-959.7920
112.800	.115218	1.586E+06	16652.6897	-.002571	1809.3064	-945.7060
118.440	.101146	1.669E+06	11548.0994	-.002415	1870.4343	-864.4325
124.080	.087979	1.724E+06	6906.0674	-.002252	1911.1080	-781.6782

129.720	.075748	1.754E+06	2731.5748	-.002084	1933.2606	-698.6383
135.360	.064468	1.761E+06	-976.8851	-.001915	1938.8351	-616.4184
141.000	.054144	1.749E+06	-4226.7750	-.001746	1929.7577	-536.0249
146.640	.044769	1.719E+06	-7030.9390	-.001580	1907.9140	-458.3595
152.280	.036326	1.675E+06	-9407.0009	-.001416	1875.1278	-384.2156
157.920	.028793	1.618E+06	-11376.7491	-.001258	1833.1421	-314.2766
163.560	.022137	1.551E+06	-12965.5197	-.001106	1783.6027	-249.1172
169.200	.016322	1.475E+06	-15043.3113	-9.600E-04	1728.0447	-487.6883
174.840	.011308	1.384E+06	-17398.3622	-8.225E-04	1660.8852	-347.4361
180.480	.007045	1.282E+06	-19005.3235	-6.942E-04	1585.4218	-222.4083
186.120	.003477	1.172E+06	-19950.3565	-5.762E-04	1504.5970	-112.7097
191.760	5.45E-04	1.059E+06	-20319.3120	-4.689E-04	1420.9946	-18.1256
197.400	-.001813	9.443E+05	-20196.0653	-3.726E-04	1336.8447	61.8301
203.040	-.003658	8.320E+05	-19661.1239	-2.872E-04	1254.0345	127.8654
208.680	-.005052	7.235E+05	-18790.5092	-2.123E-04	1174.1247	180.8632
214.320	-.006053	6.207E+05	-17654.9031	-1.477E-04	1098.3702	221.8340
219.960	-.006718	5.248E+05	-16319.0491	-9.259E-05	1027.7432	251.8731
225.600	-.007098	4.369E+05	-14841.3901	-4.633E-05	962.9587	272.1195
231.240	-.007241	3.576E+05	-13412.6535	-8.120E-06	904.5016	234.5247
236.880	-.007189	2.856E+05	-12080.3185	2.282E-05	851.4999	237.9346
242.520	-.006983	2.212E+05	-10743.7277	4.720E-05	804.0419	236.0338
248.160	-.006657	1.643E+05	-9430.3568	6.574E-05	762.0904	229.7005
253.800	-.006242	1.147E+05	-8162.8544	7.916E-05	725.5036	219.7684
259.440	-.005764	71969.0804	-6959.3208	8.814E-05	694.0546	207.0166
265.080	-.005247	35861.2503	-5833.6388	9.332E-05	667.4493	192.1614
270.720	-.004711	5860.3560	-4795.8420	9.533E-05	645.3437	175.8516
276.360	-.004172	-18547.6903	-3852.5049	9.472E-05	654.6921	158.6651
282.000	-.003643	-37905.7465	-3007.1451	9.200E-05	668.9557	141.1079
287.640	-.003134	-52769.2518	-2260.6243	8.764E-05	679.9076	123.6158
293.280	-.002654	-63692.2859	-1611.5403	8.204E-05	687.9560	106.5558
298.920	-.002209	-71215.7997	-1056.6020	7.555E-05	693.4995	90.2308
304.560	-.001802	-75857.9034	-590.9803	6.848E-05	696.9200	74.8833
310.200	-.001436	-78106.0645	-208.6312	6.107E-05	698.5765	60.7015
315.840	-.001113	-78411.0456	97.4134	5.354E-05	698.8012	47.8249
321.480	-8.32E-04	-77182.3975	334.7877	4.606E-05	697.8959	36.3504
327.120	-5.94E-04	-74785.3144	619.1348	3.875E-05	696.1296	64.4819
332.760	-3.95E-04	-70325.3206	949.3716	3.177E-05	692.8434	52.6233
338.400	-2.35E-04	-64180.3354	1212.2312	2.530E-05	688.3156	40.5893
344.040	-1.10E-04	-56734.1215	1404.9157	1.949E-05	682.8290	27.7385
349.680	-1.53E-05	-48396.6310	1512.2729	1.443E-05	676.6857	10.3315
355.320	5.29E-05	-39722.8859	1487.0018	1.019E-05	670.2946	-19.2929
360.960	9.96E-05	-31656.5890	1357.9698	6.758E-06	664.3511	-26.4632
366.600	1.29E-04	-24427.0947	1198.3636	4.061E-06	659.0242	-30.1347
372.240	1.45E-04	-18152.3306	1023.1871	2.013E-06	654.4008	-31.9846
377.880	1.52E-04	-12892.1285	840.7966	5.195E-07	650.5249	-32.6928
383.520	1.51E-04	-8669.8441	656.5542	-5.176E-07	647.4138	-32.6414
389.160	1.46E-04	-5484.5040	474.0483	-1.198E-06	645.0668	-32.0770
394.800	1.38E-04	-3318.6590	295.7013	-1.622E-06	643.4709	-31.1666
400.440	1.28E-04	-2143.6876	191.0103	-1.885E-06	642.6052	-5.9579
406.080	1.17E-04	-1157.8977	158.6507	-2.043E-06	641.8788	-5.5171
411.720	1.05E-04	-347.4231	128.9069	-2.116E-06	641.2816	-5.0303
417.360	9.26E-05	303.0932	101.9815	-2.118E-06	641.2490	-4.5177
423.000	8.08E-05	809.8567	77.9725	-2.064E-06	641.6224	-3.9962
428.640	6.94E-05	1189.3761	56.8897	-1.968E-06	641.9020	-3.4800
434.280	5.86E-05	1458.0110	38.6710	-1.841E-06	642.0999	-2.9805
439.920	4.86E-05	1631.6065	23.1969	-1.692E-06	642.2279	-2.5067
445.560	3.95E-05	1725.2081	10.3046	-1.531E-06	642.2968	-2.0651

451.200	3.13E-05	1752.8495	-.2006	-1.364E-06	642.3172	-1.6602
456.840	2.41E-05	1727.4053	-8.5339	-1.196E-06	642.2984	-1.2949
462.480	1.78E-05	1660.5000	-14.9218	-1.033E-06	642.2491	-.9704
468.120	1.25E-05	1562.4668	-19.5946	-8.782E-07	642.1769	-.6866
473.760	7.93E-06	1442.3458	-22.7792	-7.336E-07	642.0884	-.4427
479.400	4.19E-06	1307.9169	-24.6945	-6.013E-07	641.9894	-.2365
485.040	1.15E-06	1165.7585	-25.5468	-4.824E-07	641.8846	-.065706
490.680	-1.26E-06	1021.3267	-25.5269	-3.772E-07	641.7782	.072756
496.320	-3.11E-06	879.0484	-24.8082	-2.858E-07	641.6733	.1821
501.960	-4.48E-06	742.4250	-23.5451	-2.078E-07	641.5727	.2658
507.600	-5.45E-06	614.1394	-21.8728	-1.425E-07	641.4782	.3272
513.240	-6.09E-06	496.1658	-19.9073	-8.912E-08	641.3912	.3698
518.880	-6.45E-06	389.8761	-17.7460	-4.650E-08	641.3129	.3967
524.520	-6.61E-06	296.1430	-15.4685	-1.350E-08	641.2438	.4109
530.160	-6.61E-06	215.4353	-13.1384	1.110E-08	641.1844	.4153
535.800	-6.49E-06	147.9057	-10.8044	2.858E-08	641.1346	.4123
541.440	-6.28E-06	93.4682	-8.5026	4.019E-08	641.0945	.4039
547.080	-6.03E-06	51.8652	-6.2580	4.718E-08	641.0639	.3920
552.720	-5.75E-06	22.7232	-4.0871	5.077E-08	641.0424	.3778
558.360	-5.46E-06	5.5968	-1.9994	5.213E-08	641.0298	.3625
564.000	-5.16E-06	0.0000	0.0000	5.240E-08	641.0256	.3465

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection	=	.40000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-6006595.974 lbs-in
Maximum shear force	=	107131.230 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6
Number of zero deflection points	=	3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	-7.232E+06	1.248E+05	0.0000	5969.8111	-379.1008
5.640	.498038	-6.534E+06	1.224E+05	-6.621E-04	5455.3353	-475.5092

11.280	.492531	-5.850E+06	1.194E+05	-.001258	4951.2470	-563.5467
16.920	.483851	-5.183E+06	1.160E+05	-.001788	4459.6892	-649.3404
22.560	.472358	-4.535E+06	1.121E+05	-.002256	3982.7499	-723.6451
28.200	.458405	-3.910E+06	1.079E+05	-.002662	3522.2457	-789.1483
33.840	.442331	-3.310E+06	1.033E+05	-.003009	3079.7845	-840.2783
39.480	.424460	-2.736E+06	98410.1368	-.003300	2656.6343	-884.6318
45.120	.405106	-2.189E+06	93325.6019	-.003537	2253.9011	-918.3948
50.760	.384564	-1.671E+06	88054.9354	-.003723	1872.4397	-950.6359
56.400	.363115	-1.184E+06	82595.4667	-.003860	1513.0657	-985.3459
62.040	.341024	-7.269E+05	76990.5885	-.003952	1176.6494	-1002.1996
67.680	.318539	-3.021E+05	71347.7876	-.004001	863.6385	-998.7937
73.320	.295890	90961.3849	65735.4517	-.004011	708.0486	-991.3964
78.960	.273290	4.525E+05	60036.1624	-.003985	974.4374	-1029.6282
84.600	.250936	7.812E+05	54148.2244	-.003926	1216.6410	-1058.2931
90.240	.229005	1.076E+06	48127.9769	-.003837	1433.9496	-1076.5465
95.880	.207658	1.337E+06	42036.0202	-.003721	1625.9010	-1083.7218
101.520	.187037	1.562E+06	35864.6879	-.003581	1792.2969	-1104.6939
107.160	.167263	1.753E+06	29596.8175	-.003422	1932.6196	-1117.9552
112.800	.148440	1.908E+06	23278.3203	-.003246	2046.5362	-1122.6466
118.440	.130653	2.026E+06	16963.6174	-.003056	2133.9188	-1116.6097
124.080	.113964	2.109E+06	10959.3913	-.002858	2194.8951	-1012.5485
129.720	.098420	2.159E+06	5544.1630	-.002652	2231.8945	-907.7453
135.360	.084047	2.180E+06	718.1065	-.002444	2247.3677	-803.6223
141.000	.070857	2.175E+06	-3526.2857	-.002234	2243.7527	-701.4814
146.640	.058847	2.148E+06	-7203.5023	-.002026	2223.4440	-602.4962
152.280	.048002	2.101E+06	-10334.2738	-.001822	2188.7649	-507.7065
157.920	.038297	2.037E+06	-12944.8133	-.001623	2141.9425	-418.0167
163.560	.029697	1.960E+06	-15066.0518	-.001431	2085.0864	-334.1956
169.200	.022160	1.872E+06	-17875.6692	-.001246	2020.1701	-662.1227
174.840	.015639	1.762E+06	-21097.8854	-.001071	1939.5179	-480.5072
180.480	.010074	1.637E+06	-23349.7990	-9.080E-04	1847.3991	-318.0437
186.120	.005397	1.502E+06	-24740.0697	-7.570E-04	1747.6360	-174.9601
191.760	.001535	1.361E+06	-25377.4666	-6.193E-04	1643.5982	-51.0672
197.400	-.001588	1.218E+06	-25368.6892	-4.953E-04	1538.2056	54.1798
203.040	-.004051	1.076E+06	-24816.5342	-3.850E-04	1433.9418	141.6199
208.680	-.005931	9.390E+05	-23818.4096	-2.880E-04	1332.8725	212.3250
214.320	-.007300	8.084E+05	-22465.1883	-2.040E-04	1236.6709	267.5407
219.960	-.008232	6.862E+05	-20840.3876	-1.321E-04	1146.6463	308.6298
225.600	-.008791	5.737E+05	-19019.6533	-7.150E-05	1063.7758	337.0206
231.240	-.009038	4.719E+05	-17243.6986	-2.120E-05	988.7380	292.7505
236.880	-.009030	3.793E+05	-15575.4044	1.974E-05	920.5071	298.8431
242.520	-.008815	2.961E+05	-13892.3971	5.223E-05	859.2365	297.9680
248.160	-.008441	2.224E+05	-12230.8124	7.717E-05	804.9155	291.2465
253.800	-.007945	1.579E+05	-10620.6100	9.547E-05	757.3949	279.7473
259.440	-.007364	1.023E+05	-9085.9123	1.080E-04	716.4129	264.4718
265.080	-.006727	55090.1826	-7645.4121	1.156E-04	681.6177	246.3439
270.720	-.006060	15694.7741	-6312.8313	1.190E-04	652.5900	226.2025
276.360	-.005385	-16507.6927	-5097.4120	1.189E-04	653.1890	204.7973
282.000	-.004719	-42193.0429	-4004.4244	1.161E-04	672.1147	182.7870
287.640	-.004075	-62057.3744	-3035.6780	1.111E-04	686.7513	160.7401
293.280	-.003466	-76798.8624	-2190.0220	1.044E-04	697.6133	139.1379
298.920	-.002898	-87102.3466	-1463.8269	9.652E-05	705.2052	118.3781
304.560	-.002377	-93626.5649	-851.4372	8.783E-05	710.0124	98.7813
310.200	-.001907	-96993.8575	-345.5903	7.866E-05	712.4935	80.5970
315.840	-.001490	-97782.1308	62.2044	6.929E-05	713.0744	64.0111
321.480	-.001126	-96518.8524	381.3287	5.994E-05	712.1435	49.1535
327.120	-8.14E-04	-93676.8334	732.8739	5.080E-05	710.0495	75.5079

332.760	-5.53E-04	-88418.1989	1121.3038	4.204E-05	706.1747	62.2332
338.400	-3.39E-04	-81166.0396	1434.3805	3.388E-05	700.8311	48.7869
344.040	-1.70E-04	-72349.2185	1669.4623	2.650E-05	694.3347	34.5755
349.680	-4.06E-05	-62421.1824	1814.6065	2.001E-05	687.0194	16.8941
355.320	5.54E-05	-51945.9293	1806.7241	1.451E-05	679.3009	-19.6893
360.960	1.23E-04	-42088.8128	1668.3338	9.991E-06	672.0379	-29.3852
366.600	1.68E-04	-33159.8059	1488.6213	6.372E-06	665.4588	-34.3426
372.240	1.95E-04	-25318.0075	1287.4241	3.559E-06	659.6807	-37.0039
377.880	2.08E-04	-18649.3039	1075.2173	1.444E-06	654.7670	-38.2468
383.520	2.11E-04	-13194.2800	858.6806	-8.751E-08	650.7476	-38.5393
389.160	2.07E-04	-8963.0999	642.3451	-1.153E-06	647.6299	-38.1754
394.800	1.98E-04	-5944.8547	429.3592	-1.870E-06	645.4060	-37.3515
400.440	1.86E-04	-4113.8097	299.5438	-2.354E-06	644.0568	-8.6823
406.080	1.72E-04	-2558.2994	252.1273	-2.675E-06	642.9107	-8.1320
411.720	1.56E-04	-1261.0631	208.0599	-2.859E-06	641.9548	-7.4947
417.360	1.39E-04	-202.0322	167.7438	-2.929E-06	641.1745	-6.8018
423.000	1.23E-04	640.6687	131.4166	-2.908E-06	641.4977	-6.0802
428.640	1.07E-04	1289.8597	99.1757	-2.815E-06	641.9760	-5.3527
434.280	9.12E-05	1768.5801	71.0021	-2.668E-06	642.3288	-4.6379
439.920	7.66E-05	2099.4913	46.7820	-2.482E-06	642.5726	-3.9508
445.560	6.32E-05	2304.4001	26.3275	-2.270E-06	642.7236	-3.3026
451.200	5.10E-05	2403.8918	9.3952	-2.044E-06	642.7969	-2.7018
456.840	4.01E-05	2417.0631	-4.2975	-1.812E-06	642.8066	-2.1538
462.480	3.05E-05	2361.3430	-15.0575	-1.582E-06	642.7655	-1.6618
468.120	2.23E-05	2252.3894	-23.2039	-1.360E-06	642.6853	-1.2270
473.760	1.52E-05	2104.0522	-29.0571	-1.151E-06	642.5760	-.8486
479.400	9.29E-06	1928.3889	-32.9304	-9.566E-07	642.4465	-.5249
485.040	4.42E-06	1735.7261	-35.1230	-7.804E-07	642.3046	-.2526
490.680	4.85E-07	1534.7538	-35.9147	-6.230E-07	642.1565	-.028079
496.320	-2.61E-06	1332.6469	-35.5618	-4.851E-07	642.0076	.1532
501.960	-4.99E-06	1135.2035	-34.2952	-3.664E-07	641.8621	.2959
507.600	-6.75E-06	946.9954	-32.3184	-2.663E-07	641.7234	.4051
513.240	-7.99E-06	771.5230	-29.8072	-1.836E-07	641.5941	.4854
518.880	-8.82E-06	611.3708	-26.9103	-1.171E-07	641.4761	.5419
524.520	-9.31E-06	468.3584	-23.7500	-6.517E-08	641.3707	.5788
530.160	-9.55E-06	343.6842	-20.4243	-2.612E-08	641.2789	.6005
535.800	-9.61E-06	238.0575	-17.0088	1.866E-09	641.2010	.6107
541.440	-9.53E-06	151.8184	-13.5592	2.062E-08	641.1375	.6126
547.080	-9.37E-06	85.0425	-10.1139	3.201E-08	641.0883	.6091
552.720	-9.17E-06	37.6285	-6.6977	3.791E-08	641.0534	.6023
558.360	-8.95E-06	9.3686	-3.3242	4.017E-08	641.0325	.5939
564.000	-8.72E-06	0.0000	0.0000	4.062E-08	641.0256	.5849

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-7232050.040 lbs-in
Maximum shear force	=	124767.742 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6

Number of zero deflection points = 3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .600000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	-8.424E+06	1.417E+05	0.0000	6848.4406	-405.2299
5.640	.597715	-7.631E+06	1.391E+05	-7.722E-04	6263.7657	-508.7670
11.280	.591289	-6.852E+06	1.360E+05	-.001469	5690.1308	-603.5214
16.920	.581146	-6.092E+06	1.323E+05	-.002091	5129.8469	-696.0914
22.560	.567697	-5.353E+06	1.282E+05	-.002642	4585.1719	-776.5782
28.200	.551344	-4.638E+06	1.236E+05	-.003123	4058.0779	-847.3232
33.840	.532475	-3.948E+06	1.187E+05	-.003535	3550.3061	-902.5476
39.480	.511464	-3.287E+06	1.134E+05	-.003883	3063.2307	-951.8275
45.120	.488669	-2.656E+06	1.080E+05	-.004169	2598.0833	-991.0421
50.760	.464434	-2.056E+06	1.023E+05	-.004396	2155.8563	-1029.6855
56.400	.439082	-1.488E+06	96335.5690	-.004566	1737.5249	-1072.6895
62.040	.412924	-9.543E+05	90213.0491	-.004684	1344.1630	-1098.4168
67.680	.386247	-4.552E+05	84001.2797	-.004752	976.4354	-1104.3383
73.320	.359324	8803.7433	77769.3986	-.004773	647.5125	-1105.5486
78.960	.332406	4.376E+05	71403.8835	-.004752	963.4960	-1151.7263
84.600	.305725	8.298E+05	64806.9439	-.004691	1252.4343	-1187.6140
90.240	.279494	1.184E+06	58039.5172	-.004594	1513.4408	-1212.1827
95.880	.253905	1.499E+06	51167.8382	-.004465	1745.8986	-1224.5829
101.520	.229130	1.776E+06	44190.0673	-.004307	1949.4805	-1249.8039
107.160	.205319	2.012E+06	37094.4989	-.004125	2123.5634	-1266.3551
112.800	.182599	2.208E+06	29932.6584	-.003922	2267.7318	-1273.3047
118.440	.161077	2.363E+06	22759.6066	-.003702	2381.8003	-1270.3307
124.080	.140837	2.477E+06	15648.5888	-.003470	2465.8205	-1251.3068
129.720	.121940	2.550E+06	8948.3084	-.003228	2520.2253	-1124.6791
135.360	.104427	2.588E+06	2960.9636	-.002981	2547.9738	-998.4928
141.000	.088319	2.594E+06	-2320.4666	-.002731	2552.0194	-874.3548
146.640	.073617	2.571E+06	-6911.6409	-.002483	2535.2709	-753.7212
152.280	.060310	2.524E+06	-10835.9846	-.002238	2500.5586	-637.8900
157.920	.048373	2.456E+06	-14123.7898	-.001998	2450.6026	-527.9983
163.560	.037768	2.371E+06	-16811.3076	-.001766	2387.9866	-425.0222
169.200	.028449	2.272E+06	-20406.9447	-.001543	2315.1339	-850.0264
174.840	.020363	2.146E+06	-24568.3523	-.001330	2222.0947	-625.6500
180.480	.013441	1.999E+06	-27529.3435	-.001131	2114.1426	-424.3468
186.120	.007604	1.839E+06	-29421.1169	-9.465E-04	1996.0127	-246.4948
191.760	.002764	1.670E+06	-30375.5414	-7.777E-04	1871.8923	-91.9536
197.400	-.001169	1.499E+06	-30522.4400	-6.253E-04	1745.4230	39.8619
203.040	-.004289	1.328E+06	-29987.2927	-4.893E-04	1619.7142	149.9066
208.680	-.006688	1.162E+06	-28889.3619	-3.695E-04	1497.3649	239.4305

214.320	-.008457	1.004E+06	-27340.2326	-2.653E-04	1380.4928	309.9061
219.960	-.009681	8.547E+05	-25442.7513	-1.759E-04	1270.7679	362.9596
225.600	-.010441	7.172E+05	-23290.3407	-1.003E-04	1169.4511	400.3066
231.240	-.010813	5.923E+05	-21173.8333	-3.737E-05	1077.4337	350.2280
236.880	-.010863	4.784E+05	-19172.3781	1.414E-05	993.5563	359.5079
242.520	-.010653	3.760E+05	-17143.1275	5.523E-05	918.0497	360.0845
248.160	-.010240	2.849E+05	-15131.3067	8.702E-05	850.9392	353.3271
253.800	-.009672	2.050E+05	-13174.5892	1.106E-04	792.0771	340.5443
259.440	-.008992	1.359E+05	-11303.4902	1.270E-04	741.1730	322.9659
265.080	-.008239	77083.2560	-9541.8499	1.372E-04	697.8228	301.7292
270.720	-.007444	27835.6599	-7907.3807	1.423E-04	661.5358	277.8698
276.360	-.006635	-12577.3900	-6412.2591	1.430E-04	650.2930	252.3152
282.000	-.005831	-44962.4153	-5063.7404	1.402E-04	674.1553	225.8829
287.640	-.005053	-70155.1202	-3864.7798	1.347E-04	692.7180	199.2804
293.280	-.004312	-88997.7572	-2814.6447	1.270E-04	706.6018	173.1079
298.920	-.003620	-1.023E+05	-1909.5052	1.178E-04	716.4179	147.8636
304.560	-.002983	-1.109E+05	-1142.9912	1.076E-04	722.7565	123.9499
310.200	-.002406	-1.156E+05	-506.7106	9.669E-05	726.1771	101.6815
315.840	-.001892	-1.170E+05	9.2803	8.551E-05	727.2011	81.2940
321.480	-.001442	-1.157E+05	416.0561	7.432E-05	726.3061	62.9528
327.120	-.001054	-1.125E+05	835.9544	6.334E-05	723.9222	85.9474
332.760	-7.27E-04	-1.065E+05	1279.6969	5.280E-05	719.5108	71.4081
338.400	-4.58E-04	-98242.1827	1640.9805	4.295E-05	713.4133	56.7066
344.040	-2.43E-04	-88147.6716	1917.3379	3.399E-05	705.9754	41.2925
349.680	-7.48E-05	-76725.7939	2098.6491	2.606E-05	697.5594	23.0023
355.320	5.14E-05	-64560.1517	2110.3268	1.926E-05	688.5954	-18.8612
360.960	1.42E-04	-52984.3193	1968.1695	1.361E-05	680.0660	-31.5492
366.600	2.05E-04	-42403.7170	1772.4218	9.021E-06	672.2699	-37.8649
372.240	2.44E-04	-33020.9100	1548.9953	5.393E-06	665.3564	-41.3644
377.880	2.66E-04	-24948.6924	1310.6396	2.605E-06	659.4086	-43.1589
383.520	2.74E-04	-18245.4167	1065.3854	5.273E-07	654.4694	-43.8107
389.160	2.72E-04	-12932.8700	818.7089	-9.724E-07	650.5550	-43.6633
394.800	2.63E-04	-9007.1999	574.4768	-2.028E-06	647.6624	-42.9438
400.440	2.49E-04	-6446.1387	420.6501	-2.771E-06	645.7753	-11.6046
406.080	2.31E-04	-4253.2023	357.0257	-3.286E-06	644.1595	-10.9572
411.720	2.12E-04	-2408.1413	297.4346	-3.606E-06	642.8000	-10.1744
417.360	1.91E-04	-886.3445	242.5165	-3.764E-06	641.6787	-9.3001
423.000	1.69E-04	339.7593	192.6800	-3.791E-06	641.2760	-8.3724
428.640	1.48E-04	1299.4862	148.1349	-3.712E-06	641.9831	-7.4237
434.280	1.27E-04	2022.8630	108.9239	-3.552E-06	642.5161	-6.4809
439.920	1.08E-04	2539.7674	74.9528	-3.333E-06	642.8970	-5.5656
445.560	8.98E-05	2879.2321	46.0180	-3.072E-06	643.1471	-4.6949
451.200	7.32E-05	3068.8996	21.8324	-2.786E-06	643.2869	-3.8815
456.840	5.84E-05	3134.6151	2.0483	-2.487E-06	643.3353	-3.1342
462.480	4.52E-05	3100.1412	-13.7226	-2.188E-06	643.3099	-2.4583
468.120	3.37E-05	2986.9806	-25.8908	-1.895E-06	643.2265	-1.8566
473.760	2.38E-05	2814.2913	-34.8748	-1.616E-06	643.0993	-1.3292
479.400	1.55E-05	2598.8789	-41.0879	-1.355E-06	642.9406	-.8741
485.040	8.53E-06	2355.2540	-44.9285	-1.117E-06	642.7611	-.4879
490.680	2.86E-06	2095.7393	-46.7723	-9.030E-07	642.5698	-.1659
496.320	-1.66E-06	1830.6169	-46.9657	-7.142E-07	642.3745	.097344
501.960	-5.19E-06	1568.3030	-45.8224	-5.507E-07	642.1812	.3081
507.600	-7.87E-06	1315.5414	-43.6208	-4.120E-07	641.9950	.4727
513.240	-9.84E-06	1077.6081	-40.6024	-2.969E-07	641.8197	.5977
518.880	-1.12E-05	858.5175	-36.9724	-2.038E-07	641.6582	.6896
524.520	-1.21E-05	661.2265	-32.9003	-1.307E-07	641.5129	.7544
530.160	-1.27E-05	487.8296	-28.5223	-7.540E-08	641.3851	.7980

535.800	-1.30E-05	339.7413	-23.9436	-3.560E-08	641.2760	.8256
541.440	-1.31E-05	217.8617	-19.2417	-8.777E-09	641.1862	.8417
547.080	-1.31E-05	122.7236	-14.4700	7.604E-09	641.1161	.8504
552.720	-1.30E-05	54.6156	-9.6621	1.613E-08	641.0659	.8546
558.360	-1.29E-05	13.6828	-4.8362	1.942E-08	641.0357	.8567
564.000	-1.28E-05	0.0000	0.0000	2.008E-08	641.0256	.8582

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

```
Pile-head deflection             =      .60000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =   -8424496.611 lbs-in
Maximum shear force              =     141716.947 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              6
Number of zero deflection points =              3
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .700000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	-9.595E+06	1.582E+05	0.0000	7710.5830	-431.3590
5.640	.697397	-8.708E+06	1.555E+05	-8.803E-04	7057.4619	-542.0268
11.280	.690070	-7.838E+06	1.522E+05	-.001676	6416.0354	-643.5051
16.920	.678490	-6.986E+06	1.482E+05	-.002389	5788.7828	-742.8657
22.560	.663120	-6.158E+06	1.438E+05	-.003021	5178.1318	-829.5570
28.200	.644409	-5.354E+06	1.389E+05	-.003575	4586.2102	-905.5754
33.840	.622793	-4.579E+06	1.336E+05	-.004053	4014.8930	-964.9343
39.480	.598693	-3.834E+06	1.280E+05	-.004457	3465.6614	-1019.1936
45.120	.572512	-3.120E+06	1.222E+05	-.004792	2939.8734	-1063.9281
50.760	.544639	-2.440E+06	1.160E+05	-.005059	2438.6603	-1108.8840
56.400	.515443	-1.794E+06	1.097E+05	-.005263	1963.1546	-1159.3396
62.040	.485273	-1.186E+06	1.030E+05	-.005406	1514.6138	-1192.0312
67.680	.454460	-6.146E+05	96262.5135	-.005493	1093.8747	-1204.4583
73.320	.423313	-81795.2178	89446.7053	-.005526	701.2947	-1212.4949
78.960	.392122	4.124E+05	82457.5692	-.005511	944.9273	-1265.9221
84.600	.361154	8.664E+05	75196.5071	-.005449	1279.3792	-1308.9226
90.240	.330657	1.278E+06	67727.0673	-.005346	1583.0518	-1339.8149

95.880	.300853	1.648E+06	60120.4302	-.005205	1855.1733	-1357.5741
101.520	.271944	1.974E+06	52380.7923	-.005031	2095.2846	-1386.9783
107.160	.244105	2.255E+06	44502.2734	-.004827	2302.6588	-1406.8227
112.800	.217489	2.491E+06	36541.6003	-.004599	2476.7981	-1416.1110
118.440	.192226	2.682E+06	28559.3880	-.004350	2617.4574	-1414.4608
124.080	.168417	2.828E+06	20618.1152	-.004085	2724.6533	-1401.5934
129.720	.146143	2.928E+06	12864.5149	-.003808	2798.6704	-1347.9102
135.360	.125458	2.985E+06	5680.5906	-.003524	2840.7554	-1199.5807
141.000	.106393	3.004E+06	-672.4952	-.003236	2854.3782	-1053.2867
146.640	.088957	2.988E+06	-6211.1499	-.002948	2842.9656	-910.7753
152.280	.073142	2.943E+06	-10961.1225	-.002662	2809.8596	-773.6122
157.920	.058925	2.873E+06	-14956.4686	-.002383	2758.2802	-643.1773
163.560	.046266	2.783E+06	-18238.5021	-.002111	2691.2927	-520.6644
169.200	.035118	2.675E+06	-22665.7560	-.001848	2611.7792	-1049.2838
174.840	.025420	2.533E+06	-27827.2498	-.001598	2507.3623	-781.0332
180.480	.017097	2.366E+06	-31551.8883	-.001362	2384.3457	-539.7606
186.120	.010057	2.181E+06	-33993.3824	-.001143	2248.4037	-326.0175
191.760	.004201	1.986E+06	-35306.7963	-9.428E-04	2104.5675	-139.7321
197.400	-5.78E-04	1.786E+06	-35645.2754	-7.613E-04	1957.2260	19.7041
203.040	-.004387	1.587E+06	-35157.2677	-5.991E-04	1810.1393	153.3483
208.680	-.007335	1.392E+06	-33984.2414	-4.558E-04	1666.4628	262.6184
214.320	-.009529	1.205E+06	-32258.8950	-3.310E-04	1528.7802	349.2065
219.960	-.011069	1.029E+06	-30103.8404	-2.235E-04	1399.1428	414.9973
225.600	-.012050	8.660E+05	-27630.7325	-1.324E-04	1279.1129	461.9914
231.240	-.012562	7.176E+05	-25180.5011	-5.620E-05	1169.8109	406.8850
236.880	-.012684	5.821E+05	-22849.2815	6.316E-06	1069.9623	419.7886
242.520	-.012491	4.599E+05	-20474.9041	5.644E-05	979.8854	422.1891
248.160	-.012048	3.510E+05	-18112.0366	9.544E-05	899.6505	415.7071
253.800	-.011414	2.553E+05	-15806.3985	1.246E-04	829.1184	401.8951
259.440	-.010642	1.723E+05	-13595.2065	1.452E-04	767.9764	382.2155
265.080	-.009777	1.014E+05	-11507.7302	1.583E-04	715.7728	358.0243
270.720	-.008856	41968.1433	-9565.9272	1.652E-04	671.9490	330.5584
276.360	-.007913	-6999.7712	-7785.1341	1.669E-04	646.1833	300.9286
282.000	-.006973	-46394.1671	-6174.7888	1.643E-04	675.2102	270.1159
287.640	-.006059	-77188.9859	-4739.1631	1.584E-04	697.9007	238.9713
293.280	-.005187	-1.004E+05	-3478.0872	1.499E-04	714.9812	208.2188
298.920	-.004369	-1.169E+05	-2387.6511	1.394E-04	727.1698	178.4607
304.560	-.003614	-1.278E+05	-1460.8697	1.276E-04	735.1621	150.1852
310.200	-.002929	-1.338E+05	-688.3016	1.151E-04	739.6194	123.7751
315.840	-.002316	-1.359E+05	-58.6146	1.021E-04	741.1602	99.5181
321.480	-.001777	-1.348E+05	440.9070	8.906E-05	740.3526	77.6172
327.120	-.001312	-1.312E+05	930.0777	7.627E-05	737.7103	95.8476
332.760	-9.17E-04	-1.246E+05	1426.3969	6.397E-05	732.8062	80.1521
338.400	-5.90E-04	-1.153E+05	1833.7642	5.243E-05	726.0090	64.3044
344.040	-3.26E-04	-1.040E+05	2149.8675	4.188E-05	717.6913	47.7890
349.680	-1.18E-04	-91223.1193	2365.7625	3.248E-05	708.2415	28.7695
355.320	4.08E-05	-77468.5995	2399.5325	2.437E-05	698.1068	-16.7943
360.960	1.57E-04	-64236.1118	2258.7508	1.755E-05	688.3567	-33.1283
366.600	2.39E-04	-52047.3139	2050.1230	1.196E-05	679.3756	-40.8532
372.240	2.92E-04	-41149.8517	1807.4599	7.478E-06	671.3461	-45.1975
377.880	3.23E-04	-31683.6301	1545.9314	3.975E-06	664.3711	-47.5431
383.520	3.37E-04	-23724.7498	1274.9370	1.310E-06	658.5067	-48.5542
389.160	3.38E-04	-17306.6269	1000.8874	-6.634E-07	653.7777	-48.6265
394.800	3.30E-04	-12432.5705	728.3481	-2.094E-06	650.1863	-48.0186
400.440	3.14E-04	-9084.0108	551.5886	-3.129E-06	647.7190	-14.6621
406.080	2.94E-04	-6200.4168	470.9548	-3.864E-06	645.5943	-13.9314
411.720	2.71E-04	-3759.0007	394.9779	-4.343E-06	643.7954	-13.0108

417.360	2.45E-04	-1730.8602	324.5672	-4.607E-06	642.3010	-11.9575
423.000	2.19E-04	-82.8121	260.3292	-4.694E-06	641.0867	-10.8219
428.640	1.92E-04	1221.0087	202.6077	-4.639E-06	641.9253	-9.6467
434.280	1.66E-04	2217.7796	151.5247	-4.474E-06	642.6598	-8.4678
439.920	1.42E-04	2944.8427	107.0181	-4.226E-06	643.1955	-7.3146
445.560	1.19E-04	3438.7669	68.8780	-3.919E-06	643.5594	-6.2102
451.200	9.76E-05	3734.6054	36.7796	-3.574E-06	643.7774	-5.1722
456.840	7.85E-05	3865.3304	10.3129	-3.208E-06	643.8737	-4.2131
462.480	6.14E-05	3861.4290	-10.9903	-2.836E-06	643.8709	-3.3412
468.120	4.65E-05	3750.6386	-27.6334	-2.470E-06	643.7892	-2.5606
473.760	3.36E-05	3557.8057	-40.1349	-2.119E-06	643.6471	-1.8726
479.400	2.26E-05	3304.8475	-49.0122	-1.789E-06	643.4607	-1.2754
485.040	1.34E-05	3010.7998	-54.7670	-1.485E-06	643.2441	-.7653
490.680	5.82E-06	2691.9337	-57.8753	-1.211E-06	643.0091	-.3369
496.320	-2.81E-07	2361.9265	-58.7789	-9.676E-07	642.7660	.016497
501.960	-5.10E-06	2032.0725	-57.8794	-7.562E-07	642.5229	.3025
507.600	-8.81E-06	1711.5205	-55.5345	-5.762E-07	642.2867	.5291
513.240	-1.16E-05	1407.5284	-52.0559	-4.261E-07	642.0627	.7045
518.880	-1.36E-05	1125.7237	-47.7094	-3.043E-07	641.8551	.8369
524.520	-1.50E-05	870.3623	-42.7150	-2.083E-07	641.6669	.9342
530.160	-1.60E-05	644.5794	-37.2501	-1.354E-07	641.5006	1.0038
535.800	-1.66E-05	450.6244	-31.4516	-8.274E-08	641.3577	1.0525
541.440	-1.69E-05	290.0765	-25.4204	-4.711E-08	641.2394	1.0863
547.080	-1.71E-05	164.0365	-19.2260	-2.527E-08	641.1465	1.1103
552.720	-1.72E-05	73.2898	-12.9116	-1.385E-08	641.0796	1.1288
558.360	-1.72E-05	18.4386	-6.5001	-9.442E-09	641.0392	1.1448
564.000	-1.73E-05	0.0000	0.0000	-8.555E-09	641.0256	1.1602

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

```
Pile-head deflection             =      .70000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =   -9594567.661 lbs-in
Maximum shear force              =     158244.700 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              7
Number of zero deflection points =              3
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .800000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =      290000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	-1.075E+07	1.745E+05	0.0000	8561.0145	-457.4880
5.640	.797084	-9.771E+06	1.716E+05	-9.870E-04	7840.6034	-575.2881
11.280	.788867	-8.810E+06	1.680E+05	-.001881	7132.5433	-683.4957
16.920	.775870	-7.869E+06	1.639E+05	-.002683	6439.4818	-789.6575
22.560	.758603	-6.953E+06	1.592E+05	-.003396	5764.0161	-882.5702
28.200	.737564	-6.063E+06	1.540E+05	-.004022	5108.4303	-963.8857
33.840	.713236	-5.203E+06	1.483E+05	-.004564	4474.7334	-1027.4096
39.480	.686085	-4.375E+06	1.424E+05	-.005024	3864.5139	-1086.6889
45.120	.656560	-3.581E+06	1.361E+05	-.005407	3279.2573	-1136.9957
50.760	.625092	-2.822E+06	1.295E+05	-.005715	2720.2348	-1188.3311
56.400	.592094	-2.101E+06	1.227E+05	-.005952	2188.7376	-1246.3251
62.040	.557956	-1.418E+06	1.155E+05	-.006121	1686.2085	-1286.0846
67.680	.523048	-7.772E+05	1.082E+05	-.006227	1213.6585	-1304.9690
73.320	.487719	-1.772E+05	1.008E+05	-.006273	771.6046	-1318.5641
78.960	.452293	3.808E+05	93238.2962	-.006263	921.6163	-1376.2085
84.600	.417074	8.950E+05	85341.7681	-.006201	1300.4859	-1423.9788
90.240	.382341	1.364E+06	77206.5037	-.006093	1645.8761	-1460.8667
95.880	.348348	1.786E+06	68901.8103	-.005941	1956.8681	-1484.0600
101.520	.315323	2.160E+06	60437.1955	-.005751	2232.8693	-1517.5765
107.160	.283471	2.486E+06	51812.8500	-.005528	2473.0507	-1540.7020
112.800	.252967	2.763E+06	43090.3508	-.005276	2676.8326	-1552.3828
118.440	.223963	2.990E+06	34335.4912	-.004999	2843.9089	-1552.1774
124.080	.196581	3.167E+06	25616.2351	-.004703	2974.2584	-1539.7574
129.720	.170916	3.294E+06	17002.0945	-.004392	3068.1516	-1514.9023
135.360	.147039	3.373E+06	8765.3478	-.004071	3126.1562	-1405.9298
141.000	.124992	3.406E+06	1311.1001	-.003745	3150.8173	-1237.4205
146.640	.104793	3.400E+06	-5204.0333	-.003418	3146.0806	-1072.9105
152.280	.086438	3.359E+06	-10807.7960	-.003093	3115.8025	-914.2393
157.920	.069906	3.288E+06	-15537.7126	-.002773	3063.7070	-763.0361
163.560	.055157	3.192E+06	-19439.9019	-.002461	2993.3460	-620.7190
169.200	.042141	3.077E+06	-24680.2037	-.002160	2908.0663	-1237.5441
174.840	.030794	2.921E+06	-30838.2081	-.001871	2793.4241	-946.1454
180.480	.021032	2.735E+06	-35378.8037	-.001599	2656.2672	-663.9949
186.120	.012753	2.527E+06	-38417.1417	-.001346	2503.2304	-413.4300
191.760	.005846	2.306E+06	-40131.4157	-.001114	2340.2106	-194.4686
197.400	1.90E-04	2.078E+06	-40698.1375	-9.029E-04	2172.3653	-6.4966
203.040	-.004338	1.850E+06	-40288.8589	-7.139E-04	2004.1269	151.6308
208.680	-.007863	1.626E+06	-39067.4673	-5.467E-04	1839.2279	281.4868
214.320	-.010505	1.411E+06	-37188.0491	-4.006E-04	1680.7380	384.9736
219.960	-.012382	1.208E+06	-34793.3019	-2.747E-04	1531.1076	464.2276
225.600	-.013603	1.019E+06	-32013.4661	-1.675E-04	1392.2178	521.5298
231.240	-.014271	8.474E+05	-29239.1829	-7.773E-05	1265.4336	462.2586
236.880	-.014480	6.899E+05	-26584.2124	-3.783E-06	1149.3857	479.2203
242.520	-.014314	5.476E+05	-23868.4282	5.574E-05	1044.4898	483.8237
248.160	-.013851	4.205E+05	-21156.2482	1.023E-04	950.8705	477.9422
253.800	-.013160	3.086E+05	-18501.7343	1.374E-04	868.4045	463.3748
259.440	-.012302	2.114E+05	-15949.0858	1.624E-04	796.7635	441.8197
265.080	-.011328	1.282E+05	-13533.2641	1.787E-04	735.4534	414.8547
270.720	-.010286	58122.3498	-11280.7130	1.877E-04	683.8519	383.9223
276.360	-.009212	293.8108	-9210.1487	1.905E-04	641.2421	350.3204
282.000	-.008137	-46391.2230	-7333.3878	1.883E-04	675.2080	315.1977
287.640	-.007088	-83042.6455	-5656.1914	1.820E-04	702.2139	279.5528
293.280	-.006084	-1.108E+05	-4179.1034	1.727E-04	722.6579	244.2373

298.920	-.005140	-1.307E+05	-2898.2631	1.611E-04	737.3645	209.9614
304.560	-.004267	-1.440E+05	-1806.1798	1.479E-04	747.1349	177.3022
310.200	-.003472	-1.516E+05	-892.4543	1.337E-04	752.7329	146.7139
315.840	-.002759	-1.545E+05	-144.4420	1.189E-04	754.8746	118.5387
321.480	-.002130	-1.536E+05	452.1521	1.041E-04	754.2201	93.0195
327.120	-.001584	-1.498E+05	1011.5752	8.953E-05	751.3675	105.3575
332.760	-.001120	-1.425E+05	1558.5313	7.547E-05	746.0282	88.5986
338.400	-7.33E-04	-1.324E+05	2010.5650	6.224E-05	738.5958	71.6970
344.040	-4.18E-04	-1.200E+05	2365.5027	5.010E-05	729.4676	54.1674
349.680	-1.68E-04	-1.059E+05	2615.2724	3.923E-05	719.0559	34.4034
355.320	2.45E-05	-90658.5406	2676.0565	2.978E-05	707.8255	-12.8487
360.960	1.68E-04	-75811.5157	2543.4057	2.177E-05	696.8858	-34.1906
366.600	2.70E-04	-62040.1513	2324.5463	1.514E-05	686.7386	-43.4191
372.240	3.39E-04	-49640.1700	2064.9395	9.772E-06	677.6020	-48.6400
377.880	3.80E-04	-38779.5987	1782.3881	5.519E-06	669.5996	-51.5555
383.520	4.01E-04	-29552.8860	1487.7066	2.232E-06	662.8011	-52.9415
389.160	4.06E-04	-22005.5703	1188.2518	-2.477E-07	657.2400	-53.2482
394.800	3.98E-04	-16148.5949	889.2899	-2.083E-06	652.9244	-52.7667
400.440	3.82E-04	-11967.5662	690.2352	-3.435E-06	649.8437	-17.8201
406.080	3.59E-04	-8351.5041	591.9912	-4.413E-06	647.1793	-17.0182
411.720	3.32E-04	-5275.4716	498.9734	-5.068E-06	644.9128	-15.9668
417.360	3.02E-04	-2706.5055	412.3876	-5.452E-06	643.0199	-14.7374
423.000	2.71E-04	-605.9054	333.0593	-5.611E-06	641.4721	-13.3931
428.640	2.39E-04	1068.7594	261.4846	-5.589E-06	641.8131	-11.9880
434.280	2.08E-04	2361.9235	197.8783	-5.424E-06	642.7660	-10.5674
439.920	1.78E-04	3318.5698	142.2216	-5.151E-06	643.4709	-9.1690
445.560	1.50E-04	3983.0325	94.3059	-4.800E-06	643.9605	-7.8224
451.200	1.24E-04	4398.0403	53.7737	-4.396E-06	644.2662	-6.5507
456.840	1.00E-04	4603.9811	20.1560	-3.963E-06	644.4180	-5.3705
462.480	7.89E-05	4638.3657	-7.0944	-3.519E-06	644.4433	-4.2928
468.120	6.03E-05	4535.4677	-28.5741	-3.078E-06	644.3675	-3.3241
473.760	4.42E-05	4326.1177	-44.9036	-2.651E-06	644.2133	-2.4665
479.400	3.04E-05	4037.6283	-56.7063	-2.249E-06	644.0007	-1.7188
485.040	1.88E-05	3693.8278	-64.5908	-1.877E-06	643.7474	-1.0771
490.680	9.24E-06	3315.1845	-69.1372	-1.540E-06	643.4684	-.5351
496.320	1.45E-06	2918.9987	-70.8859	-1.240E-06	643.1764	-.085022
501.960	-4.75E-06	2519.6492	-70.3303	-9.787E-07	642.8822	.2820
507.600	-9.59E-06	2128.8750	-67.9112	-7.551E-07	642.5943	.5758
513.240	-1.33E-05	1756.0814	-64.0140	-5.683E-07	642.3196	.8062
518.880	-1.60E-05	1408.6557	-58.9679	-4.160E-07	642.0636	.9832
524.520	-1.80E-05	1092.2839	-53.0465	-2.958E-07	641.8305	1.1166
530.160	-1.93E-05	811.2585	-46.4701	-2.042E-07	641.6234	1.2155
535.800	-2.03E-05	568.7696	-39.4093	-1.378E-07	641.4447	1.2883
541.440	-2.09E-05	367.1725	-31.9899	-9.280E-08	641.2962	1.3427
547.080	-2.13E-05	208.2272	-24.2981	-6.512E-08	641.1791	1.3849
552.720	-2.16E-05	93.3030	-16.3872	-5.062E-08	641.0944	1.4204
558.360	-2.19E-05	23.5455	-8.2846	-4.500E-08	641.0430	1.4529
564.000	-2.21E-05	0.0000	0.0000	-4.387E-08	641.0256	1.4849

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection = .80000000 in

Computed slope at pile head = 0.000
Maximum bending moment = -10748744.852 lbs-in
Maximum shear force = 174494.417 lbs
Depth of maximum bending moment = 0.000 in
Depth of maximum shear force = 0.000 in
Number of iterations = 7
Number of zero deflection points = 3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = .900000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	-1.189E+07	1.905E+05	0.0000	9402.0912	-483.6171
5.640	.896774	-1.082E+07	1.875E+05	-.001092	8615.2408	-608.5506
11.280	.887677	-9.772E+06	1.837E+05	-.002083	7841.3991	-723.4916
16.920	.873278	-8.743E+06	1.793E+05	-.002974	7083.3819	-836.4630
22.560	.854135	-7.740E+06	1.743E+05	-.003766	6343.9562	-935.6105
28.200	.830793	-6.765E+06	1.688E+05	-.004464	5625.5624	-1022.2421
33.840	.803781	-5.821E+06	1.628E+05	-.005069	4930.3438	-1089.9554
39.480	.773610	-4.912E+06	1.565E+05	-.005586	4259.9969	-1154.2873
45.120	.740775	-4.038E+06	1.498E+05	-.006016	3616.1351	-1210.2089
50.760	.705749	-3.202E+06	1.428E+05	-.006364	3000.1704	-1267.9792
56.400	.668985	-2.406E+06	1.355E+05	-.006634	2413.5537	-1333.5835
62.040	.630917	-1.652E+06	1.279E+05	-.006829	1857.9150	-1380.4979
67.680	.591952	-9.411E+05	1.200E+05	-.006954	1334.4412	-1405.9425
73.320	.552477	-2.752E+05	1.120E+05	-.007012	843.8112	-1425.2140
78.960	.512853	3.454E+05	1.038E+05	-.007009	895.4976	-1487.1444
84.600	.473416	9.186E+05	95268.2512	-.006948	1317.8589	-1538.2200
90.240	.434477	1.443E+06	86481.2895	-.006835	1704.0606	-1577.7238
95.880	.396321	1.916E+06	77505.6831	-.006673	2053.1160	-1605.1153
101.520	.359205	2.339E+06	68346.8691	-.006468	2364.3281	-1642.6911
107.160	.323358	2.709E+06	59007.6233	-.006226	2636.7672	-1669.0982
112.800	.288980	3.025E+06	49554.0494	-.005950	2869.7717	-1683.2330
118.440	.256244	3.287E+06	40056.7668	-.005646	3062.9734	-1684.5977
124.080	.225291	3.495E+06	30588.8604	-.005320	3216.3101	-1672.8159
129.720	.196234	3.649E+06	21225.2059	-.004976	3330.0337	-1647.6290
135.360	.169157	3.751E+06	12041.8314	-.004620	3404.7167	-1608.8868
141.000	.144115	3.800E+06	3481.3709	-.004257	3441.2553	-1426.7375
146.640	.121135	3.804E+06	-4039.4695	-.003892	3443.9132	-1240.2272
152.280	.100219	3.768E+06	-10526.0911	-.003527	3417.0613	-1059.9932
157.920	.081347	3.697E+06	-16019.1913	-.003168	3364.9283	-887.9147
163.560	.064480	3.597E+06	-20569.4012	-.002817	3291.5555	-725.6349
169.200	.049566	3.474E+06	-26467.4608	-.002477	3200.7580	-1365.8756
174.840	.036536	3.307E+06	-33484.8484	-.002151	3077.5442	-1122.5598

180.480	.025300	3.103E+06	-38902.9222	-.001843	2927.6361	-798.7430
186.120	.015748	2.874E+06	-42594.9765	-.001555	2758.6471	-510.4961
191.760	.007755	2.628E+06	-44762.0041	-.001291	2577.3598	-257.9534
197.400	.001188	2.373E+06	-45603.6961	-.001050	2389.7218	-40.5190
203.040	-.004091	2.117E+06	-45314.6492	-8.342E-04	2200.8591	143.0179
208.680	-.008222	1.865E+06	-44081.2213	-6.427E-04	2015.1029	294.3679
214.320	-.011341	1.622E+06	-42079.0310	-4.750E-04	1836.0301	415.6286
219.960	-.013581	1.392E+06	-39471.0822	-3.301E-04	1666.5108	509.1759
225.600	-.015065	1.178E+06	-36406.4813	-2.065E-04	1508.7644	577.5620
231.240	-.015910	9.818E+05	-33324.5402	-1.026E-04	1364.4185	515.3249
236.880	-.016222	8.021E+05	-30357.3175	-1.682E-05	1232.0371	536.8818
242.520	-.016099	6.394E+05	-27308.7522	5.252E-05	1112.1462	544.1698
248.160	-.015630	4.939E+05	-24253.3260	1.070E-04	1004.9356	539.3147
253.800	-.014892	3.655E+05	-21253.7567	1.484E-04	910.3084	524.3624
259.440	-.013956	2.537E+05	-18361.5335	1.781E-04	827.9289	501.2487
265.080	-.012883	1.578E+05	-15617.6053	1.979E-04	757.2683	471.7755
270.720	-.011724	76844.7722	-13053.1836	2.092E-04	697.6471	437.5939
276.360	-.010523	9836.4311	-10690.6264	2.134E-04	648.2734	400.1924
282.000	-.009317	-44443.4987	-8544.3714	2.117E-04	673.7729	360.8910
287.640	-.008135	-87236.6377	-6621.8899	2.054E-04	705.3041	320.8400
293.280	-.007000	-1.198E+05	-4924.6375	1.954E-04	729.3053	281.0225
298.920	-.005930	-1.434E+05	-3448.9793	1.828E-04	746.7060	242.2605
304.560	-.004939	-1.593E+05	-2187.0729	1.682E-04	758.4118	205.2240
310.200	-.004033	-1.686E+05	-1127.6954	1.524E-04	765.2891	170.4418
315.840	-.003219	-1.725E+05	-257.0036	1.360E-04	768.1520	138.3142
321.480	-.002499	-1.720E+05	440.7801	1.194E-04	767.7530	109.1269
327.120	-.001872	-1.680E+05	1071.4394	1.031E-04	764.7763	114.5112
332.760	-.001336	-1.602E+05	1667.2038	8.731E-05	759.0963	96.7528
338.400	-8.87E-04	-1.494E+05	2162.4162	7.241E-05	751.1299	78.8544
344.040	-5.19E-04	-1.361E+05	2554.9796	5.868E-05	741.2980	60.3525
349.680	-2.25E-04	-1.208E+05	2837.3963	4.632E-05	730.0358	39.7953
355.320	3.38E-06	-1.042E+05	2937.6185	3.550E-05	717.8269	-4.2555
360.960	1.75E-04	-87781.4520	2827.0952	2.626E-05	705.7056	-34.9371
366.600	3.00E-04	-72428.3561	2599.6086	1.856E-05	694.3930	-45.7319
372.240	3.85E-04	-58518.5764	2324.4622	1.226E-05	684.1438	-51.8378
377.880	4.38E-04	-46248.5286	2022.2678	7.221E-06	675.1029	-55.3234
383.520	4.66E-04	-35731.0183	1705.2800	3.278E-06	667.3533	-57.0837
389.160	4.75E-04	-27023.6944	1381.8002	2.598E-07	660.9375	-57.6255
394.800	4.69E-04	-20145.1625	1057.7865	-2.009E-06	655.8692	-57.2730
400.440	4.52E-04	-15085.2907	836.7841	-3.703E-06	652.1409	-21.0967
406.080	4.27E-04	-10694.1232	720.2351	-4.943E-06	648.9054	-20.2327
411.720	3.97E-04	-6944.8678	609.4446	-5.792E-06	646.1428	-19.0547
417.360	3.62E-04	-3800.6414	505.9388	-6.309E-06	643.8261	-17.6495
423.000	3.25E-04	-1217.2408	410.7832	-6.550E-06	641.9225	-16.0936
428.640	2.88E-04	854.4201	324.6419	-6.567E-06	641.6552	-14.4530
434.280	2.51E-04	2466.2034	247.8355	-6.408E-06	642.8428	-12.7833
439.920	2.16E-04	3670.9657	180.3975	-6.113E-06	643.7305	-11.1308
445.560	1.82E-04	4521.0827	122.1270	-5.719E-06	644.3569	-9.5325
451.200	1.51E-04	5067.2642	72.6378	-5.257E-06	644.7593	-8.0169
456.840	1.23E-04	5357.6350	31.4037	-4.756E-06	644.9733	-6.6052
462.480	9.76E-05	5437.0554	-2.2019	-4.237E-06	645.0318	-5.3117
468.120	7.52E-05	5346.6572	-28.8699	-3.718E-06	644.9652	-4.1450
473.760	5.57E-05	5123.5658	-49.3253	-3.214E-06	644.8008	-3.1087
479.400	3.90E-05	4800.7831	-64.3010	-2.737E-06	644.5630	-2.2019
485.040	2.48E-05	4407.2046	-74.5160	-2.294E-06	644.2730	-1.4205
490.680	1.31E-05	3967.7469	-80.6587	-1.891E-06	643.9492	-.7577
496.320	3.49E-06	3503.5617	-83.3725	-1.532E-06	643.6072	-.2046

501.960	-4.20E-06	3032.3164	-83.2467	-1.218E-06	643.2599	.2492
507.600	-1.02E-05	2568.5218	-80.8092	-9.483E-07	642.9182	.6151
513.240	-1.49E-05	2123.8905	-76.5226	-7.226E-07	642.5906	.9049
518.880	-1.84E-05	1707.7101	-70.7829	-5.383E-07	642.2839	1.1304
524.520	-2.10E-05	1327.2202	-63.9197	-3.923E-07	642.0036	1.3033
530.160	-2.28E-05	987.9794	-56.1989	-2.809E-07	641.7536	1.4346
535.800	-2.41E-05	694.2158	-47.8267	-2.000E-07	641.5372	1.5343
541.440	-2.51E-05	449.1491	-38.9548	-1.450E-07	641.3566	1.6117
547.080	-2.58E-05	255.2806	-29.6871	-1.111E-07	641.2137	1.6747
552.720	-2.63E-05	114.6420	-20.0875	-9.335E-08	641.1101	1.7294
558.360	-2.68E-05	28.9984	-10.1884	-8.644E-08	641.0470	1.7809
564.000	-2.73E-05	0.0000	0.0000	-8.505E-08	641.0256	1.8320

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	0.000
Maximum bending moment	=	-11890226.136 lbs-in
Maximum shear force	=	190539.636 lbs
Depth of maximum bending moment	=	0.000 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	-1.301E+07	2.055E+05	0.0000	10227.1317	-483.6171
5.640	.996471	-1.186E+07	2.024E+05	-.001196	9377.9098	-609.6268
11.280	.986508	-1.072E+07	1.987E+05	-.002282	8541.6019	-728.4796
16.920	.970728	-9.609E+06	1.942E+05	-.003260	7721.1252	-849.3031
22.560	.949735	-8.521E+06	1.891E+05	-.004132	6919.4407	-961.0752
28.200	.924119	-7.462E+06	1.834E+05	-.004901	6139.2942	-1065.5621
33.840	.894454	-6.436E+06	1.772E+05	-.005569	5383.2575	-1152.5892
39.480	.861297	-5.446E+06	1.705E+05	-.006141	4653.4894	-1222.0100
45.120	.825186	-4.493E+06	1.634E+05	-.006619	3951.7317	-1283.5922
50.760	.786637	-3.581E+06	1.560E+05	-.007007	3279.5382	-1347.8558
56.400	.746145	-2.711E+06	1.482E+05	-.007310	2638.5210	-1421.1457

62.040	.704182	-1.886E+06	1.400E+05	-.007531	2030.4986	-1475.3043
67.680	.661196	-1.107E+06	1.316E+05	-.007675	1456.8362	-1507.4131
73.320	.617610	-3.764E+05	1.230E+05	-.007746	918.3765	-1532.4790
78.960	.573819	3.057E+05	1.142E+05	-.007750	866.2595	-1598.8240
84.600	.530194	9.369E+05	1.050E+05	-.007690	1331.3352	-1653.3456
90.240	.487078	1.515E+06	95563.6494	-.007572	1757.5507	-1695.2568
95.880	.444783	2.040E+06	85921.3974	-.007401	2143.8567	-1723.9815
101.520	.403595	2.509E+06	76087.2559	-.007182	2489.5192	-1763.3027
107.160	.363768	2.921E+06	66058.5340	-.006921	2793.5621	-1792.9817
112.800	.325527	3.276E+06	55899.1794	-.006623	3055.2420	-1809.6264
118.440	.289063	3.574E+06	45684.3124	-.006293	3274.1276	-1812.6669
124.080	.254537	3.812E+06	35491.8594	-.005938	3450.1131	-1801.6782
129.720	.222081	3.993E+06	25401.7871	-.005563	3583.4286	-1776.3616
135.360	.191790	4.117E+06	15495.4131	-.005173	3674.6462	-1736.5370
141.000	.163734	4.185E+06	6027.2597	-.004773	3724.6852	-1620.9642
146.640	.137948	4.201E+06	-2526.7300	-.004370	3736.2465	-1412.3654
152.280	.114441	4.171E+06	-9922.9863	-.003967	3714.2174	-1210.4205
157.920	.093197	4.102E+06	-16205.0624	-.003569	3663.3346	-1017.2661
163.560	.074179	4.000E+06	-21427.8263	-.003180	3588.1333	-834.7779
169.200	.057330	3.870E+06	-27990.0247	-.002801	3492.9027	-1492.2428
174.840	.042582	3.693E+06	-35887.6390	-.002437	3362.2478	-1308.3297
180.480	.029837	3.474E+06	-42233.5374	-.002093	3200.4997	-941.9889
186.120	.018977	3.224E+06	-46624.7482	-.001771	3016.2704	-615.1780
191.760	.009866	2.953E+06	-49284.9841	-.001473	2817.2487	-328.1680
197.400	.002357	2.672E+06	-50437.1433	-.001203	2610.1929	-80.3991
203.040	-.003702	2.389E+06	-50298.9860	-9.594E-04	2400.9429	129.3910
208.680	-.008465	2.108E+06	-49079.5347	-7.431E-04	2194.4486	303.0385
214.320	-.012084	1.837E+06	-46976.1953	-5.533E-04	1994.8127	442.8265
219.960	-.014706	1.580E+06	-44172.5797	-3.889E-04	1805.3428	551.3634
225.600	-.016471	1.340E+06	-40836.9949	-2.485E-04	1628.6127	631.4681
231.240	-.017508	1.120E+06	-37457.0191	-1.301E-04	1466.5277	567.1049
236.880	-.017938	9.182E+05	-34183.6226	-3.205E-05	1317.6047	593.6740
242.520	-.017870	7.349E+05	-30806.1539	4.746E-05	1182.4900	604.0100
248.160	-.017403	5.706E+05	-27409.4573	1.103E-04	1061.4470	600.4923
253.800	-.016626	4.253E+05	-24065.1960	1.582E-04	954.4124	585.4160
259.440	-.015619	2.986E+05	-20832.4250	1.930E-04	861.0496	560.9568
265.080	-.014449	1.897E+05	-17758.3402	2.165E-04	780.7999	529.1442
270.720	-.013177	97586.9521	-14879.1612	2.303E-04	712.9306	491.8413
276.360	-.011852	21106.7960	-12221.1080	2.360E-04	656.5777	450.7308
282.000	-.010515	-41039.1147	-9801.4382	2.350E-04	671.2645	407.3081
287.640	-.009201	-90222.2597	-7629.5108	2.287E-04	707.5040	362.8789
293.280	-.007935	-1.278E+05	-5707.8492	2.182E-04	735.2279	318.5614
298.920	-.006739	-1.553E+05	-4033.1792	2.046E-04	755.4704	275.2932
304.560	-.005627	-1.740E+05	-2597.4229	1.888E-04	769.2426	233.8403
310.200	-.004610	-1.852E+05	-1388.6305	1.715E-04	777.5137	194.8095
315.840	-.003693	-1.902E+05	-391.8403	1.534E-04	781.1974	158.6622
321.480	-.002879	-1.902E+05	410.1440	1.351E-04	781.1403	125.7294
327.120	-.002168	-1.861E+05	1112.2900	1.170E-04	778.1143	123.2585
332.760	-.001559	-1.780E+05	1754.6325	9.953E-05	772.1777	104.5225
338.400	-.001046	-1.666E+05	2290.8745	8.295E-05	763.7706	85.6343
344.040	-6.23E-04	-1.524E+05	2718.8701	6.761E-05	753.3372	66.1372
349.680	-2.83E-04	-1.361E+05	3031.2982	5.373E-05	741.3359	44.6529
355.320	-1.71E-05	-1.184E+05	3189.5639	4.149E-05	728.2722	11.4698
360.960	1.85E-04	-1.003E+05	3120.8831	3.097E-05	714.9260	-35.8247
366.600	3.32E-04	-83305.9208	2884.1359	2.214E-05	702.4079	-48.1282
372.240	4.34E-04	-67834.5170	2593.1105	1.487E-05	691.0081	-55.0722
377.880	5.00E-04	-54104.2660	2271.1644	9.002E-06	680.8912	-59.0930

383.520	5.36E-04	-42245.2278	1931.9357	4.367E-06	672.1532	-61.2008
389.160	5.49E-04	-32326.3172	1584.6314	7.805E-07	664.8446	-61.9567
394.800	5.45E-04	-24373.1392	1235.8730	-1.947E-06	658.9845	-61.7164
400.440	5.27E-04	-18379.3013	992.4780	-4.003E-06	654.5680	-24.5939
406.080	5.00E-04	-13164.8925	856.4010	-5.520E-06	650.7259	-23.6604
411.720	4.65E-04	-8701.0407	726.6661	-6.572E-06	647.4368	-22.3449
417.360	4.26E-04	-4946.6007	605.1381	-7.228E-06	644.6704	-20.7502
423.000	3.83E-04	-1851.4371	493.1353	-7.555E-06	642.3898	-18.9671
428.640	3.40E-04	640.6811	391.4984	-7.614E-06	641.4977	-17.0743
434.280	2.98E-04	2589.5711	300.6586	-7.458E-06	642.9337	-15.1384
439.920	2.56E-04	4056.5070	220.7029	-7.139E-06	644.0146	-13.2147
445.560	2.17E-04	5102.4517	151.4372	-6.698E-06	644.7853	-11.3477
451.200	1.81E-04	5786.6288	92.4433	-6.174E-06	645.2894	-9.5722
456.840	1.47E-04	6165.4090	43.1325	-5.599E-06	645.5685	-7.9139
462.480	1.17E-04	6291.4804	2.7933	-5.000E-06	645.6614	-6.3908
468.120	9.10E-05	6213.2742	-29.3669	-4.399E-06	645.6038	-5.0136
473.760	6.79E-05	5974.6112	-54.1848	-3.813E-06	645.4279	-3.7871
479.400	4.80E-05	5614.5414	-72.5103	-3.255E-06	645.1626	-2.7113
485.040	3.11E-05	5167.3433	-85.1806	-2.737E-06	644.8331	-1.7817
490.680	1.71E-05	4662.6562	-92.9992	-2.264E-06	644.4612	-.9908
496.320	5.60E-06	4125.7177	-96.7196	-1.841E-06	644.0656	-.3285
501.960	-3.66E-06	3577.6817	-97.0331	-1.471E-06	643.6618	.2173
507.600	-1.10E-05	3035.9950	-94.5603	-1.152E-06	643.2627	.6596
513.240	-1.67E-05	2514.8114	-89.8461	-8.854E-07	642.8786	1.0121
518.880	-2.10E-05	2025.4273	-83.3575	-6.670E-07	642.5180	1.2888
524.520	-2.42E-05	1576.7213	-75.4837	-4.938E-07	642.1874	1.5033
530.160	-2.65E-05	1175.5864	-66.5392	-3.614E-07	641.8918	1.6685
535.800	-2.83E-05	827.3417	-56.7677	-2.651E-07	641.6353	1.7965
541.440	-2.95E-05	536.1139	-46.3488	-1.995E-07	641.4207	1.8981
547.080	-3.05E-05	305.1803	-35.4051	-1.590E-07	641.2505	1.9826
552.720	-3.13E-05	137.2642	-24.0118	-1.377E-07	641.1268	2.0576
558.360	-3.21E-05	34.7772	-12.2064	-1.295E-07	641.0513	2.1288
564.000	-3.28E-05	0.0000	0.0000	-1.278E-07	641.0256	2.1997

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     1.00000000 in
Computed slope at pile head      =          0.000
Maximum bending moment           =  -13009943.561 lbs-in
Maximum shear force              =     205532.609 lbs
Depth of maximum bending moment  =          0.000 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              7
Number of zero deflection points =              3
```

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .100000	S= 0.000	2.900E+05	.100000	-1.711E+06	34107.5954
5	y= .200000	S= 0.000	2.900E+05	.2000	-3.382E+06	67212.3567
5	y= .300000	S= 0.000	2.900E+05	.3000	-4.733E+06	88298.0984
5	y= .400000	S= 0.000	2.900E+05	.4000	-6.007E+06	1.071E+05
5	y= .500000	S= 0.000	2.900E+05	.5000	-7.232E+06	1.248E+05
5	y= .600000	S= 0.000	2.900E+05	.6000	-8.424E+06	1.417E+05
5	y= .700000	S= 0.000	2.900E+05	.7000	-9.595E+06	1.582E+05
5	y= .800000	S= 0.000	2.900E+05	.8000	-1.075E+07	1.745E+05
5	y= .900000	S= 0.000	2.900E+05	.9000	-1.189E+07	1.905E+05
5	y= 1.000	S= 0.000	2.900E+05	1.0000	-1.301E+07	2.055E+05

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = .10000 in
Slope = .00000
Axial Load = 290000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
564.000	.10000000	-1711057.100	34107.595
535.800	.10000000	-1710724.677	34109.042
507.600	.10000000	-1710725.972	34112.612
479.400	.10000000	-1710988.289	34118.474
451.200	.10000000	-1711495.956	34125.437
423.000	.10000000	-1712297.210	34134.005
394.800	.10000000	-1712341.252	34137.415
366.600	.10000000	-1712801.173	34143.648
338.400	.10000000	-1712653.905	34143.189
310.200	.10000000	-1712468.347	34141.591

The analysis ended normally.

==========

LPILE Plus for Windows, Version 4.0

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

Mano
URS

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\RW400N-Type B\
Name of input data file: RW400N-Type B_CIDH 24_ Free.lpd
Name of output file: RW400N-Type B_CIDH 24_ Free.lpo
Name of plot output file: RW400N-Type B_CIDH 24_ Free.lpp
Name of runtime file: RW400N-Type B_CIDH 24_ Free.lpr

Time and Date of Analysis

Date: April 23, 2009 Time: 13:37:38

Problem Title

Route 84 Widening_Retaining Wall 400N-Type B - 24 inch CIDH pile

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Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 564.00 in
Depth of ground surface below top of pile = -24.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	24.000	16286.0000	452.4000	3600000.000
2	564.0000	24.000	16286.0000	452.4000	3600000.000

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 168.000 in
p-y subgrade modulus k for top of soil layer = 60.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 60.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 168.000 in
Distance from top of pile to bottom of layer = 228.000 in
p-y subgrade modulus k for top of soil layer = 150.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 228.000 in
Distance from top of pile to bottom of layer = 324.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is stiff clay with water-induced erosion
Distance from top of pile to top of layer = 324.000 in
Distance from top of pile to bottom of layer = 396.000 in
p-y subgrade modulus k for top of soil layer = 750.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 750.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 396.000 in
Distance from top of pile to bottom of layer = 570.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 6 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 570.000 in
Distance from top of pile to bottom of layer = 714.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 714.000 in
Distance from top of pile to bottom of layer = 858.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

(Depth of lowest layer extends 294.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-24.00	.06660
2	168.00	.06660
3	168.00	.07520
4	228.00	.07520
5	228.00	.03910
6	324.00	.03910
7	324.00	.03910
8	396.00	.03910
9	396.00	.04200
10	570.00	.04200
11	570.00	.04200
12	714.00	.04200
13	714.00	.03910
14	858.00	.03910

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-24.000	.00000	34.00	------	------
2	168.000	.00000	34.00	------	------
3	168.000	.00000	36.00	------	------
4	228.000	.00000	36.00	------	------
5	228.000	.00000	36.00	------	------
6	324.000	.00000	36.00	------	------
7	324.000	6.94400	.00	.00500	.0
8	396.000	6.94400	.00	.00500	.0
9	396.000	.00000	36.00	------	------
10	570.000	.00000	36.00	------	------
11	570.000	.00000	38.00	------	------
12	714.000	.00000	38.00	------	------
13	714.000	.00000	36.00	------	------
14	858.000	.00000	36.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Static loading criteria was used for computation of p-y curves

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .100 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 290000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .200 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 290000.000 lbs

Load Case Number 3

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .300 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs

Load Case Number  4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .400 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs

Load Case Number  5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .500 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs

Load Case Number  6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .600 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .700 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .800 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =            .900 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           1.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =      290000.000 lbs
```

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	84.000

Depth of ground surface below top of pile = -24.00 in

p-y Curve in Sand Computed Using Reese Criteria

Soil Layer Number	=	1
Depth below pile head	=	60.000 in
Depth below ground surface	=	84.000 in
Equivalent Depth (see note)	=	84.000 in
Pile Diameter	=	24.000 in
Angle of Friction	=	34.000 deg.
Avg. Eff. Unit Weight	=	.06660 lbs/in**3
k	=	60.000 pci
A (static)	=	.9800
B (static)	=	.6200
Pst	=	1715.339 lbs/in
Psd	=	6357.074 lbs/in
Ps	=	1715.339 lbs/in
pu	=	1681.032 lbs/in
Cbar	=	1627.7632
n	=	2.1528
m	=	1235.0441
yk	=	.1212 in
ym	=	.4000 in
yu	=	.9000 in
p-multiplier	=	1.00000
y-multiplier	=	1.00000

If Psd <= Pst then actual depth is used in place of equivalent depth in computations.

y, in	p, lbs/in
.0000	.000
.0333	168.000
.0667	336.000
.1000	504.000
.1333	638.427
.1667	708.154
.2000	770.741
.2333	827.954
.2667	880.936
.3000	930.477

.3333	977.149
.3667	1021.382
.4000	1063.510
.9000	1681.032
24.9000	1681.032
48.9000	1681.032
72.9000	1681.032

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .100000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.100000	0.0000	14342.7942	-.001155	641.0256	-144.0000
5.640	.093485	80492.3824	13467.8781	-.001151	700.3348	-166.2539
11.280	.087014	1.557E+05	12479.6232	-.001140	755.7379	-184.1911
16.920	.080627	2.250E+05	11401.9689	-.001122	806.8058	-197.9558
22.560	.074363	2.880E+05	10257.9092	-.001097	853.2079	-207.7391
28.200	.068254	3.443E+05	9069.2485	-.001066	894.7076	-213.7718
33.840	.062332	3.938E+05	7856.3941	-.001031	931.1570	-216.3185
39.480	.056624	4.363E+05	6638.1834	-9.911E-04	962.4906	-215.6711
45.120	.051153	4.719E+05	5431.7497	-9.474E-04	988.7186	-212.1423
50.760	.045938	5.007E+05	4252.4227	-9.006E-04	1009.9197	-206.0588
56.400	.040994	5.228E+05	3113.6650	-8.514E-04	1026.2331	-197.7560
62.040	.036334	5.386E+05	2027.0412	-8.003E-04	1037.8508	-187.5716
67.680	.031966	5.483E+05	1002.2190	-7.481E-04	1045.0098	-175.8406
73.320	.027896	5.523E+05	46.9976	-6.951E-04	1047.9838	-162.8904
78.960	.024125	5.511E+05	-832.6366	-6.421E-04	1047.0759	-149.0366
84.600	.020654	5.450E+05	-1632.4325	-5.893E-04	1042.6109	-134.5790
90.240	.017478	5.346E+05	-2349.7771	-5.374E-04	1034.9285	-119.7986
95.880	.014592	5.203E+05	-2983.5817	-4.867E-04	1024.3762	-104.9549
101.520	.011988	5.025E+05	-3534.1547	-4.375E-04	1011.3037	-90.2838
107.160	.009657	4.818E+05	-4003.0642	-3.901E-04	996.0568	-75.9962
112.800	.007587	4.587E+05	-4392.9936	-3.449E-04	978.9728	-62.2767
118.440	.005767	4.334E+05	-4707.5923	-3.020E-04	960.3760	-49.2831
124.080	.004181	4.065E+05	-4951.3241	-2.616E-04	940.5739	-37.1466
129.720	.002816	3.784E+05	-5129.3161	-2.238E-04	919.8539	-25.9712
135.360	.001656	3.494E+05	-5247.2096	-1.888E-04	898.4814	-15.8350
141.000	6.86E-04	3.198E+05	-5311.0140	-1.566E-04	876.6972	-6.7907
146.640	-1.11E-04	2.900E+05	-5326.9672	-1.273E-04	854.7168	1.1335
152.280	-7.50E-04	2.602E+05	-5301.4005	-1.008E-04	832.7293	7.9327
157.920	-.001248	2.305E+05	-5240.6113	-7.723E-05	810.8976	13.6238

163.560	-.001621	2.013E+05	-5150.7433	-5.646E-05	789.3585	18.2443
169.200	-.001885	1.726E+05	-4940.4636	-3.848E-05	768.2237	56.3229
174.840	-.002055	1.457E+05	-4603.5605	-2.316E-05	748.3889	63.1462
180.480	-.002146	1.208E+05	-4234.4005	-1.035E-05	730.0173	67.7616
186.120	-.002172	97979.6461	-3844.7654	1.756E-07	713.2199	70.4069
191.760	-.002144	77406.9813	-3445.0751	8.611E-06	698.0614	71.3273
197.400	-.002075	59091.0292	-3044.3650	1.518E-05	684.5656	70.7685
203.040	-.001973	43016.8976	-2650.2985	2.009E-05	672.7217	68.9714
208.680	-.001848	29129.9499	-2269.2090	2.356E-05	662.4894	66.1668
214.320	-.001707	17343.1568	-1906.1671	2.579E-05	653.8046	62.5715
219.960	-.001557	7544.0090	-1565.0691	2.699E-05	646.5843	58.3852
225.600	-.001403	-399.1144	-1248.7406	2.733E-05	641.3197	53.7880
231.240	-.001249	-6631.2009	-982.9821	2.700E-05	645.9117	40.4526
236.880	-.001098	-11575.4624	-766.3887	2.612E-05	649.5548	36.3536
242.520	-9.54E-04	-15361.5103	-572.9136	2.482E-05	652.3445	32.2546
248.160	-8.18E-04	-18119.1339	-402.3186	2.321E-05	654.3763	28.2400
253.800	-6.92E-04	-19975.6032	-253.9302	2.138E-05	655.7442	24.3800
259.440	-5.77E-04	-21053.4120	-126.7158	1.941E-05	656.5384	20.7315
265.080	-4.73E-04	-21468.4469	-19.3571	1.736E-05	656.8442	17.3390
270.720	-3.81E-04	-21328.5586	69.6811	1.530E-05	656.7411	14.2349
276.360	-3.01E-04	-20732.5090	142.0871	1.328E-05	656.3020	11.4410
282.000	-2.32E-04	-19769.2638	199.6441	1.133E-05	655.5922	8.9693
287.640	-1.73E-04	-18517.5988	244.1781	9.492E-06	654.6699	6.8229
293.280	-1.24E-04	-17045.9862	277.5111	7.782E-06	653.5856	4.9973
298.920	-8.52E-05	-15412.7291	301.4202	6.220E-06	652.3822	3.4811
304.560	-5.43E-05	-13666.3144	317.6017	4.822E-06	651.0954	2.2570
310.200	-3.08E-05	-11845.9543	327.6403	3.595E-06	649.7541	1.3027
315.840	-1.38E-05	-9982.2908	332.9819	2.545E-06	648.3809	.5915
321.480	-2.12E-06	-8098.2424	334.9112	1.675E-06	646.9927	.092657
327.120	5.13E-06	-6209.9725	318.9327	9.869E-07	645.6013	-5.7588
332.760	9.01E-06	-4503.9103	280.7939	4.716E-07	644.3443	-7.7656
338.400	1.04E-05	-3044.1600	235.2174	1.085E-07	643.2687	-8.3963
344.040	1.02E-05	-1851.0126	188.0768	-1.270E-07	642.3895	-8.3203
349.680	9.02E-06	-922.2386	142.5879	-2.603E-07	641.7052	-7.8105
355.320	7.30E-06	-241.7697	100.7543	-3.163E-07	641.2038	-7.0241
360.960	5.45E-06	215.3049	63.8427	-3.176E-07	641.1843	-6.0652
366.600	3.71E-06	479.4149	32.6212	-2.842E-07	641.3789	-5.0063
372.240	2.24E-06	584.2022	7.5290	-2.330E-07	641.4561	-3.8917
377.880	1.09E-06	565.1041	-11.1228	-1.777E-07	641.4420	-2.7224
383.520	2.37E-07	459.3185	-22.5715	-1.285E-07	641.3641	-1.3374
389.160	-3.63E-07	310.9182	-22.1437	-9.143E-08	641.2547	1.4891
394.800	-7.94E-07	209.8368	-11.6057	-6.638E-08	641.1803	2.2478
400.440	-1.11E-06	180.2229	-5.1208	-4.762E-08	641.1584	.051853
406.080	-1.33E-06	152.2301	-4.7968	-3.163E-08	641.1378	.063038
411.720	-1.47E-06	126.2186	-4.4200	-1.823E-08	641.1186	.070565
417.360	-1.54E-06	102.4318	-4.0097	-7.237E-09	641.1011	.074945
423.000	-1.55E-06	81.0129	-3.5821	1.587E-09	641.0853	.076673
428.640	-1.52E-06	62.0202	-3.1510	8.466E-09	641.0713	.076214
434.280	-1.45E-06	45.4421	-2.7274	1.364E-08	641.0591	.074000
439.920	-1.37E-06	31.2108	-2.3201	1.732E-08	641.0486	.070423
445.560	-1.26E-06	19.2146	-1.9359	1.975E-08	641.0398	.065835
451.200	-1.14E-06	9.3097	-1.5795	2.112E-08	641.0325	.060544
456.840	-1.02E-06	1.3291	-1.2542	2.163E-08	641.0266	.054818
462.480	-8.99E-07	-4.9079	-.9617	2.146E-08	641.0293	.048881
468.120	-7.79E-07	-9.5893	-.7028	2.076E-08	641.0327	.042918
473.760	-6.64E-07	-12.9040	-.4773	1.968E-08	641.0351	.037077
479.400	-5.57E-07	-15.0372	-.2840	1.834E-08	641.0367	.031471

485.040	-4.58E-07	-16.1669	-.1214	1.683E-08	641.0376	.026179
490.680	-3.67E-07	-16.4614	.012385	1.527E-08	641.0378	.021256
496.320	-2.85E-07	-16.0772	.1195	1.370E-08	641.0375	.016728
501.960	-2.12E-07	-15.1583	.2022	1.220E-08	641.0368	.012603
507.600	-1.48E-07	-13.8361	.2628	1.080E-08	641.0358	.008869
513.240	-9.05E-08	-12.2297	.3033	9.550E-09	641.0347	.005500
518.880	-4.00E-08	-10.4463	.3257	8.459E-09	641.0333	.002458
524.520	4.88E-09	-8.5832	.3318	7.544E-09	641.0320	-3.035E-04
530.160	4.51E-08	-6.7283	.3229	6.807E-09	641.0306	-.002835
535.800	8.17E-08	-4.9626	.3003	6.245E-09	641.0293	-.005191
541.440	1.16E-07	-3.3612	.2647	5.845E-09	641.0281	-.007426
547.080	1.48E-07	-1.9955	.2167	5.587E-09	641.0271	-.009590
552.720	1.79E-07	-.9346	.1566	5.446E-09	641.0263	-.011729
558.360	2.09E-07	-.2466	.084418	5.389E-09	641.0258	-.013877
564.000	2.39E-07	0.0000	0.0000	5.377E-09	641.0256	-.016059

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.10000000 in
Computed slope at pile head	=	-.00115512
Maximum bending moment	=	552310.020 lbs-in
Maximum shear force	=	14342.794 lbs
Depth of maximum bending moment	=	73.320 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .200000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.200000	0.0000	28684.0775	-.002310	641.0256	-287.4774
5.640	.186970	1.610E+05	26935.7190	-.002303	759.6438	-332.5078
11.280	.174028	3.114E+05	24959.2096	-.002280	870.4498	-368.3820
16.920	.161254	4.500E+05	22803.9017	-.002243	972.5856	-395.9115
22.560	.148725	5.759E+05	20515.7834	-.002194	1065.3897	-415.4780
28.200	.136508	6.886E+05	18138.4638	-.002133	1148.3889	-427.5432
33.840	.124665	7.875E+05	15712.7571	-.002062	1221.2875	-432.6365
39.480	.113249	8.726E+05	13276.3387	-.001982	1283.9545	-431.3417

45.120	.102306	9.438E+05	10863.4751	-.001895	1336.4105	-424.2838
50.760	.091875	1.001E+06	8504.8258	-.001801	1378.8126	-412.1167
56.400	.081988	1.046E+06	6227.3161	-.001703	1411.4393	-395.5109
62.040	.072668	1.077E+06	4054.0755	-.001601	1434.6748	-375.1418
67.680	.063932	1.097E+06	2004.4392	-.001496	1448.9927	-351.6796
73.320	.055792	1.105E+06	94.0060	-.001390	1454.9407	-325.7790
78.960	.048250	1.102E+06	-1665.2511	-.001284	1453.1249	-298.0711
84.600	.041307	1.090E+06	-3264.8301	-.001179	1444.1952	-269.1555
90.240	.034955	1.069E+06	-4699.5046	-.001075	1428.8305	-239.5943
95.880	.029183	1.041E+06	-5967.0971	-9.733E-04	1407.7262	-209.9066
101.520	.023975	1.005E+06	-7068.2242	-8.750E-04	1381.5815	-180.5640
107.160	.019313	9.637E+05	-8006.0220	-7.803E-04	1351.0881	-151.9884
112.800	.015174	9.173E+05	-8785.8573	-6.898E-04	1316.9206	-124.5489
118.440	.011533	8.668E+05	-9415.0286	-6.040E-04	1279.7276	-98.5614
124.080	.008361	8.131E+05	-9902.4635	-5.232E-04	1240.1240	-74.2878
129.720	.005631	7.568E+05	-10258.4162	-4.477E-04	1198.6850	-51.9365
135.360	.003312	6.988E+05	-10494.1690	-3.777E-04	1155.9409	-31.6637
141.000	.001371	6.397E+05	-10621.7412	-3.133E-04	1112.3736	-13.5746
146.640	-2.22E-04	5.800E+05	-10653.6083	-2.546E-04	1068.4141	2.2743
152.280	-.001501	5.204E+05	-10602.4330	-2.017E-04	1024.4406	15.8730
157.920	-.002497	4.611E+05	-10480.8107	-1.545E-04	980.7788	27.2555
163.560	-.003243	4.026E+05	-10301.0287	-1.129E-04	937.7023	36.4970
169.200	-.003771	3.453E+05	-9880.3841	-7.695E-05	895.4346	112.6678
174.840	-.004111	2.914E+05	-9206.4538	-4.632E-05	855.7676	126.3146
180.480	-.004293	2.416E+05	-8468.0094	-2.069E-05	819.0275	135.5451
186.120	-.004344	1.960E+05	-7688.6171	3.593E-07	785.4362	140.8351
191.760	-.004289	1.548E+05	-6889.1196	1.723E-05	755.1232	142.6746
197.400	-.004150	1.182E+05	-6087.5918	3.037E-05	728.1362	141.5551
203.040	-.003947	86081.9895	-5299.3649	4.020E-05	704.4534	137.9580
208.680	-.003697	58315.2498	-4537.1113	4.714E-05	683.9940	132.3447
214.320	-.003415	34749.1668	-3810.9795	5.162E-05	666.6298	125.1489
219.960	-.003114	15158.5518	-3128.7696	5.402E-05	652.1949	116.7695
225.600	-.002806	-720.0560	-2496.1423	5.471E-05	641.5562	107.5664
231.240	-.002497	-13176.9071	-1964.6996	5.404E-05	650.7348	80.8885
236.880	-.002196	-23058.6541	-1531.6373	5.230E-05	658.0159	72.6797
242.520	-.001907	-30624.8621	-1144.8783	4.972E-05	663.5909	64.4690
248.160	-.001635	-36135.5201	-803.9588	4.651E-05	667.6513	56.4245
253.800	-.001383	-39845.6525	-507.5454	4.285E-05	670.3851	48.6867
259.440	-.001152	-42000.8127	-253.5878	3.892E-05	671.9731	41.3692
265.080	-9.44E-04	-42833.4256	-39.4652	3.484E-05	672.5866	34.5608
270.720	-7.59E-04	-42559.9345	137.8765	3.073E-05	672.3850	28.3263
276.360	-5.97E-04	-41378.6976	281.7973	2.669E-05	671.5147	22.7094
282.000	-4.58E-04	-39468.5730	395.8477	2.280E-05	670.1072	17.7340
287.640	-3.40E-04	-36988.1265	483.6647	1.913E-05	668.2796	13.4068
293.280	-2.42E-04	-34075.3966	548.8791	1.571E-05	666.1334	9.7189
298.920	-1.63E-04	-30848.1506	595.0348	1.258E-05	663.7555	6.6484
304.560	-1.00E-04	-27404.5696	625.5184	9.782E-06	661.2181	4.1614
310.200	-5.24E-05	-23824.3035	643.4987	7.318E-06	658.5801	2.2146
315.840	-1.76E-05	-20169.8444	651.8750	5.202E-06	655.8874	.7558
321.480	6.28E-06	-16488.1710	653.2330	3.439E-06	653.1746	-.2742
327.120	2.12E-05	-12812.6261	618.4761	2.030E-06	650.4664	-12.0509
332.760	2.92E-05	-9518.3998	544.4911	9.557E-07	648.0391	-14.1849
338.400	3.20E-05	-6673.8926	462.5506	1.768E-07	645.9432	-14.8720
344.040	3.12E-05	-4301.4077	379.1756	-3.510E-07	644.1950	-14.6936
349.680	2.80E-05	-2395.6431	298.4238	-6.732E-07	642.7908	-13.9418
355.320	2.36E-05	-932.9850	223.0162	-8.333E-07	641.7131	-12.7985
360.960	1.86E-05	122.7059	154.8089	-8.722E-07	641.1161	-11.3886

366.600	1.37E-05	816.1122	95.0571	-8.271E-07	641.6270	-9.8000
372.240	9.29E-06	1197.6557	44.6119	-7.302E-07	641.9081	-8.0883
377.880	5.50E-06	1321.7237	4.1321	-6.090E-07	641.9995	-6.2662
383.520	2.42E-06	1246.2578	-25.5202	-4.855E-07	641.9439	-4.2488
389.160	2.38E-08	1035.4441	-37.9676	-3.758E-07	641.7886	-.1652
394.800	-1.81E-06	819.2126	-28.8588	-2.866E-07	641.6293	3.3953
400.440	-3.21E-06	710.8539	-18.8621	-2.130E-07	641.5494	.1497
406.080	-4.22E-06	607.1448	-17.8769	-1.496E-07	641.4730	.1997
411.720	-4.90E-06	509.6922	-16.6502	-9.587E-08	641.4012	.2353
417.360	-5.30E-06	419.6442	-15.2580	-5.117E-08	641.3348	.2584
423.000	-5.47E-06	337.7490	-13.7659	-1.474E-08	641.2745	.2708
428.640	-5.47E-06	264.4132	-12.2291	1.422E-08	641.2205	.2742
434.280	-5.31E-06	199.7577	-10.6936	3.654E-08	641.1728	.2703
439.920	-5.05E-06	143.6693	-9.1964	5.306E-08	641.1315	.2606
445.560	-4.71E-06	95.8489	-7.7662	6.458E-08	641.0963	.2465
451.200	-4.32E-06	55.8548	-6.4249	7.188E-08	641.0668	.2292
456.840	-3.90E-06	23.1411	-5.1876	7.568E-08	641.0427	.2096
462.480	-3.47E-06	-2.9084	-4.0640	7.665E-08	641.0278	.1888
468.120	-3.04E-06	-22.9515	-3.0593	7.541E-08	641.0426	.1675
473.760	-2.62E-06	-37.6637	-2.1746	7.249E-08	641.0534	.1462
479.400	-2.22E-06	-47.7185	-1.4082	6.839E-08	641.0608	.1255
485.040	-1.85E-06	-53.7722	-.7559	6.351E-08	641.0653	.1058
490.680	-1.51E-06	-56.4527	-.2117	5.820E-08	641.0672	.087182
496.320	-1.19E-06	-56.3510	.2312	5.278E-08	641.0672	.069894
501.960	-9.10E-07	-54.0172	.5805	4.747E-08	641.0654	.053979
507.600	-6.57E-07	-49.9579	.8439	4.247E-08	641.0625	.039425
513.240	-4.31E-07	-44.6366	1.0289	3.792E-08	641.0585	.026161
518.880	-2.29E-07	-38.4761	1.1423	3.392E-08	641.0540	.014067
524.520	-4.80E-08	-31.8622	1.1904	3.054E-08	641.0491	.002985
530.160	1.16E-07	-25.1482	1.1783	2.780E-08	641.0442	-.007264
535.800	2.66E-07	-18.6613	1.1103	2.569E-08	641.0394	-.016877
541.440	4.05E-07	-12.7084	.9892	2.418E-08	641.0350	-.026051
547.080	5.38E-07	-7.5822	.8171	2.320E-08	641.0312	-.034974
552.720	6.67E-07	-3.5672	.5949	2.267E-08	641.0283	-.043814
558.360	7.94E-07	-.9454	.3228	2.245E-08	641.0263	-.052707
564.000	9.20E-07	0.0000	0.0000	2.240E-08	641.0256	-.061744

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	.20000000 in
Computed slope at pile head	=	-.00231024
Maximum bending moment	=	1104618.347 lbs-in
Maximum shear force	=	28684.078 lbs
Depth of maximum bending moment	=	73.320 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .300000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.300000	0.0000	40870.9492	-.003446	641.0256	-324.1493
5.640	.280564	2.310E+05	38834.7535	-.003435	811.2281	-397.9059
11.280	.261253	4.493E+05	36411.3629	-.003402	972.0776	-461.4525
16.920	.242186	6.528E+05	33644.0685	-.003349	1122.0594	-519.8576
22.560	.223473	8.398E+05	30582.8733	-.003278	1259.7809	-565.6726
28.200	.205215	1.009E+06	27287.9566	-.003189	1384.1467	-602.7375
33.840	.187505	1.158E+06	23821.4305	-.003084	1494.2685	-626.5270
39.480	.170423	1.287E+06	20254.0286	-.002967	1589.5713	-638.5091
45.120	.154040	1.396E+06	16660.7982	-.002838	1669.7594	-635.6860
50.760	.138414	1.485E+06	13117.3130	-.002699	1734.8862	-620.8690
56.400	.123593	1.553E+06	9685.1387	-.002553	1785.2889	-596.2141
62.040	.109615	1.602E+06	6408.0385	-.002401	1821.5373	-565.8782
67.680	.096507	1.633E+06	3315.2265	-.002246	1844.3368	-530.8636
73.320	.084284	1.647E+06	436.2234	-.002088	1854.5044	-490.0594
78.960	.072955	1.645E+06	-2216.6776	-.001930	1852.9950	-450.6856
84.600	.062518	1.628E+06	-4636.3882	-.001772	1840.7316	-407.3678
90.240	.052965	1.598E+06	-6808.9420	-.001617	1818.7314	-363.0414
95.880	.044279	1.557E+06	-8730.8516	-.001465	1788.0369	-318.4868
101.520	.036437	1.505E+06	-10402.8323	-.001318	1749.6972	-274.4141
107.160	.029412	1.444E+06	-11829.3936	-.001176	1704.7512	-231.4587
112.800	.023170	1.375E+06	-13018.4074	-.001041	1654.2129	-190.1775
118.440	.017674	1.300E+06	-13980.6622	-9.119E-04	1599.0578	-151.0477
124.080	.012883	1.220E+06	-14729.4104	-7.907E-04	1540.2116	-114.4659
129.720	.008755	1.137E+06	-15279.9150	-6.773E-04	1478.5411	-80.7485
135.360	.005243	1.050E+06	-15649.0027	-5.721E-04	1414.8461	-50.1336
141.000	.002301	9.620E+05	-15854.6275	-4.753E-04	1349.8544	-22.7829
146.640	-1.19E-04	8.729E+05	-15915.4489	-3.871E-04	1284.2172	1.2151
152.280	-.002065	7.837E+05	-15850.4288	-3.074E-04	1218.5073	21.8417
157.920	-.003586	6.951E+05	-15678.4482	-2.363E-04	1153.2184	39.1443
163.560	-.004730	6.077E+05	-15417.9463	-1.736E-04	1088.7664	53.2322
169.200	-.005545	5.218E+05	-14800.6518	-1.193E-04	1025.4916	165.6665
174.840	-.006076	4.411E+05	-13807.0360	-7.297E-05	966.0393	186.6795
180.480	-.006368	3.663E+05	-12713.6788	-3.414E-05	910.9112	201.0358
186.120	-.006461	2.978E+05	-11556.1260	-2.200E-06	860.4527	209.4439
191.760	-.006393	2.359E+05	-10365.8624	2.347E-05	814.8686	212.6354
197.400	-.006196	1.808E+05	-9170.2379	4.352E-05	774.2409	211.3449
203.040	-.005902	1.324E+05	-7992.4975	5.858E-05	738.5459	206.2935
208.680	-.005535	90448.3500	-6851.9022	6.929E-05	707.6706	198.1730
214.320	-.005120	54835.0696	-5763.9257	7.628E-05	681.4297	187.6343
219.960	-.004675	25181.7340	-4740.5145	8.013E-05	659.5803	175.2774
225.600	-.004216	1099.9416	-3790.3970	8.140E-05	641.8361	161.6436
231.240	-.003757	-17840.2042	-2991.4104	8.059E-05	654.1708	121.6850
236.880	-.003307	-32906.7930	-2339.6075	7.815E-05	665.2723	109.4508
242.520	-.002875	-44486.6174	-1756.8914	7.443E-05	673.8047	97.1861

248.160	-.002468	-52967.9916	-1242.7168	6.974E-05	680.0540	85.1453
253.800	-.002089	-58732.5936	-795.2199	6.437E-05	684.3015	73.5416
259.440	-.001742	-62148.6271	-411.4475	5.855E-05	686.8186	62.5479
265.080	-.001428	-63565.2573	-87.5771	5.251E-05	687.8624	52.2997
270.720	-.001149	-63308.2529	180.8774	4.640E-05	687.6730	42.8969
276.360	-9.05E-04	-61676.7540	398.8749	4.039E-05	686.4709	34.4071
282.000	-6.94E-04	-58941.0733	571.6730	3.459E-05	684.4551	26.8688
287.640	-5.15E-04	-55341.4334	704.6722	2.909E-05	681.8028	20.2941
293.280	-3.65E-04	-51087.5401	803.2771	2.397E-05	678.6684	14.6722
298.920	-2.44E-04	-46358.8916	872.7750	1.929E-05	675.1842	9.9724
304.560	-1.48E-04	-41305.7297	918.2312	1.507E-05	671.4609	6.1468
310.200	-7.41E-05	-36050.5421	944.3989	1.135E-05	667.5887	3.1325
315.840	-1.99E-05	-30690.0372	955.6428	8.140E-06	663.6390	.8547
321.480	1.77E-05	-25297.5175	955.8743	5.447E-06	659.6656	-.7726
327.120	4.15E-05	-19925.5922	905.7544	3.272E-06	655.7074	-17.0005
332.760	5.46E-05	-15091.3096	802.7891	1.587E-06	652.1454	-19.5121
338.400	5.95E-05	-10875.3240	690.3023	3.383E-07	649.0389	-20.3769
344.040	5.84E-05	-7305.8067	575.8437	-5.362E-07	646.4088	-20.2113
349.680	5.34E-05	-4378.0528	464.3050	-1.098E-06	644.2515	-19.3414
355.320	4.60E-05	-2064.8537	359.0736	-1.408E-06	642.5471	-17.9747
360.960	3.75E-05	-323.0971	262.5449	-1.523E-06	641.2637	-16.2554
366.600	2.88E-05	901.6339	176.4157	-1.495E-06	641.6900	-14.2869
372.240	2.07E-05	1671.7631	101.8959	-1.371E-06	642.2574	-12.1386
377.880	1.34E-05	2055.5055	39.9143	-1.192E-06	642.5402	-9.8407
383.520	7.21E-06	2125.8959	-8.5756	-9.909E-07	642.5921	-7.3543
389.160	2.20E-06	1962.0136	-41.8981	-7.943E-07	642.4713	-4.4621
394.800	-1.75E-06	1655.8837	-45.7754	-6.202E-07	642.2457	3.0872
400.440	-4.80E-06	1447.6957	-36.4386	-4.710E-07	642.0923	.2237
406.080	-7.06E-06	1246.3971	-34.8649	-3.414E-07	641.9440	.3343
411.720	-8.65E-06	1055.5368	-32.7502	-2.307E-07	641.8034	.4156
417.360	-9.66E-06	877.7294	-30.2497	-1.377E-07	641.6724	.4711
423.000	-1.02E-05	714.7707	-27.4981	-6.108E-08	641.5523	.5046
428.640	-1.04E-05	567.7502	-24.6107	6.044E-10	641.4440	.5193
434.280	-1.02E-05	437.1602	-21.6837	4.894E-08	641.3478	.5186
439.920	-9.80E-06	322.9984	-18.7958	8.550E-08	641.2636	.5055
445.560	-9.23E-06	224.8642	-16.0096	1.119E-07	641.1913	.4826
451.200	-8.54E-06	142.0447	-13.3729	1.295E-07	641.1303	.4524
456.840	-7.77E-06	73.5939	-10.9208	1.399E-07	641.0799	.4171
462.480	-6.96E-06	18.4005	-8.6768	1.443E-07	641.0392	.3786
468.120	-6.14E-06	-24.7522	-6.6548	1.440E-07	641.0439	.3384
473.760	-5.34E-06	-57.1366	-4.8608	1.401E-07	641.0677	.2978
479.400	-4.56E-06	-80.0400	-3.2941	1.335E-07	641.0846	.2578
485.040	-3.83E-06	-94.7311	-1.9492	1.250E-07	641.0954	.2192
490.680	-3.15E-06	-102.4360	-.8165	1.156E-07	641.1011	.1825
496.320	-2.53E-06	-104.3197	.1158	1.056E-07	641.1025	.1481
501.960	-1.96E-06	-101.4750	.8613	9.572E-08	641.1004	.1162
507.600	-1.45E-06	-94.9169	1.4341	8.628E-08	641.0956	.086861
513.240	-9.86E-07	-85.5807	1.8479	7.759E-08	641.0887	.059885
518.880	-5.71E-07	-74.3262	2.1158	6.990E-08	641.0804	.035114
524.520	-1.97E-07	-61.9431	2.2494	6.335E-08	641.0713	.012264
530.160	1.43E-07	-49.1600	2.2586	5.801E-08	641.0619	-.009000
535.800	4.57E-07	-36.6556	2.1513	5.388E-08	641.0526	-.029049
541.440	7.51E-07	-25.0694	1.9333	5.091E-08	641.0441	-.048262
547.080	1.03E-06	-15.0145	1.6082	4.898E-08	641.0367	-.067006
552.720	1.30E-06	-7.0886	1.1779	4.792E-08	641.0309	-.085611
558.360	1.57E-06	-1.8849	.6422	4.749E-08	641.0270	-.1043
564.000	1.84E-06	0.0000	0.0000	4.740E-08	641.0256	-.1234

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	.30000000 in
Computed slope at pile head	=	-.00344615
Maximum bending moment	=	1646892.921 lbs-in
Maximum shear force	=	40870.949 lbs
Depth of maximum bending moment	=	73.320 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	5
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .400000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.400000	0.0000	48775.7230	-.004469	641.0256	-352.9717
5.640	.374798	2.768E+05	46555.9060	-.004455	844.9725	-434.1974
11.280	.349745	5.397E+05	43907.9386	-.004416	1038.7104	-504.7981
16.920	.324986	7.865E+05	40875.8427	-.004352	1220.5542	-570.4132
22.560	.300653	1.015E+06	37510.6477	-.004265	1388.9373	-622.9184
28.200	.276871	1.224E+06	33876.2115	-.004158	1542.6026	-665.8888
33.840	.253753	1.411E+06	30039.7603	-.004031	1680.5188	-694.5549
39.480	.231400	1.576E+06	26072.8598	-.003887	1801.9923	-712.1474
45.120	.209902	1.718E+06	22047.9801	-.003729	1906.5916	-715.1149
50.760	.189336	1.837E+06	18024.8547	-.003558	1994.2308	-711.5253
56.400	.169767	1.933E+06	14031.8636	-.003377	2064.9802	-704.4290
62.040	.151246	2.006E+06	10130.0597	-.003187	2118.9949	-679.1894
67.680	.133813	2.057E+06	6422.4408	-.002992	2156.8581	-635.5691
73.320	.117496	2.088E+06	2964.9919	-.002793	2179.5862	-590.4766
78.960	.102313	2.100E+06	-354.9753	-.002591	2188.2325	-586.8167
84.600	.088268	2.093E+06	-3631.5008	-.002390	2182.8814	-575.0717
90.240	.075359	2.067E+06	-6709.8464	-.002189	2163.8090	-516.5402
95.880	.063571	2.024E+06	-9455.9453	-.001993	2132.3902	-457.2537
101.520	.052881	1.967E+06	-11868.4928	-.001801	2090.0195	-398.2595
107.160	.043258	1.896E+06	-13951.5887	-.001615	2038.0864	-340.4269
112.800	.034664	1.814E+06	-15713.9538	-.001437	1977.9544	-284.5252
118.440	.027055	1.723E+06	-17168.3561	-.001266	1910.9434	-231.2203
124.080	.020380	1.625E+06	-18331.0236	-.001105	1838.3131	-181.0732

129.720	.014587	1.520E+06	-19221.0523	-9.540E-04	1761.2504	-134.5399
135.360	.009619	1.411E+06	-19859.8180	-8.130E-04	1680.8580	-91.9728
141.000	.005417	1.299E+06	-20270.3995	-6.826E-04	1598.1464	-53.6234
146.640	.001919	1.185E+06	-20477.0177	-5.632E-04	1514.0273	-19.6454
152.280	-9.36E-04	1.070E+06	-20504.4974	-4.547E-04	1429.3105	9.9009
157.920	-.003211	9.550E+05	-20377.7537	-3.573E-04	1344.7016	35.0437
163.560	-.004967	8.411E+05	-20121.3066	-2.709E-04	1260.8034	55.8950
169.200	-.006267	7.289E+05	-19435.6492	-1.954E-04	1178.1178	187.2460
174.840	-.007171	6.225E+05	-18286.2639	-1.304E-04	1099.7364	220.3375
180.480	-.007738	5.231E+05	-16975.9980	-7.532E-05	1026.4471	244.2958
186.120	-.008021	4.313E+05	-15553.8469	-2.942E-05	958.8230	260.0131
191.760	-.008070	3.477E+05	-14063.6505	8.055E-06	897.2432	268.4253
197.400	-.007930	2.726E+05	-12543.9228	3.789E-05	841.9145	270.4852
203.040	-.007642	2.061E+05	-11027.8250	6.092E-05	792.8939	267.1381
208.680	-.007243	1.480E+05	-9543.2677	7.796E-05	750.1107	259.3007
214.320	-.006763	98207.4904	-8113.1204	8.980E-05	713.3878	247.8437
219.960	-.006230	56236.7932	-6755.5135	9.723E-05	682.4626	233.5772
225.600	-.005666	21687.2442	-5484.2124	1.010E-04	657.0054	217.2388
231.240	-.005091	-5955.4377	-4406.5916	1.017E-04	645.4138	164.8962
236.880	-.004519	-28351.8991	-3519.8552	1.001E-04	661.9161	149.5493
242.520	-.003962	-45986.7964	-2720.4844	9.651E-05	674.9101	133.9155
248.160	-.003430	-59354.6583	-2009.0740	9.144E-05	684.7599	118.3577
253.800	-.002930	-68948.2718	-1384.3271	8.527E-05	691.8287	103.1838
259.440	-.002468	-75248.8025	-843.3589	7.833E-05	696.4712	88.6490
265.080	-.002047	-78717.6057	-381.9887	7.093E-05	699.0271	74.9575
270.720	-.001668	-79789.6555	4.9816	6.330E-05	699.8170	62.2660
276.360	-.001333	-78868.4947	323.5088	5.567E-05	699.1382	50.6869
282.000	-.001040	-76322.5945	580.0705	4.821E-05	697.2624	40.2924
287.640	-7.89E-04	-72483.0001	781.4494	4.105E-05	694.4332	31.1186
293.280	-5.77E-04	-67642.1326	934.5411	3.431E-05	690.8663	23.1693
298.920	-4.02E-04	-62053.6171	1046.1840	2.807E-05	686.7486	16.4204
304.560	-2.60E-04	-55933.0104	1123.0125	2.240E-05	682.2387	10.8237
310.200	-1.49E-04	-49459.3058	1171.3292	1.733E-05	677.4687	6.3099
315.840	-6.50E-05	-42777.1039	1196.9975	1.289E-05	672.5451	2.7923
321.480	-3.88E-06	-35999.3488	1205.3496	9.104E-06	667.5510	.1694
327.120	3.77E-05	-29210.5409	1160.1549	5.967E-06	662.5488	-16.1959
332.760	6.34E-05	-22932.3213	1055.1424	3.459E-06	657.9228	-21.0426
338.400	7.67E-05	-17319.8506	930.4988	1.523E-06	653.7874	-23.1572
344.040	8.06E-05	-12441.2773	798.2235	9.166E-08	650.1927	-23.7489
349.680	7.78E-05	-8316.1888	665.4449	-9.067E-07	647.1533	-23.3358
355.320	7.04E-05	-4932.0928	536.9892	-1.544E-06	644.6598	-22.2159
360.960	6.03E-05	-2253.8999	416.2864	-1.890E-06	642.6864	-20.5865
366.600	4.91E-05	-230.2014	305.8169	-2.009E-06	641.1953	-18.5870
372.240	3.77E-05	1202.2870	207.3888	-1.962E-06	641.9115	-16.3165
377.880	2.69E-05	2115.5633	122.3538	-1.803E-06	642.5844	-13.8377
383.520	1.73E-05	2588.3351	51.8411	-1.576E-06	642.9328	-11.1668
389.160	9.15E-06	2705.4878	-2.8531	-1.322E-06	643.0191	-8.2283
394.800	2.43E-06	2560.4765	-39.1369	-1.069E-06	642.9123	-4.6383
400.440	-2.90E-06	2267.5191	-51.8351	-8.364E-07	642.6964	.1354
406.080	-7.00E-06	1978.5119	-50.5180	-6.321E-07	642.4835	.3317
411.720	-1.00E-05	1699.7438	-48.2230	-4.552E-07	642.2781	.4822
417.360	-1.21E-05	1436.0455	-45.1941	-3.044E-07	642.0838	.5919
423.000	-1.35E-05	1190.9504	-41.6463	-1.780E-07	641.9032	.6661
428.640	-1.41E-05	966.8579	-37.7661	-7.425E-08	641.7381	.7098
434.280	-1.43E-05	765.1919	-33.7122	9.061E-09	641.5895	.7277
439.920	-1.40E-05	586.5548	-29.6169	7.408E-08	641.4578	.7245
445.560	-1.35E-05	430.8710	-25.5879	1.230E-07	641.3431	.7042

451.200	-1.27E-05	297.5204	-21.7105	1.580E-07	641.2449	.6708
456.840	-1.17E-05	185.4595	-18.0495	1.813E-07	641.1623	.6275
462.480	-1.06E-05	93.3294	-14.6518	1.947E-07	641.0944	.5774
468.120	-9.49E-06	19.5502	-11.5490	2.001E-07	641.0400	.5229
473.760	-8.36E-06	-37.5975	-8.7592	1.993E-07	641.0533	.4663
479.400	-7.24E-06	-79.9053	-6.2899	1.936E-07	641.0845	.4093
485.040	-6.17E-06	-109.1810	-4.1398	1.845E-07	641.1061	.3532
490.680	-5.16E-06	-127.2056	-2.3008	1.731E-07	641.1194	.2989
496.320	-4.22E-06	-135.7008	-.7603	1.605E-07	641.1256	.2474
501.960	-3.35E-06	-136.3063	.4979	1.474E-07	641.1261	.1988
507.600	-2.56E-06	-130.5664	1.4914	1.346E-07	641.1218	.1535
513.240	-1.83E-06	-119.9240	2.2381	1.225E-07	641.1140	.1113
518.880	-1.17E-06	-105.7217	2.7554	1.117E-07	641.1035	.072147
524.520	-5.73E-07	-89.2078	3.0593	1.023E-07	641.0914	.035611
530.160	-2.02E-08	-71.5471	3.1633	9.456E-08	641.0784	.001269
535.800	4.94E-07	-53.8348	3.0784	8.853E-08	641.0653	-.031385
541.440	9.78E-07	-37.1124	2.8126	8.416E-08	641.0530	-.062885
547.080	1.44E-06	-22.3845	2.3708	8.129E-08	641.0421	-.093761
552.720	1.90E-06	-10.6355	1.7553	7.971E-08	641.0335	-.1245
558.360	2.34E-06	-2.8451	.9658	7.906E-08	641.0277	-.1555
564.000	2.79E-06	0.0000	0.0000	7.892E-08	641.0256	-.1870

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      .40000000 in
Computed slope at pile head      =     -.00446852
Maximum bending moment           =    2099817.547 lbs-in
Maximum shear force              =      48775.723 lbs
Depth of maximum bending moment  =         78.960 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              6
Number of zero deflection points =              4
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head     =         .500000 in
Specified bending moment at pile head =            .000 in-lbs
Specified axial load at pile head     =      290000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.500000	0.0000	55877.2609	-.005460	641.0256	-379.1008
5.640	.469208	3.180E+05	53494.3849	-.005444	875.3725	-465.8907

11.280	.438589	6.212E+05	50652.9396	-.005399	1098.7629	-541.7141
16.920	.408307	9.071E+05	47396.5214	-.005326	1309.3844	-613.0441
22.560	.378517	1.173E+06	43774.5995	-.005225	1505.5321	-671.3253
28.200	.349364	1.418E+06	39852.5884	-.005101	1685.8091	-719.4588
33.840	.320980	1.640E+06	35701.7832	-.004954	1849.0589	-752.4579
39.480	.293485	1.837E+06	31393.8188	-.004787	1994.4823	-775.1890
45.120	.266987	2.009E+06	26997.8501	-.004602	2121.5236	-783.6652
50.760	.241580	2.156E+06	22571.1756	-.004401	2229.9643	-786.0776
56.400	.217342	2.278E+06	18139.0362	-.004188	2319.7307	-785.6031
62.040	.194340	2.375E+06	13764.1674	-.003964	2390.8199	-765.7688
67.680	.172627	2.447E+06	9557.9350	-.003732	2443.6854	-725.8029
73.320	.152241	2.495E+06	5585.4969	-.003495	2479.2558	-682.8631
78.960	.133209	2.521E+06	1735.2155	-.003253	2498.5318	-682.4850
84.600	.115544	2.525E+06	-2087.1763	-.003011	2501.5193	-672.9731
90.240	.099249	2.507E+06	-5830.0951	-.002769	2488.4408	-654.3031
95.880	.084315	2.468E+06	-9385.4487	-.002529	2459.7359	-606.4606
101.520	.070720	2.410E+06	-12597.6130	-.002295	2416.5305	-532.6047
107.160	.058432	2.334E+06	-15396.2957	-.002066	2360.5624	-459.8360
112.800	.047410	2.243E+06	-17790.4177	-.001846	2293.5460	-389.1434
118.440	.037605	2.139E+06	-19794.1241	-.001636	2217.1488	-321.3907
124.080	.028961	2.025E+06	-21426.0697	-.001435	2132.9707	-257.3134
129.720	.021415	1.902E+06	-22708.6938	-.001246	2042.5269	-197.5179
135.360	.014902	1.773E+06	-23667.4953	-.001070	1947.2332	-142.4827
141.000	.009350	1.639E+06	-24330.3179	-9.056E-04	1848.3943	-92.5608
146.640	.004687	1.501E+06	-24726.6533	-7.546E-04	1747.1961	-47.9836
152.280	8.38E-04	1.362E+06	-24886.9675	-6.168E-04	1644.6991	-8.8654
157.920	-.002271	1.223E+06	-24842.0585	-4.925E-04	1541.8365	24.7906
163.560	-.004717	1.084E+06	-24622.4445	-3.816E-04	1439.4131	53.0867
169.200	-.006576	9.461E+05	-23918.6935	-2.840E-04	1338.1084	196.4705
174.840	-.007920	8.147E+05	-22678.3812	-1.993E-04	1241.2990	243.3566
180.480	-.008823	6.909E+05	-21206.5654	-1.269E-04	1150.0989	278.5639
186.120	-.009351	5.759E+05	-19566.1391	-6.593E-05	1065.3478	303.1476
191.760	-.009567	4.704E+05	-17813.8489	-1.561E-05	987.6352	318.2319
197.400	-.009528	3.750E+05	-16000.0029	2.505E-05	917.3268	324.9759
203.040	-.009285	2.898E+05	-14168.3647	5.703E-05	854.5918	324.5412
208.680	-.008884	2.150E+05	-12356.2137	8.131E-05	799.4299	318.0655
214.320	-.008367	1.502E+05	-10594.5499	9.888E-05	751.6980	306.6380
219.960	-.007769	95151.0340	-8908.4195	1.107E-04	711.1357	291.2805
225.600	-.007119	49351.7964	-7317.3421	1.176E-04	677.3895	272.9313
231.240	-.006442	12226.6302	-5959.2465	1.206E-04	650.0346	208.6629
236.880	-.005759	-18262.9779	-4833.3661	1.203E-04	654.4823	190.5855
242.520	-.005085	-42687.2640	-3811.2151	1.174E-04	672.4789	171.8794
248.160	-.004435	-61637.4189	-2894.9910	1.124E-04	686.4419	153.0228
253.800	-.003818	-75710.2827	-2084.3838	1.057E-04	696.8112	134.4266
259.440	-.003242	-85495.1777	-1376.9517	9.799E-05	704.0210	116.4359
265.080	-.002712	-91562.8429	-768.4868	8.947E-05	708.4918	99.3318
270.720	-.002233	-94456.3961	-253.3650	8.053E-05	710.6239	83.3355
276.360	-.001804	-94684.2193	175.1257	7.143E-05	710.7917	68.6116
282.000	-.001427	-92714.6375	524.4813	6.242E-05	709.3405	55.2734
287.640	-.001100	-88972.2444	802.7043	5.368E-05	706.5830	43.3873
293.280	-8.21E-04	-83835.7210	1018.0548	4.537E-05	702.7982	32.9782
298.920	-5.88E-04	-77636.9839	1178.8303	3.760E-05	698.2308	24.0344
304.560	-3.97E-04	-70661.5071	1293.1720	3.047E-05	693.0911	16.5123
310.200	-2.45E-04	-63149.6627	1368.8985	2.403E-05	687.5562	10.3411
315.840	-1.26E-04	-55298.9368	1413.3636	1.833E-05	681.7715	5.4267
321.480	-3.79E-05	-47266.8888	1433.3358	1.340E-05	675.8533	1.6556
327.120	2.48E-05	-39174.7393	1401.2262	9.241E-06	669.8907	-13.0420

332.760	6.63E-05	-31491.2873	1303.8667	5.842E-06	664.2293	-21.4826
338.400	9.07E-05	-24486.2344	1172.3037	3.150E-06	659.0678	-25.1709
344.040	1.02E-04	-18278.0046	1026.0304	1.093E-06	654.4934	-26.6991
349.680	1.03E-04	-12916.1869	874.9209	-4.075E-07	650.5427	-26.8858
355.320	9.73E-05	-8407.5638	725.3558	-1.433E-06	647.2206	-26.1515
360.960	8.69E-05	-4729.4857	581.7850	-2.065E-06	644.5105	-24.7601
366.600	7.40E-05	-1838.2736	447.3935	-2.381E-06	642.3801	-22.8964
372.240	6.00E-05	324.9010	324.4600	-2.454E-06	641.2650	-20.6970
377.880	4.63E-05	1829.6622	214.5900	-2.350E-06	642.3738	-18.2640
383.520	3.35E-05	2753.1642	118.8954	-2.130E-06	643.0543	-15.6702
389.160	2.23E-05	3177.7692	38.1715	-1.844E-06	643.3671	-12.9553
394.800	1.27E-05	3189.7721	-26.8843	-1.538E-06	643.3760	-10.1142
400.440	4.92E-06	2879.5454	-56.0529	-1.246E-06	643.1474	-.2293
406.080	-1.33E-06	2561.5722	-56.5216	-9.845E-07	642.9131	.063081
411.720	-6.19E-06	2245.2026	-55.5048	-7.533E-07	642.6800	.2975
417.360	-9.83E-06	1937.9420	-53.3143	-5.521E-07	642.4536	.4793
423.000	-1.24E-05	1645.6230	-50.2305	-3.797E-07	642.2382	.6143
428.640	-1.41E-05	1372.5845	-46.5015	-2.346E-07	642.0370	.7081
434.280	-1.51E-05	1121.8537	-42.3435	-1.146E-07	641.8523	.7664
439.920	-1.54E-05	895.3251	-37.9413	-1.757E-08	641.6853	.7947
445.560	-1.53E-05	693.9332	-33.4500	5.887E-08	641.5370	.7980
451.200	-1.47E-05	517.8160	-28.9968	1.172E-07	641.4072	.7812
456.840	-1.39E-05	366.4666	-24.6829	1.597E-07	641.2957	.7486
462.480	-1.29E-05	238.8708	-20.5867	1.888E-07	641.2016	.7040
468.120	-1.18E-05	133.6308	-16.7661	2.067E-07	641.1241	.6509
473.760	-1.06E-05	49.0731	-13.2610	2.155E-07	641.0618	.5921
479.400	-9.38E-06	-16.6583	-10.0964	2.171E-07	641.0379	.5301
485.040	-8.16E-06	-65.5242	-7.2847	2.131E-07	641.0739	.4669
490.680	-6.98E-06	-99.5266	-4.8284	2.052E-07	641.0990	.4041
496.320	-5.85E-06	-120.6593	-2.7223	1.946E-07	641.1145	.3427
501.960	-4.78E-06	-130.8703	-.9557	1.825E-07	641.1221	.2837
507.600	-3.79E-06	-132.0364	.4856	1.698E-07	641.1229	.2274
513.240	-2.87E-06	-125.9483	1.6177	1.574E-07	641.1184	.1741
518.880	-2.01E-06	-114.3037	2.4571	1.459E-07	641.1099	.1236
524.520	-1.22E-06	-98.7090	3.0195	1.356E-07	641.0984	.075821
530.160	-4.82E-07	-80.6869	3.3187	1.270E-07	641.0851	.030279
535.800	2.13E-07	-61.6889	3.3660	1.202E-07	641.0711	-.013522
541.440	8.74E-07	-43.1114	3.1695	1.151E-07	641.0574	-.056151
547.080	1.51E-06	-26.3132	2.7343	1.118E-07	641.0450	-.098191
552.720	2.13E-06	-12.6343	2.0620	1.099E-07	641.0350	-.1402
558.360	2.75E-06	-3.4129	1.1517	1.091E-07	641.0282	-.1826
564.000	3.37E-06	0.0000	0.0000	1.090E-07	641.0256	-.2258

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	.50000000 in
Computed slope at pile head	=	-.00545951
Maximum bending moment	=	2525000.037 lbs-in
Maximum shear force	=	55877.261 lbs
Depth of maximum bending moment	=	84.600 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	6

Number of zero deflection points = 4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .600000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.600000	0.0000	62559.6118	-.006432	641.0256	-405.2299
5.640	.563726	3.569E+05	60014.1208	-.006414	904.0078	-497.4265
11.280	.527645	6.979E+05	56982.0944	-.006364	1155.2898	-577.7601
16.920	.491944	1.020E+06	53510.7046	-.006281	1392.9491	-653.2292
22.560	.456795	1.322E+06	49652.2856	-.006168	1615.1797	-715.0045
28.200	.422365	1.601E+06	45474.1926	-.006028	1820.4985	-766.5887
33.840	.388802	1.855E+06	41047.3047	-.005862	2007.6642	-803.2297
39.480	.356246	2.083E+06	36439.6732	-.005672	2175.7886	-830.6821
45.120	.324820	2.284E+06	31716.0811	-.005462	2324.2018	-844.3505
50.760	.294634	2.459E+06	26930.8645	-.005234	2452.5601	-852.5348
56.400	.265781	2.605E+06	22105.6013	-.004990	2560.6514	-858.5515
62.040	.238342	2.724E+06	17303.5255	-.004734	2648.3178	-844.3123
67.680	.212380	2.816E+06	12642.3864	-.004468	2715.8792	-808.5739
73.320	.187947	2.881E+06	8194.9412	-.004194	2764.1625	-768.5343
78.960	.165077	2.922E+06	3851.7720	-.003914	2794.0987	-771.5966
84.600	.143792	2.938E+06	-480.3093	-.003633	2805.6112	-764.6025
90.240	.124101	2.929E+06	-4744.2190	-.003350	2798.8623	-747.4223
95.880	.106000	2.895E+06	-8882.8047	-.003070	2774.2556	-720.1613
101.520	.089468	2.838E+06	-12813.7880	-.002795	2732.4339	-673.8044
107.160	.074477	2.760E+06	-16366.7347	-.002525	2674.4903	-586.1058
112.800	.060983	2.662E+06	-19431.1070	-.002264	2602.4896	-500.5511
118.440	.048934	2.548E+06	-22022.0053	-.002014	2518.4481	-418.2072
124.080	.038267	2.420E+06	-24160.1229	-.001775	2424.3093	-339.9905
129.720	.028912	2.281E+06	-25870.8923	-.001549	2321.9210	-266.6653
135.360	.020796	2.133E+06	-27183.6271	-.001336	2213.0182	-198.8435
141.000	.013837	1.979E+06	-28130.6719	-.001139	2099.2074	-136.9880
146.640	.007952	1.820E+06	-28746.5701	-9.559E-04	1981.9565	-81.4157
152.280	.003054	1.658E+06	-29067.2582	-7.887E-04	1862.5863	-32.3035
157.920	-9.44E-04	1.495E+06	-29129.2926	-6.370E-04	1742.2669	10.3055
163.560	-.004132	1.331E+06	-28969.1145	-5.011E-04	1622.0156	46.4953
169.200	-.006597	1.169E+06	-28282.1670	-3.808E-04	1502.6998	197.1031
174.840	-.008427	1.014E+06	-26996.1530	-2.758E-04	1387.8682	258.9302
180.480	-.009708	8.658E+05	-25401.6595	-1.854E-04	1278.9879	306.4930
186.120	-.010519	7.277E+05	-23575.7439	-1.088E-04	1177.1910	340.9948
191.760	-.010935	6.002E+05	-21588.4016	-4.492E-05	1083.3019	363.7365
197.400	-.011026	4.843E+05	-19502.1349	7.249E-06	997.8687	376.0744
203.040	-.010853	3.802E+05	-17371.7515	4.883E-05	921.1938	379.3807
208.680	-.010475	2.882E+05	-15244.3699	8.098E-05	853.3668	375.0099

214.320	-.009940	2.080E+05	-13159.6040	1.048E-04	794.2960	364.2687
219.960	-.009292	1.394E+05	-11149.9033	1.216E-04	743.7389	348.3911
225.600	-.008569	81844.9105	-9241.0205	1.322E-04	701.3314	328.5177
231.240	-.007801	34727.9006	-7602.0499	1.378E-04	666.6142	252.6775
236.880	-.007014	-4357.0033	-6234.8572	1.393E-04	644.2360	232.1426
242.520	-.006230	-36056.8590	-4986.3841	1.373E-04	667.5934	210.5784
248.160	-.005465	-61052.6268	-3860.7478	1.327E-04	686.0110	188.5834
253.800	-.004734	-80040.0262	-2858.9150	1.259E-04	700.0015	166.6765
259.440	-.004046	-93712.9204	-1979.1480	1.175E-04	710.0761	145.2976
265.080	-.003408	-1.027E+05	-1217.4431	1.081E-04	716.7343	124.8105
270.720	-.002827	-1.078E+05	-567.9524	9.793E-05	720.4552	105.5054
276.360	-.002304	-1.095E+05	-23.3821	8.748E-05	721.6908	87.6046
282.000	-.001840	-1.083E+05	424.6361	7.700E-05	720.8604	71.2670
287.640	-.001435	-1.049E+05	785.2047	6.675E-05	718.3471	56.5942
293.280	-.001087	-99710.3092	1067.8538	5.690E-05	714.4951	43.6360
298.920	-7.93E-04	-93078.8165	1282.2674	4.763E-05	709.6088	32.3972
304.560	-5.50E-04	-85402.1377	1438.0433	3.904E-05	703.9524	22.8425
310.200	-3.53E-04	-76985.4106	1544.4852	3.123E-05	697.7507	14.9028
315.840	-1.97E-04	-68082.5173	1610.4246	2.426E-05	691.1908	8.4799
321.480	-7.90E-05	-58899.1682	1644.0706	1.815E-05	684.4243	3.4512
327.120	7.35E-06	-49596.7696	1633.6227	1.293E-05	677.5700	-7.1562
332.760	6.68E-05	-40514.2020	1552.4259	8.596E-06	670.8777	-21.6370
338.400	1.04E-04	-32113.5252	1415.1489	5.103E-06	664.6878	-27.0427
344.040	1.24E-04	-24568.0145	1255.5888	2.376E-06	659.1281	-29.5389
349.680	1.31E-04	-17958.2575	1086.7313	3.310E-07	654.2578	-30.3397
355.320	1.28E-04	-12310.7679	916.5621	-1.125E-06	650.0966	-30.0040
360.960	1.18E-04	-7615.7573	750.5510	-2.083E-06	646.6372	-28.8652
366.600	1.05E-04	-3837.7382	592.5858	-2.634E-06	643.8534	-27.1508
372.240	8.87E-05	-922.7722	445.4379	-2.863E-06	641.7056	-25.0293
377.880	7.23E-05	1196.1669	311.0373	-2.850E-06	641.9070	-22.6305
383.520	5.66E-05	2595.0518	190.6638	-2.668E-06	642.9378	-20.0552
389.160	4.22E-05	3355.5814	85.1032	-2.381E-06	643.4981	-17.3777
394.800	2.97E-05	3562.8059	-5.1889	-2.049E-06	643.6508	-14.6408
400.440	1.91E-05	3303.7528	-48.9912	-1.718E-06	643.4599	-.8920
406.080	1.03E-05	3015.8063	-52.8855	-1.414E-06	643.2478	-.4890
411.720	3.17E-06	2711.8313	-54.6936	-1.139E-06	643.0238	-.1522
417.360	-2.52E-06	2402.5883	-54.7761	-8.930E-07	642.7959	.1229
423.000	-6.91E-06	2096.8776	-53.4662	-6.765E-07	642.5707	.3416
428.640	-1.02E-05	1801.7031	-51.0664	-4.890E-07	642.3532	.5094
434.280	-1.24E-05	1522.4478	-47.8478	-3.291E-07	642.1474	.6320
439.920	-1.39E-05	1263.0561	-44.0488	-1.952E-07	641.9563	.7152
445.560	-1.46E-05	1026.2155	-39.8758	-8.505E-08	641.7818	.7646
451.200	-1.48E-05	813.5352	-35.5043	3.437E-09	641.6251	.7856
456.840	-1.46E-05	625.7159	-31.0805	7.266E-08	641.4867	.7831
462.480	-1.40E-05	462.7094	-26.7235	1.250E-07	641.3666	.7619
468.120	-1.32E-05	323.8656	-22.5277	1.628E-07	641.2643	.7260
473.760	-1.22E-05	208.0645	-18.5653	1.884E-07	641.1789	.6791
479.400	-1.10E-05	113.8331	-14.8892	2.039E-07	641.1095	.6244
485.040	-9.87E-06	39.4471	-11.5360	2.113E-07	641.0547	.5647
490.680	-8.67E-06	-16.9837	-8.5281	2.124E-07	641.0382	.5020
496.320	-7.47E-06	-57.4446	-5.8771	2.088E-07	641.0680	.4381
501.960	-6.31E-06	-83.9602	-3.5857	2.020E-07	641.0875	.3744
507.600	-5.19E-06	-98.5519	-1.6504	1.932E-07	641.0983	.3119
513.240	-4.13E-06	-103.2082	-.063280	1.835E-07	641.1017	.2509
518.880	-3.12E-06	-99.8660	1.1857	1.737E-07	641.0992	.1920
524.520	-2.17E-06	-90.4014	2.1077	1.646E-07	641.0923	.1350
530.160	-1.27E-06	-76.6297	2.7129	1.566E-07	641.0821	.079675

535.800	-4.05E-07	-60.3115	3.0103	1.500E-07	641.0701	.025764
541.440	4.24E-07	-43.1643	3.0061	1.450E-07	641.0574	-.027260
547.080	1.23E-06	-26.8774	2.7038	1.416E-07	641.0454	-.079931
552.720	2.02E-06	-13.1289	2.1039	1.397E-07	641.0353	-.1328
558.360	2.81E-06	-3.6021	1.2042	1.389E-07	641.0283	-.1863
564.000	3.59E-06	0.0000	0.0000	1.387E-07	641.0256	-.2407

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection = .60000000 in
Computed slope at pile head = -.00643158
Maximum bending moment = 2937703.425 lbs-in
Maximum shear force = 62559.612 lbs
Depth of maximum bending moment = 84.600 in
Depth of maximum shear force = 0.000 in
Number of iterations = 7
Number of zero deflection points = 4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .700000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.700000	0.0000	68992.9304	-.007391	641.0256	-431.3590
5.640	.658315	3.943E+05	66284.7553	-.007372	931.5929	-528.9868
11.280	.616843	7.718E+05	63061.9123	-.007316	1209.7159	-613.8653
16.920	.575791	1.130E+06	59375.0897	-.007224	1473.3615	-693.5186
22.560	.535351	1.465E+06	55280.0600	-.007100	1720.6213	-758.6196
28.200	.495706	1.776E+06	50849.5110	-.006944	1949.9305	-812.4971
33.840	.457025	2.061E+06	46160.0590	-.006759	2159.9903	-850.4292
39.480	.419463	2.319E+06	41278.0708	-.006548	2349.8785	-880.7723
45.120	.383159	2.549E+06	36258.7764	-.006314	2518.8541	-899.1194
50.760	.348237	2.749E+06	31149.0537	-.006060	2666.4604	-912.8391
56.400	.314807	2.920E+06	25965.8743	-.005787	2792.3528	-925.1678
62.040	.282961	3.061E+06	20772.1714	-.005499	2896.2223	-916.5708
67.680	.252776	3.172E+06	15690.6493	-.005199	2978.2542	-885.3874
73.320	.224311	3.255E+06	10800.4778	-.004890	3039.1664	-848.7160
78.960	.197612	3.310E+06	5995.2527	-.004575	3079.8089	-855.2645
84.600	.172710	3.337E+06	1183.7903	-.004255	3100.0218	-850.9278
90.240	.149617	3.337E+06	-3571.8529	-.003934	3099.9035	-835.4706

95.880	.128336	3.310E+06	-8209.0008	-.003614	3079.8164	-808.9081
101.520	.108850	3.256E+06	-12731.6809	-.003298	3040.3862	-794.8791
107.160	.091131	3.177E+06	-16995.6334	-.002989	2981.9479	-717.1608
112.800	.075135	3.074E+06	-20757.1442	-.002688	2906.3323	-616.7083
118.440	.060808	2.952E+06	-23961.7752	-.002398	2815.9057	-519.6857
124.080	.048082	2.812E+06	-26631.9779	-.002121	2712.9564	-427.1947
129.720	.036881	2.658E+06	-28795.9233	-.001858	2599.6684	-340.1619
135.360	.027123	2.493E+06	-30486.5145	-.001610	2478.0995	-259.3385
141.000	.018717	2.320E+06	-31740.4023	-.001379	2350.1630	-185.3026
146.640	.011570	2.140E+06	-32597.0204	-.001164	2217.6145	-118.4627
152.280	.005584	1.956E+06	-33097.6466	-9.673E-04	2082.0414	-59.0643
157.920	6.59E-04	1.770E+06	-33284.5017	-7.881E-04	1944.8571	-7.1963
163.560	-.003306	1.583E+06	-33199.8889	-6.269E-04	1807.2991	37.2009
169.200	-.006412	1.397E+06	-32554.7228	-4.835E-04	1670.4294	191.5815
174.840	-.008760	1.217E+06	-31255.4449	-3.578E-04	1537.8882	269.1554
180.480	-.010448	1.046E+06	-29566.2403	-2.490E-04	1411.5143	329.8533
186.120	-.011568	8.845E+05	-27578.5095	-1.561E-04	1292.7504	375.0157
191.760	-.012209	7.351E+05	-25375.7307	-7.823E-05	1182.6737	406.1115
197.400	-.012451	5.985E+05	-23032.8777	-1.408E-05	1082.0303	424.6874
203.040	-.012368	4.753E+05	-20616.1123	3.757E-05	991.2714	432.3216
208.680	-.012027	3.658E+05	-18182.7232	7.803E-05	910.5903	430.5824
214.320	-.011488	2.700E+05	-15781.2822	1.086E-04	839.9589	420.9924
219.960	-.010802	1.875E+05	-13451.9895	1.306E-04	779.1635	404.9979
225.600	-.010014	1.178E+05	-11227.1751	1.453E-04	727.8387	383.9433
231.240	-.009163	60358.1948	-9307.4950	1.539E-04	685.4993	296.7943
236.880	-.008279	12327.9602	-7697.8800	1.574E-04	650.1092	273.9911
242.520	-.007388	-26988.6655	-6221.0282	1.567E-04	660.9117	249.7152
248.160	-.006512	-58357.7055	-4883.2105	1.526E-04	684.0253	224.6883
253.800	-.005667	-82570.3188	-3686.8846	1.458E-04	701.8659	199.5408
259.440	-.004867	-1.004E+05	-2631.2117	1.370E-04	715.0200	174.8113
265.080	-.004122	-1.127E+05	-1712.5662	1.267E-04	724.0652	150.9495
270.720	-.003438	-1.202E+05	-925.0291	1.155E-04	729.5593	128.3190
276.360	-.002819	-1.235E+05	-260.8566	1.038E-04	732.0319	107.2031
282.000	-.002267	-1.234E+05	289.0809	9.193E-05	731.9776	87.8102
287.640	-.001782	-1.206E+05	734.8965	8.019E-05	729.8508	70.2804
293.280	-.001362	-1.154E+05	1087.3201	6.884E-05	726.0628	54.6925
298.920	-.001005	-1.085E+05	1357.3729	5.807E-05	720.9796	41.0709
304.560	-7.07E-04	-1.003E+05	1556.0796	4.803E-05	714.9211	29.3925
310.200	-4.64E-04	-91115.3286	1694.2192	3.882E-05	708.1621	19.5932
315.840	-2.69E-04	-81304.6364	1782.1117	3.053E-05	700.9333	11.5744
321.480	-1.19E-04	-71112.9761	1829.4380	2.320E-05	693.4238	5.2080
327.120	-7.71E-06	-60744.4617	1864.0301	1.686E-05	685.7839	7.0587
332.760	7.09E-05	-50141.8569	1820.7320	1.152E-05	677.9716	-22.4126
338.400	1.22E-04	-40244.2977	1674.6515	7.175E-06	670.6788	-29.3890
344.040	1.52E-04	-31275.2593	1499.4294	3.735E-06	664.0702	-32.7465
349.680	1.64E-04	-23342.9524	1310.9488	1.108E-06	658.2254	-34.0906
355.320	1.64E-04	-16491.3821	1118.6312	-8.078E-07	653.1770	-34.1071
360.960	1.55E-04	-10722.1503	928.8500	-2.117E-06	648.9260	-33.1912
366.600	1.40E-04	-6007.0302	746.1147	-2.921E-06	645.4518	-31.6085
372.240	1.22E-04	-2296.4200	573.6347	-3.321E-06	642.7177	-29.5546
377.880	1.03E-04	474.4326	413.6402	-3.408E-06	641.3752	-27.1811
383.520	8.39E-05	2380.5906	267.5921	-3.271E-06	642.7797	-24.6090
389.160	6.61E-05	3503.5720	136.3433	-2.988E-06	643.6072	-21.9332
394.800	5.02E-05	3928.3174	20.2867	-2.631E-06	643.9201	-19.2217
400.440	3.64E-05	3741.0110	-38.7079	-2.262E-06	643.7821	-1.6984
406.080	2.47E-05	3499.0905	-46.7915	-1.913E-06	643.6039	-1.1681
411.720	1.48E-05	3219.4626	-52.0947	-1.590E-06	643.3978	-.7125

417.360	6.73E-06	2916.6646	-55.0293	-1.295E-06	643.1747	-.3281
423.000	2.16E-07	2602.9695	-55.9848	-1.030E-06	642.9436	-.010681
428.640	-4.89E-06	2288.5250	-55.3236	-7.944E-07	642.7119	.2451
434.280	-8.75E-06	1981.5175	-53.3777	-5.891E-07	642.4857	.4449
439.920	-1.15E-05	1688.3514	-50.4458	-4.125E-07	642.2697	.5947
445.560	-1.34E-05	1413.8380	-46.7930	-2.633E-07	642.0674	.7006
451.200	-1.45E-05	1161.3873	-42.6505	-1.395E-07	641.8814	.7684
456.840	-1.50E-05	933.1963	-38.2165	-3.872E-08	641.7132	.8039
462.480	-1.49E-05	730.4316	-33.6579	4.130E-08	641.5638	.8126
468.120	-1.45E-05	553.4006	-29.1121	1.031E-07	641.4334	.7994
473.760	-1.38E-05	401.7104	-24.6898	1.490E-07	641.3216	.7688
479.400	-1.28E-05	274.4119	-20.4778	1.815E-07	641.2278	.7248
485.040	-1.17E-05	170.1274	-16.5413	2.029E-07	641.1510	.6711
490.680	-1.05E-05	87.1621	-12.9277	2.153E-07	641.0899	.6104
496.320	-9.30E-06	23.5983	-9.6690	2.206E-07	641.0430	.5452
501.960	-8.05E-06	-22.6260	-6.7848	2.206E-07	641.0423	.4776
507.600	-6.81E-06	-53.6556	-4.2849	2.170E-07	641.0652	.4089
513.240	-5.60E-06	-71.6700	-2.1724	2.109E-07	641.0784	.3402
518.880	-4.43E-06	-78.8502	-.4451	2.037E-07	641.0837	.2723
524.520	-3.30E-06	-77.3571	.9017	1.962E-07	641.0826	.2053
530.160	-2.22E-06	-69.3208	1.8738	1.891E-07	641.0767	.1394
535.800	-1.17E-06	-56.8393	2.4766	1.831E-07	641.0675	.074354
541.440	-1.53E-07	-41.9837	2.7139	1.783E-07	641.0566	.009808
547.080	8.42E-07	-26.8095	2.5874	1.750E-07	641.0454	-.054692
552.720	1.82E-06	-13.3707	2.0957	1.731E-07	641.0355	-.1196
558.360	2.79E-06	-3.7356	1.2353	1.723E-07	641.0284	-.1855
564.000	3.76E-06	0.0000	0.0000	1.721E-07	641.0256	-.2526

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

```
Pile-head deflection             =      .70000000 in
Computed slope at pile head      =     -.00739101
Maximum bending moment           =    3337267.623 lbs-in
Maximum shear force              =      68992.930 lbs
Depth of maximum bending moment  =         84.600 in
Depth of maximum shear force     =          0.000 in
Number of iterations             =              7
Number of zero deflection points =              4
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 8

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head     =         .800000 in
Specified bending moment at pile head =            .000 in-lbs
Specified axial load at pile head     =      290000.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.800000	0.0000	75258.0502	-.008341	641.0256	-457.4880
5.640	.752957	4.308E+05	72387.1404	-.008320	958.4675	-560.5651
11.280	.706149	8.437E+05	68973.3080	-.008259	1262.7207	-650.0138
16.920	.659798	1.236E+06	65070.7149	-.008159	1551.6409	-733.8845
22.560	.614117	1.604E+06	60738.5305	-.008022	1823.2169	-802.3511
28.200	.569307	1.947E+06	56054.7412	-.007851	2075.8012	-858.5671
33.840	.525554	2.262E+06	51101.8814	-.007649	2308.0365	-897.7662
39.480	.483028	2.549E+06	45947.9623	-.007417	2518.9674	-929.8647
45.120	.441884	2.805E+06	40645.7055	-.007160	2707.8084	-950.3682
50.760	.402263	3.031E+06	35235.0871	-.006879	2874.0493	-968.2908
56.400	.364286	3.225E+06	29721.8825	-.006578	3017.2438	-986.7463
62.040	.328058	3.387E+06	24164.9959	-.006260	3136.9368	-983.7809
67.680	.293668	3.518E+06	18690.9832	-.005928	3233.1790	-957.3584
73.320	.261187	3.618E+06	13384.4858	-.005585	3306.5746	-924.3782
78.960	.230669	3.687E+06	8142.6744	-.005234	3357.8850	-934.4201
84.600	.202151	3.727E+06	2877.0513	-.004877	3386.8668	-932.8221
90.240	.175656	3.736E+06	-2345.7779	-.004518	3393.5528	-919.2450
95.880	.151186	3.715E+06	-7458.0347	-.004160	3378.2602	-893.6121
101.520	.128733	3.665E+06	-12460.2972	-.003805	3341.5923	-880.2399
107.160	.108268	3.587E+06	-17345.2829	-.003456	3283.8682	-852.0245
112.800	.089749	3.481E+06	-21825.3674	-.003116	3205.7583	-736.6579
118.440	.073118	3.351E+06	-25664.9536	-.002788	3109.9789	-624.8975
124.080	.058306	3.200E+06	-28888.0199	-.002472	2999.1645	-518.0338
129.720	.045229	3.033E+06	-31525.2661	-.002173	2875.8373	-417.1599
135.360	.033799	2.852E+06	-33612.9972	-.001890	2742.3810	-323.1703
141.000	.023915	2.660E+06	-35192.0080	-.001624	2601.0195	-236.7626
146.640	.015475	2.460E+06	-36306.4854	-.001378	2453.8003	-158.4421
152.280	.008370	2.255E+06	-37002.9389	-.001151	2302.5823	-88.5272
157.920	.002488	2.047E+06	-37329.1708	-9.444E-04	2149.0280	-27.1578
163.560	-.002283	1.837E+06	-37333.2916	-7.576E-04	1994.5999	25.6966
169.200	-.006058	1.628E+06	-36750.3695	-5.910E-04	1840.5610	181.0134
174.840	-.008950	1.424E+06	-35464.4641	-4.442E-04	1690.5761	274.9814
180.480	-.011068	1.229E+06	-33703.5869	-3.165E-04	1546.8711	349.4431
186.120	-.012520	1.045E+06	-31573.6110	-2.071E-04	1411.2139	405.8675
191.760	-.013405	8.739E+05	-29171.6715	-1.148E-04	1284.9484	445.8841
197.400	-.013815	7.166E+05	-26585.4238	-3.831E-05	1169.0322	471.2250
203.040	-.013837	5.742E+05	-23892.6193	2.377E-05	1064.0777	483.6702
208.680	-.013547	4.470E+05	-21160.9697	7.289E-05	970.3930	484.9998
214.320	-.013015	3.352E+05	-18448.2676	1.105E-04	888.0241	476.9513
219.960	-.012300	2.385E+05	-15802.7291	1.381E-04	816.7951	461.1830
225.600	-.011457	1.565E+05	-13263.5247	1.571E-04	756.3478	439.2441
231.240	-.010528	88421.9622	-11063.1884	1.689E-04	706.1775	341.0170
236.880	-.009552	31166.1879	-9210.0622	1.746E-04	663.9898	316.1200
242.520	-.008558	-16038.8406	-7502.8499	1.754E-04	652.8435	289.2745
248.160	-.007574	-54039.6400	-5950.1495	1.720E-04	680.8436	261.3285
253.800	-.006618	-83719.1820	-4556.0689	1.654E-04	702.7124	233.0263
259.440	-.005708	-1.060E+05	-3320.8109	1.563E-04	719.1097	205.0084
265.080	-.004856	-1.217E+05	-2241.2548	1.453E-04	730.6897	177.8129
270.720	-.004069	-1.317E+05	-1311.5220	1.331E-04	738.0880	151.8796
276.360	-.003354	-1.369E+05	-523.5149	1.202E-04	741.9112	127.5555
282.000	-.002713	-1.380E+05	132.5754	1.070E-04	742.7288	105.1007
287.640	-.002147	-1.358E+05	667.8020	9.380E-05	741.0671	84.6960
293.280	-.001655	-1.308E+05	1094.0357	8.098E-05	737.4045	66.4507

298.920	-.001234	-1.237E+05	1423.5847	6.873E-05	732.1693	50.4106
304.560	-8.80E-04	-1.150E+05	1668.8568	5.726E-05	725.7382	36.5654
310.200	-5.88E-04	-1.051E+05	1842.0676	4.667E-05	718.4367	24.8569
315.840	-3.53E-04	-94343.1518	1954.9892	3.708E-05	710.5404	15.1862
321.480	-1.70E-04	-83128.7073	2018.7383	2.855E-05	702.2773	7.4198
327.120	-3.15E-05	-71665.1611	2081.3338	2.110E-05	693.8306	14.7772
332.760	6.81E-05	-59720.2837	2061.2378	1.478E-05	685.0293	-21.9034
338.400	1.35E-04	-48462.7480	1912.5012	9.577E-06	676.7344	-30.8401
344.040	1.76E-04	-38178.5982	1726.2914	5.410E-06	669.1567	-35.1917
349.680	1.96E-04	-29007.8767	1522.2615	2.178E-06	662.3995	-37.1593
355.320	2.01E-04	-21014.6130	1311.4706	-2.280E-07	656.5098	-37.5893
360.960	1.94E-04	-14213.7428	1101.2742	-1.922E-06	651.4987	-36.9485
366.600	1.79E-04	-8585.9517	896.8487	-3.019E-06	647.3520	-35.5428
372.240	1.60E-04	-4087.4133	701.8811	-3.629E-06	644.0374	-33.5946
377.880	1.38E-04	-656.8627	518.9480	-3.857E-06	641.5096	-31.2753
383.520	1.16E-04	1778.9367	349.7566	-3.803E-06	642.3364	-28.7217
389.160	9.52E-05	3300.8314	195.3219	-3.559E-06	643.4578	-26.0424
394.800	7.60E-05	3993.8089	56.1246	-3.208E-06	643.9684	-23.3184
400.440	5.90E-05	3944.4101	-17.3943	-2.826E-06	643.9320	-2.7522
406.080	4.41E-05	3806.8457	-31.0484	-2.453E-06	643.8306	-2.0897
411.720	3.13E-05	3602.2089	-41.1872	-2.097E-06	643.6799	-1.5056
417.360	2.05E-05	3349.1128	-48.2494	-1.762E-06	643.4934	-.9987
423.000	1.15E-05	3063.7211	-52.6630	-1.454E-06	643.2831	-.5664
428.640	4.08E-06	2759.8299	-54.8378	-1.174E-06	643.0592	-.2048
434.280	-1.79E-06	2448.9904	-55.1585	-9.232E-07	642.8301	.091060
439.920	-6.33E-06	2140.6622	-53.9806	-7.025E-07	642.6029	.3266
445.560	-9.71E-06	1842.3876	-51.6271	-5.109E-07	642.3832	.5079
451.200	-1.21E-05	1559.9795	-48.3873	-3.473E-07	642.1751	.6410
456.840	-1.36E-05	1297.7150	-44.5157	-2.098E-07	641.9818	.7319
462.480	-1.45E-05	1058.5291	-40.2329	-9.648E-08	641.8056	.7868
468.120	-1.47E-05	844.2037	-35.7268	-4.962E-09	641.6477	.8111
473.760	-1.45E-05	655.5474	-31.1543	6.717E-08	641.5087	.8103
479.400	-1.40E-05	492.5630	-26.6442	1.224E-07	641.3886	.7891
485.040	-1.31E-05	354.6010	-22.2990	1.631E-07	641.2869	.7518
490.680	-1.21E-05	240.4964	-18.1990	1.918E-07	641.2028	.7022
496.320	-1.10E-05	148.6891	-14.4044	2.105E-07	641.1352	.6435
501.960	-9.75E-06	77.3265	-10.9589	2.214E-07	641.0826	.5784
507.600	-8.48E-06	24.3492	-7.8925	2.262E-07	641.0436	.5090
513.240	-7.20E-06	-12.4406	-5.2245	2.268E-07	641.0348	.4371
518.880	-5.92E-06	-35.3252	-2.9662	2.245E-07	641.0517	.3637
524.520	-4.66E-06	-46.6339	-1.1232	2.206E-07	641.0600	.2898
530.160	-3.43E-06	-48.7168	.3022	2.160E-07	641.0615	.2157
535.800	-2.23E-06	-43.9316	1.3094	2.115E-07	641.0580	.1415
541.440	-1.04E-06	-34.6384	1.8978	2.078E-07	641.0512	.067151
547.080	1.18E-07	-23.2038	2.0656	2.050E-07	641.0427	-.007639
552.720	1.27E-06	-12.0085	1.8094	2.033E-07	641.0345	-.083241
558.360	2.41E-06	-3.4593	1.1233	2.025E-07	641.0282	-.1600
564.000	3.55E-06	0.0000	0.0000	2.024E-07	641.0256	-.2383

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection = .80000000 in

Computed slope at pile head = -.00834088
Maximum bending moment = 3735638.054 lbs-in
Maximum shear force = 75258.050 lbs
Depth of maximum bending moment = 90.240 in
Depth of maximum shear force = 0.000 in
Number of iterations = 7
Number of zero deflection points = 4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = .900000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.900000	0.0000	81385.5390	-.009282	641.0256	-483.6171
5.640	.847652	4.665E+05	78351.8460	-.009259	984.7591	-592.1605
11.280	.795556	9.141E+05	74746.8585	-.009193	1314.5593	-686.2038
16.920	.743957	1.340E+06	70628.1702	-.009084	1628.1702	-774.3239
22.560	.693085	1.741E+06	66058.3073	-.008936	1923.4769	-846.1948
28.200	.643156	2.114E+06	61120.5212	-.008751	2198.7485	-904.7931
33.840	.594375	2.459E+06	55903.2398	-.008531	2452.5682	-945.3066
39.480	.546928	2.773E+06	50476.0818	-.008279	2683.9466	-979.2175
45.120	.500985	3.055E+06	44889.7565	-.007999	2892.0525	-1001.7489
50.760	.456700	3.305E+06	39182.6490	-.007693	3076.3249	-1022.0481
56.400	.414207	3.522E+06	33355.0950	-.007365	3236.2591	-1044.4604
62.040	.373626	3.705E+06	27457.2984	-.007017	3371.3047	-1046.9568
67.680	.335055	3.855E+06	21613.0859	-.006653	3481.3819	-1025.4590
73.320	.298576	3.971E+06	15911.3406	-.006277	3566.9773	-996.4365
78.960	.264251	4.055E+06	10253.1885	-.005891	3628.7575	-1010.0004
84.600	.232126	4.106E+06	4553.3021	-.005498	3666.3950	-1011.2359
90.240	.202228	4.124E+06	-1117.5392	-.005103	3679.8549	-999.7008
95.880	.174569	4.110E+06	-6686.8321	-.004707	3669.4055	-975.2258
101.520	.149139	4.064E+06	-12151.5516	-.004313	3635.6220	-962.6180
107.160	.125914	3.987E+06	-17518.8578	-.003926	3578.8052	-940.6821
112.800	.104852	3.879E+06	-22598.5493	-.003548	3499.4783	-860.6269
118.440	.085895	3.744E+06	-27095.6675	-.003181	3399.5301	-734.0958
124.080	.068970	3.584E+06	-30893.8612	-.002829	3281.9419	-612.7814
129.720	.053989	3.405E+06	-34026.1151	-.002492	3149.5757	-497.9470
135.360	.040855	3.209E+06	-36531.9159	-.002174	3005.1438	-390.6349
141.000	.029461	3.000E+06	-38456.0083	-.001876	2851.1841	-291.6674
146.640	.019696	2.781E+06	-39847.1666	-.001598	2690.0405	-201.6511
152.280	.011439	2.555E+06	-40756.9955	-.001341	2523.8482	-120.9832
157.920	.004568	2.326E+06	-41238.7723	-.001106	2354.5239	-49.8596
163.560	-.001041	2.094E+06	-41346.3392	-8.938E-04	2183.7615	11.7153
169.200	-.005514	1.862E+06	-40848.6990	-7.035E-04	2013.0309	164.7529
174.840	-.008977	1.635E+06	-39606.3125	-5.353E-04	1845.9460	275.8097

180.480	-.011552	1.417E+06	-37800.0330	-3.885E-04	1685.1359	364.7149
186.120	-.013359	1.210E+06	-35550.3212	-2.621E-04	1532.7099	433.0552
191.760	-.014509	1.017E+06	-32968.1379	-1.550E-04	1390.2936	482.6126
197.400	-.015107	8.388E+05	-30154.0307	-6.575E-05	1259.0711	515.2977
203.040	-.015251	6.770E+05	-27197.5840	7.153E-06	1139.8289	533.0876
208.680	-.015027	5.320E+05	-24177.1991	6.530E-05	1033.0029	537.9708
214.320	-.014514	4.040E+05	-21160.1697	1.103E-04	938.7243	531.8978
219.960	-.013782	2.929E+05	-18203.0149	1.438E-04	856.8657	516.7387
225.600	-.012892	1.982E+05	-15352.0322	1.675E-04	787.0845	494.2481
231.240	-.011893	1.192E+05	-12871.9077	1.827E-04	728.8646	385.2286
236.880	-.010830	52433.3043	-10774.7802	1.910E-04	679.6600	358.4336
242.520	-.009739	-2952.1527	-8835.7147	1.934E-04	643.2009	329.1782
248.160	-.008649	-47866.1168	-7065.8334	1.909E-04	676.2948	298.4393
253.800	-.007585	-83279.3164	-5471.0746	1.846E-04	702.3883	267.0780
259.440	-.006566	-1.102E+05	-4052.8471	1.753E-04	722.2123	235.8396
265.080	-.005608	-1.296E+05	-2808.6813	1.638E-04	736.4958	205.3540
270.720	-.004719	-1.424E+05	-1732.8676	1.507E-04	745.9512	176.1403
276.360	-.003908	-1.496E+05	-817.0665	1.367E-04	751.2617	148.6119
282.000	-.003178	-1.521E+05	-50.8847	1.221E-04	753.0716	123.0838
287.640	-.002530	-1.506E+05	577.5913	1.076E-04	751.9790	99.7801
293.280	-.001964	-1.459E+05	1081.3085	9.333E-05	748.5303	78.8430
298.920	-.001477	-1.387E+05	1473.8095	7.964E-05	743.2167	60.3417
304.560	-.001066	-1.295E+05	1768.8453	6.674E-05	736.4728	44.2809
310.200	-7.24E-04	-1.190E+05	1980.0376	5.479E-05	728.6759	30.6100
315.840	-4.48E-04	-1.074E+05	2120.5887	4.390E-05	720.1479	19.2308
321.480	-2.29E-04	-95179.4328	2203.0359	3.416E-05	711.1566	10.0058
327.120	-6.23E-05	-82643.5507	2289.9000	2.560E-05	701.9198	20.7971
332.760	5.97E-05	-69433.1180	2290.5636	1.829E-05	692.1860	-20.5618
338.400	1.44E-04	-56865.8221	2142.7666	1.221E-05	682.9260	-31.8485
344.040	1.97E-04	-45302.6682	1947.8191	7.301E-06	674.4060	-37.2818
349.680	2.26E-04	-34918.3053	1730.1155	3.442E-06	666.7545	-39.9181
355.320	2.36E-04	-25798.2259	1502.5031	5.218E-07	660.0345	-40.7955
360.960	2.32E-04	-17971.7770	1273.3633	-1.583E-06	654.2678	-40.4597
366.600	2.18E-04	-11429.5086	1048.5563	-2.998E-06	649.4472	-39.2590
372.240	1.98E-04	-6134.2564	832.2586	-3.842E-06	645.5455	-37.4423
377.880	1.75E-04	-2029.0629	627.4081	-4.235E-06	642.5207	-35.1997
383.520	1.51E-04	956.7607	435.9809	-4.287E-06	641.7306	-32.6823
389.160	1.27E-04	2902.8244	259.1896	-4.101E-06	643.1645	-30.0097
394.800	1.04E-04	3893.8339	97.6538	-3.774E-06	643.8947	-27.2725
400.440	8.42E-05	4016.7051	9.6718	-3.394E-06	643.9853	-3.9269
406.080	6.61E-05	4014.0325	-10.2328	-3.007E-06	643.9833	-3.1315
411.720	5.03E-05	3911.1166	-25.8749	-2.626E-06	643.9075	-2.4154
417.360	3.65E-05	3730.7539	-37.7067	-2.259E-06	643.7746	-1.7803
423.000	2.48E-05	3493.1735	-46.1844	-1.911E-06	643.5995	-1.2260
428.640	1.50E-05	3216.0454	-51.7573	-1.588E-06	643.3953	-.7502
434.280	6.87E-06	2914.5469	-54.8582	-1.294E-06	643.1732	-.3494
439.920	3.62E-07	2601.4766	-55.8961	-1.028E-06	642.9425	-.018685
445.560	-4.73E-06	2287.4026	-55.2512	-7.931E-07	642.7111	.2474
451.200	-8.58E-06	1980.8375	-53.2709	-5.878E-07	642.4852	.4548
456.840	-1.14E-05	1688.4293	-50.2679	-4.113E-07	642.2697	.6100
462.480	-1.32E-05	1415.1609	-46.5190	-2.620E-07	642.0684	.7193
468.120	-1.43E-05	1164.5515	-42.2658	-1.379E-07	641.8837	.7889
473.760	-1.48E-05	938.8542	-37.7151	-3.674E-08	641.7174	.8248
479.400	-1.47E-05	739.2457	-33.0414	4.397E-08	641.5703	.8325
485.040	-1.43E-05	566.0035	-28.3890	1.068E-07	641.4427	.8173
490.680	-1.35E-05	418.6688	-23.8747	1.541E-07	641.3341	.7836
496.320	-1.25E-05	296.1927	-19.5911	1.885E-07	641.2439	.7355

501.960	-1.14E-05	197.0649	-15.6094	2.122E-07	641.1708	.6765
507.600	-1.01E-05	119.4241	-11.9832	2.274E-07	641.1136	.6094
513.240	-8.83E-06	61.1499	-8.7512	2.361E-07	641.0707	.5367
518.880	-7.49E-06	19.9379	-5.9404	2.400E-07	641.0403	.4601
524.520	-6.13E-06	-6.6431	-3.5691	2.407E-07	641.0305	.3809
530.160	-4.77E-06	-21.1084	-1.6492	2.393E-07	641.0412	.3000
535.800	-3.43E-06	-26.0289	-.1889	2.371E-07	641.0448	.2179
541.440	-2.10E-06	-24.0147	.8057	2.347E-07	641.0433	.1348
547.080	-7.81E-07	-17.7082	1.3289	2.327E-07	641.0387	.050721
552.720	5.27E-07	-9.7856	1.3744	2.313E-07	641.0329	-.034599
558.360	1.83E-06	-2.9620	.9344	2.307E-07	641.0278	-.1214
564.000	3.13E-06	0.0000	0.0000	2.306E-07	641.0256	-.2099

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 9:

Pile-head deflection	=	.90000000 in
Computed slope at pile head	=	-.00928163
Maximum bending moment	=	4124197.832 lbs-in
Maximum shear force	=	81385.539 lbs
Depth of maximum bending moment	=	90.240 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head = 1.000000 in
Specified bending moment at pile head = .000 in-lbs
Specified axial load at pile head = 290000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	1.000	0.0000	87291.5156	-.010218	641.0256	-483.6171
5.640	.942373	5.013E+05	84208.5669	-.010193	1010.4306	-609.6271
11.280	.885018	9.832E+05	80452.2060	-.010122	1365.4888	-722.4158
16.920	.828197	1.442E+06	76117.2523	-.010005	1703.5009	-814.8019
22.560	.772158	1.875E+06	71309.4373	-.009846	2022.2483	-890.0971
28.200	.717136	2.279E+06	66117.2606	-.009646	2319.9161	-951.1003
33.840	.663351	2.652E+06	60635.0322	-.009409	2595.0276	-992.9523
39.480	.611004	2.993E+06	54933.9604	-.009137	2846.5586	-1028.7044
45.120	.560281	3.301E+06	49062.7146	-.008835	3073.6315	-1053.2977
50.760	.511349	3.576E+06	43058.0566	-.008504	3275.6343	-1076.0137
56.400	.464357	3.815E+06	36917.8317	-.008148	3452.0026	-1101.3711

62.040	.419435	4.019E+06	30690.6722	-.007772	3602.1145	-1106.8415
67.680	.376694	4.187E+06	24495.5377	-.007377	3725.8181	-1090.0147
73.320	.336224	4.319E+06	18418.1467	-.006968	3823.4883	-1065.0885
78.960	.298097	4.417E+06	12363.0280	-.006548	3895.6939	-1082.1167
84.600	.262366	4.480E+06	6248.4461	-.006120	3942.0246	-1086.1747
90.240	.229067	4.508E+06	149.0828	-.005687	3962.3778	-1076.7201
95.880	.198213	4.500E+06	-5858.1141	-.005254	3956.9720	-1053.4916
101.520	.169800	4.459E+06	-11766.3563	-.004823	3926.3526	-1041.6297
107.160	.143807	4.383E+06	-17579.6754	-.004398	3870.8022	-1019.8310
112.800	.120192	4.275E+06	-23237.6321	-.003981	3790.8406	-986.5367
118.440	.098896	4.134E+06	-28403.1504	-.003577	3687.2607	-845.2074
124.080	.079844	3.966E+06	-32787.1272	-.003187	3563.3914	-709.3942
129.720	.062943	3.775E+06	-36424.7219	-.002815	3422.4353	-580.5330
135.360	.048090	3.564E+06	-39358.5052	-.002462	3267.4349	-459.8157
141.000	.035171	3.339E+06	-41637.0866	-.002130	3101.2440	-348.1918
146.640	.024063	3.102E+06	-43313.7557	-.001820	2926.5050	-246.3717
152.280	.014639	2.856E+06	-44445.1543	-.001534	2745.6319	-154.8335
157.920	.006764	2.605E+06	-45089.9907	-.001271	2560.7986	-73.8319
163.560	3.03E-04	2.352E+06	-45307.8094	-.001032	2373.9328	-3.4087
169.200	-.004882	2.098E+06	-44906.0412	-8.185E-04	2186.7144	145.8797
174.840	-.008929	1.848E+06	-43720.9724	-6.287E-04	2002.6720	274.3575
180.480	-.011974	1.607E+06	-41881.2425	-4.625E-04	1824.8458	378.0290
186.120	-.014147	1.377E+06	-39521.9648	-3.190E-04	1655.6937	458.5943
191.760	-.015572	1.162E+06	-36768.0140	-1.969E-04	1497.1306	517.9840
197.400	-.016368	9.630E+05	-33732.9374	-9.469E-05	1350.5734	558.2843
203.040	-.016640	7.817E+05	-30518.2735	-1.077E-05	1216.9897	581.6674
208.680	-.016489	6.188E+05	-27213.2438	5.659E-05	1096.9487	590.3289
214.320	-.016002	4.745E+05	-23894.7792	1.092E-04	990.6723	586.4316
219.960	-.015258	3.489E+05	-20627.8404	1.488E-04	898.0857	572.0574
225.600	-.014324	2.414E+05	-17465.9884	1.772E-04	818.8668	549.1667
231.240	-.013259	1.513E+05	-14706.2165	1.961E-04	752.4913	429.4758
236.880	-.012112	74832.6161	-12364.6395	2.069E-04	696.1645	400.8706
242.520	-.010925	11127.4802	-10192.8254	2.111E-04	649.2247	369.2762
248.160	-.009732	-40832.8779	-8204.5125	2.096E-04	671.1125	335.7993
253.800	-.008560	-82105.1703	-6407.5549	2.037E-04	701.5231	301.4197
259.440	-.007434	-1.138E+05	-4804.6435	1.943E-04	724.8595	266.9886
265.080	-.006369	-1.369E+05	-3394.0289	1.822E-04	741.9249	233.2294
270.720	-.005378	-1.527E+05	-2170.2305	1.683E-04	753.5080	200.7417
276.360	-.004470	-1.620E+05	-1124.7192	1.532E-04	760.3683	170.0070
282.000	-.003650	-1.658E+05	-246.5621	1.374E-04	763.2252	141.3962
287.640	-.002920	-1.652E+05	476.9772	1.215E-04	762.7488	115.1780
293.280	-.002280	-1.609E+05	1059.8906	1.058E-04	759.5537	91.5288
298.920	-.001727	-1.536E+05	1516.9301	9.068E-05	754.1946	70.5419
304.560	-.001257	-1.440E+05	1863.1697	7.636E-05	747.1644	52.2381
310.200	-8.65E-04	-1.328E+05	2113.6214	6.305E-05	738.8931	36.5746
315.840	-5.46E-04	-1.204E+05	2282.9056	5.087E-05	729.7491	23.4552
321.480	-2.92E-04	-1.072E+05	2384.9712	3.992E-05	720.0415	12.7383
327.120	-9.57E-05	-93640.6358	2493.6235	3.025E-05	710.0228	25.7909
332.760	4.96E-05	-79208.5173	2513.3727	2.194E-05	699.3888	-18.7876
338.400	1.52E-04	-65361.5630	2368.1409	1.499E-05	689.1859	-32.7130
344.040	2.19E-04	-52544.9121	2165.2574	9.315E-06	679.7423	-39.2315
349.680	2.57E-04	-40967.9323	1934.7007	4.818E-06	671.2120	-42.5262
355.320	2.73E-04	-30737.2471	1691.1416	1.369E-06	663.6737	-43.8423
360.960	2.72E-04	-21896.3320	1443.9745	-1.163E-06	657.1595	-43.8056
366.600	2.60E-04	-14445.4109	1199.7297	-2.911E-06	651.6694	-42.8060
372.240	2.40E-04	-8353.8591	963.0646	-4.008E-06	647.1810	-41.1178
377.880	2.15E-04	-3568.9324	737.2780	-4.581E-06	643.6553	-38.9484

383.520	1.88E-04	-22.3781	524.6222	-4.754E-06	641.0421	-36.4614
389.160	1.61E-04	2364.3565	326.5242	-4.641E-06	642.7678	-33.7861
394.800	1.35E-04	3675.9966	143.7701	-4.351E-06	643.7342	-31.0203
400.440	1.12E-04	4000.3151	41.5672	-3.981E-06	643.9732	-5.2219
406.080	9.06E-05	4157.8981	14.7467	-3.589E-06	644.0893	-4.2889
411.720	7.15E-05	4178.3981	-7.0326	-3.188E-06	644.1044	-3.4342
417.360	5.46E-05	4088.9991	-24.2272	-2.790E-06	644.0385	-2.6631
423.000	4.00E-05	3914.2432	-37.3153	-2.405E-06	643.9098	-1.9780
428.640	2.75E-05	3675.9510	-46.7817	-2.040E-06	643.7342	-1.3788
434.280	1.70E-05	3393.2198	-53.1051	-1.700E-06	643.5259	-.8635
439.920	8.30E-06	3082.4870	-56.7480	-1.389E-06	643.2969	-.4283
445.560	1.31E-06	2757.6452	-58.1485	-1.108E-06	643.0576	-.068315
451.200	-4.19E-06	2430.1965	-57.7144	-8.584E-07	642.8163	.2222
456.840	-8.38E-06	2109.4350	-55.8193	-6.400E-07	642.5799	.4498
462.480	-1.14E-05	1802.6486	-52.7999	-4.519E-07	642.3539	.6209
468.120	-1.35E-05	1515.3300	-48.9552	-2.923E-07	642.1422	.7425
473.760	-1.47E-05	1251.3905	-44.5461	-1.592E-07	641.9477	.8210
479.400	-1.53E-05	1013.3709	-39.7972	-5.028E-08	641.7723	.8630
485.040	-1.53E-05	802.6423	-34.8983	3.707E-08	641.6171	.8742
490.680	-1.49E-05	619.5963	-30.0071	1.055E-07	641.4822	.8603
496.320	-1.41E-05	463.8177	-25.2517	1.576E-07	641.3674	.8260
501.960	-1.31E-05	334.2413	-20.7348	1.960E-07	641.2719	.7757
507.600	-1.19E-05	229.2882	-16.5361	2.231E-07	641.1946	.7131
513.240	-1.06E-05	146.9840	-12.7165	2.412E-07	641.1339	.6413
518.880	-9.16E-06	85.0567	-9.3212	2.523E-07	641.0883	.5627
524.520	-7.71E-06	41.0160	-6.3827	2.584E-07	641.0559	.4793
530.160	-6.24E-06	12.2145	-3.9245	2.610E-07	641.0346	.3924
535.800	-4.77E-06	-4.1065	-1.9634	2.613E-07	641.0287	.3030
541.440	-3.29E-06	-10.7874	-.5117	2.606E-07	641.0336	.2117
547.080	-1.83E-06	-10.7313	.4202	2.596E-07	641.0335	.1187
552.720	-3.66E-07	-6.8967	.8228	2.588E-07	641.0307	.024046
558.360	1.09E-06	-2.2962	.6863	2.583E-07	641.0273	-.072453
564.000	2.55E-06	0.0000	0.0000	2.582E-07	641.0256	-.1709

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.01021751
Maximum bending moment	=	4507628.453 lbs-in
Maximum shear force	=	87291.516 lbs
Depth of maximum bending moment	=	90.240 in
Depth of maximum shear force	=	0.000 in
Number of iterations	=	7
Number of zero deflection points	=	4

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .100000	M= 0.000	2.900E+05	.100000	5.523E+05	14342.7942
4	y= .200000	M= 0.000	2.900E+05	.2000	1.105E+06	28684.0775
4	y= .300000	M= 0.000	2.900E+05	.3000	1.647E+06	40870.9492
4	y= .400000	M= 0.000	2.900E+05	.4000	2.100E+06	48775.7230
4	y= .500000	M= 0.000	2.900E+05	.5000	2.525E+06	55877.2609
4	y= .600000	M= 0.000	2.900E+05	.6000	2.938E+06	62559.6118
4	y= .700000	M= 0.000	2.900E+05	.7000	3.337E+06	68992.9304
4	y= .800000	M= 0.000	2.900E+05	.8000	3.736E+06	75258.0502
4	y= .900000	M= 0.000	2.900E+05	.9000	4.124E+06	81385.5390
4	y= 1.000	M= 0.000	2.900E+05	1.0000	4.508E+06	87291.5156

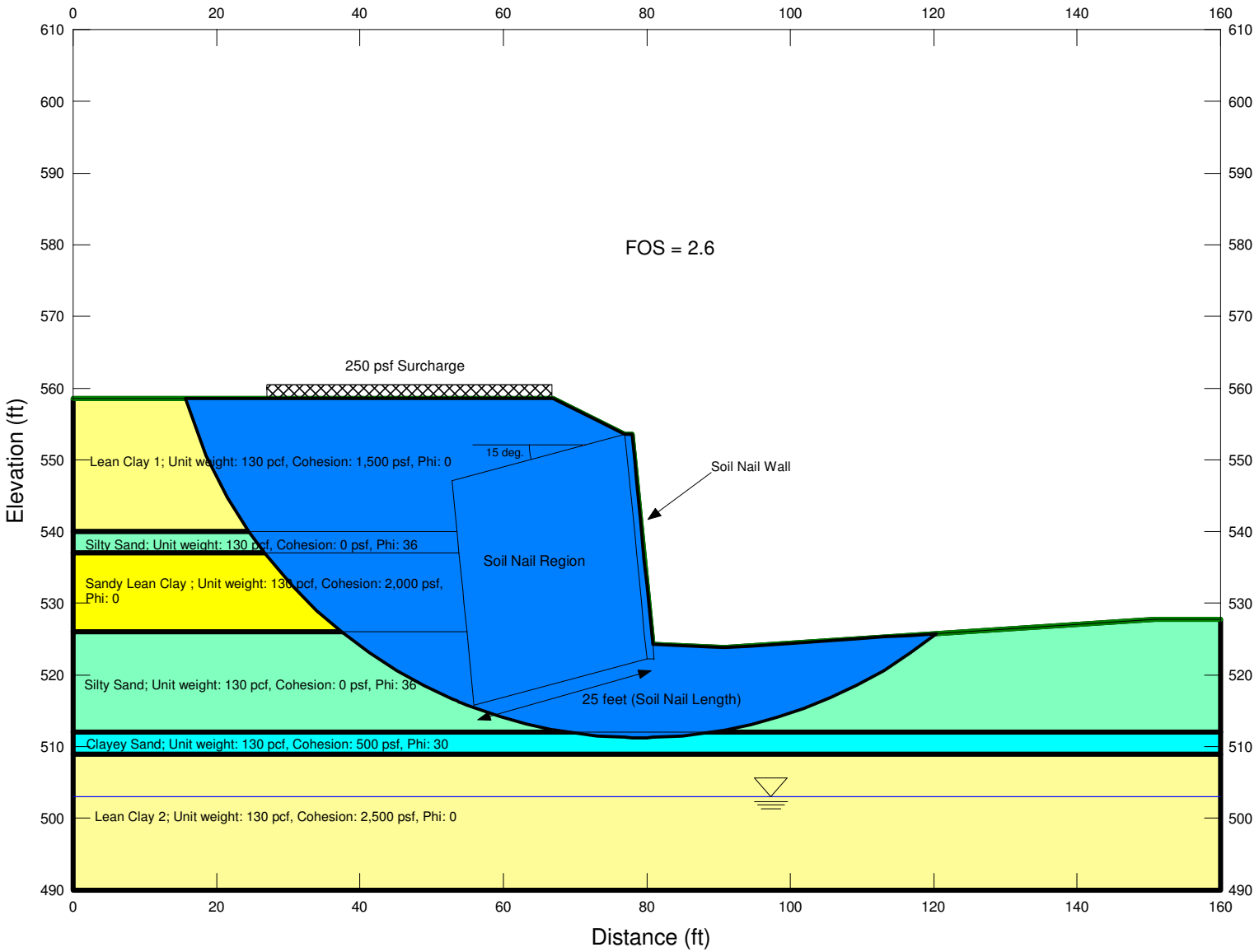
Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = .10000 in
Moment = 0. in-lbs
Axial Load = 290000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
564.000	.10000000	552310.020	14342.794
535.800	.10000000	552467.656	14343.201
507.600	.10000000	552299.864	14343.697
479.400	.10000000	552179.228	14345.167
451.200	.10000000	552195.388	14346.866
423.000	.10000000	552340.571	14348.662
394.800	.10000000	552498.408	14349.556
366.600	.10000000	552357.339	14351.186
338.400	.10000000	552478.351	14351.333
310.200	.10000000	552210.119	14347.677

The analysis ended normally.



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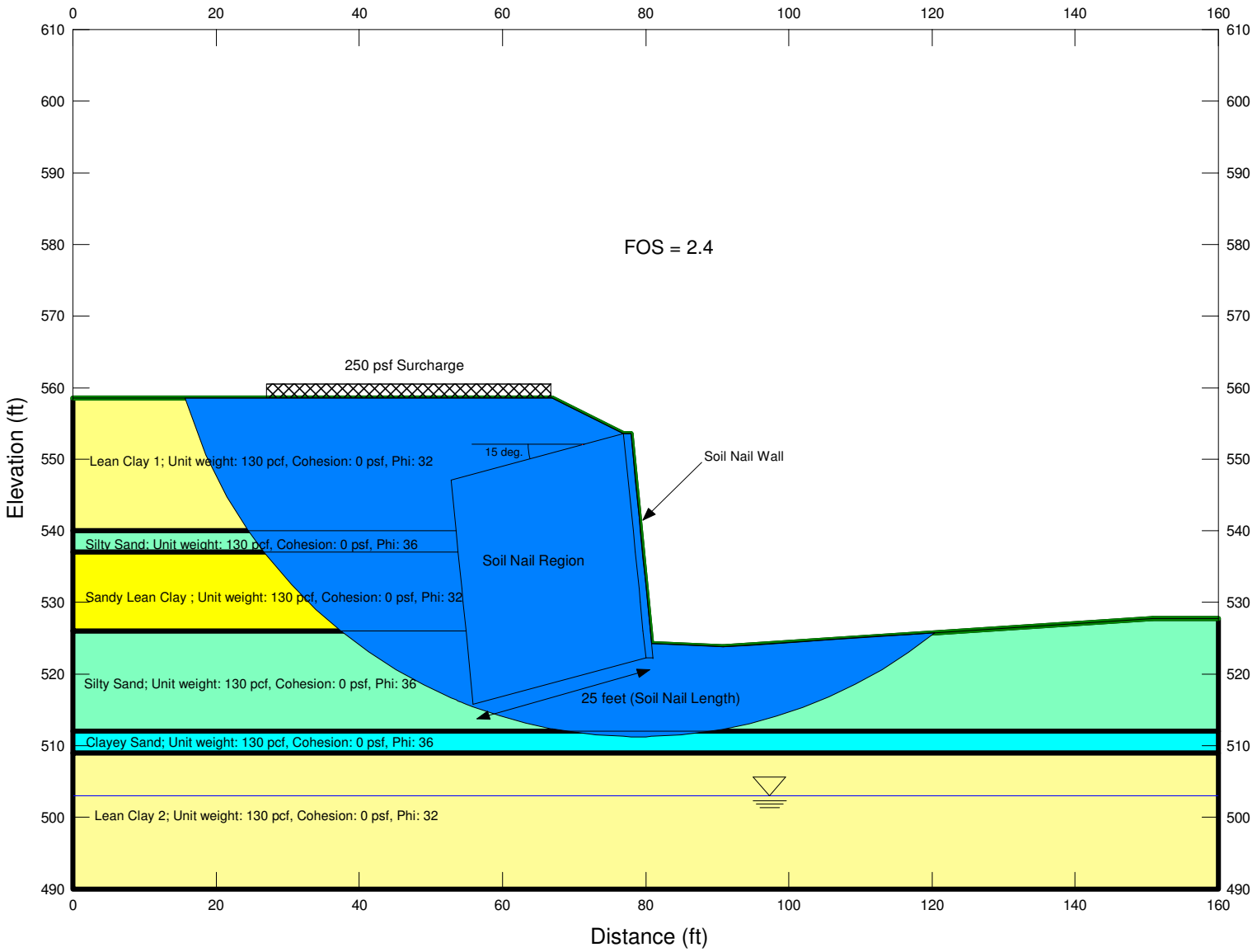
Date February 12, 2009	CHECKED BY Michael Larson	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – END OF CONSTRUCTION
RW 246 (A1-Sta.# 251+80)

FIGURE
F-1



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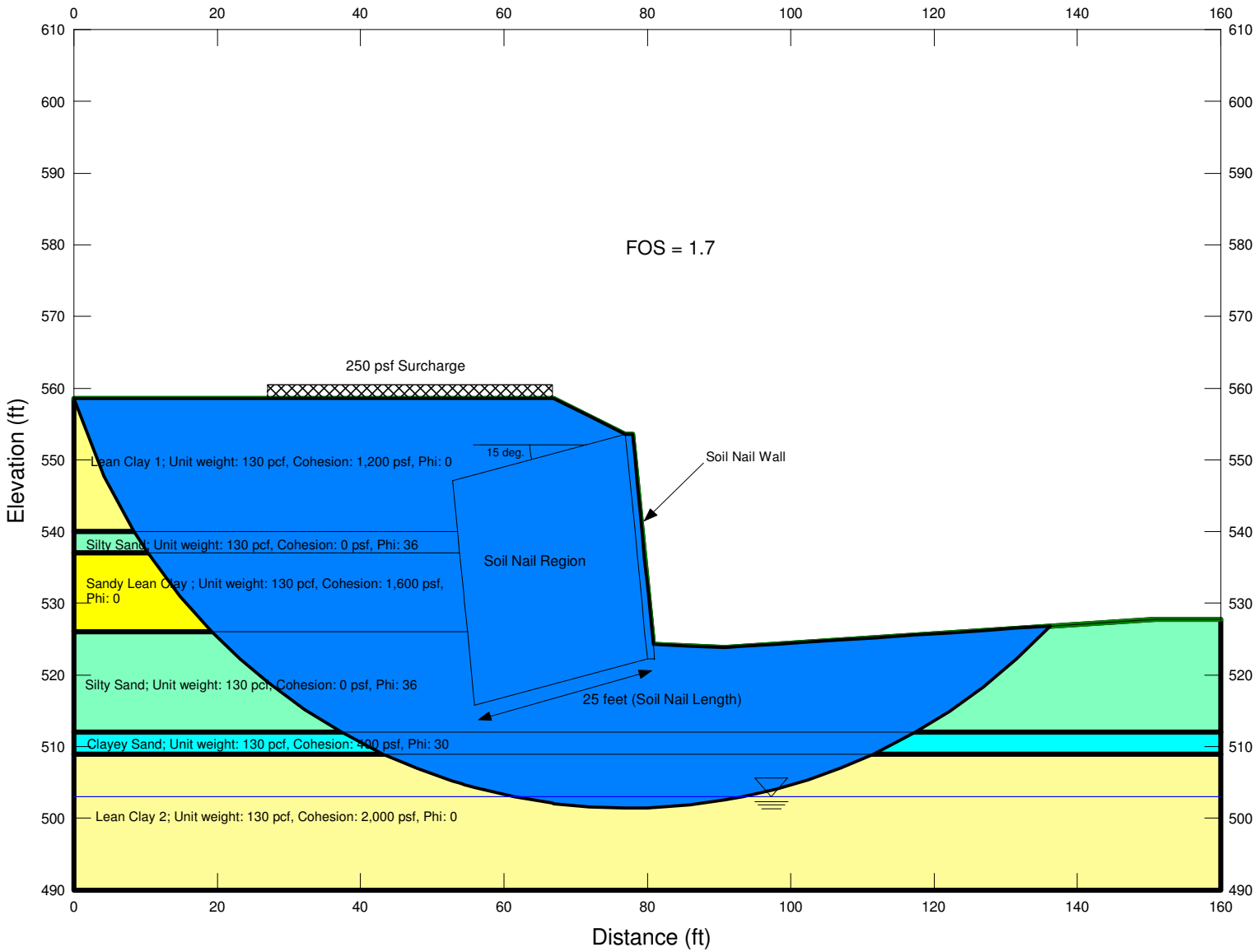
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 246 (A1-Sta.# 251+80)

FIGURE
F-2



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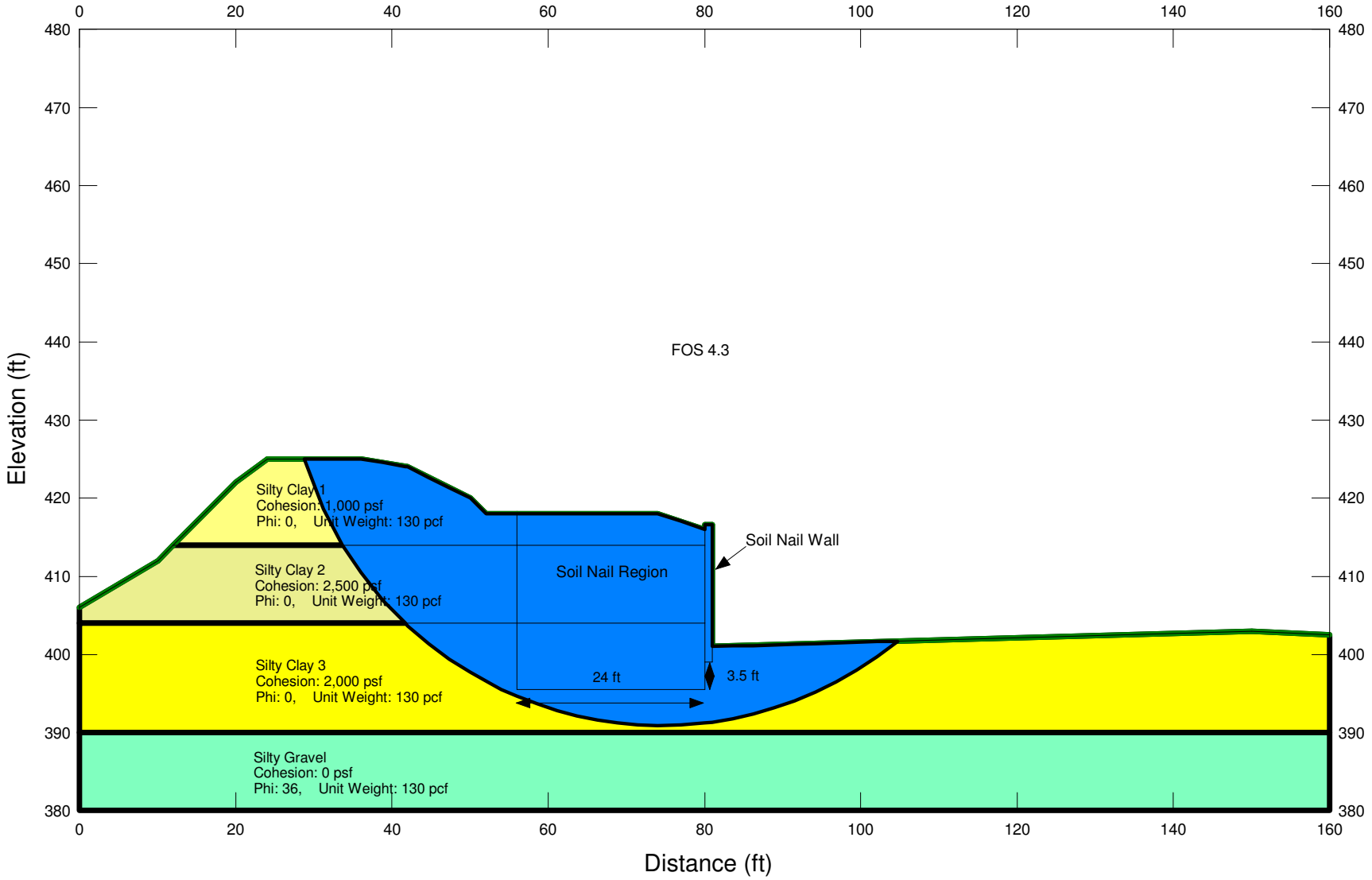
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 246 (A1-Sta.# 251+80)

FIGURE
F-3



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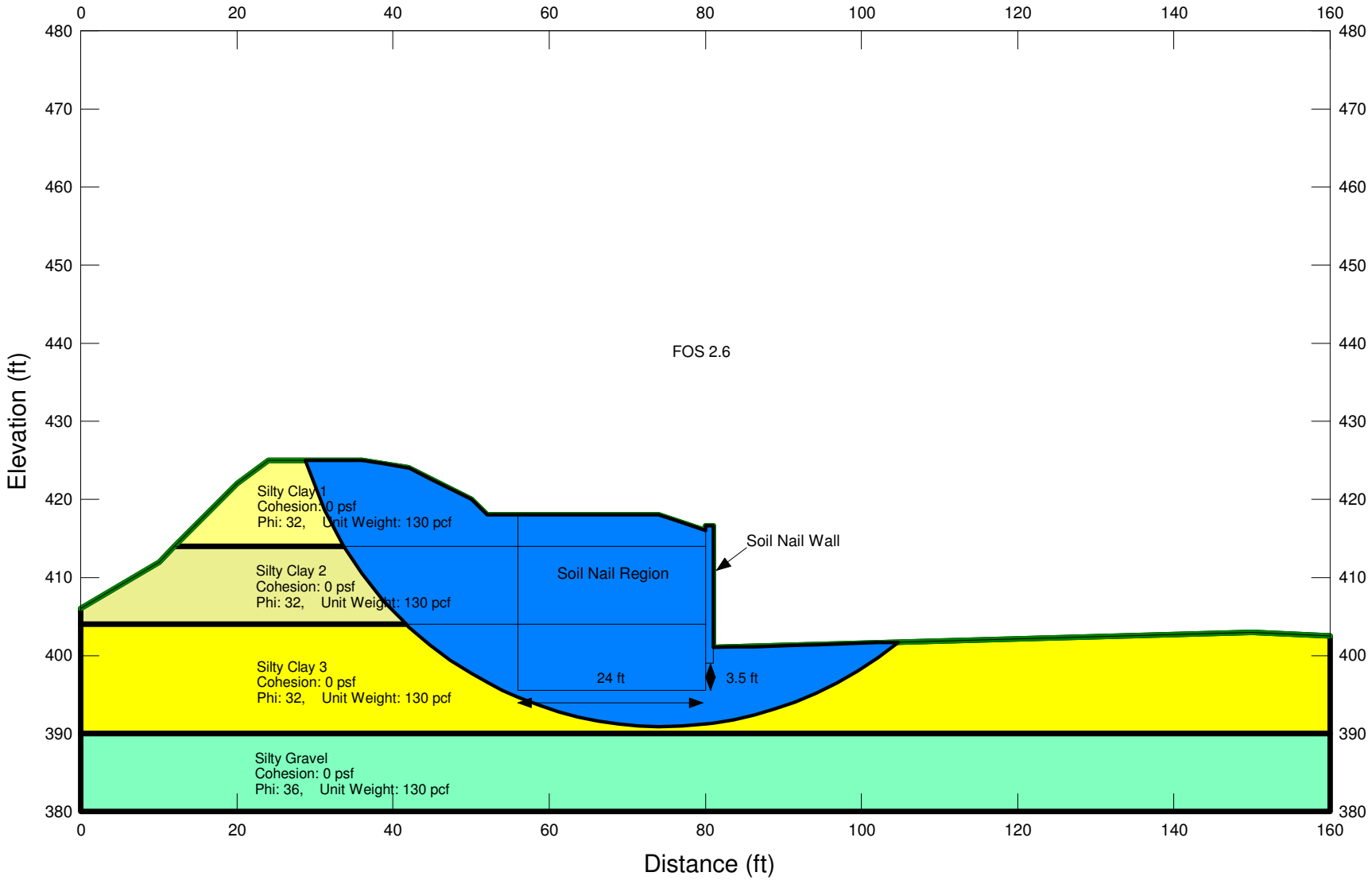
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – END OF CONSTRUCTION **RW 391 (A3-Sta.# 396+16)**
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-4



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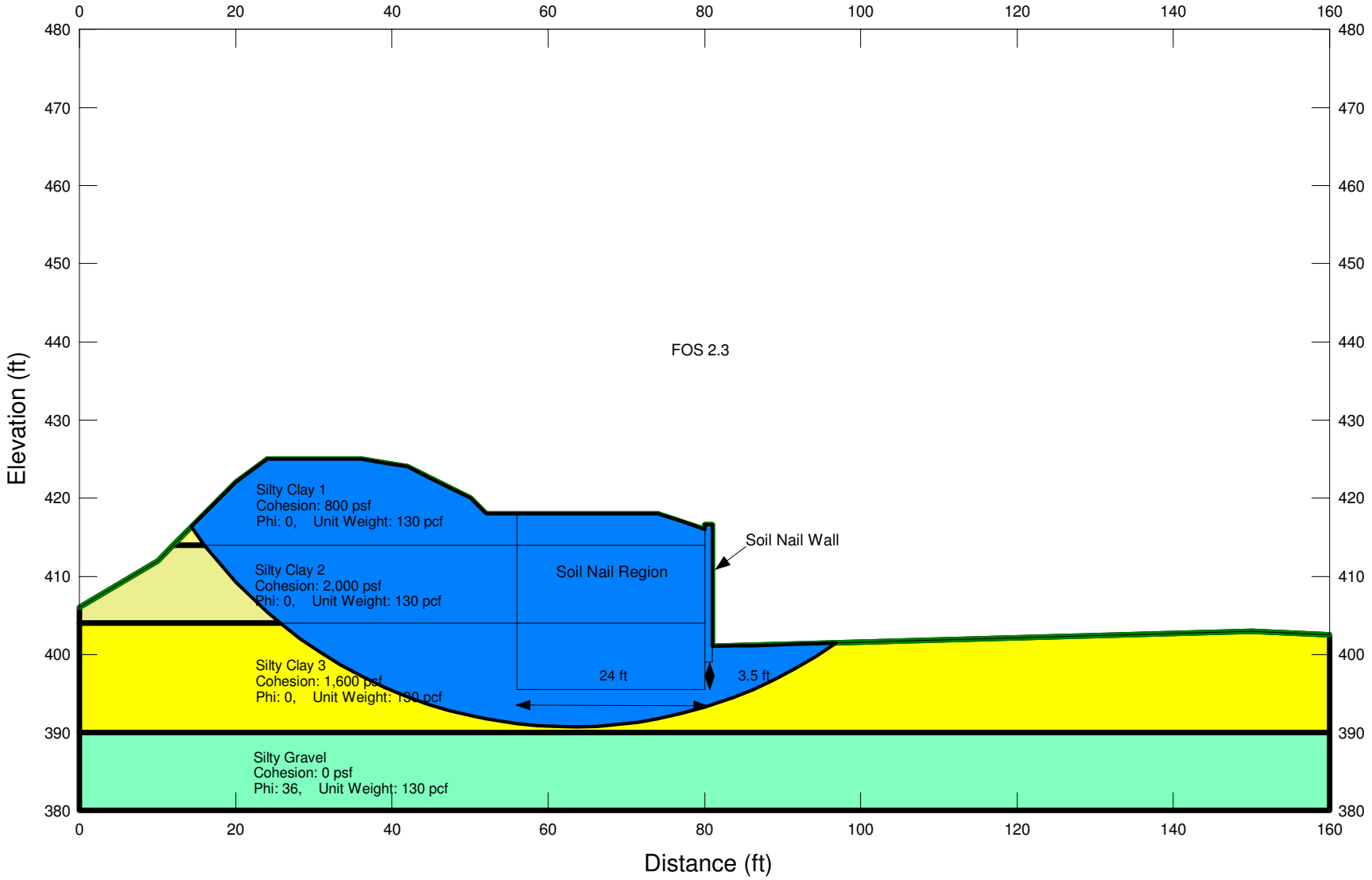
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – LONG TERM **RW 391 (A3-Sta.# 396+16)**
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-5



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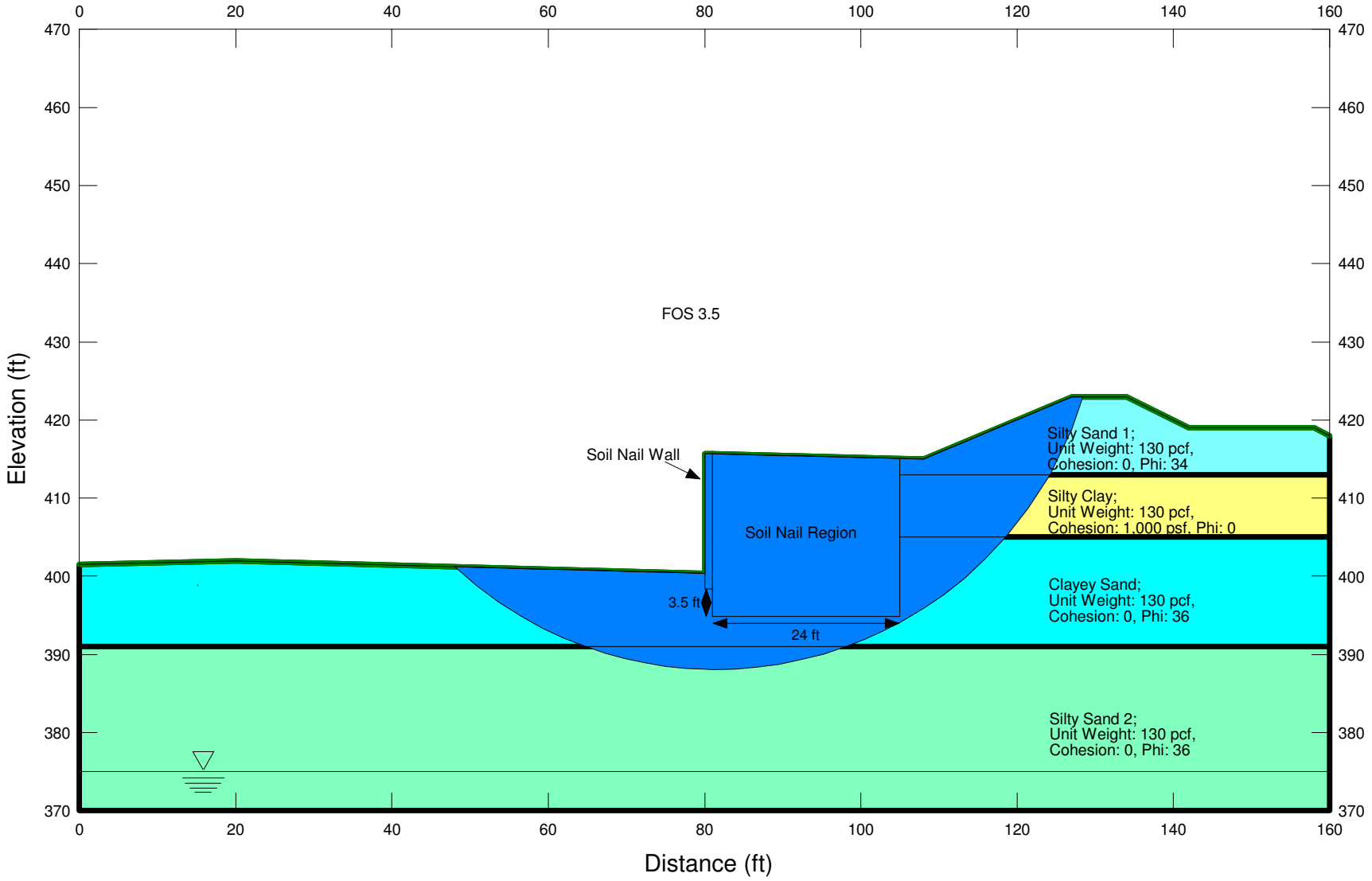
PROJECT No	CALCULATED BY
28649640	S. Manoharan
Date	CHECKED BY
February 12, 2009	Michael Larson

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 391 (A3-Sta.# 396+16)

FIGURE
F-6



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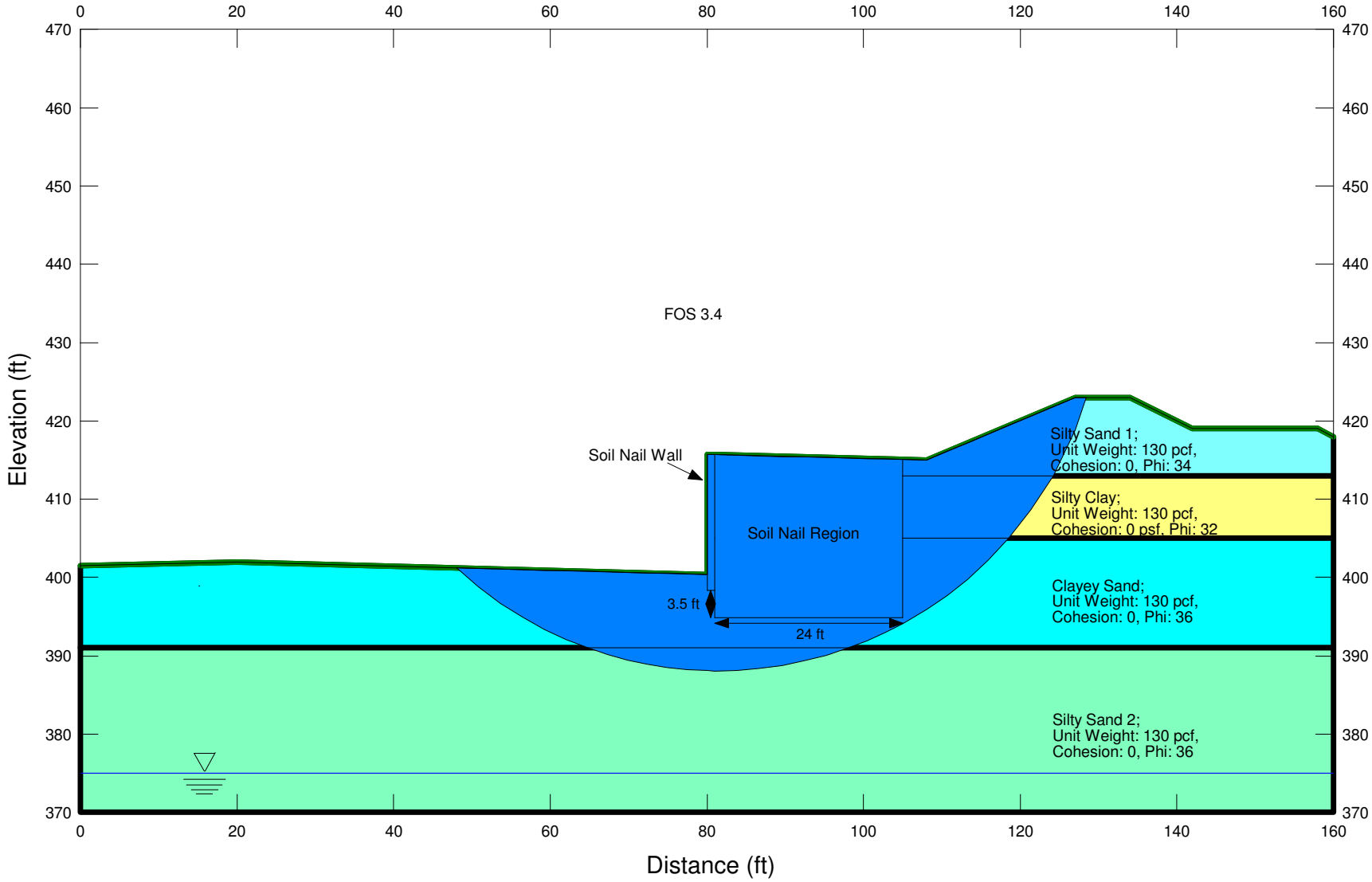
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – END OF CONSTRUCTION **RW 400N (A3-Sta.# 405+77)** **(Soil Nail)**
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-7



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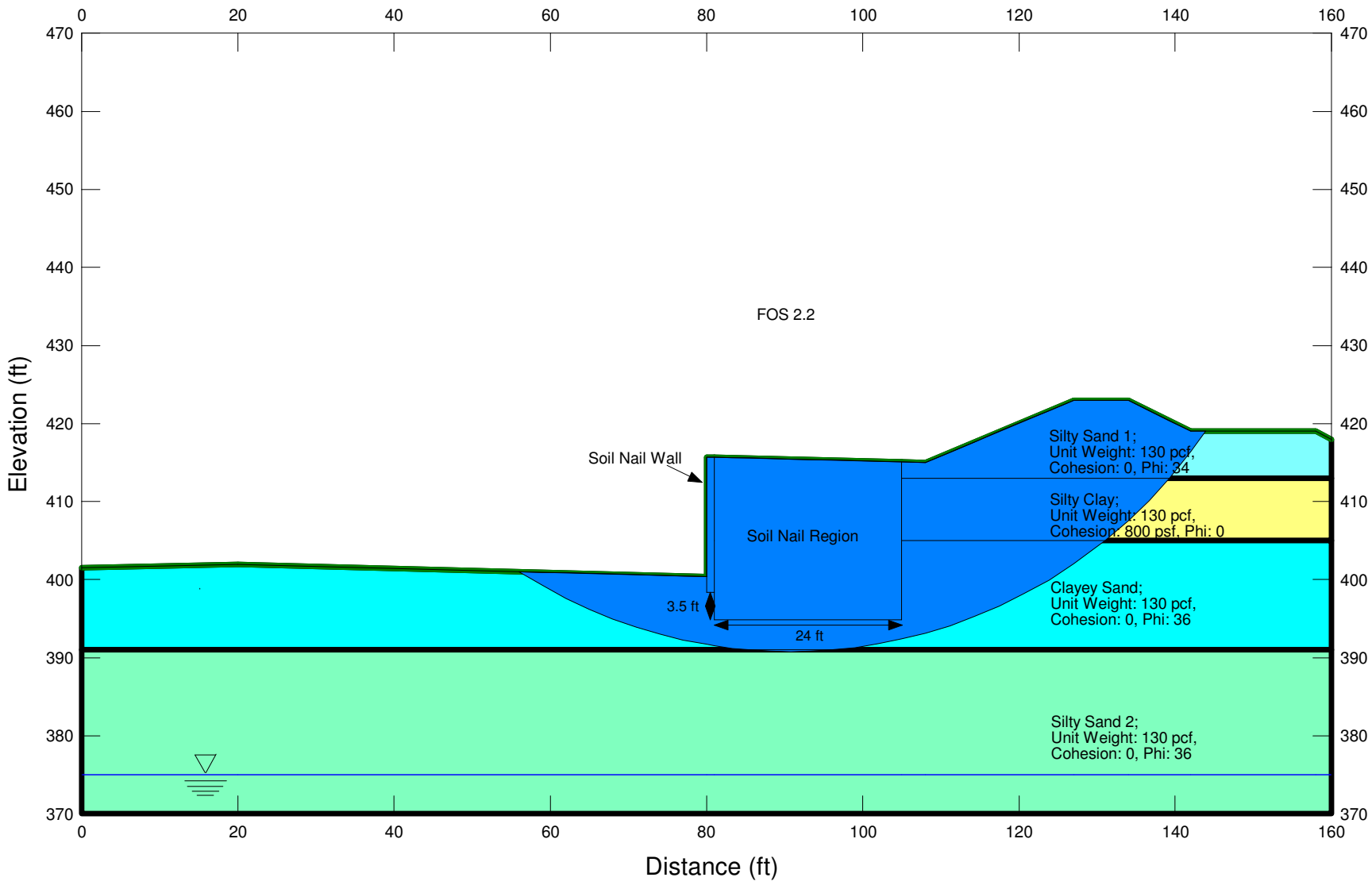
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 400N (A3-Sta.# 405+77)
(Soil Nail)

FIGURE
F-8



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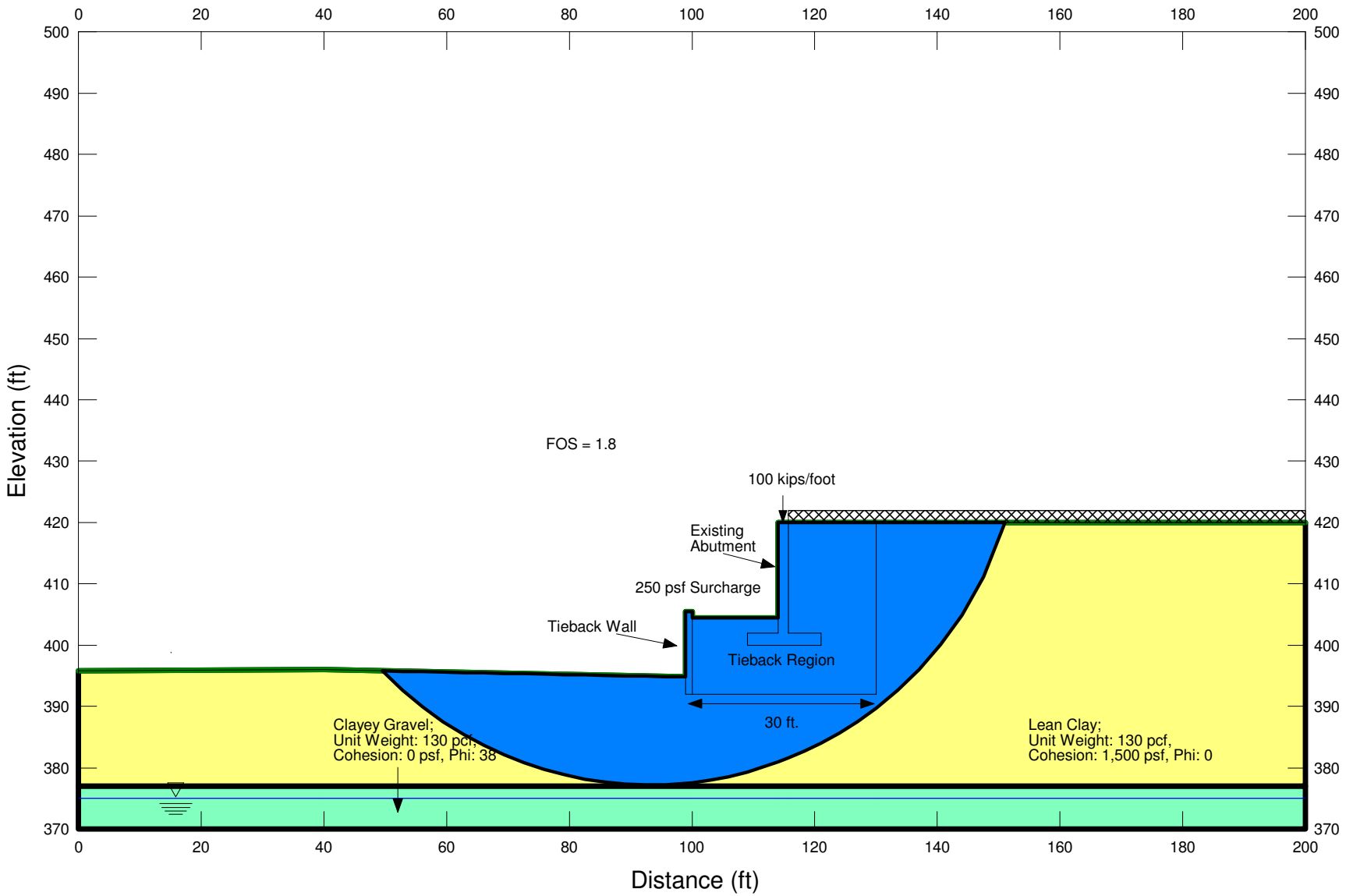
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS PSEUDO STATIC **RW 400N (A3-Sta.# 405+77)** **(Soil Nail)**
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-9



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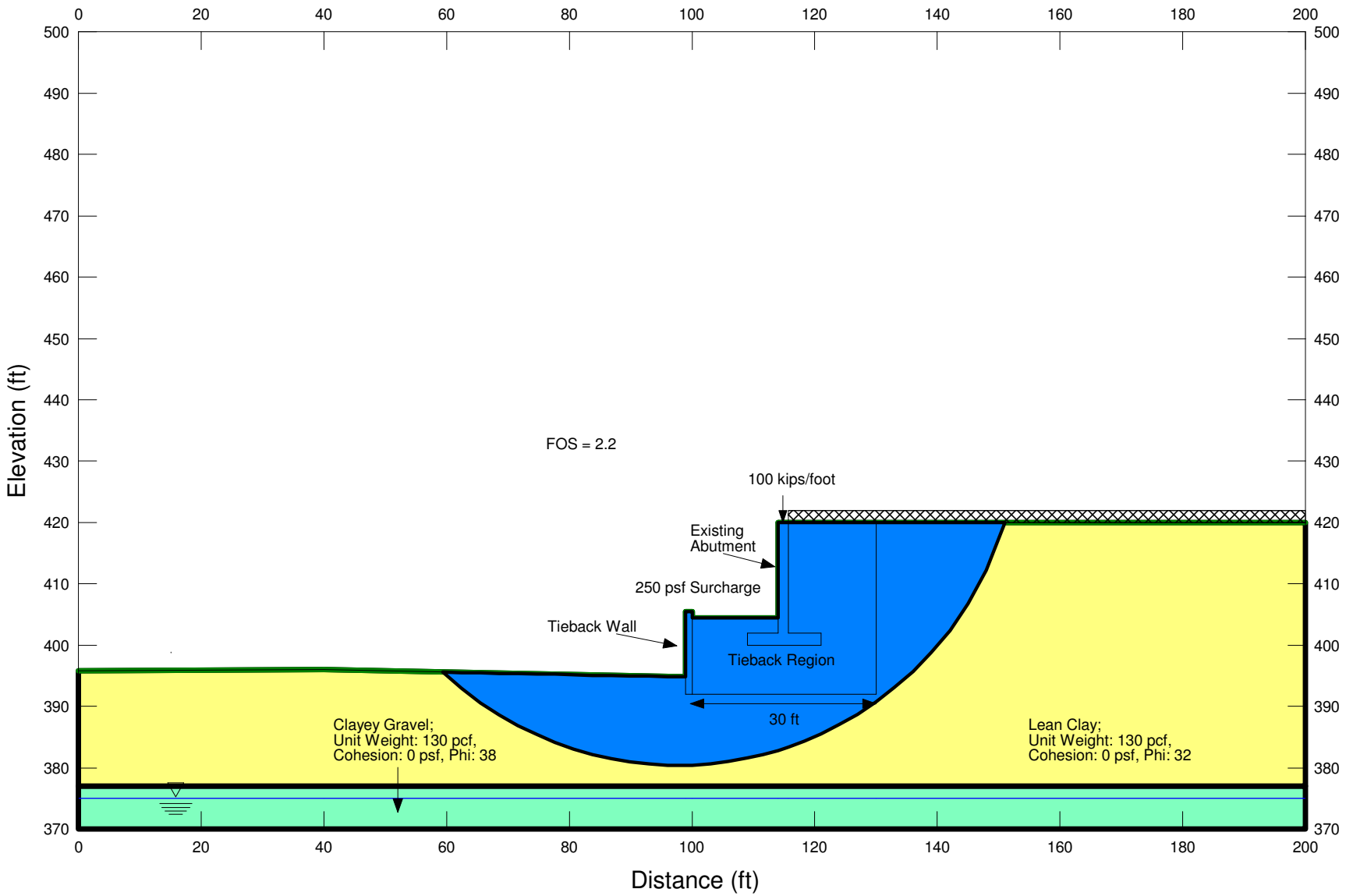
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – END OF CONSTRUCTION
RW 400N (A3-Sta.# 401+60)
Type A (Tieback)

FIGURE
F-10



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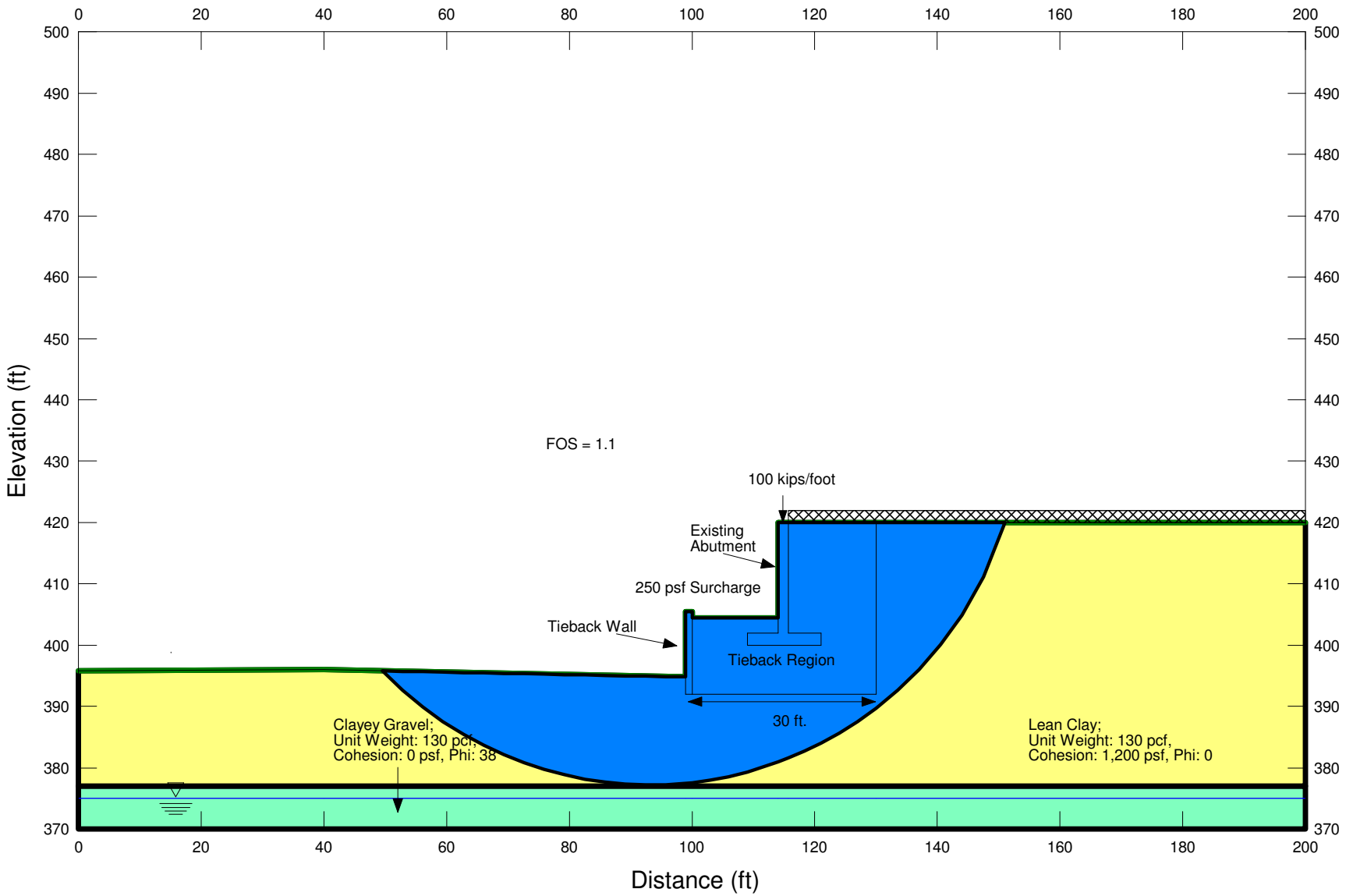
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-11



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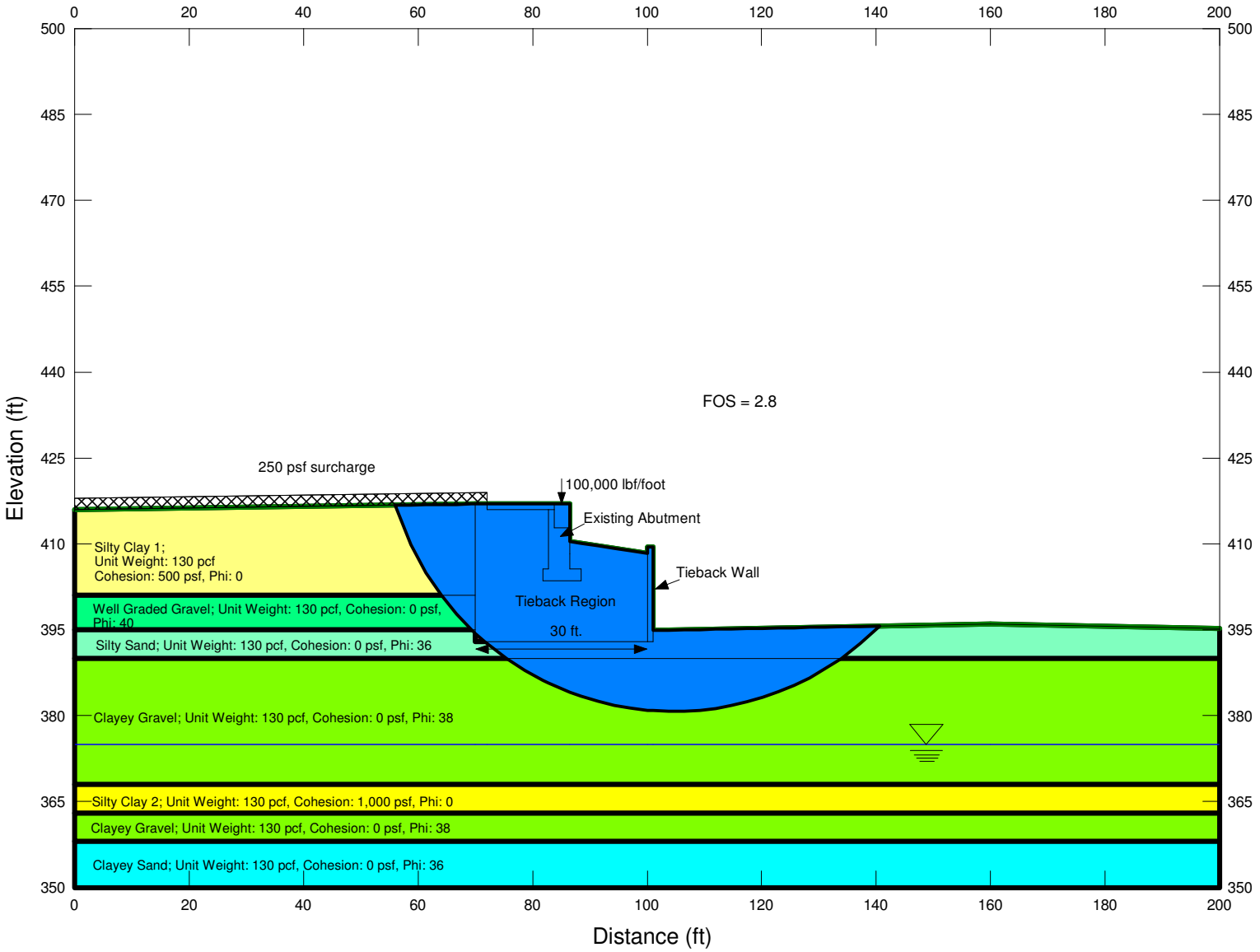
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-12



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PROJECT No 28649640	CALCULATED BY S. Manoharan	
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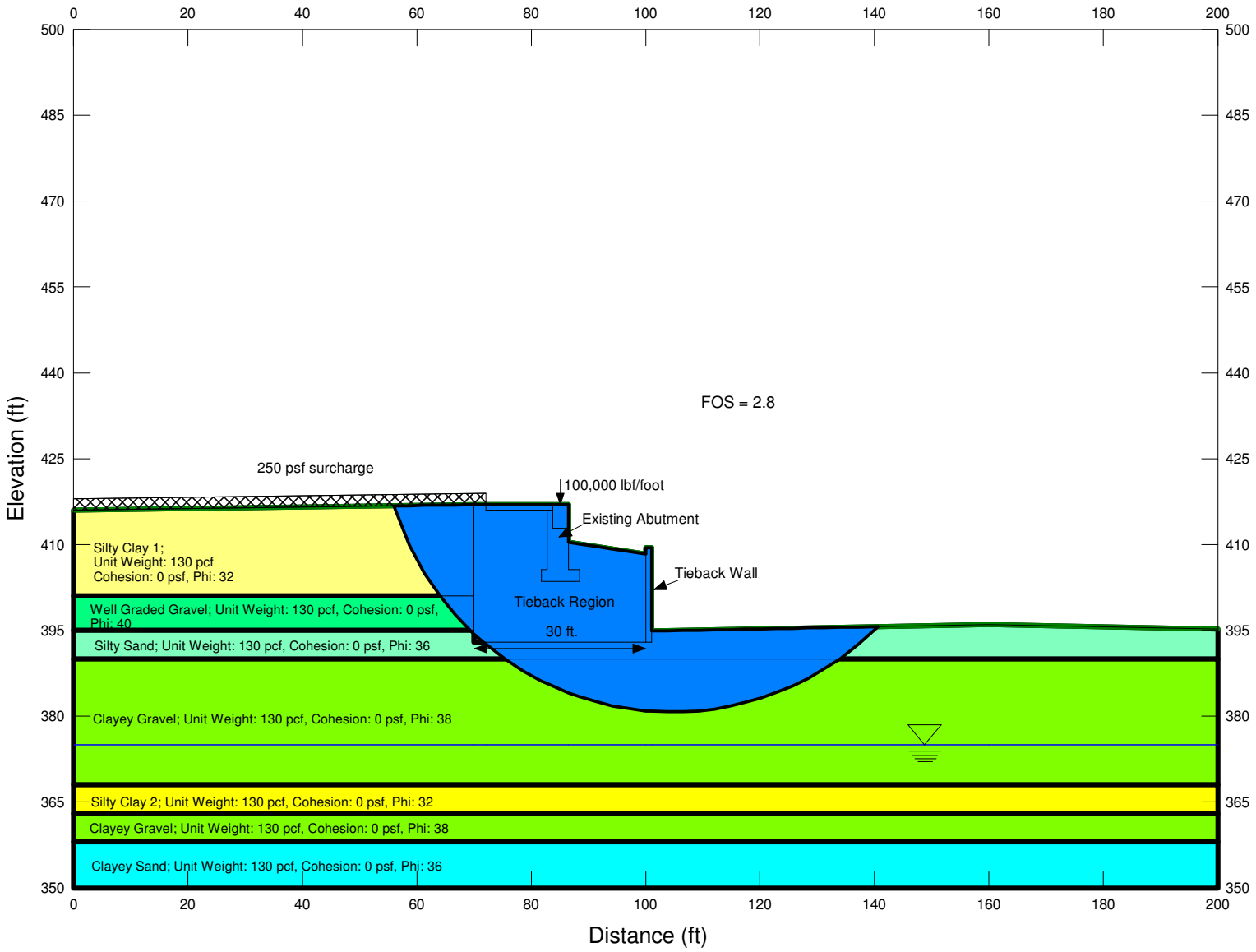
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – END OF CONSTRUCTION
RW 400S (A3-Sta.# 401+00)

FIGURE
F-13



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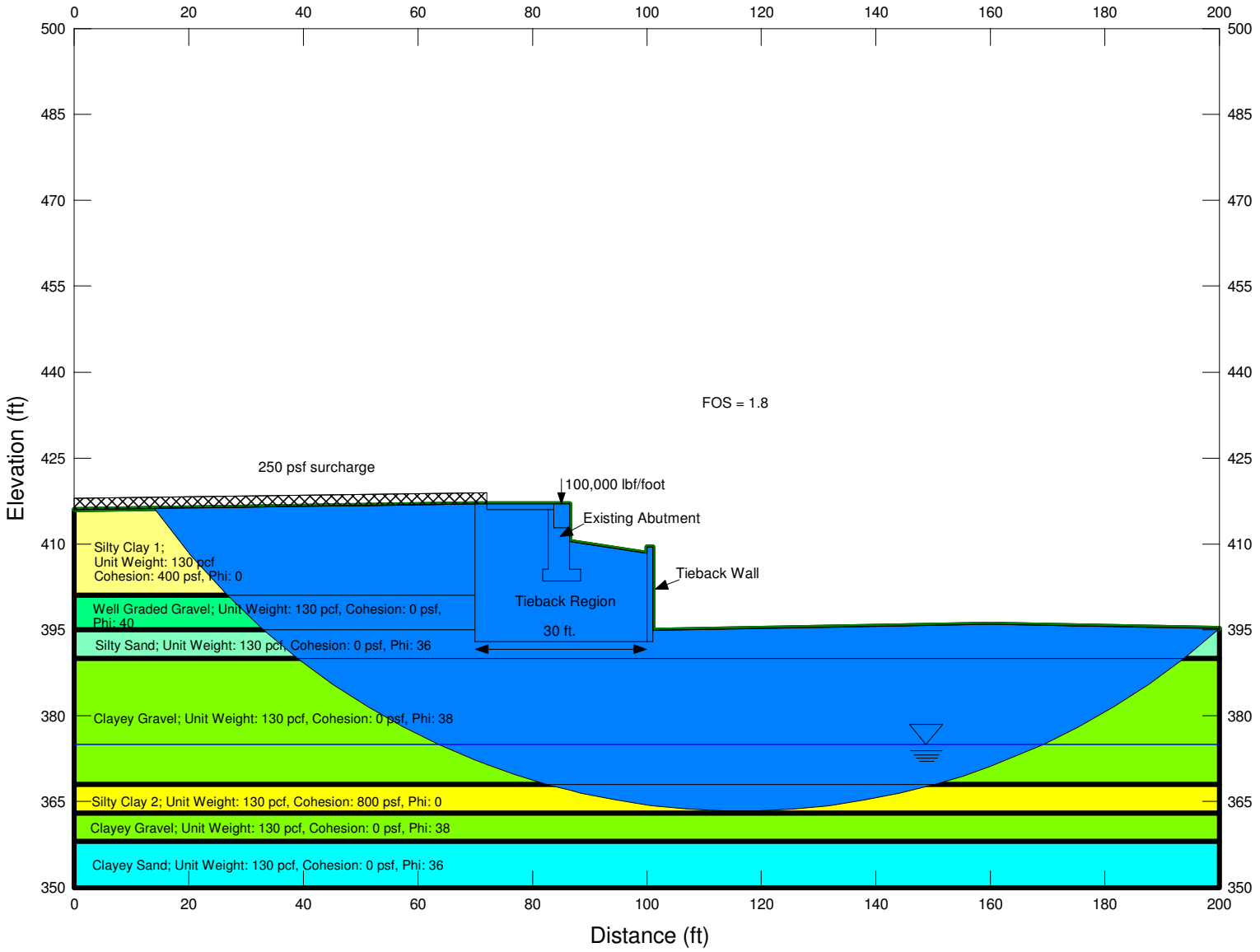
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-14



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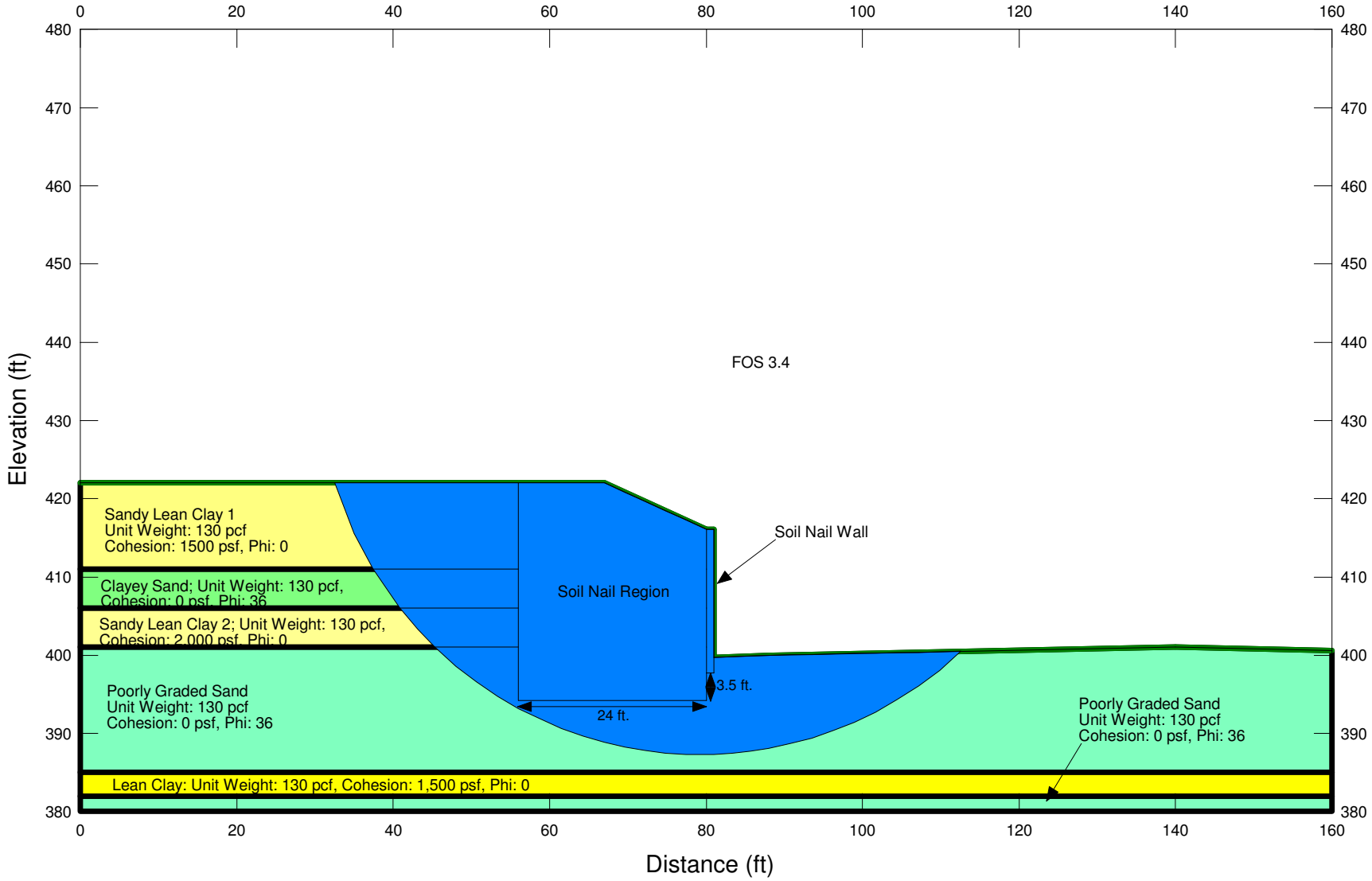
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS PSEUDO STATIC **RW 400S (A3-Sta.# 401+00)**
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-15



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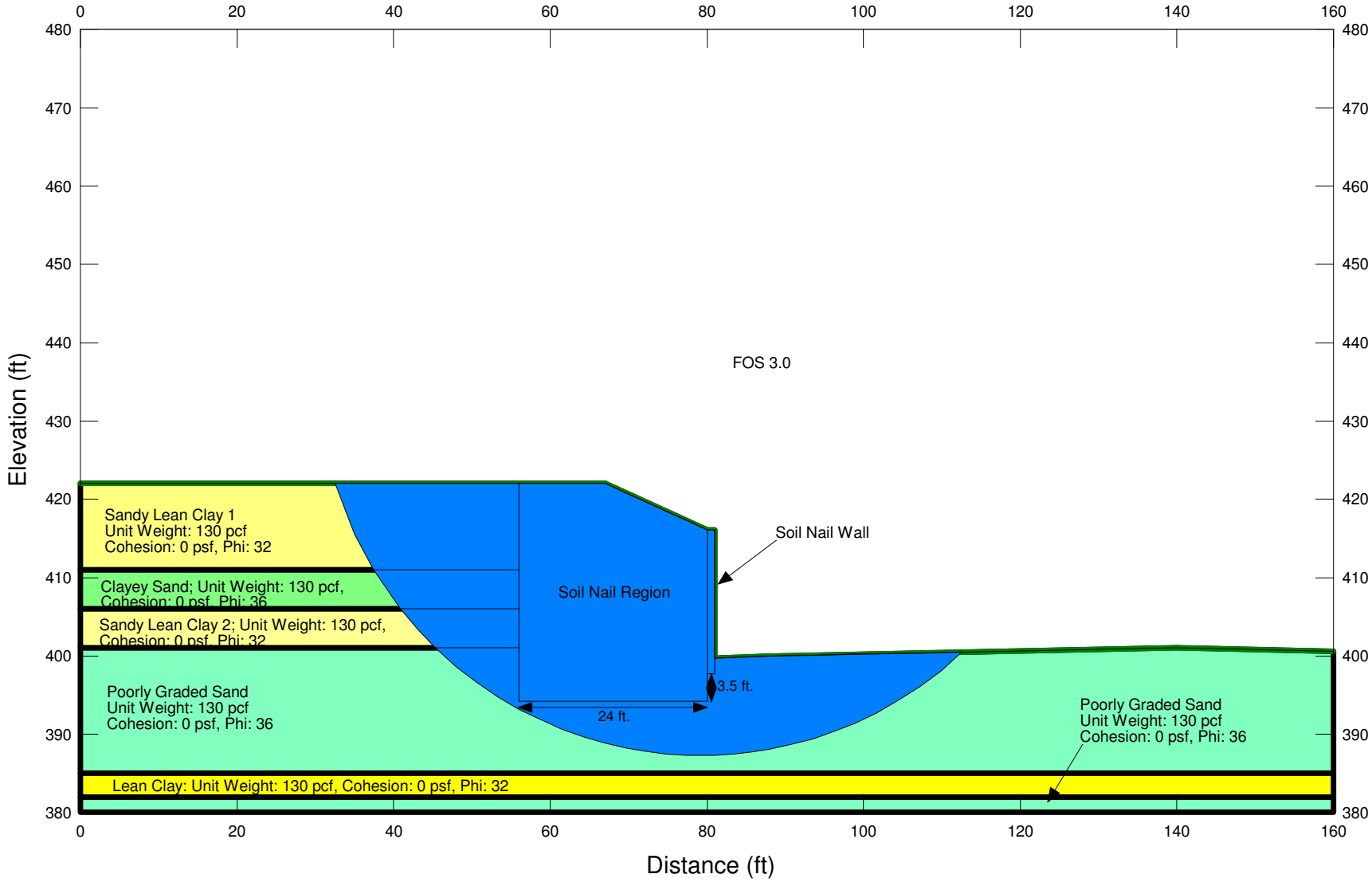
PROJECT No 28649640	CALCULATED BY S. Manoharan	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS STATIC – END OF CONSTRUCTION **RW 403 (A3-Sta.# 405+00)**
Date February 12, 2009	CHECKED BY Michael Larson	

FIGURE

F-16



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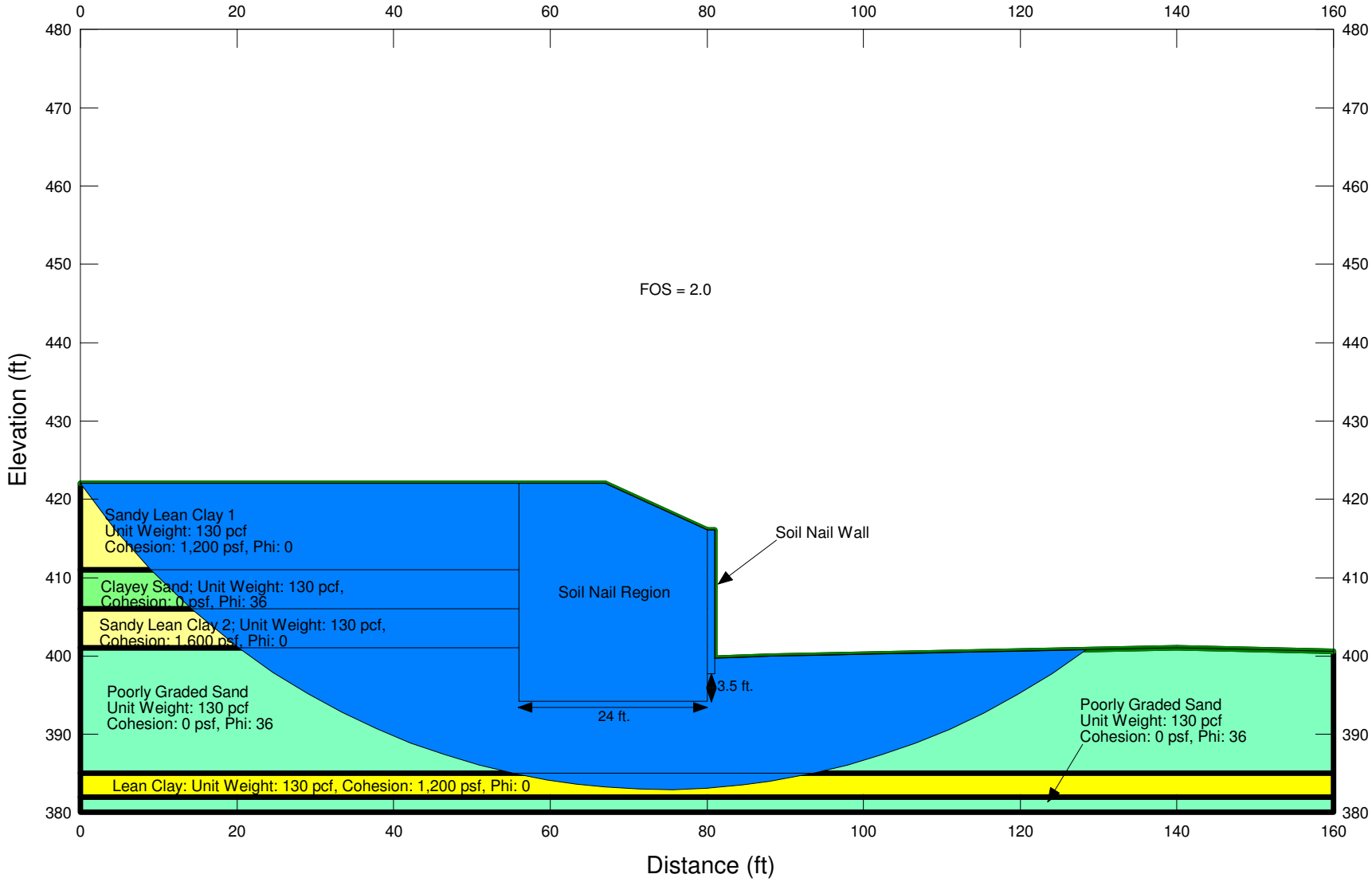
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 403 (A3-Sta.# 405+00)

FIGURE
F-17



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ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 403 (A3-Sta.# 405+00)

FIGURE

F-18

ROUTE 84 EXPRESSWAY WIDENING PROJECT

LIVERMORE, CA.

FROM RUBY HILL DRIVE TO JACK LONDON BOULEVARD

Proposed Retaining Walls: Ruby Hills Dr./Vallecitos Rd. Intersection and Stanley Blvd. Underpass

FOUNDATION INVESTIGATION REPORT

Prepared for:

URS Corporation
55 South Market Street, Suite 1500
San Jose, CA 95113

Prepared By:

V&A
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July 2008

Hwy 84 Found Report_Retaining Walls.doc

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INTRODUCTION

V&A was retained by URS Corporation to perform a corrosion survey on State Highway 84, from Ruby Hill Drive to Jack London Boulevard, in Livermore, California. The objective of the investigation was to measure various soil parameters and evaluate the results with respect to possible levels of corrosion along the highway the soil was tested at depths ranging from 0 to 19 meters below existing grade. This report provides recommendations for corrosion control of structural foundation materials under consideration for a proposed retaining wall between the Ruby Hill Drive and Vallecitos Road intersections and modifications to existing retaining structures at the Stanley Boulevard Underpass. The materials being considered as part of this investigation include buried reinforced concrete.

The investigation was conducted in accordance with California Department of Transportation's Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch "Corrosion Guidelines" (Guidelines) dated September 2003. These Guidelines consider representative soil or water samples to be corrosive to structural elements if one or more of the following conditions exist:

1) **The chloride concentration is 500 ppm or greater,**
2) **The sulfate concentration is 2000 ppm or greater,**
3) **The pH is 5.5 or less.**

Evaluation of the soil environment was made in terms of potential corrosion damage to concrete and metal structures. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, soil samples taken during a geotechnical investigation were provided to V&A for laboratory testing. The soil samples were analyzed for minimum (saturated) resistivity, as well as for pH, chloride and sulfate ion concentrations. All of these affect the corrosion rate of buried structures.

Soil samples were selected from two borings taken between the Ruby Hill Drive and Vallecitos Road intersections at the southern end of the Highway 84 project alignment. The minimum (saturated) resistivity of the samples ranged from 3,302 ohm-cm to 7,312 ohm-cm. The soil pH ranged from 7.5 to 8.6 and the water-soluble chloride concentrations ranged from below the detection limit of 2 mg/kg to 9 mg/kg. The water-soluble sulfate concentrations ranged from below the detection limit of 5 mg/kg to 7 mg/kg. The pH, chloride and sulfate ion concentrations all indicate the sampled soils are *non-corrosive* to metallic and reinforced concrete structures, as defined by the Guidelines.

CONCLUSIONS

- The soil boring chemical analyses gave pH values higher than 5.5, soluble chloride concentrations less than 500 mg/kg, and soluble sulfate concentrations less than 2,000 mg/kg. According to the Guidelines, the soils at the proposed retaining wall site near the Vallecitos Road intersection and sites at the Stanley Boulevard Underpass are considered *non-corrosive*.

RECOMMENDATIONS

The test data and a review of the project requirements were used to make recommendations for the structural foundation material listed below:

Buried Reinforced Concrete Structures

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following for installations in *non-corrosive* soil:

- The water/cement ratio should not exceed 0.50.
- A minimum concrete cover of 5.1 centimeters should be applied over all steel reinforcement.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of water-soluble chloride ions and water-soluble sulfate ions. They should also have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.
- Based on sulfate ion concentrations, Type I-P (MS) modified or Type II modified cement should be used.

TEST METHODS

When predicting potential corrosion problems associated with a particular type of structure, it is necessary to investigate the soil conditions the structure will encounter. Since corrosion is an electrochemical process accompanied by current flow, the electrochemical characteristics of a soil are of primary importance. Test methods utilized during this investigation reflect the most practical methods of evaluating corrosivity.

Resistivity is a measure of the ability of a soil to conduct an electric current. The higher the resistivity the more difficult it is for the soil to conduct current. Resistivity is primarily dependent on the soluble chemical and moisture content of the soil. Soils with high dissolved ion contents generally have low resistivity. As moisture is added to a soil, its resistivity will decrease as more ions are taken into solution. The soil resistivity decreases until the maximum solubility of the dissolved ions is reached. Increasing the moisture content beyond this point increases the soil resistivity as the solution becomes more diluted. Since corrosion rate depends on current flow through the soil, corrosivity normally increases as soil resistivity decreases.

Soils can contain a wide variety of soluble salts. Therefore, soils with similar resistivities can have significantly different corrosion characteristics, depending on the ions present. In most soils, the principle agents of corrosion are the chloride and sulfate ions, as well as pH. Chloride ions break down the protective surface films on metals and can corrode reinforcing steel in concrete structures. Sulfates attack the Portland cement in concretes. This is an expansive reaction that disrupts the concrete matrix and softens the surface. A high bicarbonate ion concentration lowers soil resistivity and facilitates other forms of corrosion; however, bicarbonate is not corrosive to metals. Soil pH is another measure of corrosivity. Acid (low pH) soils are corrosive to buried metallic and concrete structures. Neutral (pH 7) and alkaline (pH greater than 7) soils are passive to metal surfaces; therefore, corrosion rates become negligible.

Field Soil Resistivity

Field (in-situ) soil resistivity was measured at 17 locations along the Highway 84 project alignment. The same testing configuration was used at each location. Two resistivity stations (Station 2 at 248+00 and Station 3 at 253+00) were located along the proposed retaining wall transect between the Ruby Hill Drive and Vallecitos Road intersections at the south end of the highway alignment. At the Stanley Boulevard Underpass, one resistivity station (Station 14 at 398+00) was located about 150 feet south of the bridge on the east side of Highway 84. Figure 1 is a vicinity and project location map for the Highway 84 Widening Project. Figures 2 and 3 show the soil resistivity test sites and the soil boring locations for the proposed retaining walls.

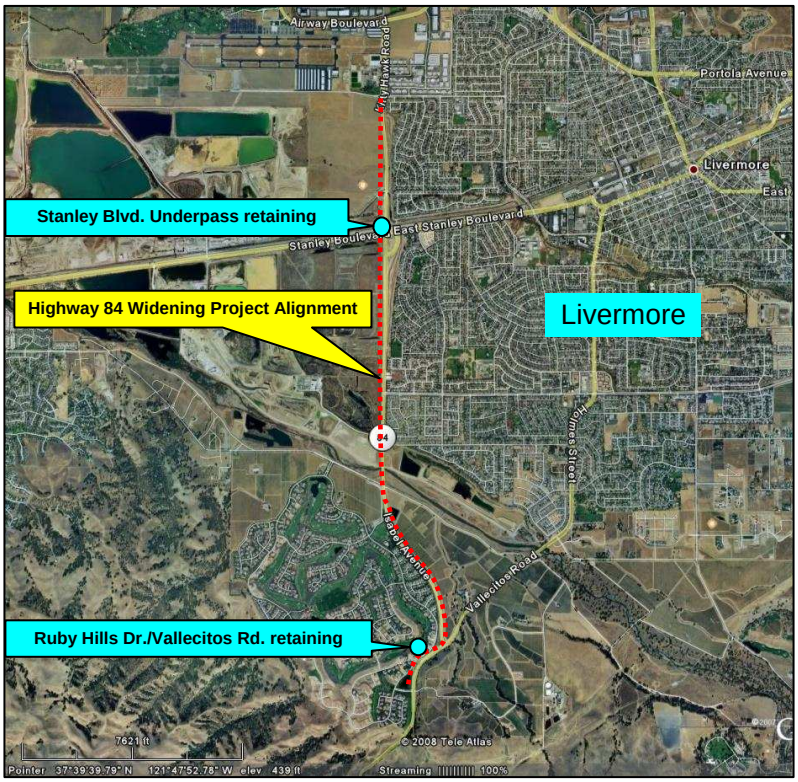

Figure 1. Vicinity Map, Including Retaining Wall Locations for the Highway 84 Widening Project, Livermore, CA.

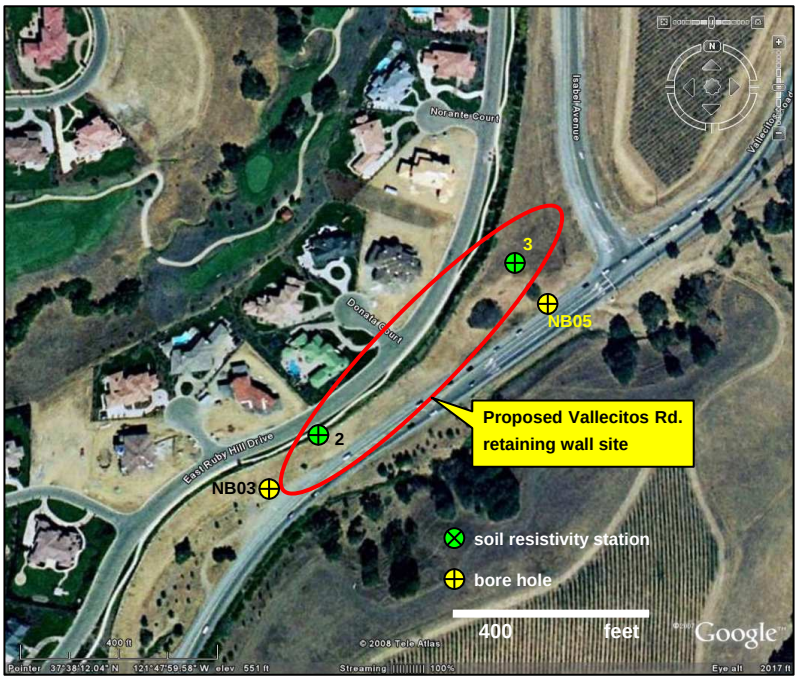

Figure 2. Soil Resistivity Test Sites and Soil Boring Sites at the Vallecitos Rd. Retaining Wall Site

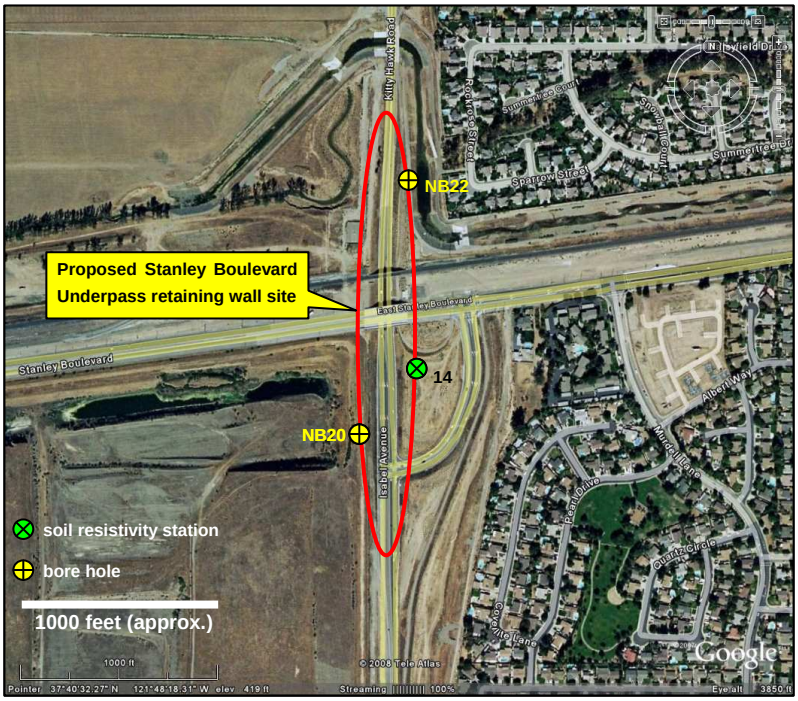

Figure 3. Soil Resistivity Test Site and Soil Bore Locations at the Stanley Blvd. Underpass.

In-situ soil resistivity measurements were conducted by the Wenner Electrode Method using an AEMC Soil Resistance Meter, Model 4500. The Wenner Electrode Method uses four equally spaced metal pins, driven into the ground in a straight line, as electrodes (see Figure 4).

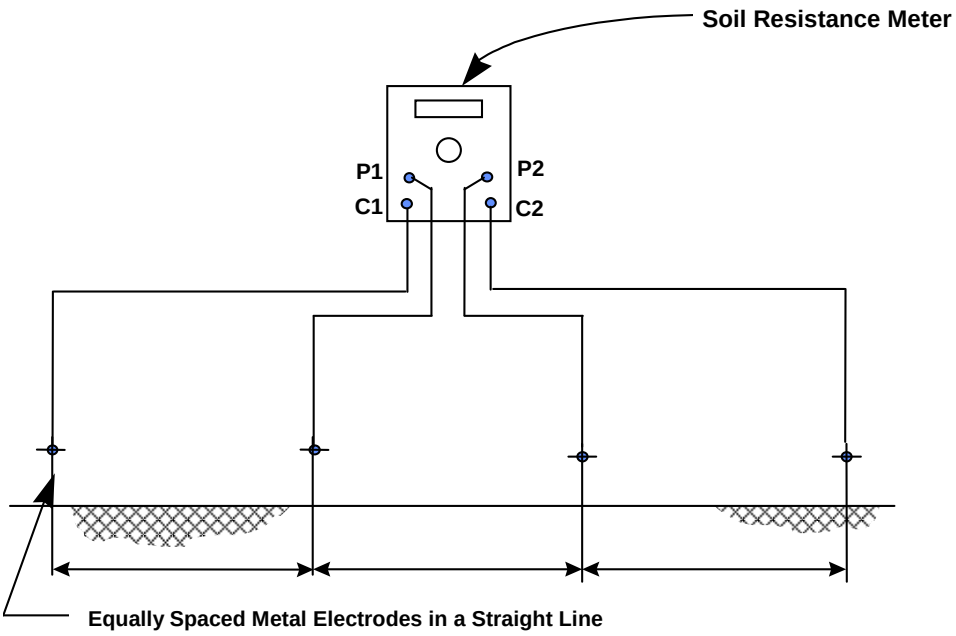

Figure 4. Wenner Electrode Method for Soil Resistivity Measurement

An alternating current from the Soil Resistance Meter causes a current to flow through the soil between the outside electrodes, C1 and C2. The current flowing through the soil creates a voltage gradient, which is proportional to the average resistance of the soil mass to a depth equal to the distance between electrodes. The voltage drop is measured across electrodes P1 and P2. Resistivity of the soil is then computed from the instrument reading according to the following formula:

$$\rho = 2\pi AR$$

where: ρ = soil resistivity in ohm-cm
A = the distance between probes in cm
R = soil resistance in ohms (instrument reading)
π = 3.1416

Soil resistivity measurements were conducted at electrode spacings of 1.5, 3.0, 4.5 and 6.0 meters. Another method of calculating the soil resistivity using the data from the Wenner Electrode Method is the Barnes-Layer Resistivity calculation. The Barnes-Layer calculation is used to determine the resistivity for each soil layer. While the Wenner Electrode Method with 6.0 meter electrode spacings will consider the entire six meters below the surface, the Barnes-Layer method will calculate the resistivity of layers 0 to 1.5 meters, 1.5 to 3.0 meters, 3.0 to 4.5 meters and 4.5 to 6.0 meters below the surface. This method assumes the soil layers have a uniform thickness and are parallel to the surface; this may not always be true.

The Barnes-Layer method uses the following parameters to calculate layer resistivities:

$$\rho_{b-a} = KR_{b-a}$$

and

$$\frac{1}{R_{b-a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

where:

ρ_{b-a}	=	Soil resistivity of layer depth b-a (ohm-cm)
a	=	Soil depth to top of layer (cm)
b	=	Soil depth to bottom of layer (cm)
R_a	=	Soil resistance read at depth a (ohms)
R_b	=	Soil resistance read at depth b (ohms)
R_{b-a}	=	Resistance of soil layer from a to b (ohms)
K	=	Layer constant (cm)
	=	$2\pi(b-a)$

Soil resistivities measured at the Ruby Hill Drive to Vallecitos Road Retaining Wall Site and at the Stanley Boulevard Underpass, with Barnes-Layer resistivities calculated from this data, are listed in Table 1.

Laboratory Soil Analysis

To supplement the field resistivity test data, soil samples were obtained from soil borings NB03, NB05, NB20, and NB22A for laboratory soil resistivity analysis using a Soil Box in accordance with California Test Method 643. This apparatus is shown in Figure 5.

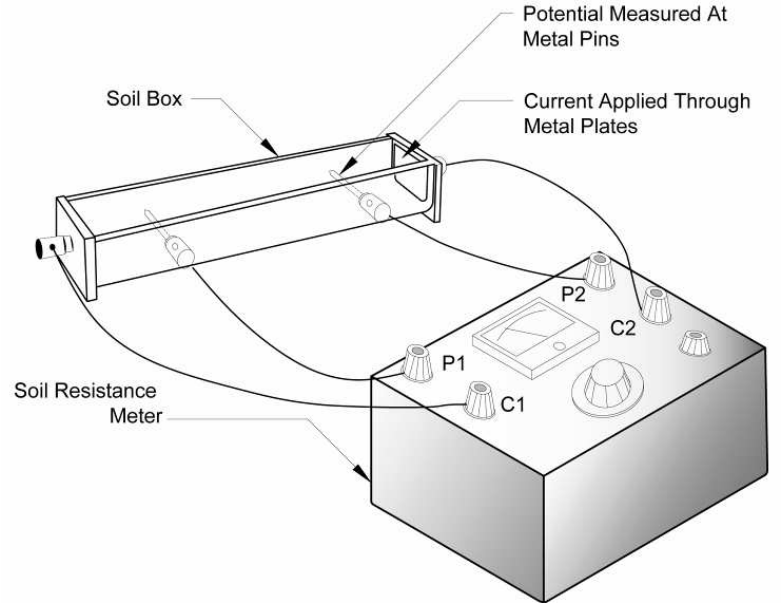

Figure 5. Soil Resistivity Measurement Using the Soil Box Method

This apparatus consists of a small plastic box with metal end plates for passing current through a tightly packed soil sample. Current is passed through the sample, causing a voltage drop across the sample. The soil resistivity is measured with a Soil Resistance Meter, similar to the AEMC Model 4500.

Soil resistivity is first measured in the "as-received" state. Distilled water is then added to the soil sample in 10-mL increments. The resistivity is measured after each addition. As the soil sample becomes more saturated, the soil resistivity decreases until the minimum soil resistivity is reached.

Soil boring samples from this study were forwarded to Cooper Testing Labs, Inc., in Palo Alto, CA, for minimum resistivity measurement, pH analysis and analysis of water soluble chloride and sulfate ion concentrations. The analytical procedures followed California Test Methods 417, 422 and 643.

TEST RESULTS

Table 1 lists the results of the field soil resistivity measurements taken at the proposed Ruby Hill Drive/Vallecitos Road retaining wall site and at the existing Stanley Boulevard Underpass retaining walls. Barnes-Layer resistivities calculated from this data are also included in Table 1. Table 2 lists the minimum resistivities and chemical analyses for the soil bore samples from these sites.

Table 1. Field Soil Resistivity Data

Site	Survey Station	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
2	248+00	1.5	8,570	0 - 1.5	8,570
		3.0	6,435	1.5 - 3.0	5,151
		4.5	4,223	3.0 - 4.5	2,502
		6.0	1,494	4.5 - 6.0	508
3	253+00	1.5	6,885	0 - 1.5	6,885
		3.0	6,109	1.5 - 3.0	5,491
		4.5	4,654	3.0 - 4.5	3,152
		6.0	4,137	4.5 - 6.0	3,102
14	398+00	1.5	4,012	0 - 1.5	4,012
		3.0	3,581	1.5 - 3.0	3,234
		4.5	3,993	3.0 - 4.5	5,185
		6.0	4,596	4.5 - 6.0	8,406

Table 2. Laboratory Soil Resistivity and Chemical Data

Item No.	Boring No.	Sample No.	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
					pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	NB03	2-3	1.5 - 2.0	3,302	7.5	<5	6
2	NB05	2-3	1.5 - 2.0	7,312	8.4	<5	<2
3	NB20	2-3	1.1 - 1.5	5,340	8.2	7	<2
4	NB22A	1-4	1.1 - 1.5	5,386	8.6	<5	9

Based on the Guidelines, the analyzed soil samples are considered *non-corrosive* to buried metallic objects and reinforced concrete structures in regard to chloride and sulfate contents, pH and minimum soil resistivity.

Appendix 1. Soil Sample Minimum Resistivities and Chemical Analyses

Corrosivity Test Summary

CTL # 632-005 & 006 **Date:** 6/13/2008 **Tested By:** PJ **Checked:** PJ

Client: V&A **Project:** URS-Caltrans Hwy 84 Widening **Proj. No:** 08-0216

Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Sample Description
Boring	Sample, No.	Depth, ft.	As Rec.	Minimum	Saturated	mg/kg	mg/kg	%		(Redox)	As Received	
						Dry Wt.	Dry Wt.	Dry Wt.		mv	%	
			ASTM G57	Cal 643	ASTM G57	Cal 422-mod.	Cal 417-mod.	Cal 417-mod.	Cal 643	SM 2580B	ASTM D2216	
NB03-2-3	-	5 - 6.5	-	3,302	-	6	<5	<0.0005	7.5	-	2.7	Brown Clayey SAND, trace Gravel
NB05-2-3	-	5-6.5	-	7,312	-	<2	<5	<0.0005	8.4	-	1.6	Reddish Brown SAND w/ Gravel, trace Clay
NB07-3-3	-	5 - 6.5	-	1,510	-	20	<5	<0.0005	7.1	-	3.0	Brown Sandy CLAY
NB11-5-3	-	20 - 21.5	-	7,255	-	<2	<5	<0.0005	7.4	-	1.6	Brown GRAVEL w/ Clay & Sand
NB12-2-X	-	5 - 6.5	-	10,028	-	<2	<5	<0.0005	8.6	-	0.9	Brown SAND w/ Clay & Gravel
NB13-6-3	-	25-26.5	-	7,992	-	<2	<5	<0.0005	8.3	-	1.2	Brown GRAVEL w/ Sand, trace Silt
NB14-2-3	-	5 - 6.5	-	10,586	-	<2	<5	<0.0005	8.5	-	0.7	Brown GRAVEL w/ Sand
NB20-2-3	-	3.5 - 5	-	5,340	-	<2	7	0.0007	8.2	-	2.0	Brown Clayey SAND
NB22A-1-4	-	3.5 - 5	-	5,386	-	9	<5	<0.0005	8.6	-	1.3	Brown SAND w/ Clay & Gravel
NB23-2-4	-	5 - 6.5	-	5,347	-	2	<5	<0.0005	8.4	-	1.1	Brown SAND w/ Clay & Gravel
NB23-13-3	-	60 - 61.5	-	6,052	-	3	<5	<0.0005	7.9	-	1.9	Reddish Brown Silty SAND w/ Gravel (slightly plastic)
NB24-2-X	-	5 - 6.5	-	14,478	-	<2	<5	<0.0005	9.1	-	0.6	Grayish Brown SAND w/ Clay & Gravel
NB24-13-4	-	60 - 61.5	-	1,978	-	7	<5	<0.0005	7.8	-	2.1	Reddish Brown Sandy SILT
NB25A-2-4	-	8.5 - 10	-	23,278	-	<2	<5	<0.0005	8.3	-	0.5	Brown GRAVEL w/ Silt & Sand
Arroyo del Valle		water	-	1,686	-	63.7*	19.9*	-	8.3	-	-	Water sampled at existing Arroyo del Valle bridge
Note: The Chloride and Sulfate results for the water sample are in units of mg/L.												

10-1.__ SOIL NAIL WALL EARTHWORK

This work shall consist of stability testing, excavating for soil nail wall construction, and backfilling around completed soil nail walls in conformance with the details shown on the plans, the provisions in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications, and these special provisions.

Horizontal Borings

Prior to construction of this soil nail wall and submittal of working drawings, the Contractor shall make three horizontal borings, one at each Wall Zone as defined in "Stability Testing." The location of each horizontal boring shall be submitted to the Engineer for his approval. Each horizontal boring shall extend horizontally a minimum of 50 feet.

The Contractor shall retain either a California Professional Geotechnical Engineer or Certified Engineering Geologist to supervise the drilling and log the boreholes on a full time basis during drilling. Soil/rock samples shall be classified in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007). Soil and/or rock sample shall be obtained with either an auger (disturbed) or NX rock core with minimum 2-inch diameter if bedrock is encountered. Soil and/or rock samples shall be collected, identified and placed in water tight bags. Engineer shall witness all drilling operations.

The Contractor shall furnish all equipment and labor to drill these borings, provide access to and from the drill holes, and backfill holes with a soil-cement-bentonite grout mixture approved by the Engineer. Contractor shall provide all access/permission necessary for drilling and provide surveyed locations of holes (horizontal and vertical location, including a site plan with marked locations to the Engineer. Utility locations shall be the responsibility of the Contractor. Contractor is advised that an existing 24 inch diameter high pressure gas line is located on Ruby Hill Drive as shown on Plans; Contractor shall locate horizontal borings to avoid interference with gas lines.

Working Drawings

The Contractor shall submit a complete working drawing submittal for earthwork for each soil nail wall to the Offices of Structure Design in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. Working drawings shall be 11" x 17" in size. For initial review, 5 sets of drawings shall be submitted. After review, between 6 and 12 sets, as requested by the Engineer, shall be submitted to Offices of Structure Design for final approval and use during construction.

Working drawing submittals for soil nail wall earthwork shall show the contract number, structure number, full name of the structure as shown on the project plans, and District-County-Route-Post Mile on each drawing and calculation sheet. The Contractor's name, address, and telephone and fax numbers shall be shown on the working drawings. Each sheet shall be numbered in the lower right hand corner.

The working drawing submittal for soil nail wall earthwork shall contain all information required for the construction and quality control of the earthwork, including the following:

A. A proposed schedule and detailed construction sequence. The construction sequence shall include measures to ensure wall and slope stability during all stages of wall construction, including provisions for installation of verification and proof test soil nails and discontinuous rows of soil nails.
B. Methods of excavation to the staged lifts indicated and types of excavation equipment.

C. Exposed vertical soil lift height and proposed maximum duration of exposure for each wall zone, including supporting calculations, and provisions for stabilization of the exposed soil face.
D. Details for the monitoring system for wall deflection.
E. Information on space requirements for installation equipment.
F. A detailed construction dewatering plan addressing all elements necessary to divert, control, and dispose of surface water and ground water.

The working drawings shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California.

The Contractor shall allow the Engineer 4 weeks to review the working drawings after a complete submittal has been received.

Should the Engineer fail to review the complete working drawing submittal within the time specified and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the soil nail wall earthwork working drawing submittal, an extension of time commensurate with the delay in completion of the work thus caused will be granted in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Stability Testing

The Contractor shall perform stability testing to verify the Contractor's proposed excavation lift height and exposure duration for soil nail wall construction. Stability testing shall be performed before roadway excavation.

A minimum of one stability test shall be performed within the limits of each wall zone as defined in the following table:

Wall Zone	Beginning Stationing	End Stationing	Upper Elevation (ft)	Lower Elevation (ft)
1	246+80	251+80	558.0	532.0
2	251+80	258+00	552.0	530.0
3	251+80	258+00	530.0	520.0

The stability tests shall be conducted by performing staged roadway excavation to produce a neat excavated face no more than 3 feet in front of the location of the final soil nail wall face. The height of the excavated face shall be as specified in the approved working drawings. The excavated face shall be 20 feet long and parallel to the soil nail wall alignment. The excavated face shall have a constant height within the 20-foot section. Ramps may be excavated outside the 20-foot section to provide construction access. The excavated face shall be left open for the duration specified in the approved working drawings.

The excavated face shall maintain its integrity without raveling, sloughing, or measurable lateral movement at the completion of the stability test. After written approval by the Engineer, the proposed excavation height may be used in that wall zone as the stand-up height of the excavated face for the duration observed in the stability test.

If at any time the exposed excavated face fails to maintain its integrity without raveling, sloughing, or measurable lateral movement for the duration of time observed in the approved stabilization test, the Contractor shall immediately stabilize the excavated face and perform additional stability testing as described herein.

If the Contractor uses a maximum excavation lift height of not greater than 5 feet, no stability testing will be required.

When stability testing is not performed, shotcrete shall be applied during the same work shift in which excavation has occurred. Completion of the shotcrete facing may be delayed up to 24 hours if the Contractor demonstrates that the integrity of the excavated face is maintained.

Construction

No excavation or drilling for installation of production soil nails will be permitted in any wall zone until stability testing and verification soil nail testing have been completed in that wall zone, and the test results have been approved by the Engineer.

Excavation for soil nail installation shall proceed from the top down in a staged lift sequence as shown on the approved wall earthwork working drawings.

The complete excavated face shall be cleaned of all loose materials, mud, rebound, and other materials that could prevent or reduce shotcrete bond to the excavated face and soil nails.

The Contractor shall remove all cobbles, boulders or portions of boulders, rubble, or debris that are encountered at the final wall alignment during wall face excavation and that protrude from the excavated face more than 2 inches into the design shotcrete thickness as shown on the plans. Such over excavation shall be backfilled with shotcrete.

The Contractor shall immediately notify the Engineer of the occurrence of raveling or local instability of the final wall face excavation or a horizontal movement of the wall face exceeding 0.4 percent of the total excavated wall height.

Unstable areas shall be temporarily stabilized by means of buttressing the exposed excavation face with an earth berm or other methods approved in writing by the Engineer. Construction of the wall in unstable areas shall be suspended until remedial measures, submitted by the Contractor and approved by the Engineer, have been taken.

The Contractor shall protect installed soil nails during excavation and subsequent operations. Damaged soil nails shall be replaced by the Contractor, at the Contractor's expense.

The Contractor shall complete soil nail construction and application of shotcrete wall facing in conformance with the construction sequence in the approved wall earthwork working drawings.

Where the Contractor's excavation and installation methods result in a discontinuous wall along any soil nail row, the ends of the structurally completed wall section shall extend beyond the ends of the next lower excavation lift by a distance equal to twice the lift height. The Contractor shall maintain temporary slopes at the ends of each wall section to ensure slope stability.

No excavation shall proceed to the next underlying excavation lift until the portion of wall in the current excavation lift is structurally complete. A portion of soil nail wall shall be considered structurally complete when:

A. Soil nail construction has been completed.
B. Reinforced shotcrete facing has been constructed.
C. Soil nail grout and shotcrete facing have been cured for at least 72 hours or have attained a minimum compressive strength of 3,000 psi.
D The soil nail facing anchorage has been attached.
E The representative soil nail tests have been completed for that portion of wall.
F The soil nail test results have been approved in writing by the Engineer.

Measurement and Payment

Excavation and backfill for soil nail wall construction will be measured and paid for as structure excavation (soil nail wall) and structure backfill (soil nail wall).

Full compensation for stability testing and furnishing, constructing, and removing working and stabilizing berms for soil nail wall construction shall be considered as included in the contract price paid per cubic yard for structure excavation (soil nail wall), and no additional compensation will be allowed therefor.

Full compensation for shotcrete used to fill voids created by the removal of cobbles and boulders or other obstructions shall be considered as included in the contract price paid per cubic yard for shotcrete and no additional compensation will be allowed therefor.

10-1.__ SOIL NAIL ASSEMBLY

This work shall consist of drilling holes in existing foundation materials, installing and grouting steel bars in drilled holes, installing anchorage systems, and testing of installed soil nails in conformance with the details shown on the plans, the provisions of the Standard Specifications, and these special provisions.

Working Drawings

The Contractor shall submit a complete working drawing submittal for soil nail assemblies to the Offices of Structure Design in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. Working drawings shall be 11" x 17" in size. For initial review, 5 sets of drawings shall be submitted. After review, between 6 and 12 sets, as requested by the Engineer, shall be submitted to the Offices of Structure Design for final approval and use during construction.

Working drawing submittals for soil nail assemblies shall show the contract number, structure number, full name of the structure as shown on the project plans, and District-County-Route-Post mile on each drawing and calculation sheet. The Contractor's name, address, and telephone and fax numbers shall also be shown on the working drawings. Each working drawing sheet shall be numbered in the lower right hand corner of the sheet.

The working drawing submittal for soil nail assemblies shall contain all information required for the construction and quality control of the soil nail wall, including the following:

A. The proposed schedule and detailed construction sequence of the installation and grouting of soil nails, application of shotcrete, and construction of cast-in-place reinforced concrete.
B. Complete details and specifications for the anchorage system, soil nails, and test soil nails, including encapsulation materials and grouting methods.
C. Drilling methods and equipment, including proposed drilled hole diameter with assumed bond strength, supporting calculations, and equipment space requirements.
D. Grout mix designs and testing procedures.
E. Grout placement procedures and equipment, including minimum required cure time.
F. Proposed soil nail testing equipment, including jacking frame and appurtenant bracing, and the method and equipment for determining soil nail displacement during testing.
G. Details for providing bonded and unbonded lengths, including type of packers or other appropriate devices.
H. Details for isolation of installed proof soil nails during shotcrete installation.
I. Procedure for extraction of grouted soil nails.

The working drawings shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California.

The Contractor shall allow the Engineer 4 weeks to review the working drawings after a complete submittal has been received.

Should the Engineer fail to review the complete working drawing submittal within the time specified, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the soil nail working drawing submittal, an extension of time commensurate with the delay in completion of the work thus caused will be granted in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Materials

The materials specified below shall be used for construction of soil nail assemblies and test soil nails.

Bar reinforcement for soil nails shall conform to the provisions for bar reinforcement in Section 52, "Reinforcement," of the Standard Specifications. When Grade 60 soil nails are shown on the plans, the bar reinforcement shall also conform to the requirements in ASTM Designation: A 615/A 615M or A706/A706M. When Grade 75 soil nails are shown on the plans, the bar reinforcement shall also conform to the requirements in ASTM Designation: A 615/A 615M. The soil nail shall be either a reinforcing bar encapsulated full length in a grouted corrugated plastic sheathing or an epoxy-coated reinforcing bar partially encapsulated in a grouted corrugated plastic sheathing. The bar shall be centered in the sheathing and the space between the sheathing and the bar shall be filled with grout. The epoxy coating shall have a minimum thickness of 12 mils.

Bar reinforcement for soil nails shall conform to the provisions for bar reinforcement in Section 52, "Reinforcement," of the Standard Specifications. When Grade 60 soil nails are shown on the plans, the bar reinforcement shall also conform to the requirements in ASTM Designation: A 615/A 615M or A 706/A 706M. When Grade 75 soil nails are shown on the plans, the bar reinforcement shall also conform to the requirements in ASTM Designation: A 615/A 615M. The soil nail shall be a reinforcing bar encapsulated full length in a grouted corrugated plastic sheathing. The bar shall be centered in the sheathing and the space between the sheathing and the bar shall be filled with grout.

Soil nails shall be lengthened or additional soil nails shall be installed if ordered by the Engineer. The lengthening or addition of soil nails, if ordered by the Engineer, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Bar reinforcement for soil nails shall have a minimum length of 6 inches of thread on the anchorage end. Threading may be continuous spiral deformed ribbing provided by the bar deformations or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the bar size shall be the next larger bar designation number from that shown on the plans and coarse threads shall be used. The epoxy coating at the anchorage end of epoxy-coated bars may be omitted for a maximum length of 6 inches. Metal surfaces of assembled splices of epoxy-coated bars shall be epoxy coated.

Corrugated plastic sheathing shall be either polyvinyl chloride (PVC) or high-density polyethylene (HDPE). The minimum sheathing wall thickness shall be 25 mils.

HDPE shall have a density between 0.940 and 0.960 grams per cubic centimeter when measured in conformance with the requirements in ASTM Designation: D 792, Test Method A.

The sheathing shall have sufficient strength to prevent damage during construction operations and shall be watertight, chemically stable without embrittlement or softening, and nonreactive with concrete.

Splicing of soil nails shall be made only at the locations shown in the approved working drawings or at ends of soil nails that the Engineer has ordered to be lengthened.

Bar reinforcement for verification and proof test soil nails shall conform to the provisions for bar reinforcement in Section 52, "Reinforcement," of the Standard Specifications and shall be of a size and grade determined by the Contractor. Test soil nail bars shall be not smaller than the production soil nails they represent.

Verification and proof test soil nails shall be lengthened if ordered by the Engineer. The lengthening of test soil nails, if ordered by the Engineer, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Bar reinforcement for verification and proof test soil nails need not be epoxy coated or encapsulated in grouted plastic sheathing. Splicing of test soil nails shall be made only at

locations outside of the bonded length.

Anchorages for soil nails shall conform to the details shown on the plans and the provisions in Section 75-1.02, "Miscellaneous Iron and Steel," of the Standard Specifications, except that nuts, washers, wedges, and bearing plates to be fully encased in concrete, grout, or shotcrete need not be galvanized. Concrete anchors on bearing plates shall conform to the provisions for stud connectors in Section 55-2, "Materials," of the Standard Specifications.

Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. California Test 541 will not be required nor will the grout be required to pass through a screen with a 0.07-inch maximum clear opening prior to being introduced into the grout pump. Fine aggregate may be added to the grout mixture of cement and water in drilled holes 6 inches or greater in diameter, but only to the extent that the cement content of the grout is not less than 930 pounds per cubic yard of grout. Fine aggregate, if used, shall conform to the provisions in Section 90-2, "Materials," and Section 90-3, "Aggregate Gradings," of the Standard Specifications. Grout with fine aggregate shall have a nominal penetration equal to or greater than 90 mm when measured in conformance with California Test 533 and shall have an air content of equal to or less than 2 percent when measured in conformance with California Test 504. Air-entraining admixtures shall not be used for grout with fine aggregate.

The consistency of grout with fine aggregate shall be verified prior to use by producing a batch to be tested. The test batch shall be produced and delivered to the project under conditions and in time periods similar to those expected during the placement of grout in the soil nails. Grout for the test batch shall be placed in an excavated hole or suitable container of adequate size to allow testing in conformance with California Test 533. The test batch shall demonstrate that the proposed grout mix achieves the specified nominal penetration. Upon completion of the testing, the grout shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Construction

No excavation or drilling for the installation of production or proof soil nails will be permitted in any wall zone until stability testing and verification soil nail testing have been completed in that wall zone and the test results have been approved by the Engineer.

Difficult soil nail assembly construction is anticipated due to caving soils, hazardous and contaminated materials, serpentine materials, tidal flow fluctuation, high ground water, cobbles and boulders, subsurface concrete debris, low overhead clearance, underground utilities, overhead utilities, the requirements of soil nail assembly embedment into existing foundation materials, sound control,and traffic control.

The Engineer shall be present during drilling, installation, grouting, and testing for verification soil nails.

The Contractor shall determine the required drilled hole diameter and installation method to achieve the soil nail pullout resistance values specified on the plans.

Drilling equipment shall be designed to drill straight and clean holes. The drilling method and the size and capability of the drilling equipment shall be as approved in the working drawings.

At locations where caving conditions are anticipated, sufficient casing and auger lengths shall be available on site to maintain uninterrupted installation of anchors.

At locations where hard drilling conditions such as rock, cobbles, boulders, or obstructions are anticipated, a down hole pneumatic hammer drill rig and drill bit shall be available on site to drill holes for soil nails.

Drilled holes for walls shall not extend beyond the right-of-way or easement limits as shown on the plans or as specified in these special provisions.

Holes shall be drilled in the existing foundation materials. Holes for verification and proof soil nails shall be of the same diameter as those for the production soil nails they represent.

Holes shall be cleaned to remove material resulting from drilling operations. Water for cleaning holes shall not be used unless approved in writing by the Engineer. Soil nails shall not be installed in the drilled holes until the holes have been inspected by the Engineer.

Soil nails shall be installed in drilled holes in an expeditious manner so that caving or deterioration of the drilled holes does not occur.

Centralizers shall be used during installation to support the soil nail in the center of the drilled hole. Centralizers shall be spaced at a maximum of 7.5 feet on center along the length of the bar, and 18 inches from the end of the bar.

Where the soil nail cannot be completely inserted, the Contractor shall remove the bar and clean or redrill the hole to permit unobstructed installation. Partially installed bars shall not be driven or forced into the drilled hole and will be rejected. When open-hole drilling methods are being used, the Contractor shall have hole cleaning tools on site suitable for cleaning drilled holes along their full length just prior to bar insertion and grouting.

The Contractor may install verification soil nails through the existing slope face, drill platform work bench, stabilization berm, stability test exposed face, or into slot cuts made for the lift in which the verification soil nails are located. Slot cuts shall only be large enough to accommodate the drill and test setup equipment. The verification test nails shall be installed within the limits of each wall test zone or within the limits of the 20-foot excavated stability test face, and shall be at least 10 feet apart.

The length of drilled hole shall be verified and recorded by the Contractor before grouting.

The Contractor shall grout the drilled hole after installation of the soil nail. Grout shall be injected at the low end of the drilled hole and shall fill the drilled hole with a dense grout free of voids or inclusion of foreign material. The Contractor shall completely grout the drilled hole in one continuous operation. Cold joints shall not be used in grout placement.

Only the bonded length of test soil nails shall be grouted.

Soil nails shall be installed and grouted in the same work shift as the drilling operation.

Any remaining void at the exterior end of the drilled hole shall be filled with shotcrete, and the soil nail secured at the face of the shotcrete. The steel bearing plate shall be seated with full bearing on the shotcrete surface, and the nut for the soil nail shall be hand tightened before the initial set of the shotcrete. The nut shall be made wrench tight after the shotcrete has set for 24 hours unless a shorter time is approved by the Engineer.

After placing grout, soil nails shall remain undisturbed for the cure time stated in the approved soil nail working drawings.

The Contractor shall construct verification soil nails using the same equipment, methods, nail inclination, and drill hole diameter as to be used for production soil nails.

Testing

The Contractor shall perform load testing of verification and proof soil nails to verify the Contractor's soil nail installation methods and pullout resistance. Load testing shall consist of incrementally loading the soil nail until either the maximum test load has been held for the specified duration or a pullout failure has occurred.Production soil nails shall be represented by proof soil nails within a given wall zone.

The Contractor shall monitor and record total movement of the test soil nail relative to the grout during application of the test load.

Test loads shall be applied using a hydraulic jack supported by a reaction frame capable of supporting the test equipment without excessive deformation. Test loads shall be maintained within 5 percent of the intended load throughout hold periods. Applied test loads shall be

determined by using either a calibrated pressure gage or a load cell. Movements of the soil nail head shall be measured using a gage capable of measuring to 0.001 inch and recorded to the nearest 0.001 inch at each increment of load, including the ending alignment load, during the load tests. The gage shall have sufficient capacity to allow the test to be completed without resetting the gage during testing. Unloading and repositioning of test equipment during testing will not be allowed.

The pressure gage shall be graduated in 100 psi increments or less, and shall have an accurately reading dial at least 6 inches in diameter. Each jack and its gage shall be calibrated as a unit with the cylinder extension in the approximate position that it will have at final jacking force, and shall be accompanied by a certified calibration chart. Each jack and pressure gage assembly shall be calibrated in conformance with the provisions for jacks used to stress tendons permanently anchored at greater than 25 percent of ultimate tensile strength in Section 50-1.08, "Prestressing," of the Standard Specifications. The load cell shall be calibrated and shall be provided with an indicator capable of measuring the test load in the soil nail. The range of the load cell shall be such that the lower 10 percent of the manufacturer's rated capacity will not be used in determining the jacking force.

The test load may be verified by State forces with State-furnished operated in conformance with the requirements of California Test 677. The Contractor shall provide sufficient labor, equipment, and material to install and support such testing equipment at the soil nails and to remove the testing equipment after the testing is complete, as ordered by the Engineer.

The Contractor shall furnish to the Engineer complete results for each soil nail tested. Data for each test shall list key personnel, test loading equipment, soil nail location, hole diameter and depth, bonded length, type of soil, method of drilling, and amount of ground water encountered within the bonded length. Test data shall also include the dates and times of drilling, soil nail installation, grouting, and testing. The test load and amount of displacement shall be included in the test data when any displacement of the soil nail relative to a fixed reference point occurs.

The test load T shall be determined by the following equation:

$$T = L_B \times Q_d$$

Where:

L_B = soil nail bonded length (ft), not less than 10 feet
Q_d = design pullout resistance (pounds/linear foot), as shown on the plans.

The Contractor shall perform load testing on verification soil nails in the presence of the Engineer. Two verification soil nails shall be installed and tested for each soil nail wall zone listed. Installation and testing of verification soil nails may be performed during stability testing.

The verification test procedure shall conform to the following:

A. The test shall be conducted by measuring and recording the test load applied to the verification soil nail and the movement of the soil nail head at each load listed in the following loading schedule.

VERIFICATION TEST	
TEST LOAD	HOLD TIME
AL (0.10T)	Until Stable
0.20T	2 minutes
0.40T	2 minutes
0.60T	2 minutes
0.80T	2 minutes
1.00T (Creep Test)	60 minutes
1.25T	2 minutes
1.50T (Maximum Test Load)	10 minutes
AL	Until Stable
T = Test load as determined by Contractor.	
AL = Alignment load = 0.10T	

B. Each increment of load shall be applied in less than one minute and held for at least one minute but not more than 2 minutes, except that the creep test load shall be held for 60 minutes. During the creep test, the movement of the soil nail head shall be measured at 1, 2, 3, 4, 5, 6, 10, 20, 30, 40, 50, and 60 minutes. The observation period for the 60-minute load shall start when the pump begins to apply the increment of load from 0.80T to 1.00T.

C If the movement measured between 6 minutes and 60 minutes at 1.00T is less than 0.08 inch, the load shall continue to be increased incrementally to 1.50T, then reduced to the ending alignment load.

D. If the movement measured between 6 minutes and 60 minutes is 0.08 inch or greater, the load shall be reduced to the ending alignment load.

The Contractor shall perform load testing on proof soil nails at locations shown on the plans in the presence of the Engineer. In addition to proof soil nails designated on the plans, the Engineer will instruct the Contractor to install and test 3 additional proof soil nails at locations to be determined by the Engineer.

Proof soil nail testing shall be performed against a temporary bearing yoke that bears directly on the shotcrete facing. Test loads transmitted through the temporary bearing yoke shall not fracture the shotcrete or cause displacement or sloughing of the soil surrounding the drilled hole.

The proof test procedure shall conform to the following:

A. The proof test shall be conducted by measuring and recording the test load applied to the soil nail and the movement of the soil nail head at each load listed in the following loading schedule.

PROOF TEST	
TEST LOAD	HOLD TIME
AL (0.10T)	Until Stable
0.20T	2 minutes
0.40T	2 minutes
0.60T	2 minutes
0.80T	2 minutes
1.00T (Creep Test)	10 minutes
1.25T*	2 minutes
1.50T*	2 minutes
AL	Until stable
T = Test load as determined by Contractor.	
AL = Alignment load = 0.10T	
* Loads for supplemental load testing only	

B. Each increment of load shall be applied in less than one minute and held for at least 2 minutes, except that the creep test load shall be held for 10 minutes. During the creep test, the movement of the soil nail head shall be measured and recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. The observation period for the 10-minute load hold shall start when the pump begins to apply the increment of load from 0.80T to 1.00T.
C. If the load of 1.00T cannot be maintained with 0.08 inch or less of measured movement between one minute and 10 minutes, the 1.00T load shall be maintained for an additional 50 minutes. Soil nail head movement shall be measured at 20, 30, 50, and 60 minutes. A creep curve showing the movement between 6 minutes and 60 minutes shall be plotted as a function of the logarithm of time.
D. The load shall be reduced to the ending alignment load after creep testing is completed.

Soil nails shall be unloaded only after completion of testing.
A soil nail test will be considered acceptable when:

A. For verification tests, a total creep movement of less than 0.08 inch is measured between 6 minutes and 60 minutes of creep testing and the creep rate is linear or decreasing in time logarithmic scale between the one-minute and 60-minute readings.
B. For proof tests, (1) a total creep movement of 0.08 inch or less is measured between one minute and 10 minutes of creep testing or (2) a creep movement of less than 0.08 inch is measured between 6 minutes and 60 minutes and the creep rate is linear or decreasing in time logarithmic scale between the 6-minute and 60-minute readings.
C. The total measured movement at the maximum test load less the measured movement at the final alignment load exceeds 80 percent of the theoretical elastic elongation of the soil nail unbonded length.
D. A pullout failure of the soil nail does not occur. A pullout failure has occurred when attempts to increase the test load result in movement of the soil nail relative to a fixed reference point without an increase in load. The pullout failure load shall be recorded as part of the test data.

The Engineer will select up to one-half of proof test nails for supplemental load testing. Only those proof nails exhibiting a creep movement of less than 0.08 inch in 10 minutes will be considered for supplemental testing. Supplemental testing shall be performed immediately following creep testing. Soil nails selected for supplemental testing shall be tested to the loads

and for the durations specified in these special provisions. The test load and movement of the soil nail head shall be recorded, and the results included in the soil nail test data.

Verification soil nails that fail to meet acceptance criteria will be rejected. The Contractor shall submit revised working drawings for additional verification soil nails.

The Engineer will determine the cause of failure for each rejected verification test nail. Installation methods, if determined to be the cause of failure, will be rejected and the Contractor shall include proposed alternative installation methods in the revised working drawings. The Contractor, at the Contractor's expense, shall install additional verification soil nails at the direction of the Engineer until acceptance criteria are met. If the Engineer revises soil nail lengths or nominal pullout resistance values, the replacement verification test nails will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

The Contractor shall log horizontal borings for additional verification soil nails and submit a test boring report to the Engineer. The soil and rock classification shall conform to the "Soil and Rock Logging Classification Manual: Field Manual" published by the Department. The test boring report shall be signed by a geologist or engineer who is registered as a Geologist or Civil Engineer in the State of California. The logging manual can be obtained by contacting the Transportation Laboratory and is available at:

http://www.dot.ca.gov/hq/esc/geotech/request.htm

The test boring report shall include the following:

A. Summary of drilling methods, drilling equipment, drill platforms, and any drilling difficulties encountered.
B. Location map of the surveyed position of the new test borings relative to existing and proposed facilities (in California Coordinate System and bridge stationing).
C. Bore hole survey notes.
D. Depth increments of borings.
E. Soil and rock classifications and descriptions.
F. Photographs of cuttings.
G. Copies of original daily drilling notes, including dates and weather conditions.

Logging of horizontal test borings and submittal of the test boring report will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Production soil nails represented by proof soil nails that fail to meet acceptance criteria, except those represented by proof soil nails selected for supplemental load testing, will be rejected. The Contractor shall propose alternative installation methods, revise production soil nails, or modify the soil nail plan to the satisfaction of the Engineer. The Contractor shall submit revised working drawings for replacement soil nails. Additional proof test soil nails, production soil nails, installation, and testing, including revised working drawings, shall be at the Contractor's expense.

Verification and proof soil nails shall be removed to 6 inches behind the front face of the shotcrete after testing has been completed, and the void filled with grout.

Verification and proof soil nails shall be extracted when requested by the Engineer, and the void filled with grout.

RESEARCH INVESTIGATION EQUIPMENT AND ACTIVITIES

The State will conduct research activities within the limits of the soil nailing.

Research activities will consist of placing and monitoring survey markers and slope indicator

casings at locations shown on the plans. Survey markers will be installed on the face and on the crest of the wall.

Research devices will be furnished and installed by State forces. Work by the Contractor that is ordered by the Engineer to assist in handling and setting up research devices will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Instrumentation and survey markers shall be protected by the Contractor and will be replaced or restored at the Contractor's expense if damaged by the Contractor's operations.

The installation of research devices will be scheduled in advance with the Contractor. The Contractor shall coordinate operations so as not to interfere with the installation and monitoring of the research devices.

In the event that the research devices are not installed by the times scheduled, and if, in the opinion of the Engineer, the Contractor's operations are delayed or interfered with by reason of the research devices not being installed by those times, the State will compensate the Contractor for such delays to the extent provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Measurement and Payment

Soil nail assembly will be measured and paid for by the linear foot. The length to be paid for will be the length of soil nail assembly or test soil nail measured along the bar centerline from the back face of shotcrete to the tip end shown on the plans or ordered in writing by the Engineer.

The contract price paid per linear foot for soil nail assembly shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the soil nail assemblies, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Verification and proof test soil nails will be paid for as soil nail assembly.

Full compensation for load testing and extracting verification and proof test soil nails shall be considered as included in the contract price paid per linear foot for soil nail assembly, and no separate payment will be made therefor.

Full compensation for furnishing, installing, and removing casing shall be considered as included in the contract price paid per linear foot for soil nail assembly, and no additional compensation will be allowed therefor.

The quantities of trial batch grout will not be included in any contract item of work, and full compensation for furnishing, producing, and disposing of trial batches shall be considered as included in the contract price paid per linear foot for soil nail assembly, and no additional compensation will be allowed therefor.

Payment for proof soil nails that fail supplemental testing will be reduced by $1.00 per linear foot of proof soil nail assembly.

FOR CONTRACT NO. 297614

DRAINAGE/HYDRAULIC INFORMATION

BRIDGE DESIGN HYDRAULIC STUDY REPORT

DATED 05/2009

04-ALA-84
EA 297601
33C-0710/33C-0713

State Route 84 Expressway Widening Project
Cities of Livermore and Pleasanton, Alameda County, California

Bridge Design Hydraulic Study Report

Prepared for:

Caltrans

and

ACTIA
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY

Prepared by:

WRECO

May 2009

04-ALA-84
EA 297601
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State Route 84 Expressway Widening Project
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Submitted to:

Caltrans

&

Alameda County Transportation Improvement Authority

This report has been prepared by or under the supervision of the following Registered Engineer. The Registered Civil Engineer attests to the technical information contained herein and has judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

Han-Bin Liang, Ph.D., P.E.
Registered Civil Engineer

May 20, 2009
Date

May 2009

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Executive Summary

This study represents the hydrologic and hydraulic assessment for the proposed State Route 84 (SR 84) Expressway Bridge widening at Arroyo del Valle, the new Trail Bridge over Arroyo del Valle, the proposed SR 84 Expressway Bridge widening at Arroyo Mocho, and the new Access Bridge over Arroyo Mocho in the City of Livermore, Alameda County, California. The bridges are located on the SR 84 Expressway Widening Project.

Hydraulic analyses were performed for the existing and proposed conditions using the design flows from the Zone 7 Water Agency (Zone 7). For Arroyo del Valle and Arroyo Mocho, the design flood simulation in the model was controlled by the normal depth calculated from the average channel slope at the downstream straight channel reach. The Zone 7 design criterion is 100-year plus 2 ft of freeboard. The results from the hydraulic analyses for the proposed conditions are summarized in Table 1 through Table 4, below.

Table 1: SR 84 Expressway at Arroyo del Valle Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	7,000	417.48	411.18	6.30	11.68
50-year	5,400	417.48	410.06	7.42	10.34

Table 2: Trail Bridge at Arroyo del Valle Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	7,000	415.58	411.71	3.87	8.31
50-year	5,400	415.58	410.55	5.03	7.62

Table 3: SR 84 Expressway at Arroyo Mocho Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	4,800	416.87	415.01	1.86	6.02
50-year	3,900	416.87	413.97	2.90	5.70

Table 4: Access Bridge at Arroyo Mocho Hydrologic & Hydraulic Summary

Design Flow Return Period	Design Flows (cfs)	Bridge Soffit Elevation (ft)	Water Surface Elevation (ft)	Freeboard (ft)	Average Flow Velocity (ft/sec)
100-year	4,800	417.02	414.66	2.36	6.31
50-year	3,900	417.02	413.62	3.40	6.00

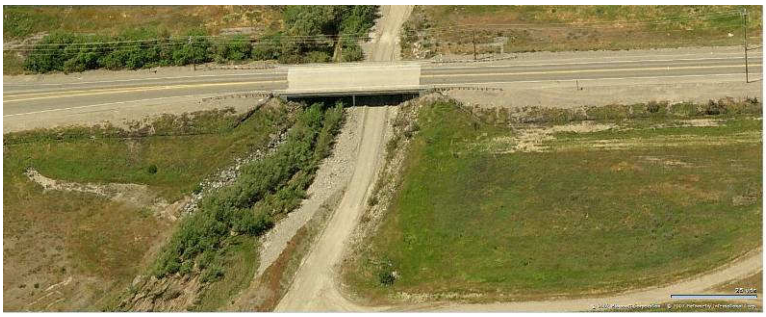

Photo 1. Aerial of SR 84 Expressway at Arroyo del Valle (maps.live.com)

The existing Arroyo del Valle Bridge was declared scour critical by Caltrans HQ. The scour analysis was conducted using the methodology recommended by the FHWA. The calculated potential scour depths at the bridge structures are summarized in Table 5 through Table 7.

Table 5: SR 84 Expressway at Arroyo del Valle Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	1.15	12.74	**13.89**
Pier #2	Negligible	1.15	13.37	**14.52**
Abutment #3	Negligible	1.15	6.31	**7.46**

Table 6: Trail Bridge at Arroyo del Valle Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	2.90	21.58	**24.48**
Pier #2	Negligible	2.90	22.43	**25.33**
Abutment #3	Negligible	2.90	22.09	**24.99**

Table 7: Access Bridge at Arroyo Mocho Scour Analysis Summary

Location	Long Term Scour (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)
Abutment #1	Negligible	1.1	-	**1.1**
Abutment #2	Negligible	1.1	-	**1.1**

Photo 2. Aerial of SR 84 Expressway at Arroyo Mocho (maps.live.com)

Extensive coordination has been made between Caltrans and the Design Team over the recommended countermeasures in scour prevention for the bridges within this Project. According to Caltrans, rock slope protection (RSP) alone is insufficient for scour protection. Supporting the piers of the SR 84 Bridge at Arroyo del Valle and the Trail Bridge at Arroyo del Valle on piles, as well as piles for the abutments of the new Trail Bridge, are the primary scour countermeasures proposed. The piers for the widened SR 84 Expressway bridge at Arroyo del Valle and the Trail Bridge at Arroyo del Valle should have piles as deep as the estimated total scour. The Access Bridge at Arroyo Mocho should have spread footings located as deep as the estimated total scour. RSP shall also be placed along the proposed embankments for the existing SR 84 Expressway bridge at Arroyo del Valle. RSP generally consists of rock on channel and structure boundaries to limit the effects of erosion. It is the most common type of countermeasure due to its general availability, ease of installation, and relatively low cost.

Per Caltrans recommendation, the existing RSP at the Arroyo del Valle bridge appears to be substandard and will be removed and replaced with new RSP meeting the current standards in HEC-23. The rock size at the toe of embankment was determined using the Isbash Formula per HEC-23. For the Trail Bridge, just upstream of the Trail Bridge, in between the bridges, and on the upstream face of the SR 84 Bridge, at least ¼-Ton rock with a thickness of 3.3 feet and Backing Class Number 1 or 2 with a minimum thickness of 1.8 feet and 1.25 feet, respectively, would be required. For the downstream face of the SR 84 Bridge and just downstream of the SR 84 Bridge, at least 1-Ton rock with a thickness of 5.4 feet and Light rock (inner layer) with a minimum thickness of 2.5 ft would be required. ¼-Ton rock would also be required for the Access Bridge.

The proposed embankment will only fill up to the edge of the low flow channel. There will be no fill in the low flow channel. Permitting agencies may require mitigation for any impacted areas in the channel and/or habitats, which would prohibit certain countermeasures.

Acronyms

ACCMA	Alameda County Congestion Management Agency
ACTIA	Alameda County Transportation Improvement Authority
Caltrans	California Department of Transportation
cfs	cubic feet per second
D/S	downstream
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
Ex	existing
ft	feet
ft/s	ft/s
HEC	Hydraulic Engineering Circular
HP	H Piles
HQ	Headquarters
m	meters
mph	miles per hour
'n'	roughness coefficient
NAVD 88	North American Vertical Datum (1988)
NGVD 29	National Geodetic Vertical Datum (1929)
NOAA	National Oceanic and Atmospheric Administration
PDT	Project Development Team
Prop	proposed
Q	flow
RSP	rock slope protection
S	slope
SR	State Route
STP/CMAQ	Surface Transportation Program and the Congestion Mitigation & Air Quality Improvement Program
WRCC	Western Regional Climate Center
U/S	upstream
USGS	United States Geological Survey
Zone 7	Alameda County Flood Control & Water Conservation District, Zone 7 Water Agency

1 GENERAL DESCRIPTION

1.1 Project Description

The State Route 84 Expressway Widening Project (Project) proposes to widen and upgrade SR 84 in Alameda County to expressway standards (55 mph) between Ruby Hill Drive and Jack London Boulevard. The purpose of this Project is to improve SR 84 as a regional route consistent with other committed projects on the route, improve local traffic circulation, upgrade SR 84 to an expressway facility with access control, and improve bicycle and pedestrian access.

The current estimated cost of the proposed improvements is $120.8 million, which includes environmental documentation, project development, engineering, right-of-way acquisition, utility relocation, construction capital, and construction support and escalation to the mid-point of construction. This project is proposed to be funded from the following sources: $93.8 million from the 2000 Measure B Program; $1 million from federal STP/CMAQ funds in fiscal year 2007/2008; $13.0 million from future State and/or Federal funds committed in the 2004 Alameda County Transportation Plan; and $13 million in funding from the Tri-Valley Transportation Development Fees, identified in the Transportation Expenditure Plan of the Tri-Valley Transportation Council. The proposed project was also included in the most recent Regional Transportation Plan (RTP) (February 2005).

This Project has been assigned the Project Development Category 4A because it requires new right-of-way, and increases traffic capacity, but does not require a new route adoption. Controlled Access Highway Agreements with the County of Alameda, the City of Livermore and the City of Pleasanton are required.

1.2 Need for Project

The objectives of the Project are to:

- Improve SR 84 as a regional connection between Route 680 and Route 580 using expressway standards to the maximum extent feasible, which would be consistent with other programmed projects, assisting the completion of a continuous four to six-lane facility between Pigeon Pass and the Route 580/Isabel Avenue Interchange
- Improve local traffic circulation through added capacity on the SR 84 and intersection improvements, thereby attracting regional traffic currently using local streets back on to the SR 84 corridor
- Complete the statutory designation of this section of SR 84 as an expressway facility by providing partial access control, and relocating private utilities out of State's right-of-way
- Improve pedestrian and bicycle access along this section of SR 84 by connecting multi-use trails.

1.3 Project History

Beginning in March 2005, development of the Route 84 Expressway Widening Project was under the management of the Alameda County Transportation Improvement Authority (ACTIA), and City of Livermore sponsorship. Monthly Project Development Team (PDT) meetings provided the forum for coordination, issue resolution, and information feedback among ACTIA, the Cities of Livermore and Pleasanton, Caltrans, Alameda County Congestion Management Agency (ACCMA), Alameda County Zone 7 Water Agency (Zone 7), and other affected agencies. Traffic studies were closely coordinated with the ACCMA Tri-Valley Triangle Traffic Study to ensure consistency in regional planning efforts. Extensive design studies were performed on the PSR/PDS Alternatives to reduce environmental impacts and identify right-of-way and cost saving refinements to the proposed improvements. Towards this end, additional design options were investigated, including: a new alignment between Ruby Hill Drive and Vallecitos Road; a modified Stanley Boulevard Intersection in lieu of a full interchange facility; and, Vallecitos/Isabel intersection options.

1.4 Project Location

The Arroyo del Valle bridge site is located along Isabel Avenue between Vineyard Avenue/East Vineyard Avenue and Alden Lane. The Arroyo Mocho bridge site is located along Isabel Avenue between Stanley Boulevard and West/East Jack London Boulevard. These bridges are part of SR 84, which is a direct link between I-580 and I-680 (see Figures 1, 2, and 3).

1.5 Key Tasks

The key tasks performed for the Bridge Hydraulic Study included: 1) a hydraulic analysis to determine the water surface elevations and flow velocities, 2) a scour analysis to determine potential scour depths at the abutments, and 3) recommended countermeasures for the stream channel, bridge piers, and bridge abutments.

1.6 Design Criteria

Per the Federal Highway Administration (FHWA) and Caltrans design criteria, the basic criterion for hydraulic design of bridges is that they should be designed to pass the one percent (1%) probability flood (100-year flood, Q100), two percent (2%) probability flood (50-year flood or Q_{50}) with 2 ft of freeboard, or the flood of-record, whichever is greater, without causing objectionable backwater, excessive flow velocities or encroaching on through traffic lanes. The Zone 7 design criteria require passing the 100-year flood with 2 ft of freeboard.

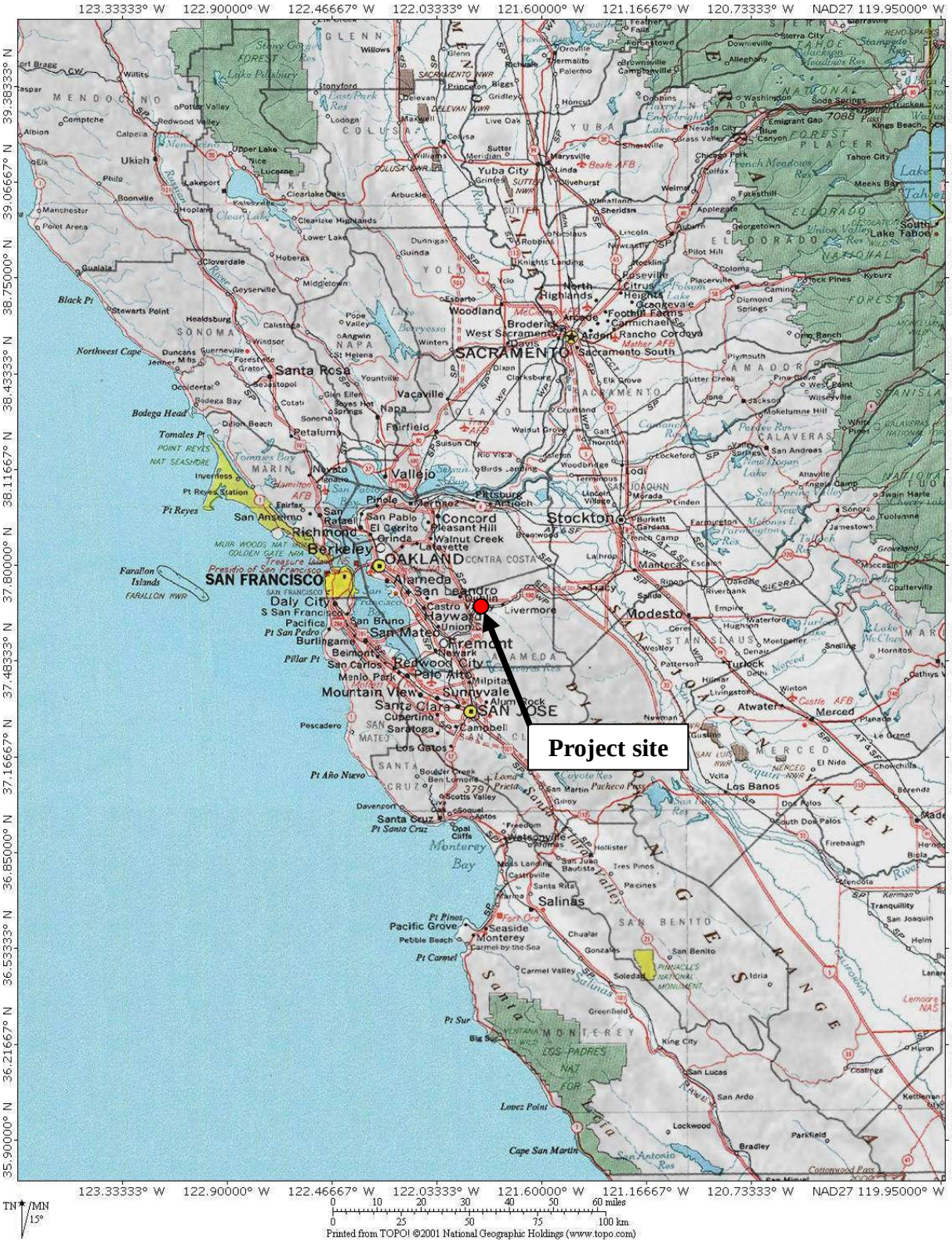

Figure 1. Project Location Map

Source: United States Geological Survey (USGS)

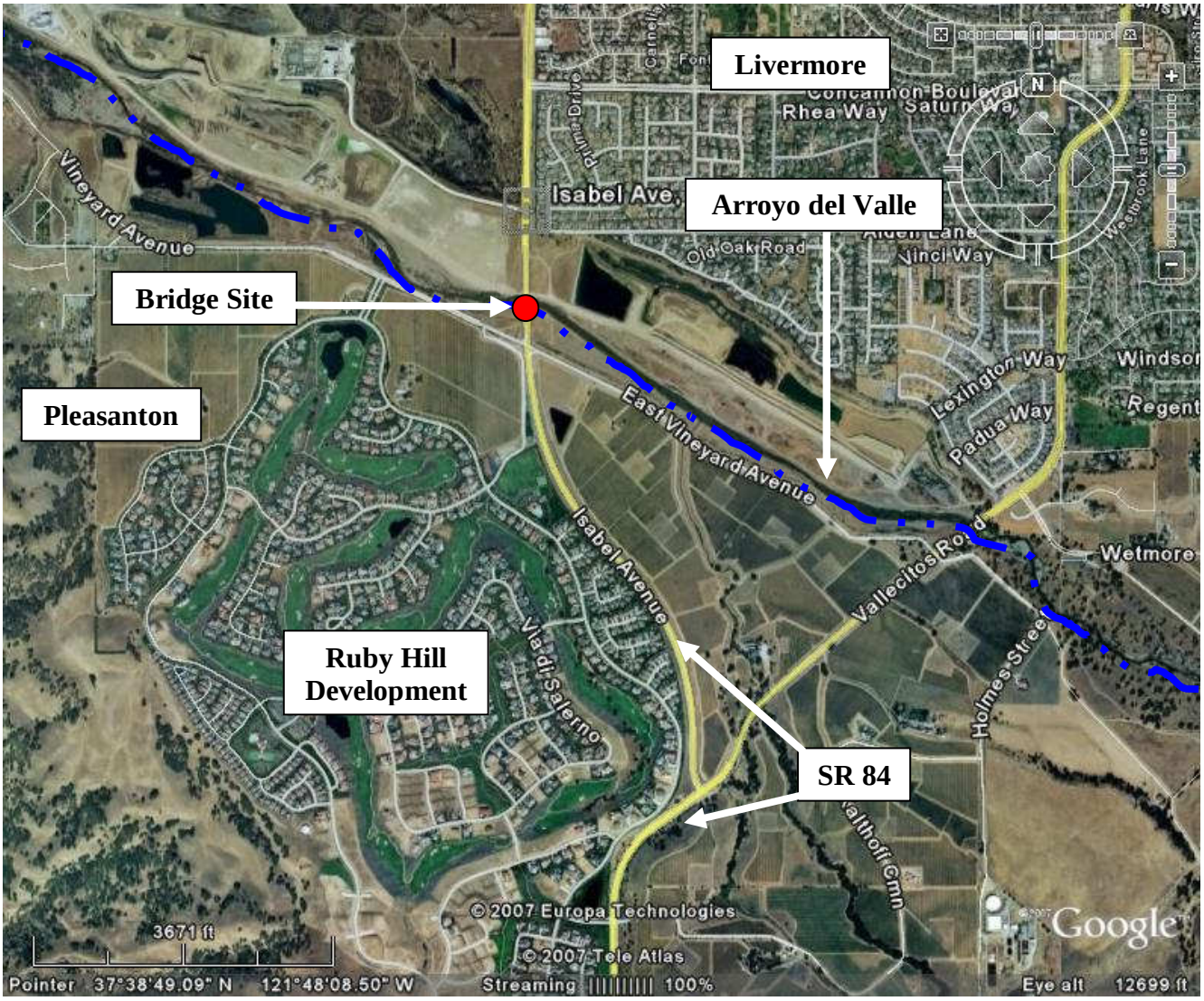

Figure 2. Arroyo del Valle Vicinity Map

Source: Google Earth

Figure 3. Arroyo Mocho Vicinity Map

Source: Google Earth

2 DESCRIPTION OF WATERSHED

2.1 Geographic Location

The proposed bridges are located in the SR 84 crossings of Arroyo del Valle and Arroyo Mocho. Arroyo del Valle begins approximately 29.5 miles upstream of the Project site, at the confluence of Arroyo Bayo and San Antonio Creek in the County of Santa Clara, between the Burnt Hills and Seeboy Ridge. Lake del Valle is located 6 miles upstream of the bridge site in the Del Valle Regional Park (State Recreation Area). The headwaters of Arroyo Mocho begin approximately 27.8 miles upstream of the Project site, at the South Pocket of Mount Mocho (3,664 ft) in the County of Santa Clara.

2.2 Watershed Size

The watershed size for the SR 84 Expressway Bridge at Arroyo del Valle is approximately 160 square miles. The watershed size for the SR 84 Expressway Bridge at Arroyo Mocho is approximately 50 square miles.

2.3 Receiving Water Bodies

Arroyo del Valle and Arroyo Mocho are tributaries to Alamo Canal. Alamo Canal turns into Arroyo de la Laguna after it passes underneath I-680 about 6.4 miles downstream of the Arroyo del Valle crossing. The confluence of Arroyo Mocho and Alamo Canal is approximately 6.8 miles downstream of the Arroyo Mocho crossing.

2.4 Precipitation

According to National Oceanic and Atmospheric Administration's (NOAA) Western Regional Climate Center (WRCC), the mean annual precipitation in the City of Livermore is 14.5 inches per year. According to the records, from 1930-2007, the maximum precipitation was 32.4 inches, in 1983, and the minimum precipitation was 6.4 inches, in 1976.

2.5 Land Use

At the Arroyo del Valle and Arroyo Mocho bridge sites, the area consists of open space and gravel mining operations. In the Project vicinity, the land use is residential with some commercial use in the City of Livermore. In general, the Arroyo Mocho watershed in the City of Livermore is more developed than the Arroyo del Valle, which is further south and farther from the developed portions of the city. Outside of the city, the watersheds can be characterized as rural, undeveloped, and hilly to mountainous. Lake del Valle is a recreational area and park. Lake del Valle is owned and operated by the Department of Water Resources. Vegetation ranges from Valley Oak Woodland to Hardwood Rangeland.

3 DESCRIPTION OF STREAM AND SITE

3.1 Soil and Bed Material

According to a preliminary geotechnical evaluation of SR 84 Expressway Bridge at Arroyo del Valle:

> "Based on available subsurface data from the aggregate mining site of Vulcan Materials Company, located about 1,100 feet north of the creek crossing, the mining site generally consists of alluvium overlying the Livermore Formation. From ground surface to about Elevation 350 to 360 feet, the upper 40 to 50 feet of alluvium consists of layers of medium dense to dense gravel, sandy silt and clayey gravel with clay interbeds. Extending to about Elevation 150 feet, the lower alluvium consists of interbeds of very dense gravel and very stiff to hard clays. Groundwater measurements from the Vulcan Materials site varied from Elevation 327 feet to 360 feet (Parikh, 2007a, page 2)."

According to a preliminary geotechnical evaluation of Arroyo Mocho Bridge, exploratory borings were drilled on November 1996 to investigate the Arroyo Mocho Bridge site. Depths of these borings ranged from 78.7 ft to 94.4 ft (24 m to 30 m). Note that this memorandum was written using metric units. Based on log test of borings, sheet number 407, the borings revealed silty sand to sandy silt in the upper 3.3 ft to 6.6 ft (1 m to 2 m) of the borings. Underlying the surficial layer, loose to medium dense sand and silt layers were dense to very dense gravel deposits; these gravel deposits extended to terminal depths of the borings. Scattered cobbles were encountered in two of the borings. Interbedded layers of very stiff to hard, sandy clay and clayey silt ranged in thickness from 3.3 ft to 6.6 ft (1 m to 3 m). Groundwater was encountered in one of the borings at Elevation 332.39 ft NAVD 88 (100.5 m NGVD 29). However, there was no indication of groundwater encountered or measured in the other borings (Parikh, 2007b, page 2).

3.2 Existing Facility

Information on the existing facilities was derived from as-built plans and from the structural engineering consultant, MGE Engineering, Inc.

Existing Bridge at Arroyo del Valle

Alignment - The existing bridge is skewed approximately 10° to the creek flow direction
Length - 121.17 ft
Total Width - 40.00 ft
Lanes - 2 lanes (One lane in each direction)
Structure - Continuous reinforced concrete "T" Beams (5) on reinforced concrete wall pier and reinforced concrete end diaphragm abutments; all on spread footings.

Photo 3. SR 84 Expressway Bridge at Arroyo del Valle (looking upstream)

Photo 4. SR 84 Expressway Bridge at Arroyo del Valle (looking downstream)

Existing Bridge at Arroyo Mocho

Alignment - The existing bridge is skewed approximately 15° to the creek flow direction
Length - 123.83 ft
Total Width - 61.25 ft
Lanes - 2 lanes (One lane in each direction)
Structure - Reinforced concrete slab on reinforced concrete pier walls and reinforced concrete diaphragm abutment. All are found on HP 10 x 57 steel piles.

3.3 Proposed Action

Information for the proposed facilities was obtained from the URS Corporation/MGE Engineering Inc. *Type Selection Bridge General Plan* entitled: *Arroyo del Valle Bridge (Widen)* and *Arroyo Mocho Bridge (Widen).*

Proposed Bridge at Arroyo del Valle

Alignment - The proposed bridge is skewed approximately 10° to the creek flow direction
Length - 121.17 ft
Total Width - 93.42 ft
Lanes - 4 (2 lanes and 10-ft shoulders in each direction, 22-ft median, and adjacent trail bridge upstream)
Structure - Reinforced concrete "T" Beams (12) on reinforced concrete pier walls and reinforced concrete diaphragm abutment; abutments are found on spread footings and the pier is found on driven piles.

Type Selection Bridge General Plan - See Figure 4.

Proposed Bridge at Arroyo Mocho

Alignment - The proposed bridge is skewed approximately 10° to the creek flow direction
Length - 123.83 ft
Total Width - 131.83 ft
Lanes - 6 (3 lanes and 10-ft shoulders in each direction, 26-ft median, bike lane, and adjacent Zone 7 access road downstream)
Structure - Three-span cast-in-place reinforced concrete slab on reinforced concrete diaphragm abutment; all are found on HP 10x57 steel piles.

Type Selection Bridge General Plan - See Figure 5.

Photo 5. SR 84 Expressway Bridge at Arroyo Mocho (looking downstream)

Photo 6. SR 84 Expressway Bridge at Arroyo del Valle's Upstream Face

Figures 6 and 7 show the *Type Selection Bridge General Plans* for the Trail Bridge at Arroyo del Valle and the Access Bridge at Arroyo Mocho, respectively. The proposed Trail Bridge is skewed approximately 30° to the creek flow direction. There is an existing 30° skew because the creek has an existing meander through this reach. As shown on the Arroyo del Valle Trail Bridge General Plan, the abutment and pier foundations shall be on piles; and the Arroyo del Valle Bridge (Widen) General Plan shows the pier foundations on piles., Per extensive coordination with Caltrans and the Design Team, piles are the proposed primary scour countermeasures.

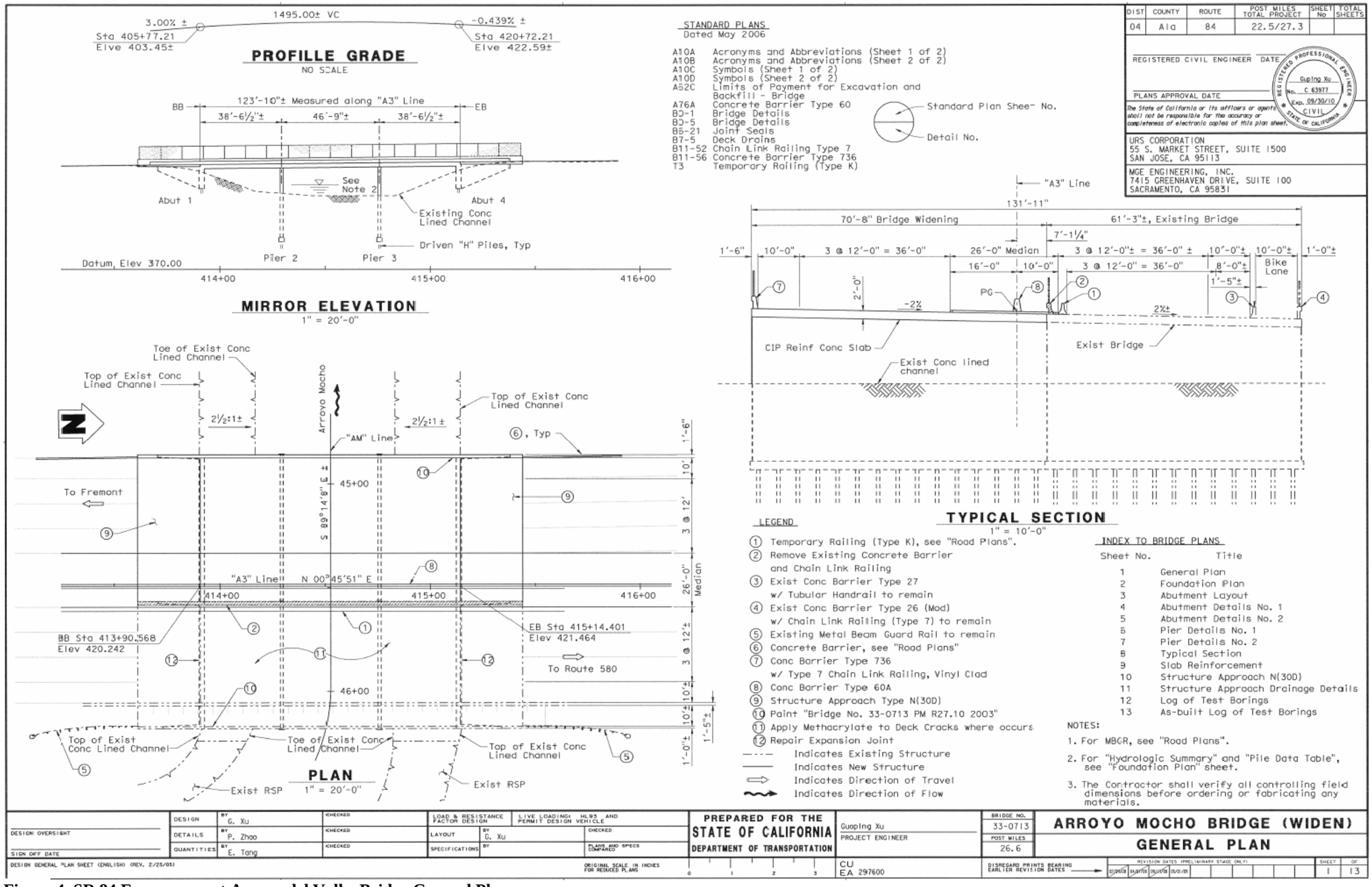

Figure 4. SR 84 Expressway at Arroyo del Valle Bridge General Plan

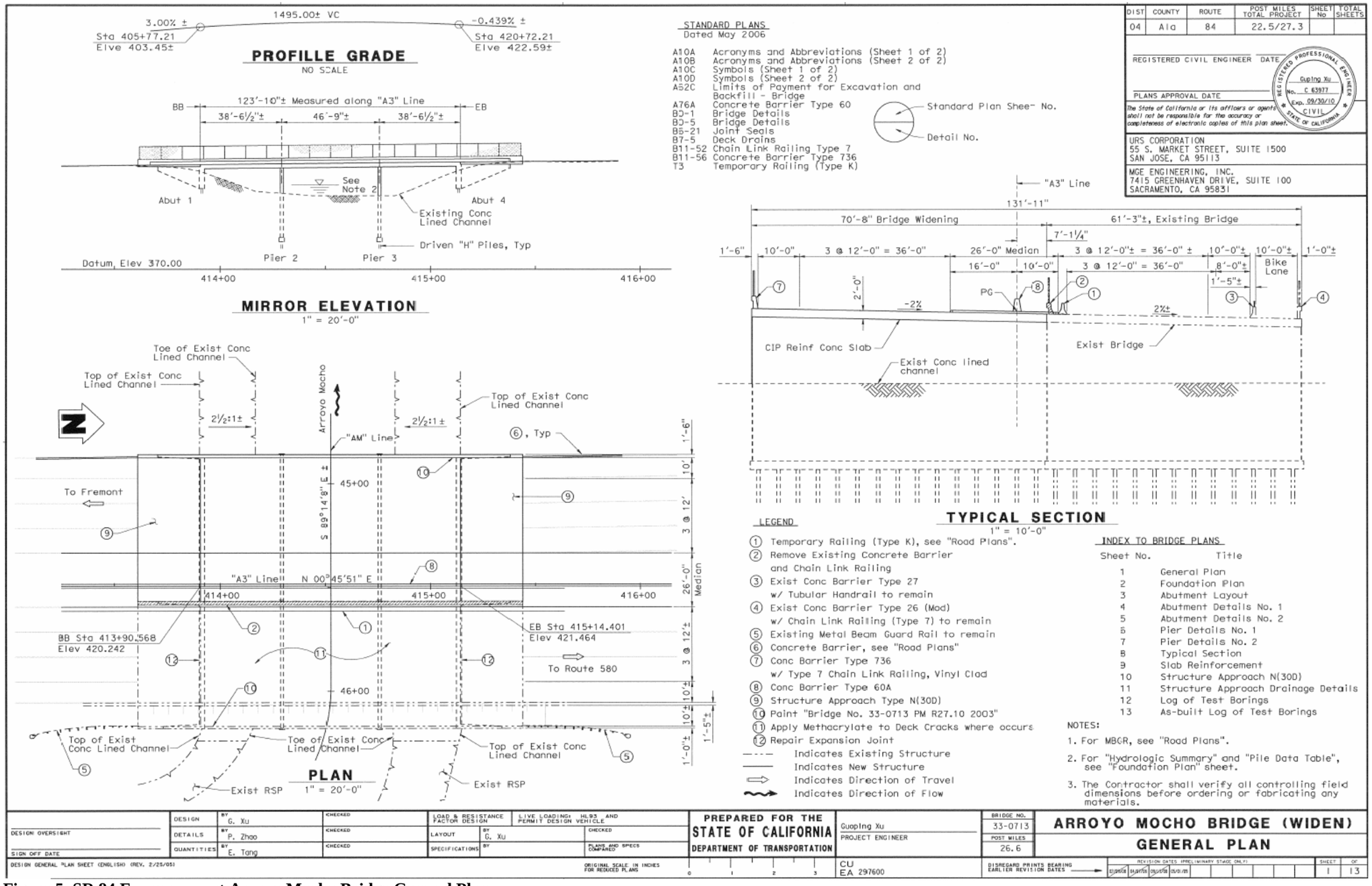

Figure 5. SR 84 Expressway at Arroyo Mocho Bridge General Plan

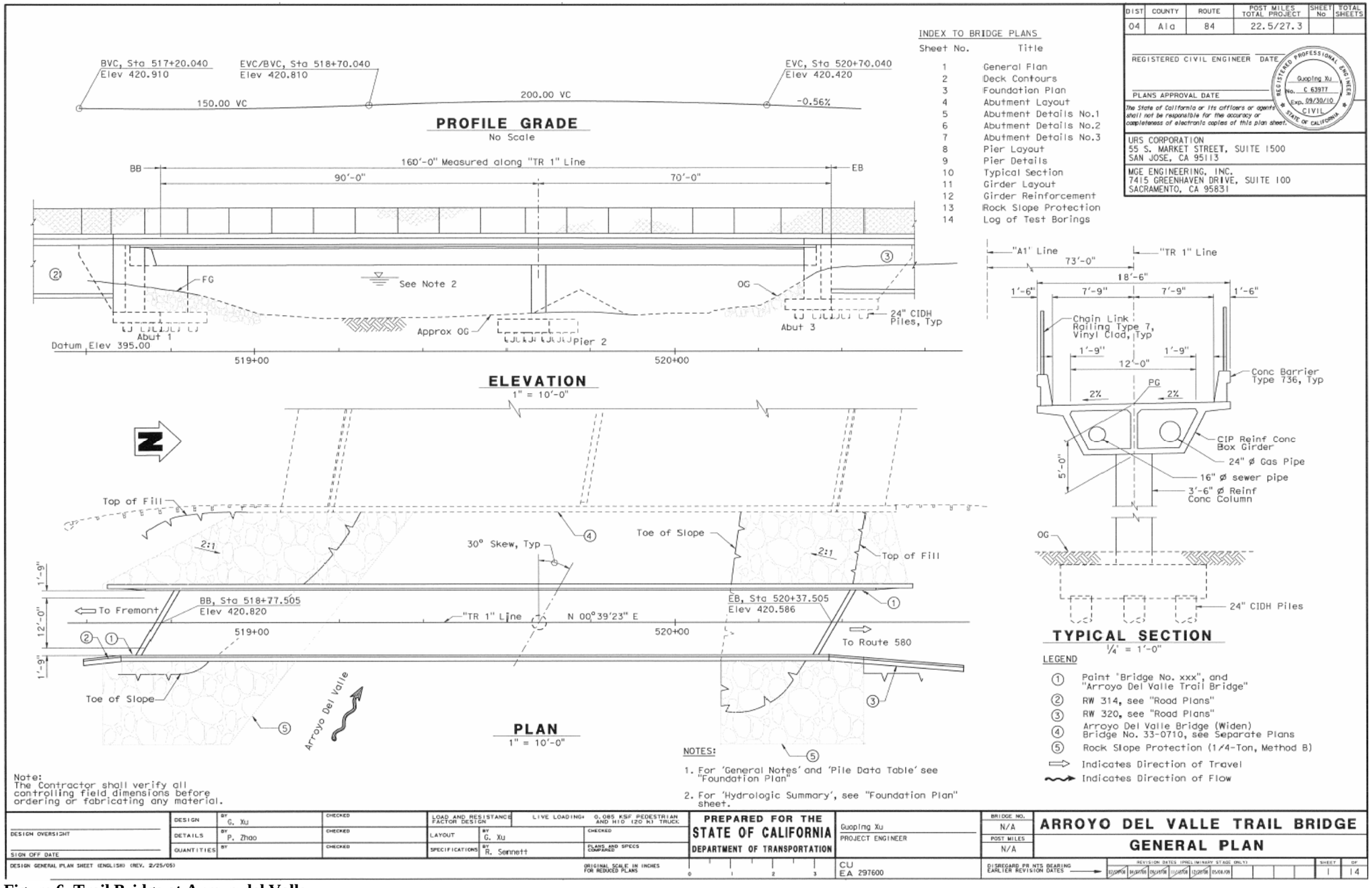

Figure 6. Trail Bridge at Arroyo del Valle

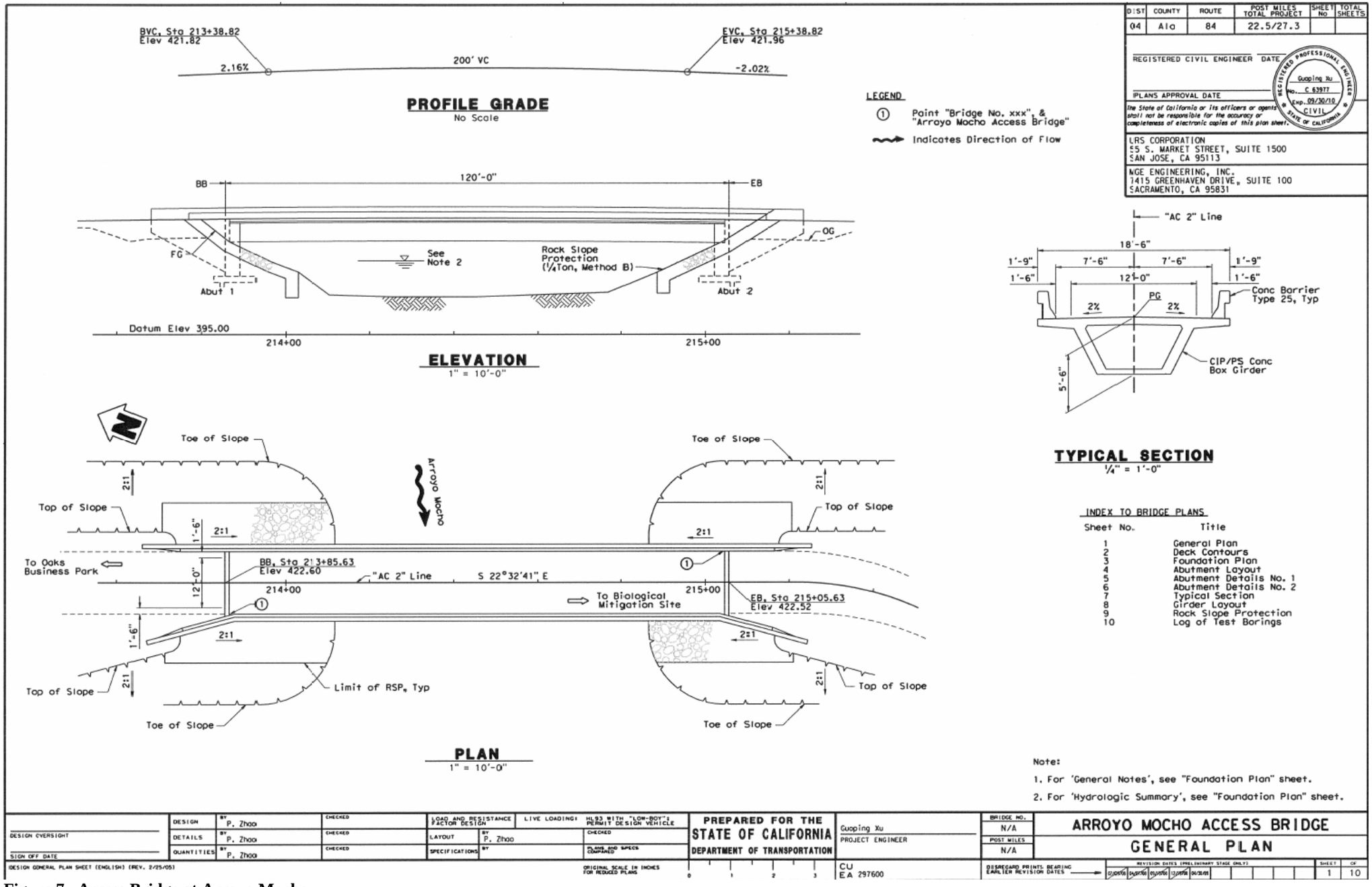

Figure 7. Access Bridge at Arroyo Mocho

4 HYDROLOGY

4.1 Hydrologic Stability

The Arroyo del Valle and Arroyo Mocho watersheds are composed of open space, gravel mining, residential, and commercial areas. Outside the limits of the City of Livermore, the watersheds can be characterized as rural, open space, recreational, and mountainous. We compared design flows from Zone 7 Water Agency and The Federal Emergency Management Agency (FEMA). The land use in the watersheds have not changed significantly upstream of the project site.

Photo 7. Arroyo del Valle floodplain

4.2 Design Discharge

According to the FEMA Flood Insurance Study for unincorporated Alameda County, the base flood (100-year flow) of Arroyo del Valle upstream of Arroyo de la Laguna is 7,000 cfs. In addition, the base flood of Arroyo Mocho upstream of Arroyo Las Positas is 5,200 cfs (February 9, 2000), which is 3.7 miles downstream of the Project site.

According to the Zone 7 Water Agency's *Draft Hydrologic Procedures and Design Discharges* (December 3, 1997), Arroyo del Valle's 100-year flow at Route 84 is 7,000 cfs and Arroyo Mocho's 100-year flow is 4,800 cfs. 7,000 cfs is the maximum release from Lake del Valle. We also interpolated the following 50-year flows from Zone 7's 15-year flows and 2-year flows. The 50-year flows are 3,900 cfs for Arroyo Mocho and 5,400 cfs for Arroyo del Valle.

The flows from Zone 7 were utilized in this study, as shown in Table 8, below because the flows are in the Project location. The flows from FEMA are located at least 3.2 miles downstream of the Project site.

Table 8. Project Design Discharges

Creek	100-year	50-year
Arroyo del Valle	7,000 cfs	5,400 cfs
Arroyo Mocho	4,800 cfs	3,900 cfs

5 HYDRAULIC ANALYSIS

5.1 Design Tools

The hydraulic analysis for Arroyo del Valle and Arroyo Mocho involved a standard step backwater calculation using the U.S. Army Corps of Engineers' HEC-RAS computer program to provide flow characteristics, water surface profiles, and channel velocities.

5.2 Cross-Section Data

Twelve cross-sections, distributed over a 2,200 ft reach of Arroyo del Valle, in the vicinity of the Project site, were obtained from a survey performed by Geomatics Transportation Services, Inc. See Appendix E for Layout Plan of Surveyed Cross-Sections. At Zone 7's request, eighteen cross-sections, distributed over a 2,100 ft reach of Arroyo Mocho were obtained from as-builts from the City of Livermore Department of Public Works (1998), which show the Arroyo Mocho Channel Realignment. The surveyed data included the siltation and aggradation of the channel, which decreased the flow area. The as-builts show the channel without siltation and aggradation. These cross-sections were incorporated into the geometry file of the hydraulic model. For the proposed condition, MGE Engineering provided the *Type Selection* for *Arroyo del Valle Bridge (Widen), Arroyo del Valle Trail Bridge, Arroyo Mocho Bridge (Widen), and Arroyo Mocho Access Bridge*.

Photo 8. Arroyo del Valle riparian vegetation

5.3 Manning's 'n'

Manning's 'n' values were used in the hydraulic model to estimate energy losses in the flow due to friction. Manning's 'n' values used for the Arroyo del Valle reach in the existing condition model were as follows: Left and right overbank – 0.05; Embankment with riprap – 0.045; Vegetation in the riparian corridor – 0.06; Low flow channel – 0.025; and Gravel mining access road – 0.03. Manning's 'n' values used for the Arroyo Mocho reach in the existing condition model, were as follows: Left and right overbanks – 0.05; main channel – 0.035; rock slope protection (RSP) – 0.04; and concrete lined – 0.015. In the proposed condition model, the 'n' values used were the same. These Manning's 'n' values were selected to best describe the friction characteristics of the existing and proposed site conditions.

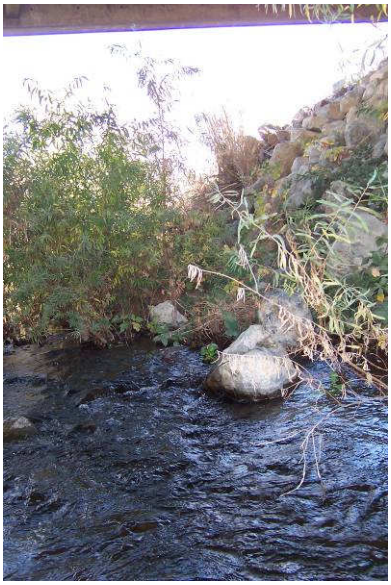

Photo 9.
Arroyo del Valle channel

5.4 Expansion and Contraction Coefficients

The expansion and contraction coefficients used to represent the channel were 0.3 and 0.1, respectively. These values describe a creek with gradual transitions between cross-sections. The expansion and contraction coefficients used in the vicinity of the Arroyo del Valle bridges were 0.7 and 0.5, respectively. The expansion and contraction coefficients used in the vicinity of the Arroyo Mocho bridges were 0.5 and 0.3, respectively. These values were used because the bridge geometry intrudes into the channel.

5.5 Water Surface Elevations

At the request of Caltrans, we used a normal depth slope for the Arroyo del Valle model: a downstream boundary condition of 0.0056 ft/ft and an upstream boundary condition of 0.008 ft/ft. These slopes were obtained from the Arroyo del Valle survey.

At Zone 7's request we used a normal depth slope for the Arroyo Mocho model: a downstream boundary condition of 0.0012 ft/ft and an upstream boundary condition of 0.0012 ft/ft. These slopes were obtained from the Arroyo Mocho Channel Realignment as-builts.

Table 9 summarizes the calculated 100-year and 50-year water surface elevations of the existing bridge and proposed bridge from the Arroyo del Valle hydraulic models.

Table 9. Arroyo del Valle Water Surface Elevations (ft)

Cross-Section	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
12	562.1	416.08	416.00	-0.08	415.16	415.04	-0.12
11	352.7	414.38	413.48	-0.90	412.99	412.26	-0.73
10	0.5	413.79	411.82	-1.97	412.21	410.65	-1.56
U/S Trail Bridge	18.0	N/A	411.67	N/A	N/A	410.52	N/A
D/S Trail Bridge	26.5	N/A	411.71	N/A	N/A	410.55	N/A
9	1.3	413.62	411.74	-1.88	412.18	410.57	-1.61
8.5	7.6	413.51	411.45	-2.06	412.04	410.24	-1.80
8 (only for Ex)	6.6	412.96	N/A	N/A	411.60	N/A	N/A
7 (only for Ex)	18.3	412.91	N/A	N/A	411.53	N/A	N/A
6.5 (only for Ex)	0.5	412.21	N/A	N/A	410.91	N/A	N/A
U/S Prop SR 84 Bridge	53.4	N/A	411.18	N/A	N/A	410.06	N/A
U/S Ex SR 84 Bridge	40.0	410.34	N/A	N/A	409.25	N/A	N/A
D/S Ex and Prop SR 84 Bridge	0.5	409.76	409.71	-0.05	408.94	408.90	-0.04
5.5	45.5	409.85	409.85	0	409.00	409.00	0
5	53.9	410.62	410.62	0	409.57	409.57	0
4	39.6	408.91	408.91	0	408.21	408.21	0
3	476.8	408.71	408.71	0	407.99	407.99	0
2	611.3	404.56	404.56	0	404.01	404.01	0
1	0	400.46	400.46	0	399.91	399.91	0

D/S = Downstream Ex = Existing Prop = Proposed U/S = Upstream

The proposed condition would decrease the Arroyo del Valle 100-year water surface elevation by 0.08 ft at Cross-Section 12 and by 0.90 ft at Cross-Section 11. The SR 84 Bridge would be widened upstream and the upstream face would be in different locations for the proposed and existing conditions. The proposed soffit elevation would be at 417.48 ft, which would be above the 100-year water surface elevation of 411.18 ft and above the 50-year water surface elevation of 410.06 ft. Freeboard clearance for the "100-year event plus 2 feet" (413.18 ft) would be +4.30 ft for the proposed SR 84 Expressway Bridge at Arroyo del Valle. The soffit elevation of the Trail Bridge would be 415.58 ft. The Arroyo del Valle 100-year water surface elevation at the downstream face of the Trail Bridge would be 411.71 ft, which would be below the soffit. Freeboard clearance for the "100-year event plus 2 feet" (413.71 ft) would be +1.87 ft for the Trail Bridge. Zone 7's design criteria for freeboard would be met.

For the 100-year and 50-year water surface elevation, there would not be any anticipated increases to water surface elevations downstream of the SR 84 Bridge. The 50-year water surface elevation would decrease by 0.12 ft at Cross-Section 12 and decrease by 0.73 ft at Cross-Section 11. At Cross-Sections 10, 9, and 8, the proposed 100-year water surface elevation would decrease by 1.97 ft, 1.88 ft, and 2.06 ft, respectively. Similarly, the 50-year water surface elevations would decrease by 1.56 ft, 1.61 ft, and 1.80 ft, respectively. The bridge would be widened upstream and the upstream face would be in different locations for the proposed and existing conditions. The other decreases would

be at the downstream face of the SR 84 Bridge: 0.05 ft for the 100-year and 0.04 ft for the 50-year water surface elevations.

Table 10 summarizes the calculated 100-year and 50-year water surface elevations of the existing bridge and proposed bridge from the Arroyo Mocho hydraulic models.

Table 10. Arroyo Mocho Water Surface Elevations (ft)

Cross-Section	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
5249.344	328.08	416.25	416.30	0.05	415.23	415.27	0.04
4921.260	65.62	415.81	415.87	0.06	414.79	414.84	0.05
4855.643	187.52	415.62	415.69	0.07	414.60	414.66	0.06
4790.026	177.57	415.35	415.42	0.07	414.31	414.38	0.07
4668.123	55.67	414.98	415.06	0.08	413.93	414.02	0.09
4612.454	12.72	414.99	415.07	0.08	413.94	414.02	0.08
4599.738	2.00	414.98	415.07	0.09	413.93	414.02	0.09
U/S SR 84 Bridge	61.3	414.93	415.01	0.08	413.88	413.97	0.09
D/S SR 84 Bridge	35.13	414.91	414.80	-0.11	413.86	413.76	-0.10
4501.312	7.88	414.91	N/A	N/A	413.87	N/A	N/A
4493.428	34	414.84	N/A	N/A	413.80	N/A	N/A
4461.920	61.5	N/A	414.81	N/A	N/A	413.77	N/A
U/S Access Bridge	18.5	N/A	414.66	N/A	N/A	413.62	N/A
D/S Access Bridge	14.31	N/A	414.64	N/A	N/A	413.59	N/A
4374.534	9.42	414.60	414.60	0.00	413.55	413.56	0.01
4365.118	50.00	414.45	414.46	0.01	413.40	413.40	0
4315.118	50.03	414.49	414.49	0	413.44	413.44	0
4265.092	6.56	412.07	412.07	0	411.28	411.28	0
4258.530	124.67	412.05	412.05	0	410.99	410.99	0
4133.858	196.85	412.38	412.38	0	411.27	411.28	0.01
3937.008	328.08	412.19	412.20	0.01	411.08	411.09	0.01
3608.924	328.08	411.89	411.89	0	410.78	410.78	0
3280.840	0	411.55	411.55	0	410.43	410.44	0.01

The Arroyo Mocho model results indicate that the SR 84 Expressway Bridge widening and new Access Bridge would have sufficient freeboard to convey the 100-year flow per FHWA and Caltrans requirements. However, the proposed widened bridge (SR 84 Bridge) would not meet the criteria for Zone 7, which is 100-year storm plus 2 ft of freeboard. The soffit of the proposed bridge upstream face would be 416.87 ft and the 100-year water surface elevation would be 415.01 ft. The soffit would not meet the Zone 7 criteria by 0.14 ft. The soffit of the proposed bridge downstream face would be 419.51 ft and the 100-year water surface elevation would be 414.80 ft. In addition, the proposed condition would raise the 100-year water surface elevations upstream of the bridge from 0.05 ft to 0.09 ft. These increases are due to energy losses from the proposed widening of SR 84 Expressway Bridge and the Access Bridge. The downstream face of the bridge would decrease by 0.11 ft. Note that the SR 84 bridge would be widened downstream and the downstream face would be in different locations for the proposed and existing conditions. For the 50-year water surface elevation, the proposed condition would have an insignificant change when compared to the existing condition. The 50-year water surface elevation ranges from -0.10 ft to +0.09 ft.

The proposed downstream bridge soffit of the proposed SR 84 Expressway Bridge widening at Arroyo Mocho would meet the "100-year plus 2ft" of 417.01 ft. However, the existing SR 84 Bridge would remain and the existing soffit would remain at 416.87 ft (which is the proposed upstream bridge soffit). The difference is 0.14 ft.

The proposed Arroyo Mocho Access Bridge would have a soffit elevation of 417.02 ft and a 100-year water surface elevation of 414.66 ft at the upstream face and 414.64 ft at the downstream face. The proposed Arroyo Mocho Access Bridge's soffit elevation would pass 416.66 ft (100-year plus 2 ft) and would meet the Zone 7 design criteria for freeboard. Freeboard clearances for the "100-year event plus 2 ft" would be -0.14 ft and +0.36 for the widening and access bridges, respectively.

5.6 Upstream Flow Velocities

Table 11 summarizes the calculated 100-year flow velocities of the existing bridge and proposed bridge from the Arroyo del Valle hydraulic models.

Table 11. Arroyo del Valle Velocities (ft/s)

Cross-Section	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
12	562.1	8.58	8.71	+0.13	7.71	7.88	+0.17
11	352.7	4.21	5.18	+0.97	4.50	5.72	+1.22
10	0.5	4.81	7.85	+3.04	5.15	7.20	+2.05
U/S Trail Bridge	18.0	N/A	8.31	N/A	N/A	7.62	N/A
D/S Trail Bridge	26.5	N/A	7.64	N/A	N/A	7.03	N/A
9	1.3	5.35	7.35	+2.00	5.07	6.76	+1.69
8.5	7.6	5.69	7.94	+2.25	5.51	7.54	+2.03
8 (only for Ex)	6.6	7.70	N/A	N/A	7.12	N/A	N/A
7 (only for Ex)	18.3	7.82	N/A	N/A	7.30	N/A	N/A
6.5 (only for Ex)	0.5	9.86	N/A	N/A	9.24	N/A	N/A
U/S Prop SR 84 Bridge	53.4	N/A	8.89	N/A	N/A	8.20	N/A
U/S Ex SR 84 Bridge	40.0	13.77	N/A	N/A	12.93	N/A	N/A
D/S Ex and Prop SR 84 Bridge	0.5	11.62	11.68	+0.06	10.31	10.34	+0.03
5.5	45.5	11.11	11.10	-0.01	9.89	9.88	-0.01
5	53.9	3.07	3.08	+0.01	2.83	2.83	0
4	39.6	10.04	10.04	0	8.88	8.88	0
3	476.8	8.90	8.90	0	7.95	7.95	0
2	611.3	7.19	7.19	0	6.54	6.54	0
1	0	5.89	5.89	0	5.32	5.32	0

The results indicate that the proposed condition would increase the Arroyo del Valle flow velocity. The largest increase would be at the upstream face of the Trail Bridge, which is 3.04 ft/s for the 100-year flow velocity and 2.05 ft/s for the 50-year flow velocity. For the 50-year flow, the increase would be 0.17 ft/s at Cross-Section 12 and 1.22 ft/s at Cross-Section 11. For the 100-year flow, the increase would be 0.13 ft/s at Cross-Section

12 and 0.97 ft/s at Cross-Section 11. In between the bridges, the 100-year flow velocity increases 2.00 ft/s and 2.25 ft/s at Cross-Sections 9 and 8, respectively. In between the bridges, the 50-year flow velocity increases 1.69 ft/s and 2.03 ft/s at Cross-Sections 9 and 8, respectively. At Cross-Section 5.5, the 100-year and 50-year flow velocities would decrease 0.01 ft/s, which is insignificant. At Cross-Section 5, the 100-year flow velocity increases 0.01 ft/s, which is also insignificant.

The following table summarizes the calculated 100-year velocities of the existing bridge and proposed bridge from the Arroyo Mocho hydraulic models.

Table 12. Arroyo Mocho Velocities (ft/s)

Cross-Section	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
5249.344	328.08	5.72	5.68	-0.04	5.37	5.34	-0.03
4921.260	65.62	5.75	5.71	-0.04	5.41	5.37	-0.04
4855.643	187.52	6.21	6.15	-0.06	5.89	5.83	-0.06
4790.026	177.57	5.97	5.91	-0.06	5.64	5.59	-0.05
4668.123	55.67	6.15	6.08	-0.07	5.84	5.77	-0.07
4612.454	12.72	5.86	5.79	-0.07	5.55	5.48	-0.07
4599.738	2.00	5.85	5.78	-0.07	5.55	5.48	-0.07
U/S SR 84 Bridge	61.3	6.09	6.02	-0.07	5.78	5.70	-0.08
D/S SR 84 Bridge	35.13	6.01	6.41	0.40	5.69	6.08	0.39
4501.312	7.88	5.82	N/A	N/A	5.51	N/A	N/A
4493.428	34	6.09	N/A	N/A	5.78	N/A	N/A
4461.920	61.5	N/A	6.18	N/A	N/A	5.86	N/A
U/S Access Bridge	18.5	N/A	6.31	N/A	N/A	6.00	N/A
D/S Access Bridge	14.31	N/A	6.23	N/A	N/A	5.92	N/A
4374.534	9.42	6.16	6.26	+0.10	5.87	5.95	+0.12
4365.118	50.00	6.75	6.75	0	6.49	6.49	0
4315.118	50.03	6.23	6.22	-0.01	5.93	5.93	0
4265.092	6.56	13.37	13.37	0	12.63	12.63	0
4258.530	124.67	8.07	8.07	0	7.56	7.56	0
4133.858	196.85	5.18	5.18	0	4.88	4.88	0
3937.008	328.08	5.16	5.15	-0.01	4.85	4.85	0
3608.924	328.08	5.10	5.10	0	4.79	4.79	0
3280.840	0	5.07	5.07	0	4.76	4.76	0

The table shows that, with the exception of SR 84 Bridge's downstream face, the Arroyo Mocho flow velocities would decrease upstream of the Access Bridge and stay the same downstream of the Access Bridge. At the downstream face of the SR 84 Bridge, the flow velocity would increase 0.28 ft/s, due to the constriction of the Access Bridge. The flow velocities would decrease in the upstream Cross-Sections due to energy losses from the proposed widened SR 84 Expressway Bridge and the Access Bridge addition.

The 100-year and 50-year HEC-RAS Cross-Sections of the upstream face of SR 84 Expressway Bridge at Arroyo del Valle, Arroyo del Valle Trail Bridge, SR 84 Expressway Bridge at Arroyo Mocho, Arroyo Mocho Access Bridge are shown in Figures 6, 7, 8, and 9, respectively. The 100-year and 50-year Profiles for Arroyo del Valle and Arroyo Mocho are in Figures 10 and 11, respectively.

5.7 Rock Slope Protection (RSP)

RSP generally consists of rock on channel and structure boundaries to limit the effects of erosion. It is the most common type of countermeasure due to its general availability, ease of installation, and relatively low cost. The photos show that there is existing RSP along the side slopes of Arroyo del Valle.

Photos 10 and 11. Existing Arroyo del Valle RSP along side slopes (embankment)

Per Caltrans recommendation, the existing RSP at the Arroyo del Valle bridge appears to be substandard and will be removed and replaced with new RSP meeting the current standards in HEC-23. The rock size at the toe of embankment was determined using the Isbash Formula per HEC-23. For the Trail Bridge, just upstream of the Trail Bridge, in between the bridges, and on the upstream face of the SR 84 Bridge, at least ¼-Ton rock with a thickness of 3.3 feet and Backing Class Number 1 or 2 with a minimum thickness of 1.8 feet and 1.25 feet, respectively, would be required. For the downstream face of the SR 84 Bridge and just downstream of the SR 84 Bridge, at least 1-Ton rock with a thickness of 5.4 feet and Light rock (inner layer) with a minimum thickness of 2.5 ft would be required. ¼-Ton rock would also be required for the Access Bridge at Arroyo Mocho.

The proposed embankment will only fill up to the edge of the low flow channel. There will be no fill in the low flow channel. Permitting agencies may require mitigation for any impacted areas in the channel and/or habitats, which would prohibit certain countermeasures.

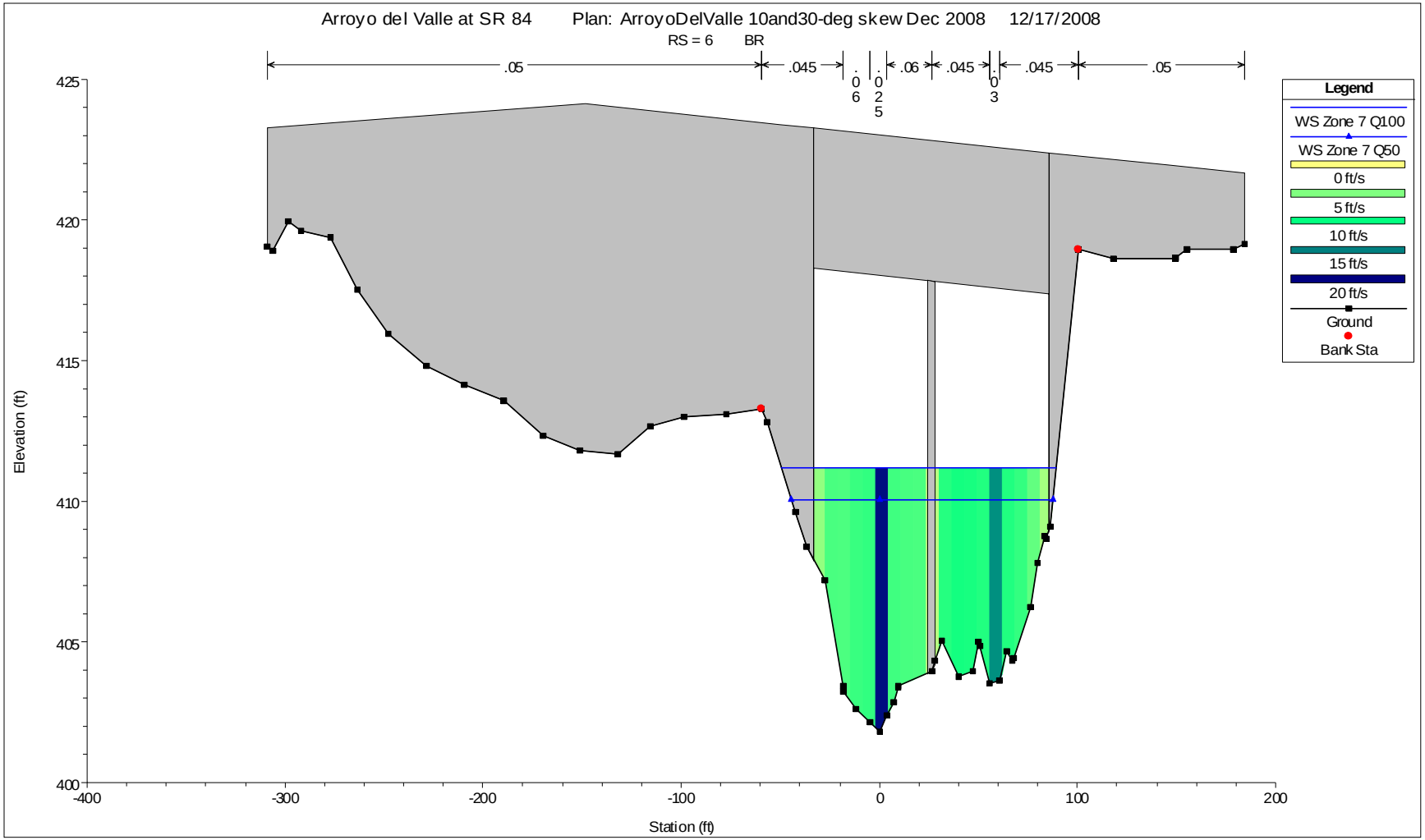

Figure 8. SR 84 Expressway Arroyo del Valle Bridge Upstream Face Cross-Section

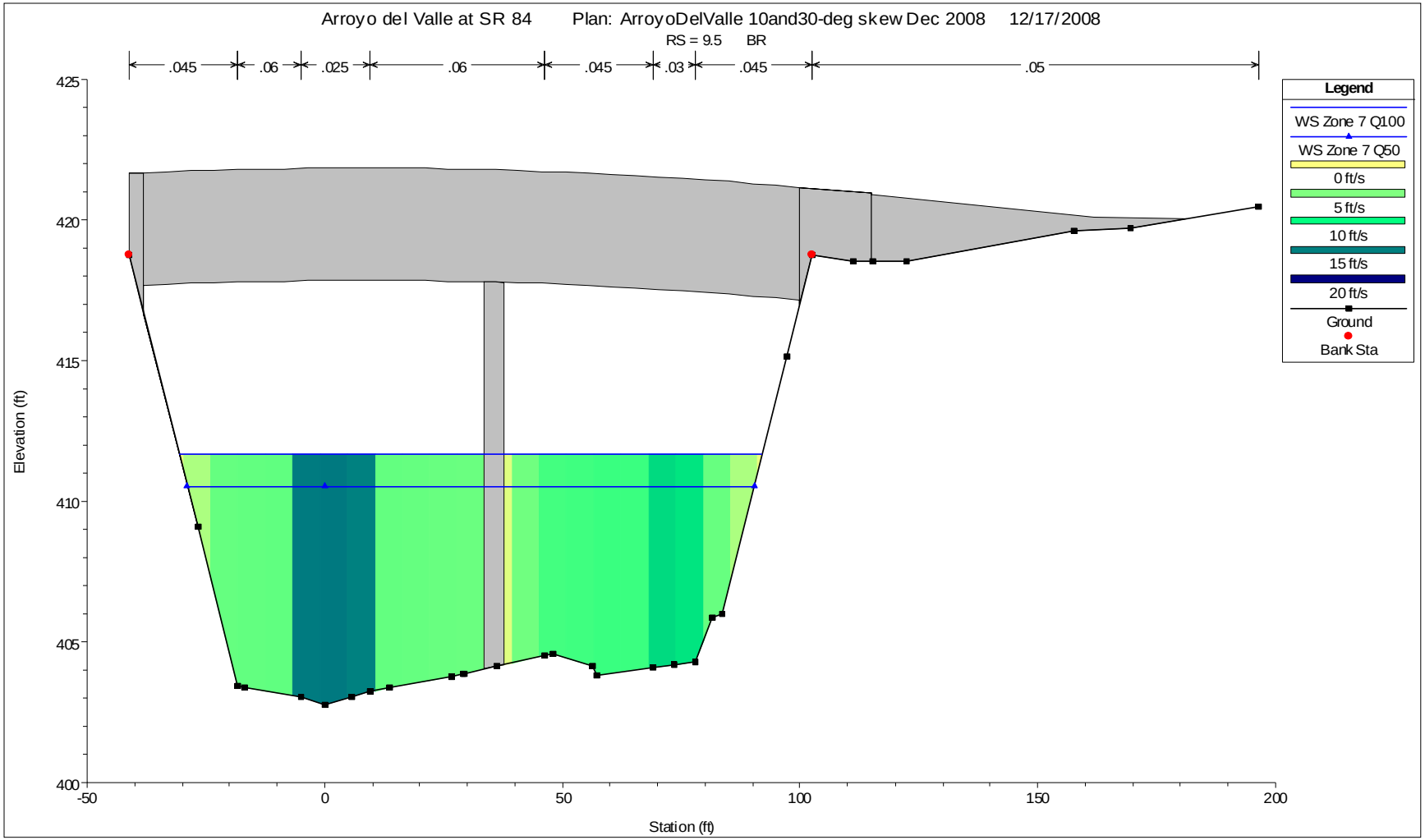

Figure 9. Arroyo del Valle Trail Bridge Upstream Face Cross-Section

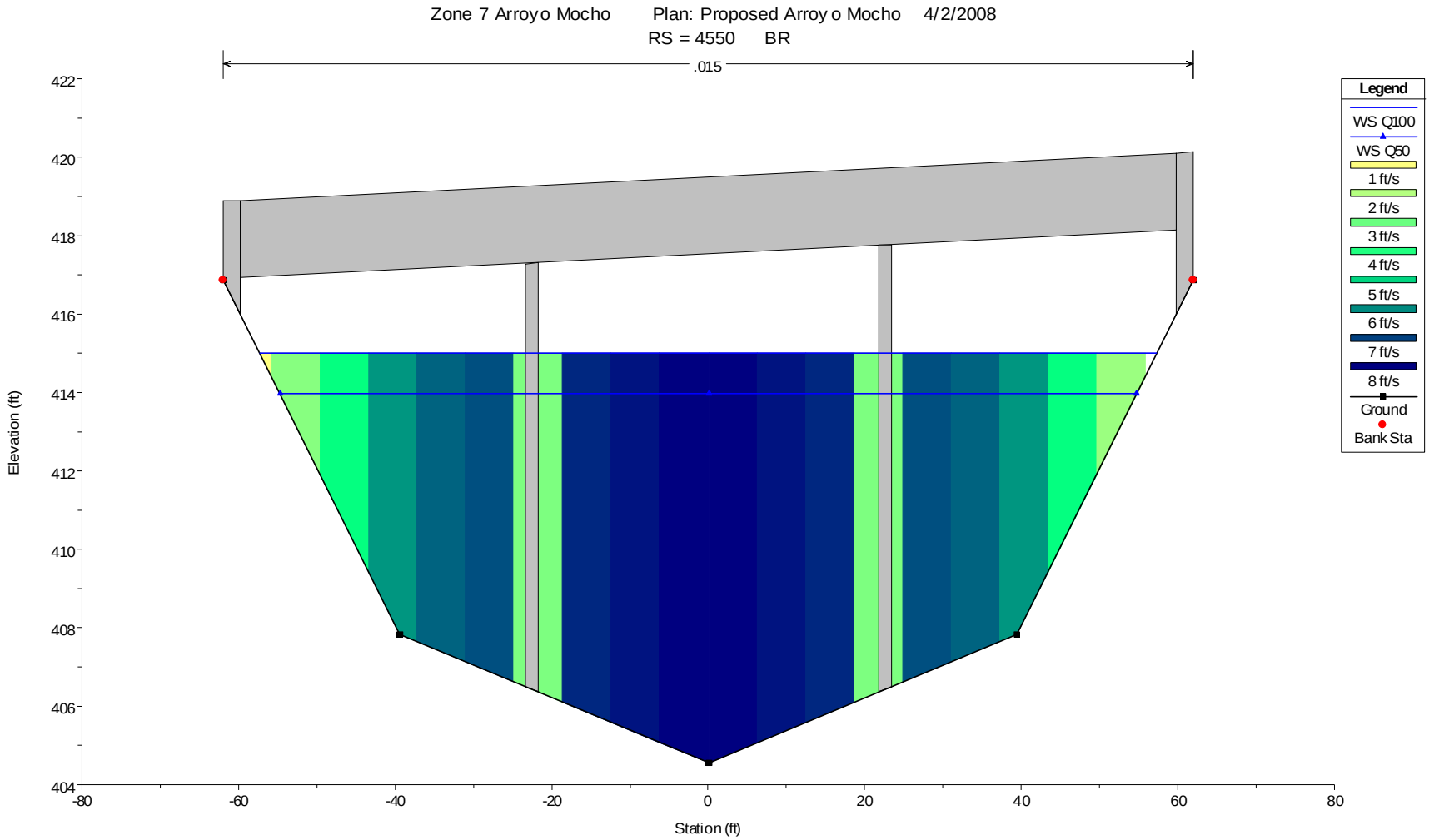

Figure 10. SR 84 Expressway Arroyo Mocho Bridge Upstream Face Cross-Section

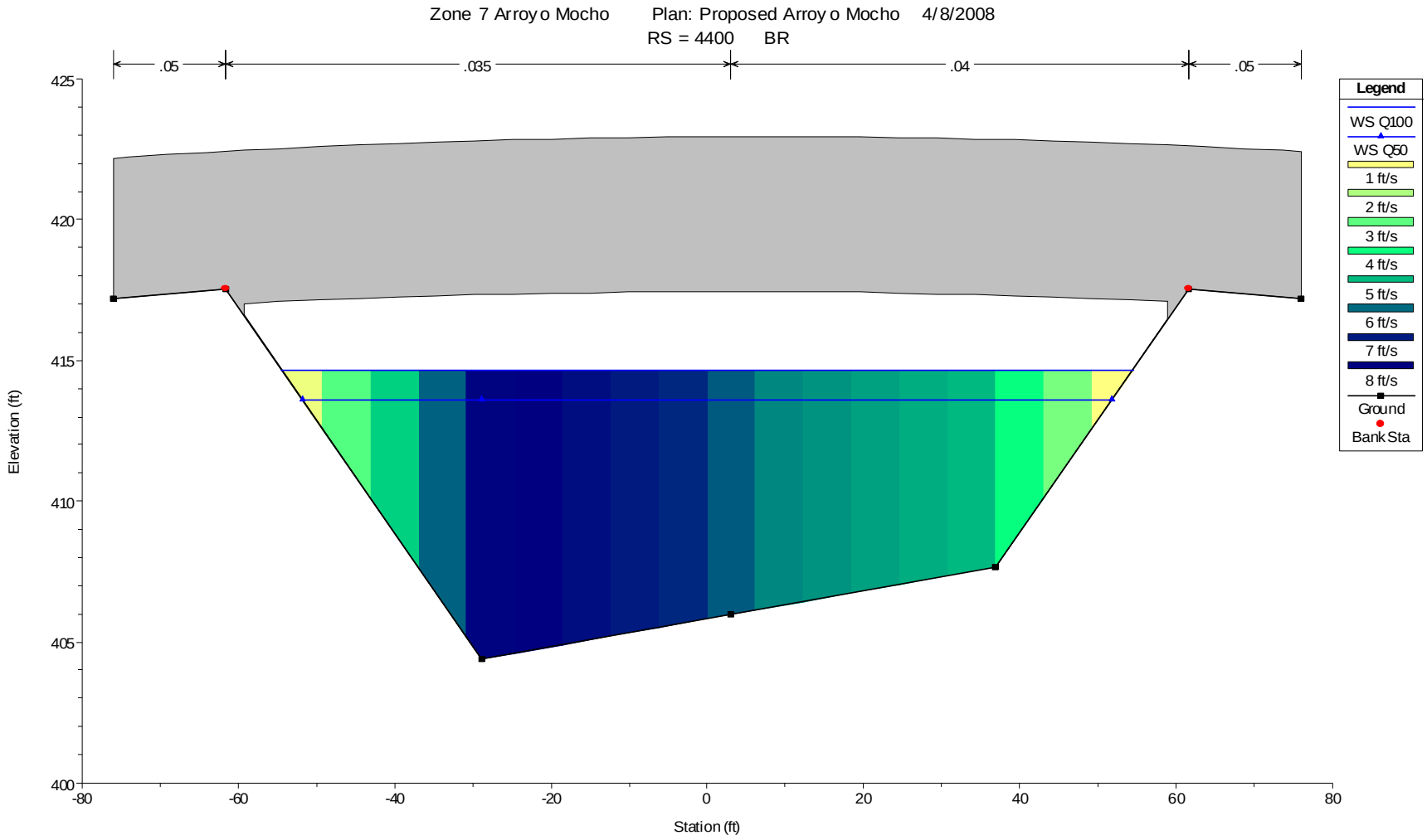

Figure 11. Arroyo Mocho Access Bridge Upstream Face Cross-Section

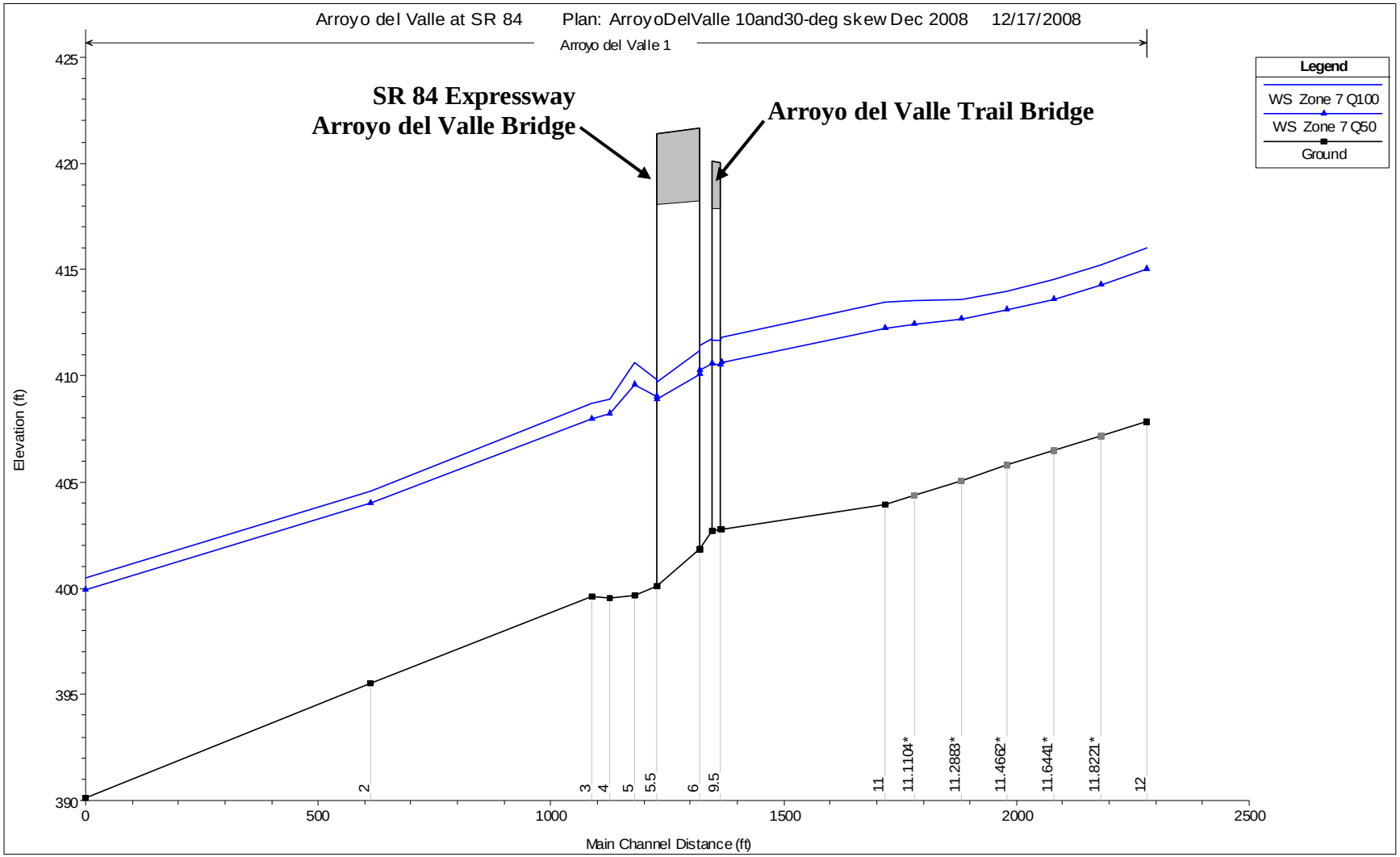

Figure 12. Arroyo del Valle Profile

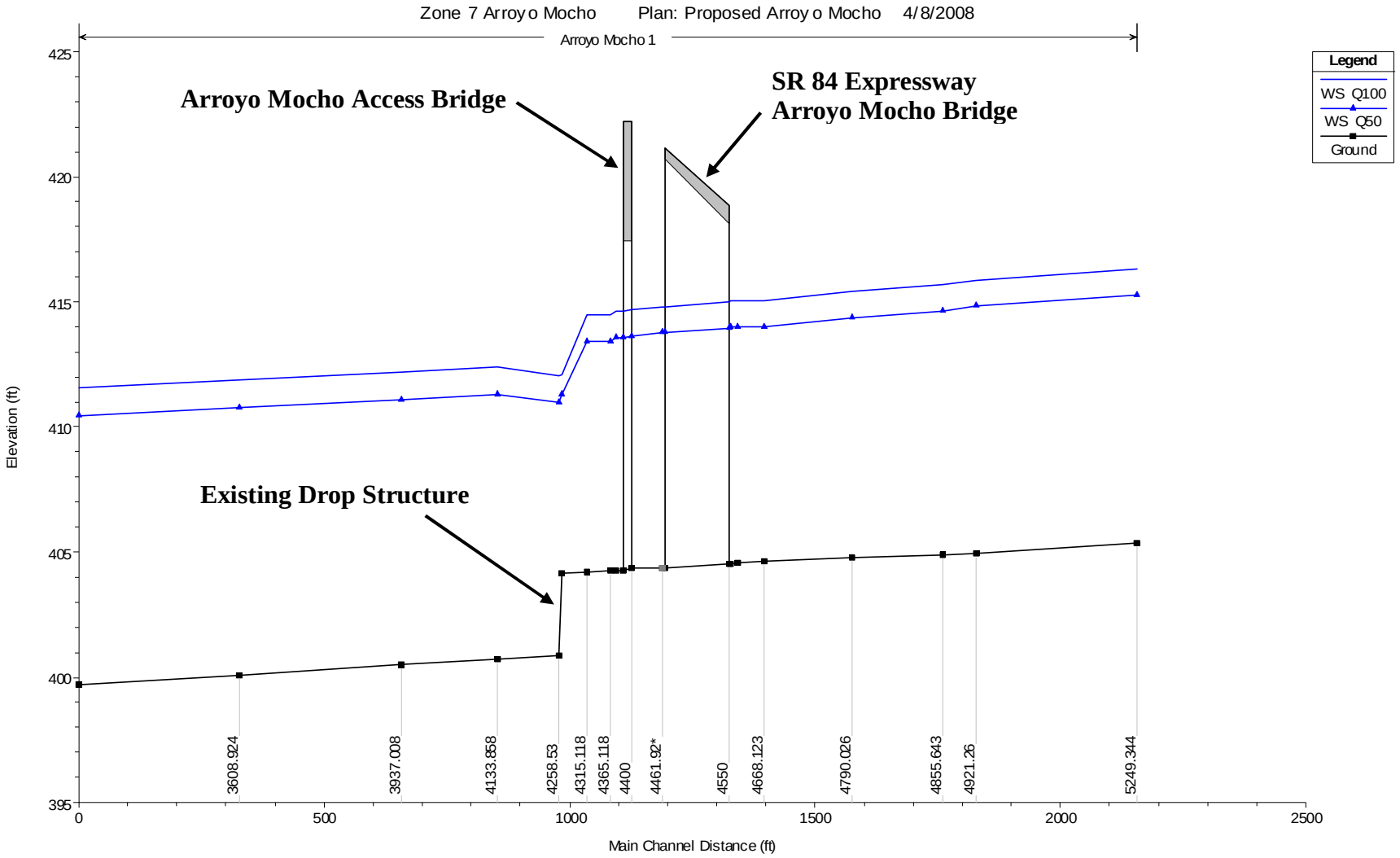

Figure 13. Arroyo Mocho Profile

6 SCOUR ANALYSIS

6.1 Design Criteria

The minimum design criteria for bridge scour are the 100-year flood requirements. The local scour at the abutments and pier was evaluated per the criteria described in the Federal Highway Administration Manual HEC-18, *Evaluating Scour at Bridges (Fourth Edition)*. The scour analysis was based on hydraulic data taken from the HEC-RAS 3.1.3 analysis of the bridge sites. The existing Arroyo del Valle Bridge was declared scour critical by Caltrans HQ.

6.2 Long-Term Bed Elevation Change

According to the Bridge Inspection Report for Bridge Number 33-0710 at Arroyo del Valle (3/2/06), "there was 5.9 ft (1.8 m) of channel degradation between 1983 and 1999; this was attributed to in-stream gravel mining." Since then the channel has stabilized and we have assumed the long-term bed change to be negligible.

The Arroyo Mocho channel is concrete lined underneath the SR 84 Expressway Bridge. According to the Bridge Inspection Report for Bridge Number 33-0713 at Arroyo Mocho (3/2/06), "the bridge is not vulnerable to scour with the channel in its current state." Scour was not calculated at the SR 84 Expressway Bridge at Arroyo Mocho because it is concrete lined. For the proposed unlined Access Bridge at Arroyo Mocho, we assumed the long-term bed elevation change is negligible since the slopes are very flat (S=0.0012 ft/ft); there is a concrete drop structure located downstream; and a concrete-lined channel is located upstream (at SR 84 Expressway Bridge).

6.3 Contraction Scour

Contraction scour occurs when the flow area of a stream is reduced significantly, either by a natural contraction or by a bridge. There is contraction that occurs at the proposed bridge sites due to the proposed new bridges and widenings. Using the Live-Bed Contraction scour equation at the channel, the calculated contraction scour depths at the channel are:

- 1.15 ft (SR 84 Expressway Bridge at Arroyo del Valle)
- 2.90 ft (Trail Bridge at Arroyo del Valle)
- 1.10 ft (Access Bridge at Arroyo Mocho)

6.4 Pier Scour

The basic mechanism causing local scour at piers is the formation of vortices (known as horseshoe vortex) at their base. The horseshoe vortex results from the pileup of water on the upstream surface of the pier and subsequent acceleration of the flow around the base of the pier. The action of the vortex removes bed material from around the base of the pier. Pier scour was calculated at the SR 84 Bridge at Arroyo Mocho because it is lined

with concrete. To determine pier scour, an equation based on the CSU Equation is recommended for both live-bed and clear-water scour. The CSU Equation was utilized to determine pier scour at the following locations:

- 13.37 ft (SR 84 Expressway Bridge at Arroyo del Valle)
- 22.43 ft (Trail Bridge at Arroyo del Valle)

6.5 Abutment Scour

High flow events will cause local scour at the abutments. Abutment scour was calculated for the Trail Bridge at Arroyo del Valle and at the SR 84 Bridge at Arroyo del Valle. Abutment scour was not calculated for the bridges at Arroyo Mocho because the concrete lined channel and banks under the SR 84 Expressway Bridge, and the 100-year water surface does not reach the Access Bridge abutments.

We assumed an angle of attack of 30º for the Trail Bridge. Using the Froelich Equation to determine live-bed abutment scour, the calculated abutment scour depths are:

- 12.74 ft (Left Abutment) at the Arroyo del Valle SR 84 Expressway Bridge
- 6.31 ft (Right Abutment) at the Arroyo del Valle SR 84 Expressway Bridge
- 21.58 ft (Left Abutment) at the Arroyo del Valle Trail Bridge
- 22.09 ft (Right Abutment) at the Arroyo del Valle Trail Bridge

6.6 Total Scour

Total scour is the sum of local scour, contraction scour, and long-term scour. HEC-18 was used to perform the detailed calculations to estimate scour. The itemized total scour depth for the abutments and piers of the proposed bridge is shown in the following tables.

Table 13. Summary of Scour at Prop SR 84 Expressway Bridge at Arroyo del Valle

Location	Long-term Bed Change	Contraction Scour	Local Scour	Total Scour Depth
Abutment 1	Negligible	1.15 ft	12.74 ft	13.89 ft
Pier 2	Negligible	1.15 ft	13.37 ft	14.52 ft
Abutment 3	Negligible	1.15 ft	6.31 ft	7.46 ft

Table 14. Summary of Scour at Proposed Arroyo del Valle Trail Bridge

Location	Long-term Bed Change	Contraction Scour	Local Scour	Total Scour Depth
Abutment 1	Negligible	2.90 ft	21.58 ft	24.48 ft
Pier 2	Negligible	2.90 ft	22.43 ft	25.33 ft
Abutment 3	Negligible	2.90 ft	22.09 ft	24.99 ft

Table 15. Summary of Scour at Proposed Arroyo Mocho Access Bridge

Location	Long-term Bed Change	Contraction Scour	Local Scour	Total Scour Depth
Abutment 1	Negligible	1.1 ft	-	1.1 ft
Abutment 2	Negligible	1.1 ft	-	1.1 ft

The potential for lateral channel migration, long-term degradation, and contraction scour must be considered in setting pier foundation depths in and near the main channel of both Arroyo del Valle and Arroyo Mocho. The foundation of the proposed bridge piers or spread footings must be constructed below the estimated total scour depth or the bedrock layer to avoid structural damage, and/or undermining. (see Appendix F for scour calculations)

Photo 12.
Existing Arroyo del Valle main channel

6.7 Scour Protection Recommendations

Extensive coordination has been made between Caltrans and the Design team over the scour protection recommendations for the bridges within the Project. A meeting took place on June 19, 2008 between Caltrans Headquaters and the Design team over the existing conditions of the bridges and several alternatives for the bridge scour countermeasures. A separate memorandum was sent to Caltrans from the Design team, summarizing approximate costs of several alternatives to limit scour on the Arroyo del Valle Bridge. The meeting minutes and memorandum can be found in Appendix G .

The proposed bridge scour countermeasure should consider the total estimated scour. In this study, we researched gabions, pre-cast concrete blocks, concrete lining, sheet piling, and riprap for scour countermeasures.

A gabion is a basket or compartmented rectangular container made of wire mesh. When filled with cobbles or other rock of suitable size, the gabion becomes a flexible and permeable unit with which flow- and erosion-control structures can be built. HEC-23

states that vandalism is always a maintenance concern since countermeasures can be made ineffective by vandals. For example, gabions may not be appropriate for an area with documented vandalism. Gabions have been eliminated as an alternative because of the potential for vandalism.

According to the HEC-11, pre-cast concrete block revetments consist of pre-formed sections, which interlock with each other, and are attached to each other, or butt together to form a continuous blanket or mat. The concrete blocks which make up the mats differ in shape and method of articulation, but share certain common features. These features include flexibility, rapid installation, and provisions for the establishment of vegetation within the revetment. Pre-cast block revetments that are assembled by simply butting individual blocks end to end (with no physical connection) should not be used on slopes steeper than 3:1 (H:V). Since some of our slopes are steeper than 3:1, we do not recommend pre-cast concrete block revetments. Furthermore, since there is little available documented experience with the use of pre-cast concrete blocks as a scour countermeasure for bridges, we have eliminated pre-cast concrete blocks as an alternative.

Concrete pavement revetments are cast-in-place, or pre-cast and set in place on a prepared slope to provide a continuous, monolithic armor for bank protection. Cast-in-place designs are the most common of the two design methods. Components of concrete pavement revetment design include layout of a general scheme, bank and foundation preparation, bank slope, pavement thickness, pavement reinforcement, edge treatment, stubwalls, filter design, pressure relief, and concrete quality. Note that cement and grout are unpopular with environmental agencies. After discussions with Caltrans HQ, it was determined that concrete lining shall be eliminated as an alternative.

According to Caltrans, RSP alone is insufficient for scour protection. Supporting the piers of the SR 84 Bridge at Arroyo del Valle and Trail Bridge at Arroyo del Valle on piles, as well as the abutments of the new Trail Bridge, are the proposed primary scour countermeasures. Please refer to Appendix G for relevant correspondences and meeting minutes.

SR 84 Expressway Bridge at Arroyo Mocho is already concrete-lined and would not require any other countermeasure.

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Appendix A Arroyo del Valle

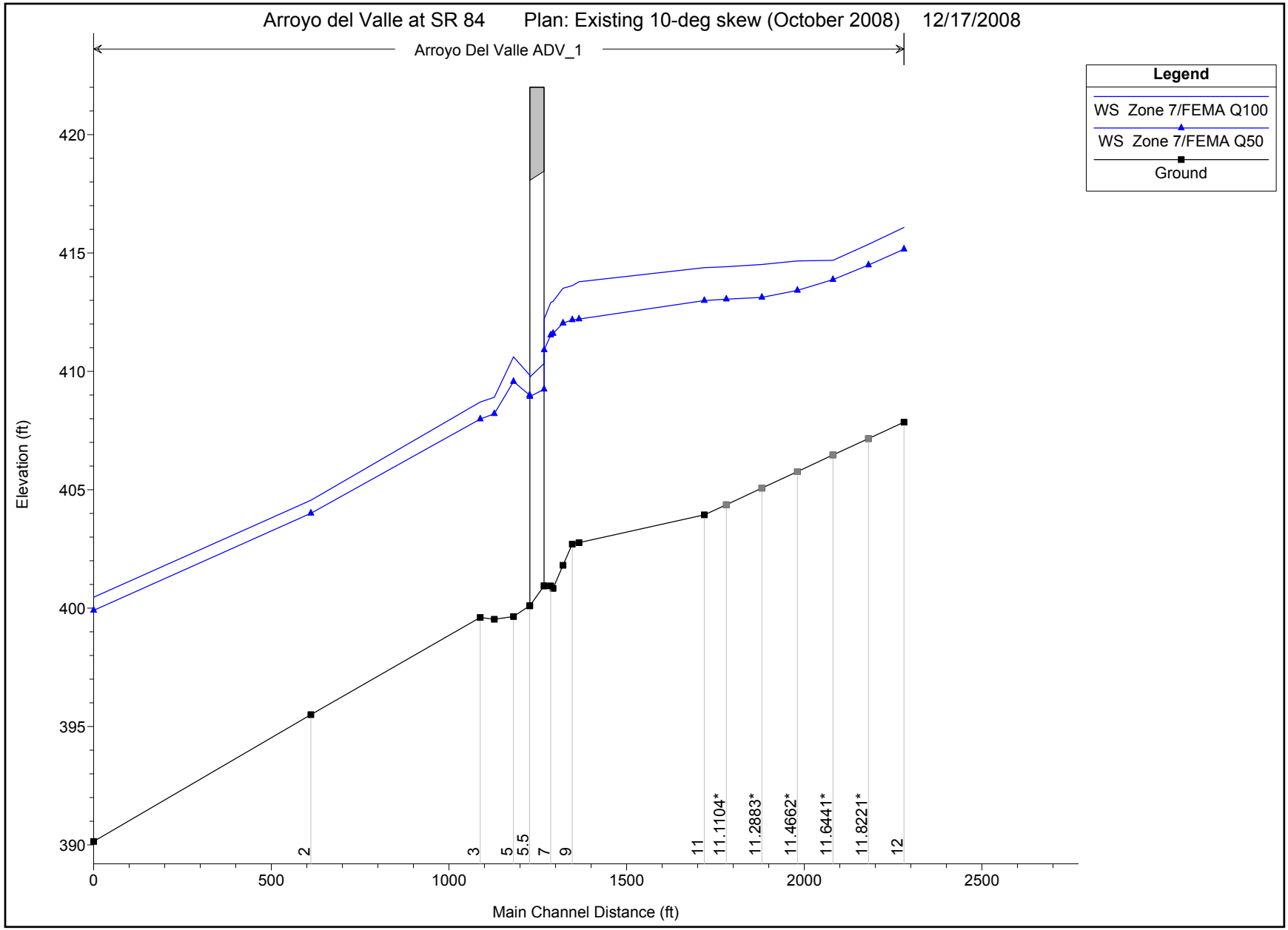
HEC-RAS Results: Existing Condition

HEC-RAS Plan: existing River: Arroyo Del Valle Reach: ADV_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
ADV_1	12	Zone 7/FEMA Q100	7000.00	407.86	416.08	414.01	417.23	0.007781	8.58	815.42	128.06	0.60	6.15	100.00
ADV_1	12	Zone 7/FEMA Q50	5400.00	407.86	415.16	413.20	416.09	0.007352	7.71	700.14	122.97	0.57	5.34	100.00
ADV_1	11.8221*	Zone 7/FEMA Q100	7000.00	407.16	415.37	413.31	416.46	0.007249	8.41	832.59	133.94	0.59	6.15	100.00
ADV_1	11.8221*	Zone 7/FEMA Q50	5400.00	407.16	414.49	412.52	415.37	0.006752	7.52	717.84	128.73	0.56	5.36	100.00
ADV_1	11.6441*	Zone 7/FEMA Q100	7000.00	406.47	414.69	412.61	415.73	0.007053	8.18	855.44	139.75	0.58	6.14	100.00
ADV_1	11.6441*	Zone 7/FEMA Q50	5400.00	406.47	413.88	411.84	414.69	0.006406	7.26	743.75	134.57	0.54	5.37	100.00
ADV_1	11.4662*	Zone 7/FEMA Q100	7000.00	405.77	414.67	411.90	415.14	0.002755	5.97	1465.41	406.33	0.41	6.13	100.00
ADV_1	11.4662*	Zone 7/FEMA Q50	5400.00	405.77	413.42	411.13	414.14	0.004346	6.80	793.67	141.25	0.51	5.36	100.00
ADV_1	11.2883*	Zone 7/FEMA Q100	7000.00	405.07	414.52	411.16	414.88	0.001912	5.25	1679.30	424.79	0.35	6.09	100.00
ADV_1	11.2883*	Zone 7/FEMA Q50	5400.00	405.07	413.13	410.41	413.73	0.003350	6.20	870.57	148.93	0.45	5.34	100.00
ADV_1	11.1104*	Zone 7/FEMA Q100	7000.00	404.37	414.42	410.42	414.70	0.001316	4.59	1928.57	443.76	0.30	6.05	62.10
ADV_1	11.1104*	Zone 7/FEMA Q50	5400.00	404.37	413.06	409.68	413.40	0.001908	4.95	1329.08	432.09	0.35	5.31	62.10
ADV_1	11	Zone 7/FEMA Q100	7000.00	403.94	414.38	409.95	414.61	0.001072	4.21	2099.00	455.65	0.27	6.01	352.70
ADV_1	11	Zone 7/FEMA Q50	5400.00	403.94	412.99	409.21	413.28	0.001516	4.50	1475.20	443.68	0.31	5.27	352.70
ADV_1	10	Zone 7/FEMA Q100	7000.00	402.77	413.79	408.81	414.12	0.001791	4.81	1706.40	430.32	0.32	6.04	19.10
ADV_1	10	Zone 7/FEMA Q50	5400.00	402.77	412.21	408.05	412.62	0.002236	5.15	1049.09	155.49	0.35	5.28	19.10
ADV_1	9	Zone 7/FEMA Q100	7000.00	402.71	413.62	408.67	414.07	0.002276	5.35	1309.02	182.46	0.35	5.96	25.90
ADV_1	9	Zone 7/FEMA Q50	5400.00	402.71	412.18	407.91	412.57	0.002200	5.07	1065.65	153.76	0.34	5.20	25.90
ADV_1	8.5	Zone 7/FEMA Q100	7000.00	401.81	413.51		414.00	0.002207	5.69	1325.01	285.68	0.36		28.00
ADV_1	8.5	Zone 7/FEMA Q50	5400.00	401.81	412.04		412.51	0.002521	5.51	987.20	179.74	0.37		28.00
ADV_1	8	Zone 7/FEMA Q100	7000.00	400.84	412.96		413.88	0.003835	7.70	909.58	113.37	0.48		6.60
ADV_1	8	Zone 7/FEMA Q50	5400.00	400.84	411.60		412.39	0.003847	7.12	758.40	107.83	0.47		6.60
ADV_1	7	Zone 7/FEMA Q100	7000.00	400.94	412.91		413.86	0.002976	7.82	894.71	121.03	0.51		18.30
ADV_1	7	Zone 7/FEMA Q50	5400.00	400.94	411.53		412.36	0.002845	7.30	739.30	109.10	0.49		18.30
ADV_1	6.5	Zone 7/FEMA Q100	7000.00	400.94	412.21	410.10	413.72	0.006292	9.86	709.61	99.87	0.65	9.16	0.50
ADV_1	6.5	Zone 7/FEMA Q50	5400.00	400.94	410.91	409.04	412.24	0.006413	9.24	584.25	92.71	0.65	8.10	0.50
ADV_1	6		Bridge											
ADV_1	5.5	Zone 7/FEMA Q100	7000.00	400.10	409.85		411.76	0.010358	11.11	630.34	100.03	0.78		45.50
ADV_1	5.5	Zone 7/FEMA Q50	5400.00	400.10	409.00		410.51	0.009547	9.89	546.12	97.39	0.74		45.50
ADV_1	5	Zone 7/FEMA Q100	7000.00	399.65	410.62	406.42	410.76	0.001146	3.07	2291.59	393.28	0.21	6.77	53.90
ADV_1	5	Zone 7/FEMA Q50	5400.00	399.65	409.57	406.05	409.70	0.001216	2.83	1905.04	352.97	0.22	6.40	53.90
ADV_1	4	Zone 7/FEMA Q100	7000.00	399.53	408.91		410.47	0.012652	10.04	699.90	137.63	0.76		39.60
ADV_1	4	Zone 7/FEMA Q50	5400.00	399.53	408.21		409.44	0.011540	8.88	607.93	125.56	0.71		39.60

HEC-RAS Plan: existing River: Arroyo Del Valle Reach: ADV_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
ADV_1	3	Zone 7/FEMA Q100	7000.00	399.61	408.71		409.94	0.009697	8.90	786.32	154.88	0.70		476.80
ADV_1	3	Zone 7/FEMA Q50	5400.00	399.61	407.99		408.97	0.008727	7.95	679.08	145.76	0.65		476.80
ADV_1	2	Zone 7/FEMA Q100	7000.00	395.50	404.56	403.62	405.36	0.008988	7.19	973.25	272.92	0.67	8.12	611.30
ADV_1	2	Zone 7/FEMA Q50	5400.00	395.50	404.01	402.97	404.67	0.008899	6.54	825.28	264.24	0.65	7.47	611.30
ADV_1	1	Zone 7/FEMA Q100	7000.00	390.15	400.46	399.06	401.00	0.005604	5.89	1187.73	312.18	0.53	8.91	
ADV_1	1	Zone 7/FEMA Q50	5400.00	390.15	399.91	398.66	400.35	0.005602	5.32	1014.42	310.93	0.52	8.51	

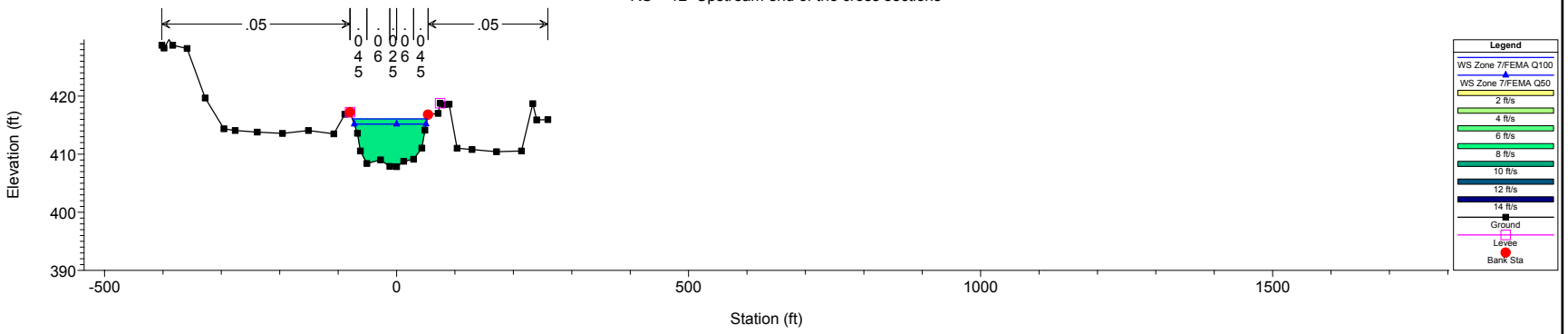


1 in Horiz. = 400 ft 1 in Vert. = 6 ft

No Data for Plot

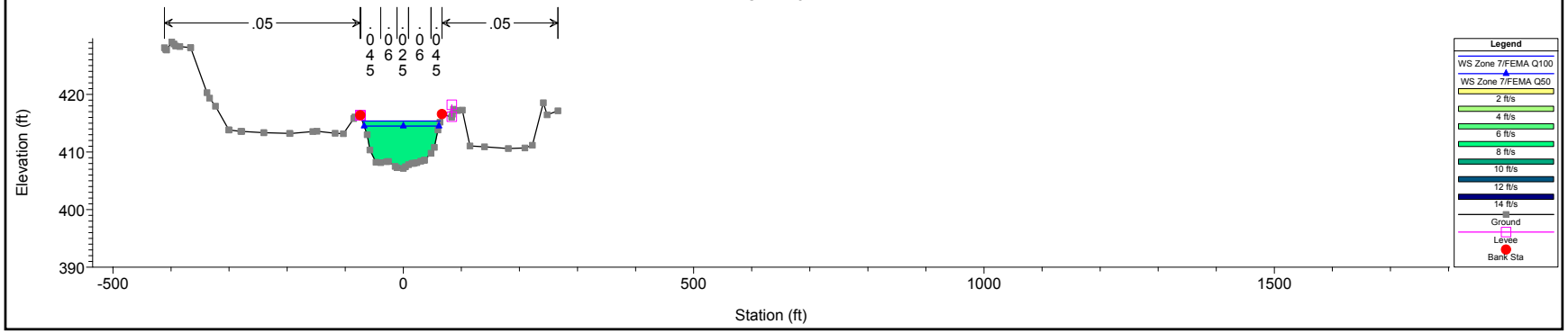
Arroyo del Valle at SR 84 Plan: Existing 10-deg skew (October 2008) 12/17/2008

RS = 12 Upstream end of the cross sections

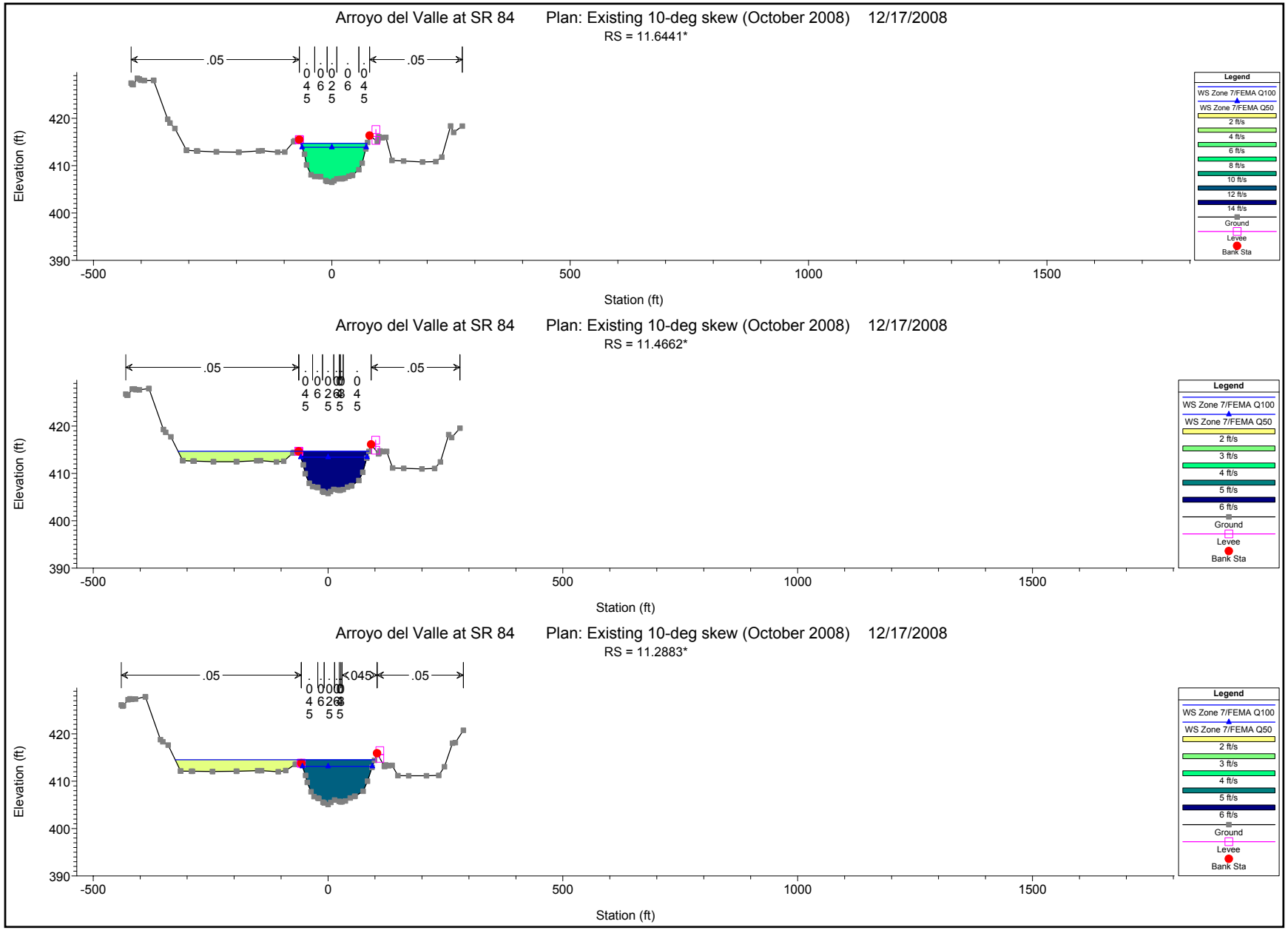


Arroyo del Valle at SR 84 Plan: Existing 10-deg skew (October 2008) 12/17/2008

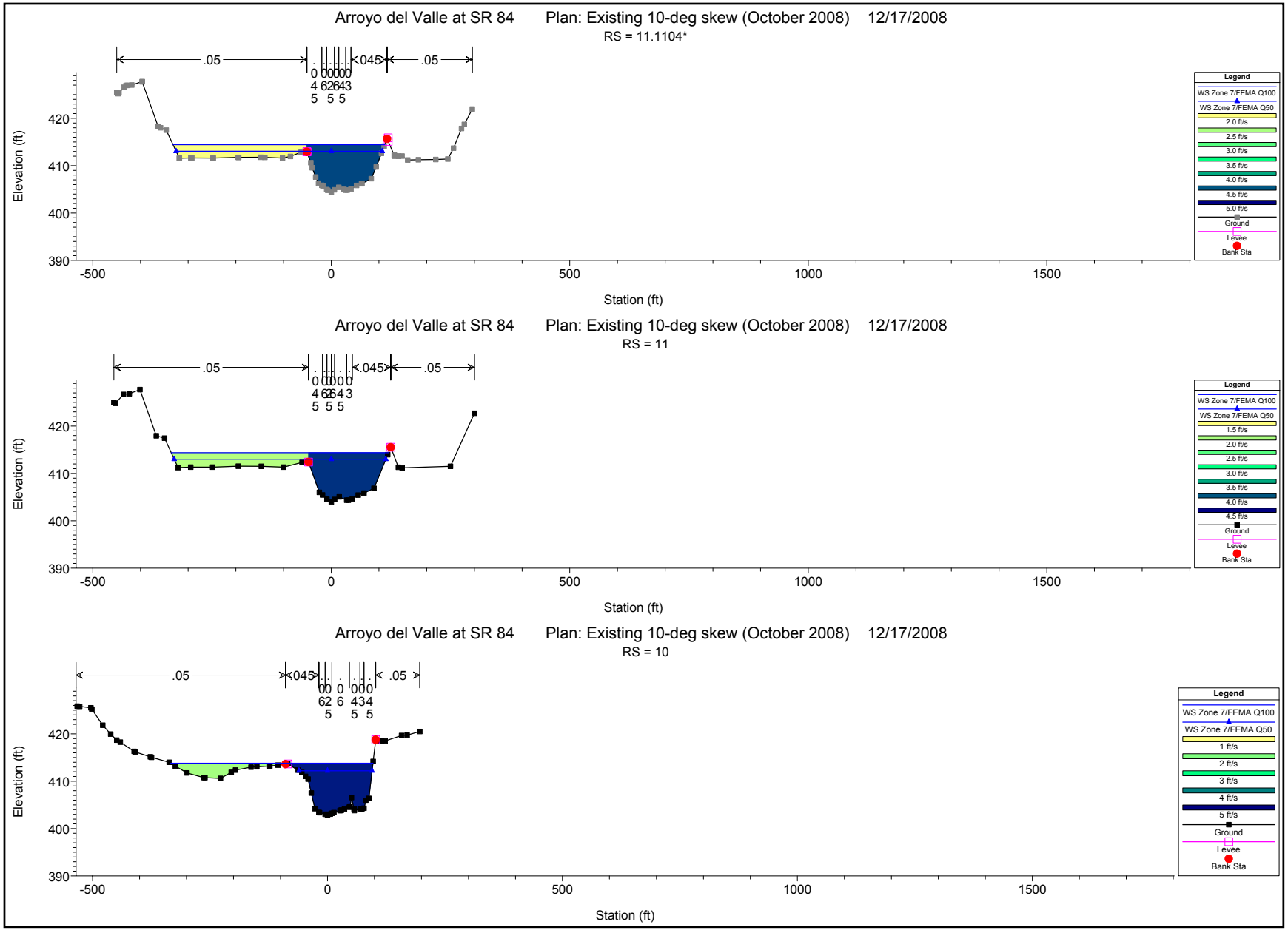
RS = 11.8221*



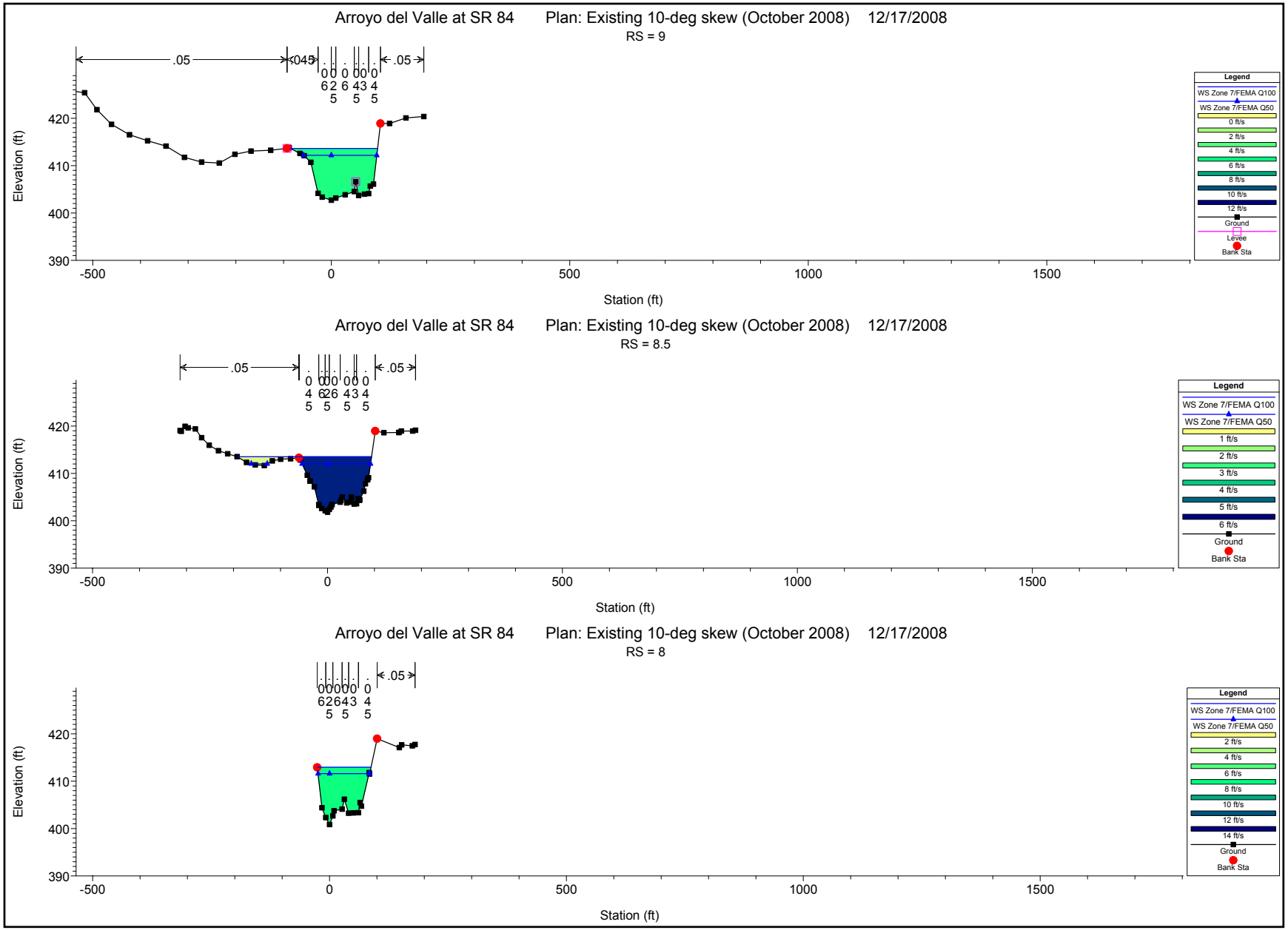
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



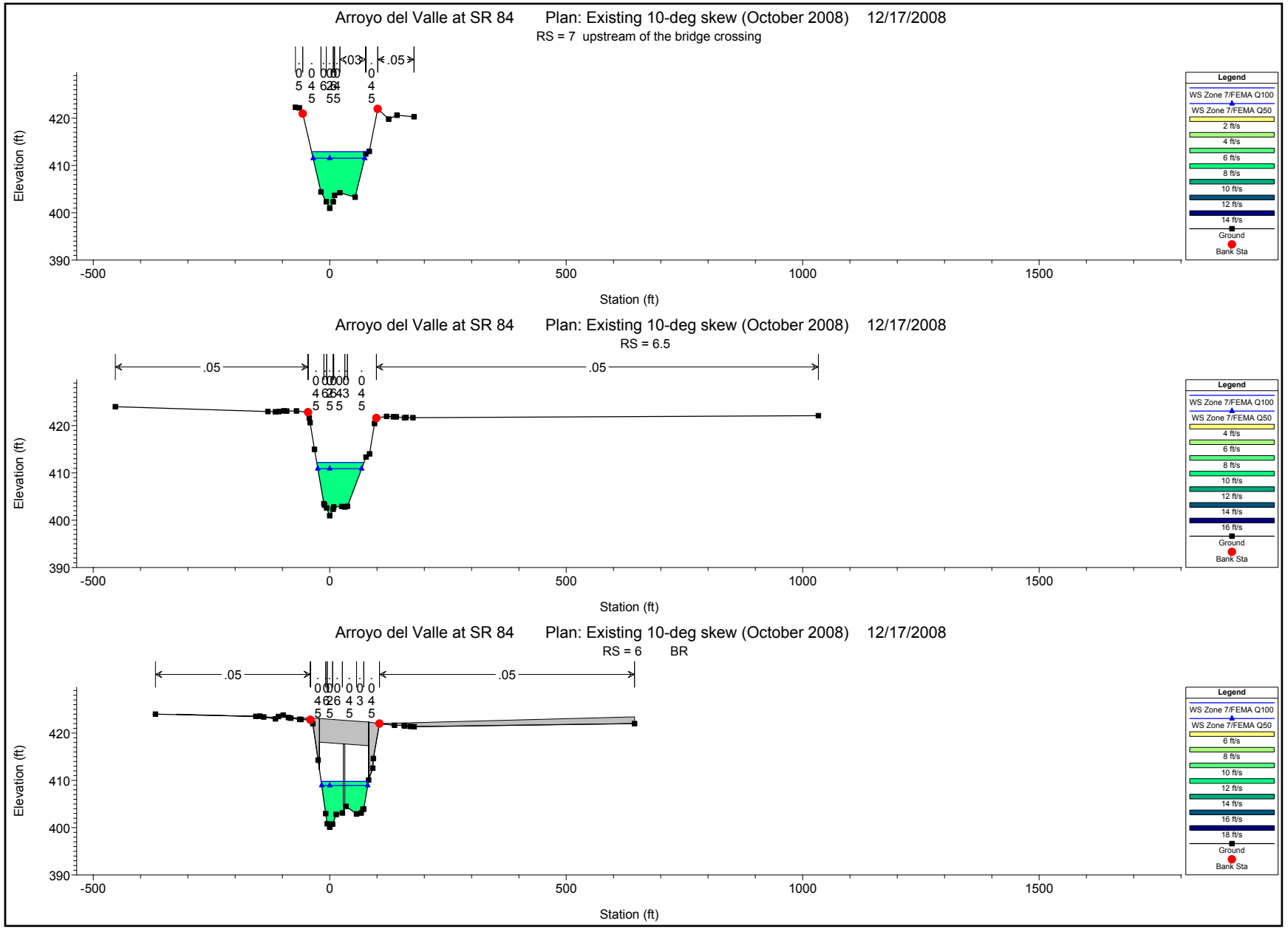
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



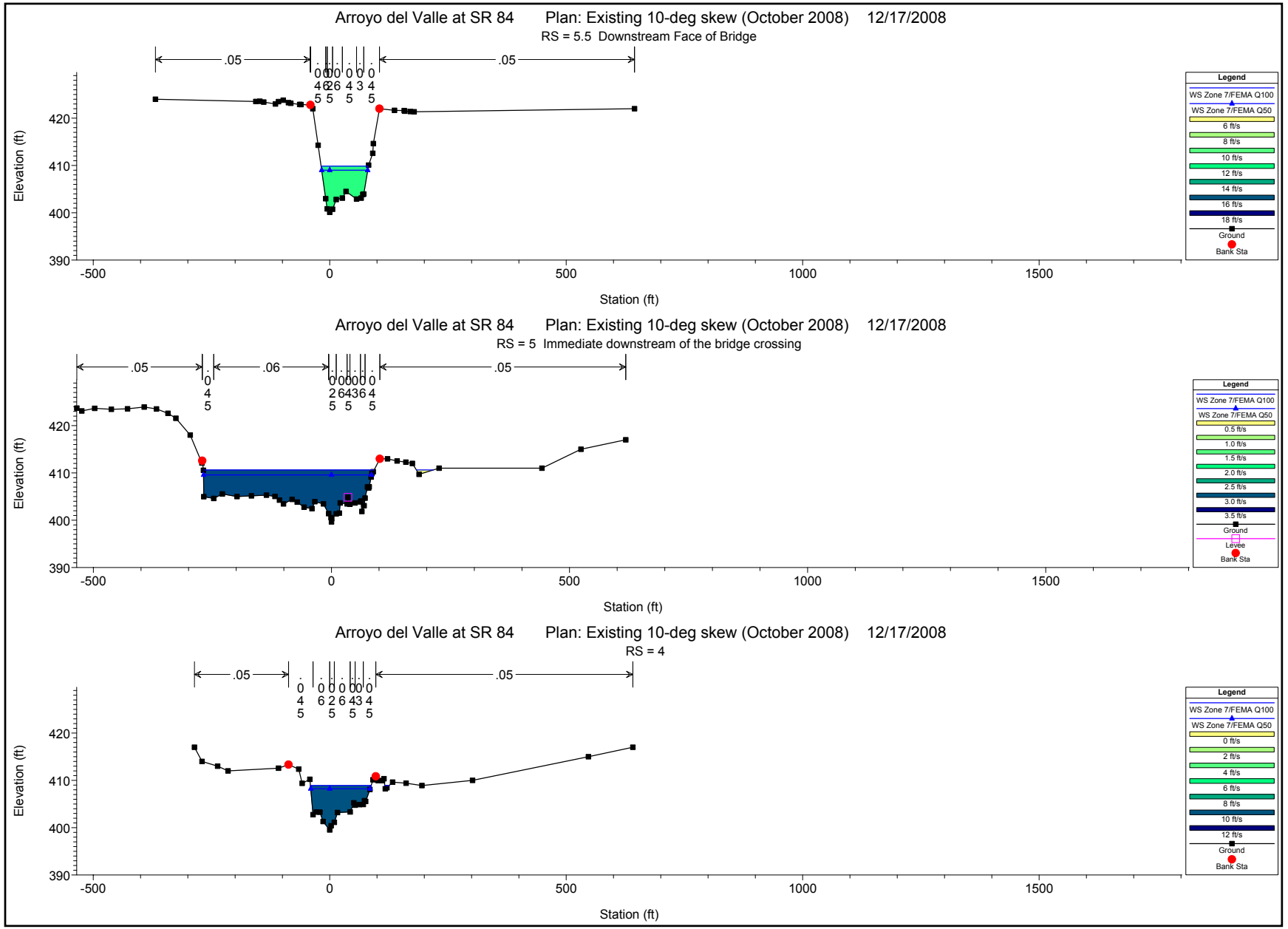
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



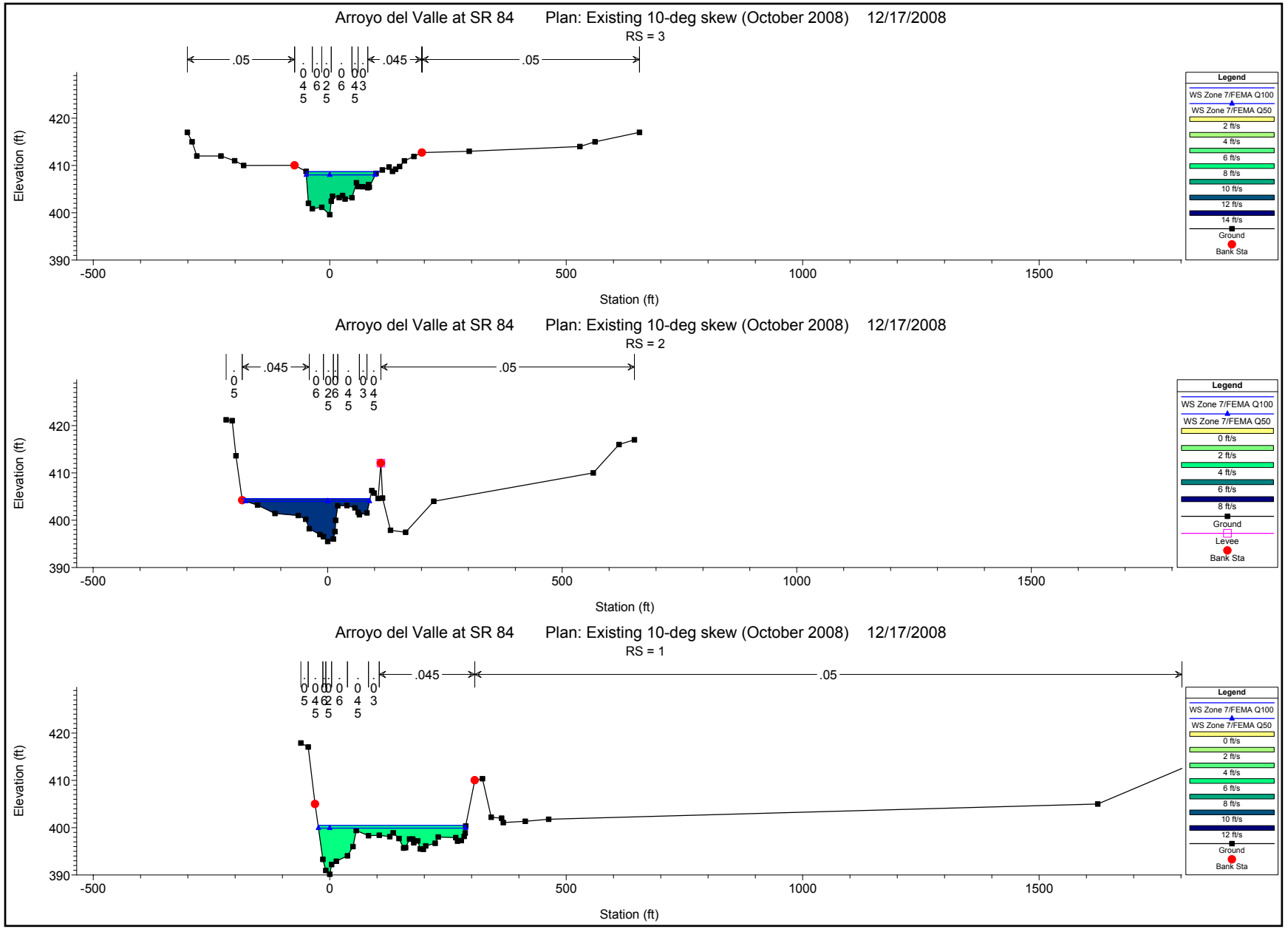
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



1 in Horiz. = 300 ft 1 in Vert. = 30 ft



1 in Horiz. = 300 ft 1 in Vert. = 30 ft



1 in Horiz. = 300 ft 1 in Vert. = 30 ft

Plan: existing Arroyo Del Valle ADV_1 RS: 6 Profile: Zone 7/FEMA Q100

E.G. US. (ft)	413.72	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	412.21	E.G. Elev (ft)	413.28	411.86
Q Total (cfs)	7000.00	W.S. Elev (ft)	410.34	409.76
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	410.34	408.93
Q Weir (cfs)		Max Chl Dpth (ft)	9.40	9.66
Weir Sta Lft (ft)		Vel Total (ft/s)	13.77	11.62
Weir Sta Rgt (ft)		Flow Area (sq ft)	508.47	602.48
Weir Submerg		Froude # Chl	1.00	0.82
Weir Max Depth (ft)		Specif Force (cu ft)	4773.86	4609.47
Min El Weir Flow (ft)	422.01	Hydr Depth (ft)	5.89	6.24
Min El Prs (ft)	418.46	W.P. Total (ft)	104.61	113.54
Delta EG (ft)	1.96	Conv. Total (cfs)	61700.8	98787.5
Delta WS (ft)	2.36	Top Width (ft)	86.38	96.56
BR Open Area (sq ft)	1271.16	Frctn Loss (ft)	0.30	0.00
BR Open Vel (ft/s)	13.77	C & E Loss (ft)	0.42	0.09
Coef of Q		Shear Total (lb/sq ft)	3.91	1.66
Br Sel Method	Energy only	Power Total (lb/ft s)	53.77	19.33

Plan: existing Arroyo Del Valle ADV_1 RS: 6 Profile: Zone 7/FEMA Q50

E.G. US. (ft)	412.24	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.91	E.G. Elev (ft)	411.85	410.59
Q Total (cfs)	5400.00	W.S. Elev (ft)	409.25	408.94
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	409.25	407.99
Q Weir (cfs)		Max Chl Dpth (ft)	8.31	8.84
Weir Sta Lft (ft)		Vel Total (ft/s)	12.93	10.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	417.53	523.82
Weir Submerg		Froude # Chl	1.00	0.77
Weir Max Depth (ft)		Specif Force (cu ft)	3445.64	3347.75
Min El Weir Flow (ft)	422.01	Hydr Depth (ft)	5.19	5.57
Min El Prs (ft)	418.46	W.P. Total (ft)	96.00	108.84
Delta EG (ft)	1.72	Conv. Total (cfs)	47405.7	42072.0
Delta WS (ft)	1.91	Top Width (ft)	80.39	94.01
BR Open Area (sq ft)	1271.16	Frctn Loss (ft)	0.58	0.01
BR Open Vel (ft/s)	12.93	C & E Loss (ft)	0.47	0.07
Coef of Q		Shear Total (lb/sq ft)	3.52	4.95
Br Sel Method	Energy only	Power Total (lb/ft s)	45.57	51.03

Appendix B Arroyo Mocho

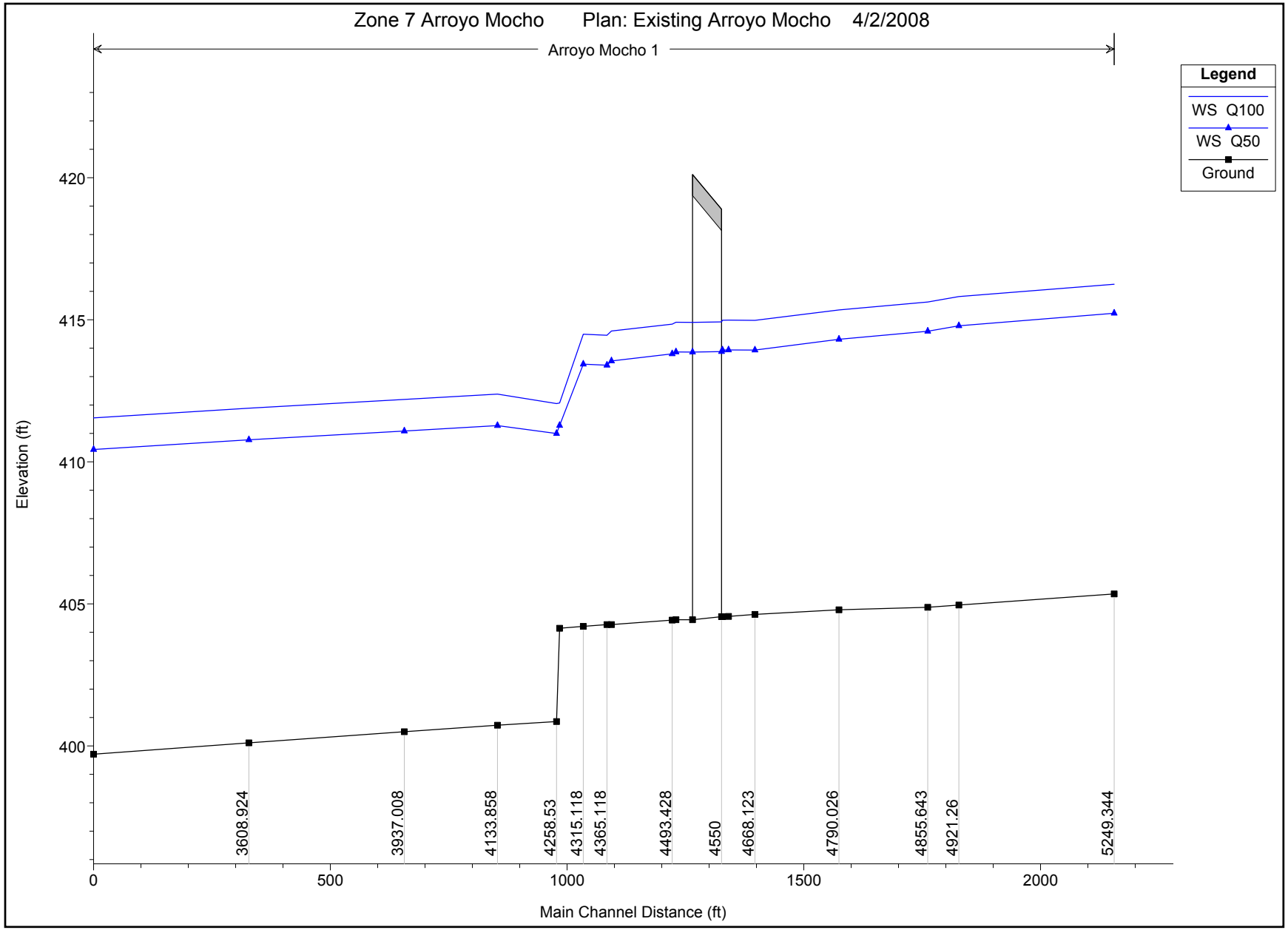
HEC-RAS Results: Existing Condition

HEC-RAS Plan: Existing River: Arroyo Mocho Reach: 1

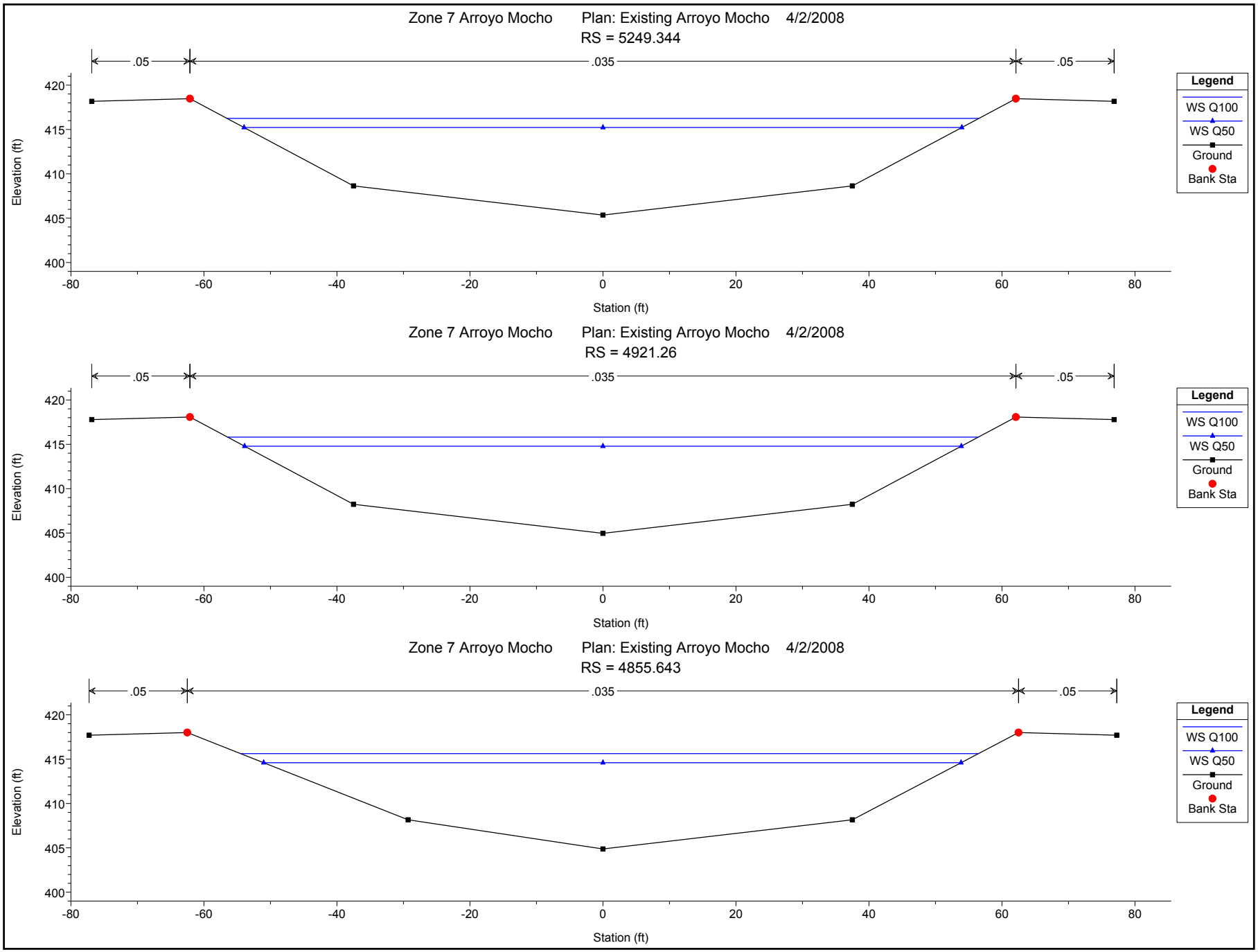
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	5249.344	Q100	4800.00	405.35	416.25		416.76	0.001302	5.72	839.06	113.06	0.37		328.08
1	5249.344	Q50	3900.00	405.35	415.23		415.68	0.001306	5.37	725.96	107.95	0.37		328.08
1	4921.26	Q100	4800.00	404.96	415.81		416.33	0.001323	5.75	834.54	112.88	0.37		65.62
1	4921.26	Q50	3900.00	404.96	414.79		415.24	0.001330	5.41	721.44	107.75	0.37		65.62
1	4855.643	Q100	4800.00	404.88	415.62		416.22	0.001664	6.21	772.84	110.94	0.41		187.52
1	4855.643	Q50	3900.00	404.88	414.60		415.14	0.001702	5.89	662.09	104.87	0.41		187.52
1	4790.026	Q100	4800.00	404.79	415.35		415.90	0.001640	5.97	803.97	112.00	0.39		177.57
1	4790.026	Q50	3900.00	404.79	414.31		414.81	0.001671	5.64	690.90	106.75	0.39		177.57
1	4668.123	Q100	4800.00	404.63	414.98		415.57	0.002114	6.15	780.82	110.95	0.41		55.67
1	4668.123	Q50	3900.00	404.63	413.93		414.46	0.002197	5.84	667.62	105.65	0.41		55.67
1	4612.454	Q100	4800.00	404.56	414.99		415.52	0.000262	5.86	819.45	114.48	0.39		12.72
1	4612.454	Q50	3900.00	404.56	413.94		414.42	0.000271	5.55	702.17	109.23	0.39		12.72
1	4599.738	Q100	4800.00	404.55	414.98	411.04	415.51	0.000262	5.85	820.27	114.51	0.39	6.49	2.00
1	4599.738	Q50	3900.00	404.55	413.93	410.43	414.41	0.000271	5.55	702.94	109.27	0.39	5.88	2.00
1	4550		Bridge											
1	4501.312	Q100	4800.00	404.44	414.91		415.44	0.000257	5.82	824.99	114.72	0.38		7.88
1	4501.312	Q50	3900.00	404.44	413.87		414.34	0.000265	5.51	707.72	109.49	0.38		7.88
1	4493.428	Q100	4800.00	404.43	414.84		415.42	0.001738	6.09	787.78	111.27	0.40		128.31
1	4493.428	Q50	3900.00	404.43	413.80		414.32	0.001790	5.78	674.60	105.99	0.40		128.31
1	4374.534	Q100	4800.00	404.27	414.60		415.19	0.001797	6.16	778.72	110.86	0.41		9.42
1	4374.534	Q50	3900.00	404.27	413.55		414.08	0.001866	5.87	664.96	105.53	0.41		9.42
1	4365.118	Q100	4800.00	404.27	414.45		415.16	0.002744	6.75	711.58	107.63	0.46		50.00
1	4365.118	Q50	3900.00	404.27	413.40		414.05	0.002925	6.49	601.30	101.39	0.47		50.00
1	4315.118	Q100	4800.00	404.21	414.49		415.09	0.000306	6.23	770.70	110.02	0.41		50.03
1	4315.118	Q50	3900.00	404.21	413.44		413.98	0.000320	5.93	657.39	104.74	0.42		50.03
1	4265.092	Q100	4800.00	404.14	412.07	412.07	414.85	0.001987	13.37	359.05	64.79	1.00	7.93	6.56
1	4265.092	Q50	3900.00	404.14	411.28	411.28	413.76	0.002051	12.63	308.67	62.42	1.00	7.14	6.56
1	4258.53	Q100	4800.00	400.86	412.05		413.06	0.000470	8.07	595.06	76.71	0.51		124.67
1	4258.53	Q50	3900.00	400.86	410.99		411.88	0.000467	7.56	515.84	73.27	0.50		124.67
1	4133.858	Q100	4800.00	400.73	412.38		412.80	0.000981	5.18	926.27	116.87	0.32		196.85

HEC-RAS Plan: Existing River: Arroyo Mocho Reach: 1 (Continued)

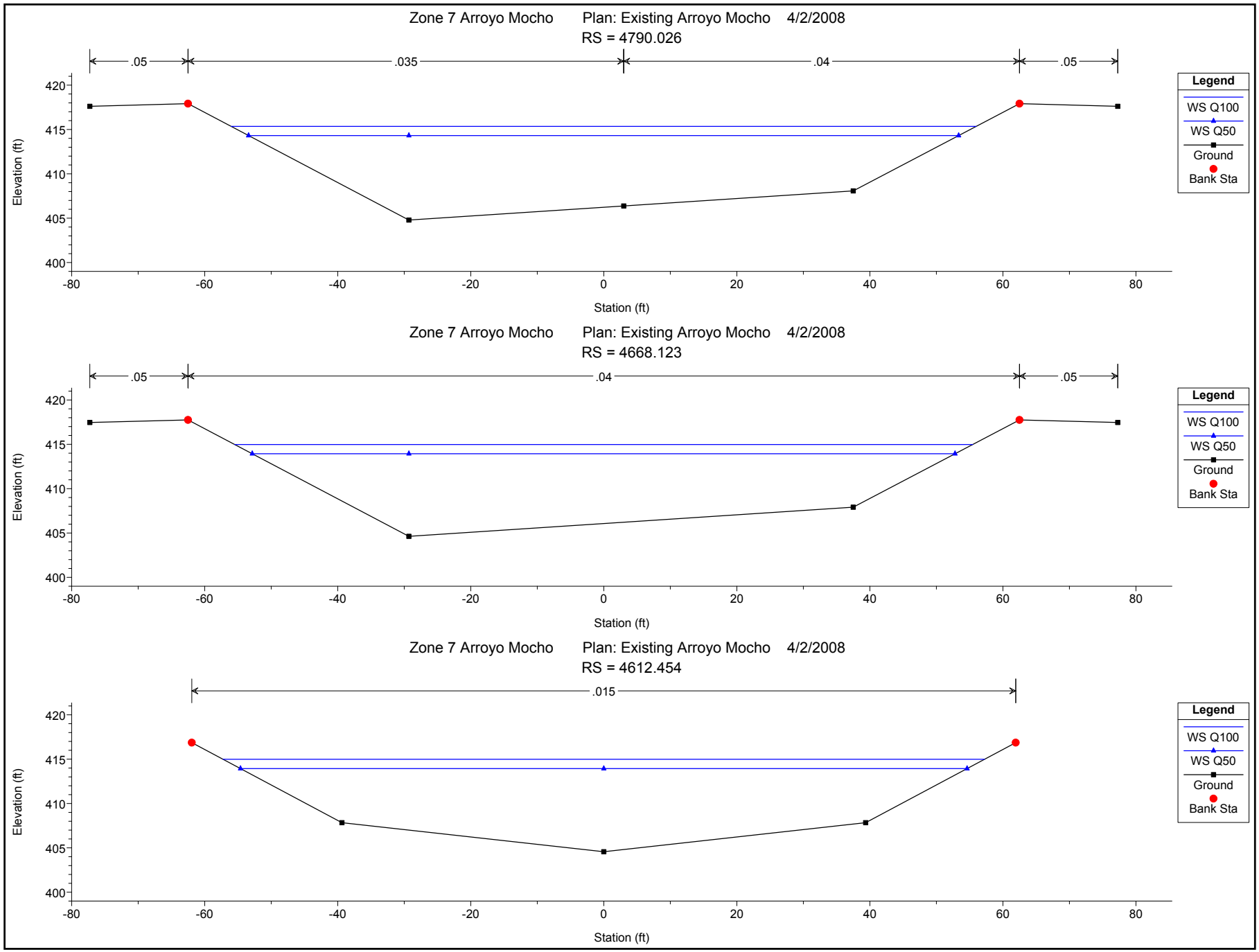
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	4133.858	Q50	3900.00	400.73	411.27		411.64	0.000987	4.88	799.77	111.33	0.32		196.85
1	3937.008	Q100	4800.00	400.50	412.19		412.61	0.000966	5.16	931.11	117.08	0.32		328.08
1	3937.008	Q50	3900.00	400.50	411.08		411.45	0.000971	4.85	804.25	111.53	0.32		328.08
1	3608.924	Q100	4800.00	400.11	411.89		412.29	0.000938	5.10	940.92	117.50	0.32		328.08
1	3608.924	Q50	3900.00	400.11	410.78		411.13	0.000940	4.79	813.44	111.94	0.31		328.08
1	3280.84	Q100	4800.00	399.71	411.55	406.33	411.94	0.001200	5.07	947.66	117.79	0.31	6.62	
1	3280.84	Q50	3900.00	399.71	410.43	405.72	410.78	0.001201	4.76	819.78	112.23	0.31	6.01	



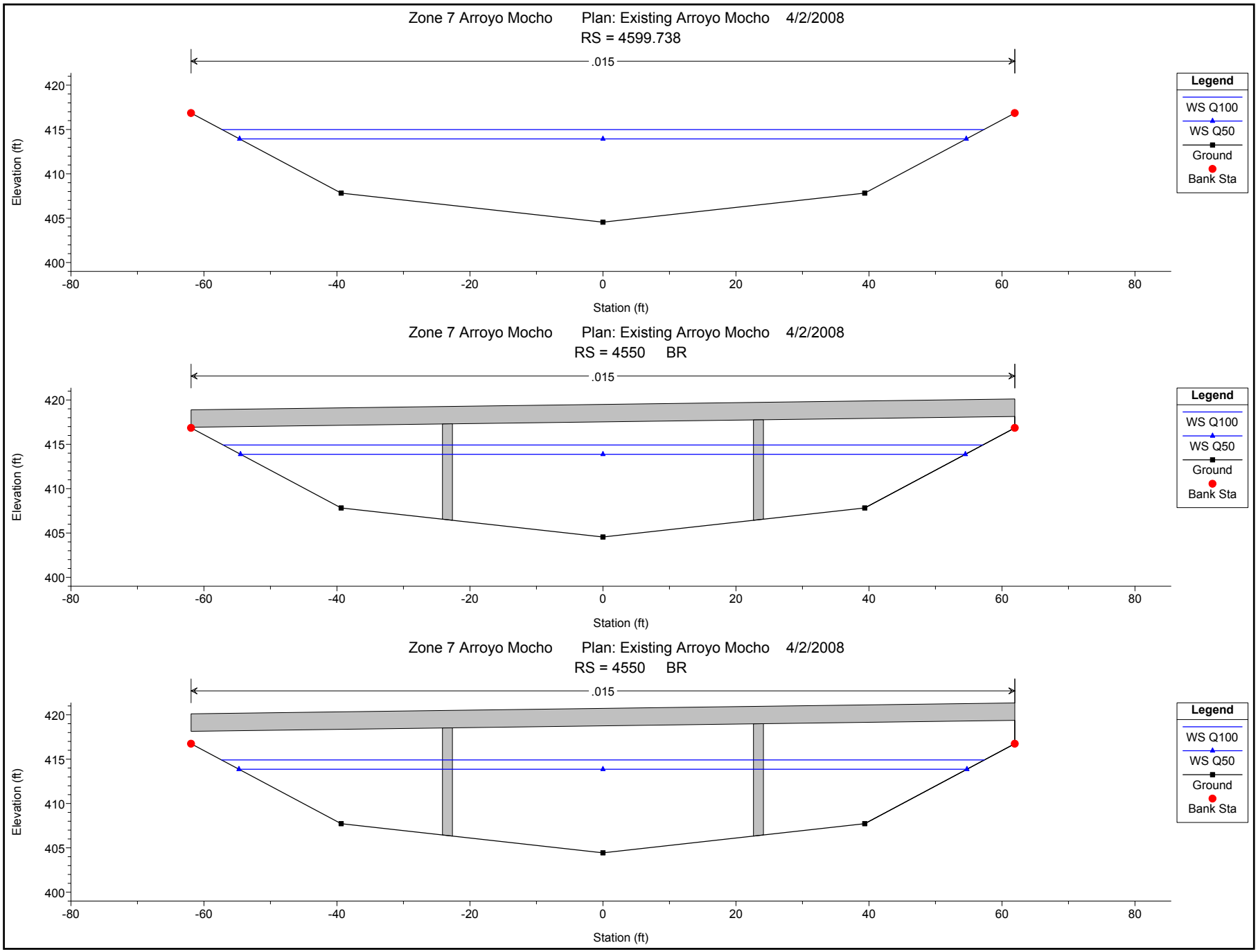
1 in Horiz. = 300 ft 1 in Vert. = 5 ft



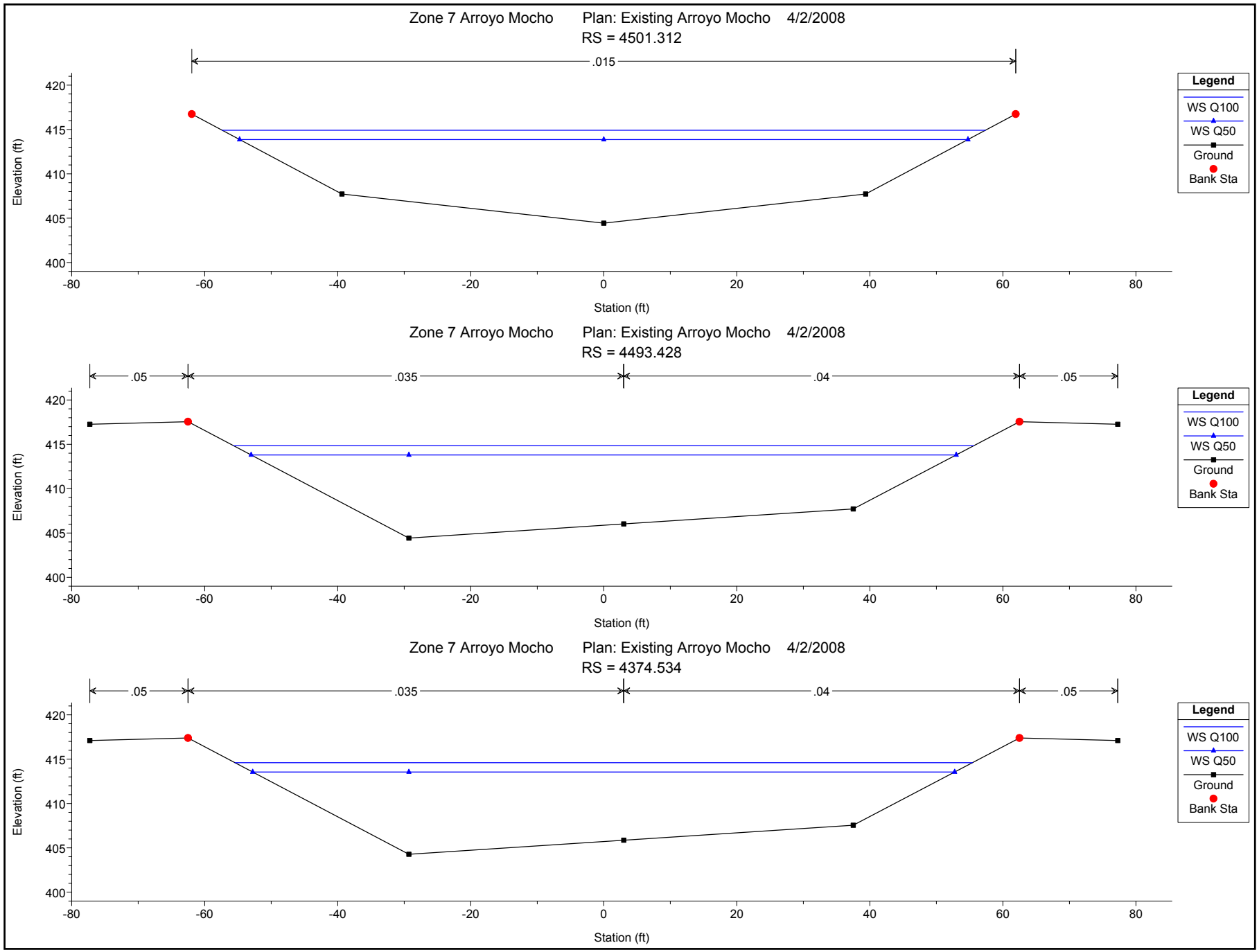
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



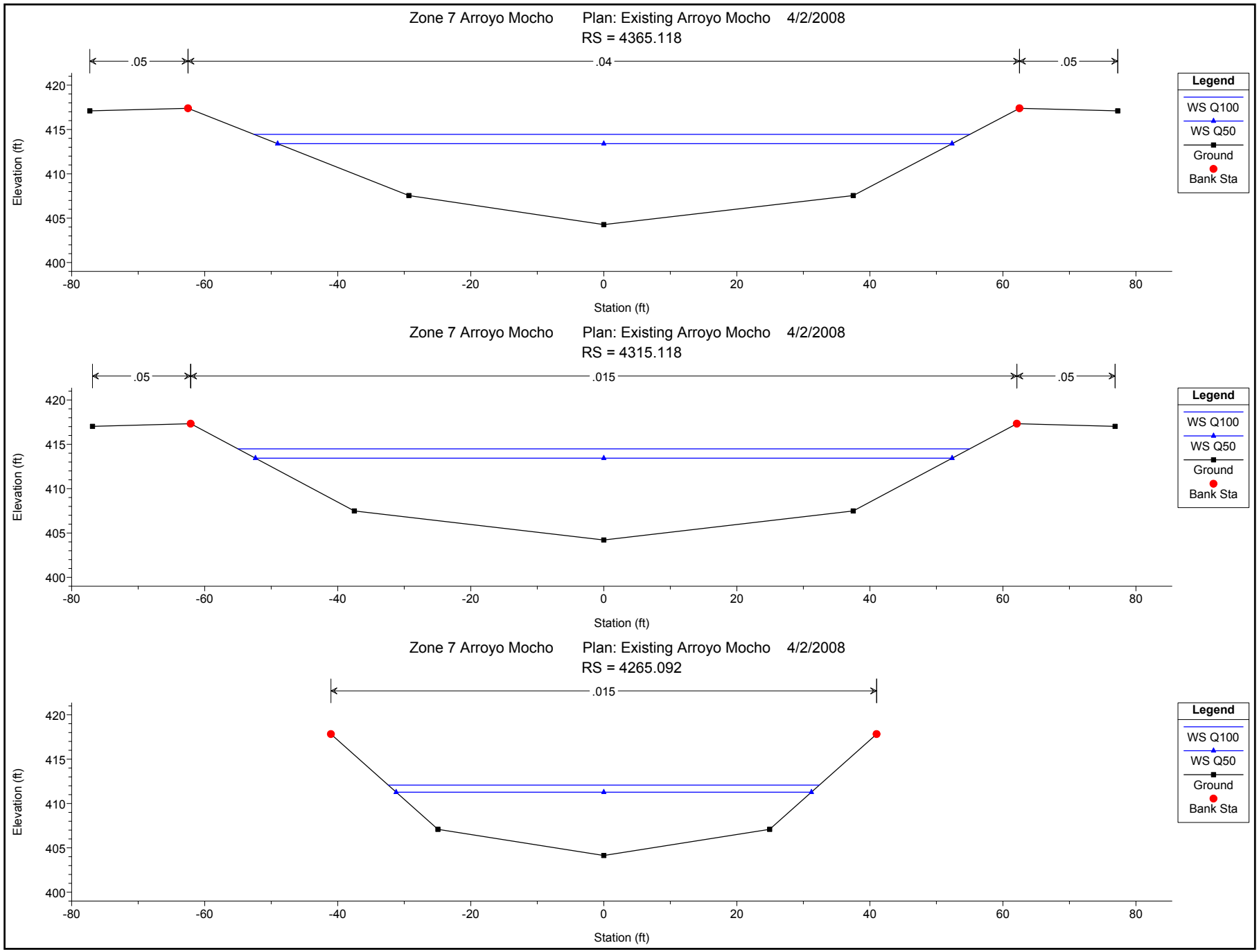
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



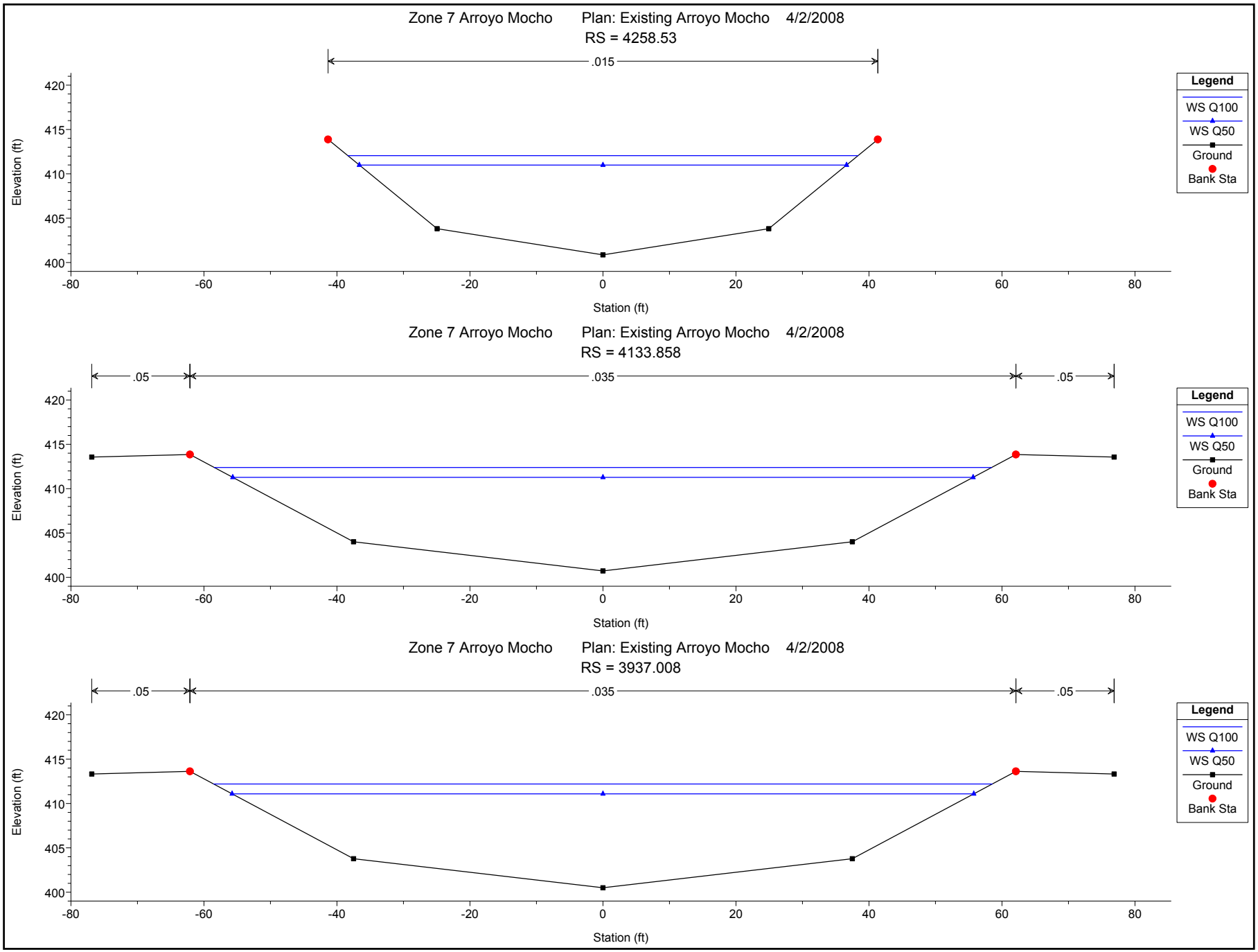
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



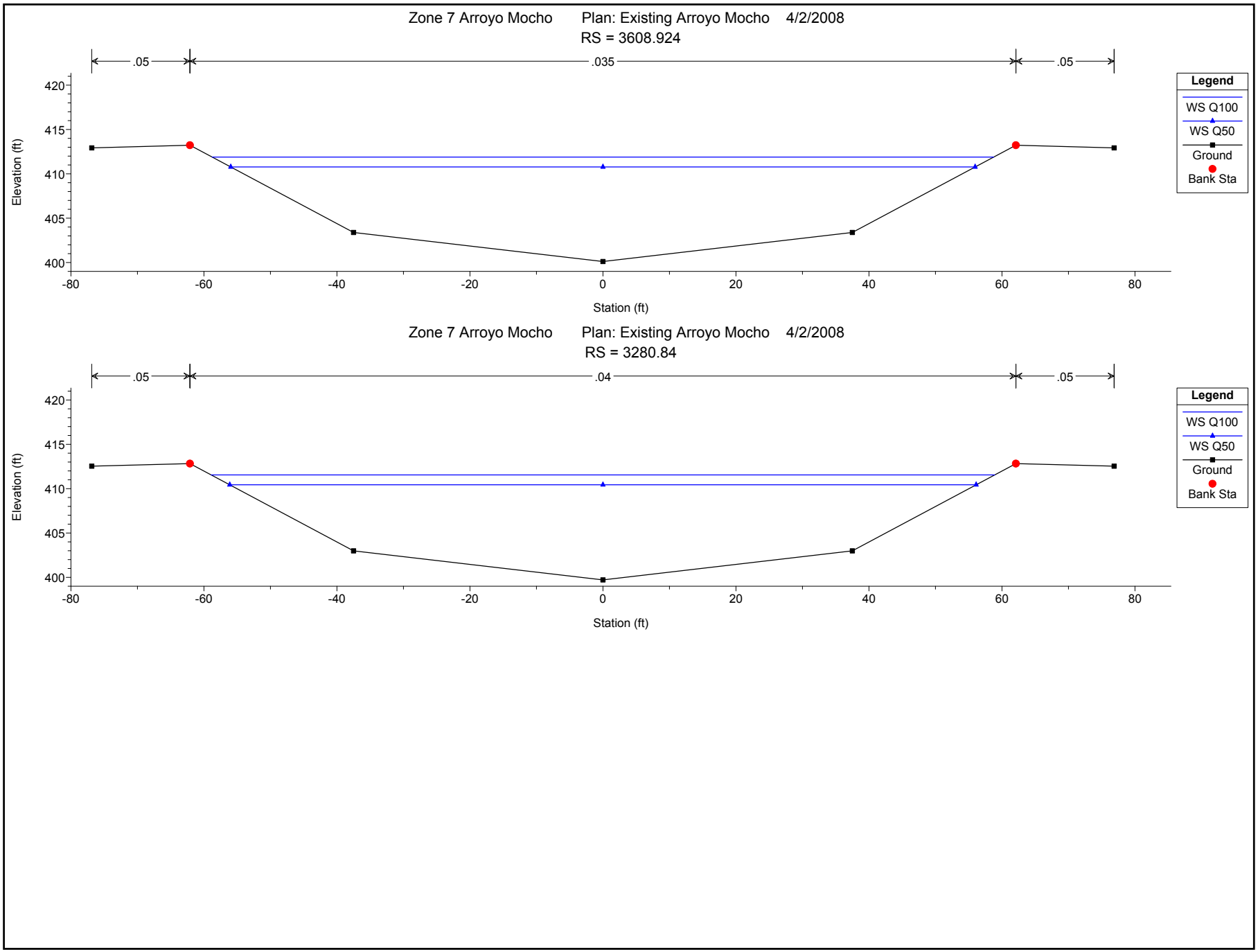
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



1 in Horiz. = 20 ft 1 in Vert. = 15 ft



1 in Horiz. = 20 ft 1 in Vert. = 15 ft



1 in Horiz. = 20 ft 1 in Vert. = 15 ft

Plan: Existing Arroyo Mocho 1 RS: 4550 Profile: Q100

E.G. US. (ft)	415.51	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	414.98	E.G. Elev (ft)	415.50	415.47
Q Total (cfs)	4800.00	W.S. Elev (ft)	414.93	414.91
Q Bridge (cfs)	4800.00	Crit W.S. (ft)	411.16	411.03
Q Weir (cfs)		Max Chl Dpth (ft)	10.38	10.47
Weir Sta Lft (ft)		Vel Total (ft/s)	6.09	6.01
Weir Sta Rgt (ft)		Flow Area (sq ft)	788.40	798.76
Weir Submerg		Froude # Chl	0.40	0.40
Weir Max Depth (ft)		Specif Force (cu ft)	4138.02	4200.03
Min El Weir Flow (ft)	420.12	Hydr Depth (ft)	7.09	7.15
Min El Prs (ft)	418.14	W.P. Total (ft)	147.93	148.80
Delta EG (ft)	0.07	Conv. Total (cfs)	238293.7	242583.4
Delta WS (ft)	0.07	Top Width (ft)	111.22	111.69
BR Open Area (sq ft)	1093.95	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	6.09	C & E Loss (ft)	0.01	0.02
Coef of Q		Shear Total (lb/sq ft)	0.14	0.13
Br Sel Method	Energy only	Power Total (lb/ft s)	0.82	0.79

Plan: Existing Arroyo Mocho 1 RS: 4550 Profile: Q50

E.G. US. (ft)	414.41	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	413.93	E.G. Elev (ft)	414.40	414.37
Q Total (cfs)	3900.00	W.S. Elev (ft)	413.88	413.86
Q Bridge (cfs)	3900.00	Crit W.S. (ft)	410.54	410.42
Q Weir (cfs)		Max Chl Dpth (ft)	9.33	9.42
Weir Sta Lft (ft)		Vel Total (ft/s)	5.78	5.69
Weir Sta Rgt (ft)		Flow Area (sq ft)	674.98	684.84
Weir Submerg		Froude # Chl	0.40	0.40
Weir Max Depth (ft)		Specif Force (cu ft)	3166.69	3219.69
Min El Weir Flow (ft)	420.12	Hydr Depth (ft)	6.37	6.43
Min El Prs (ft)	418.14	W.P. Total (ft)	138.13	139.00
Delta EG (ft)	0.07	Conv. Total (cfs)	192548.0	196431.1
Delta WS (ft)	0.07	Top Width (ft)	106.00	106.47
BR Open Area (sq ft)	1093.95	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	5.78	C & E Loss (ft)	0.01	0.02
Coef of Q		Shear Total (lb/sq ft)	0.13	0.12
Br Sel Method	Energy only	Power Total (lb/ft s)	0.72	0.69

Appendix C Arroyo del Valle

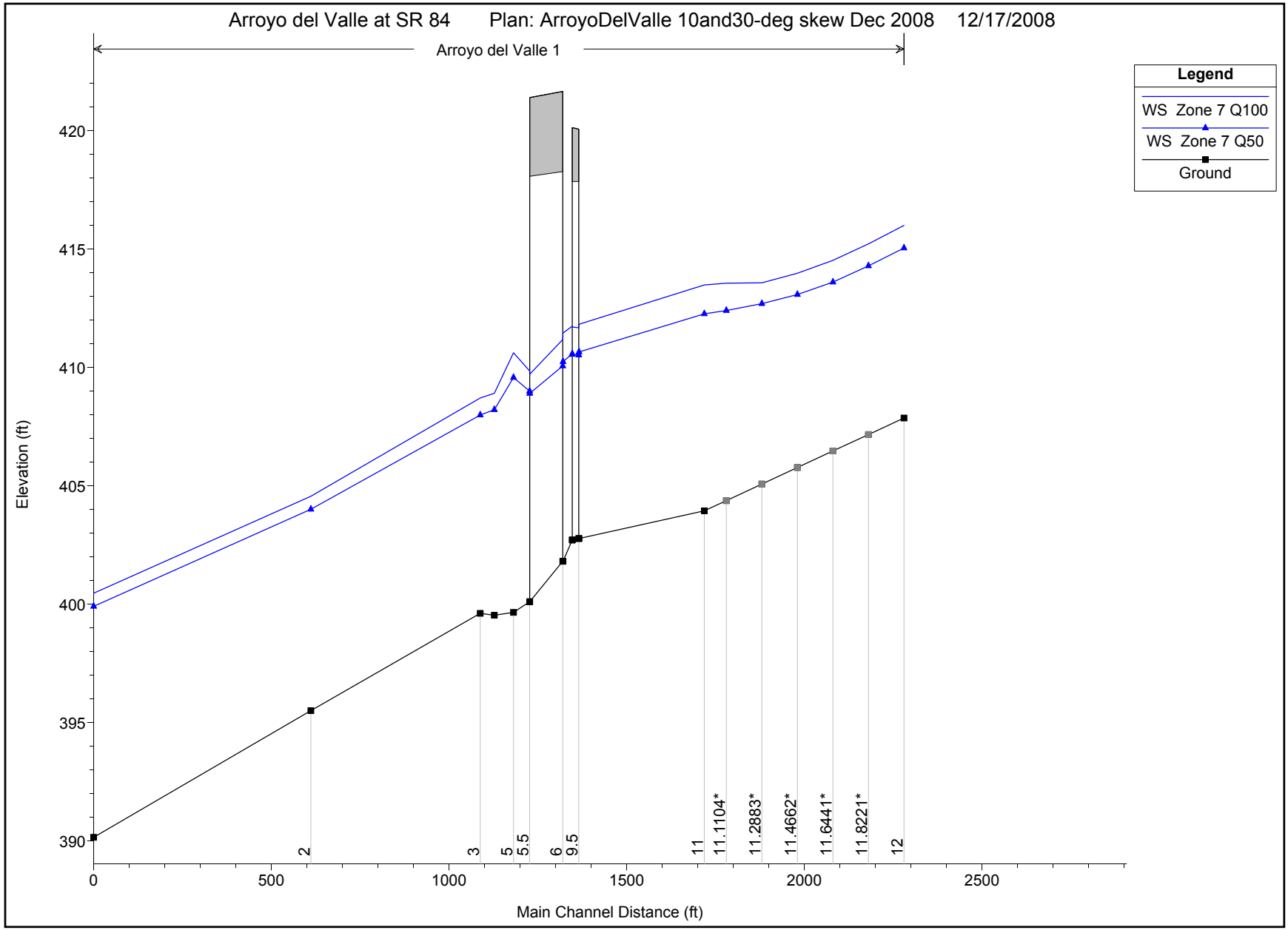
HEC-RAS Results: Proposed Condition

HEC-RAS Plan: proposed1208 River: Arroyo del Valle Reach: 1

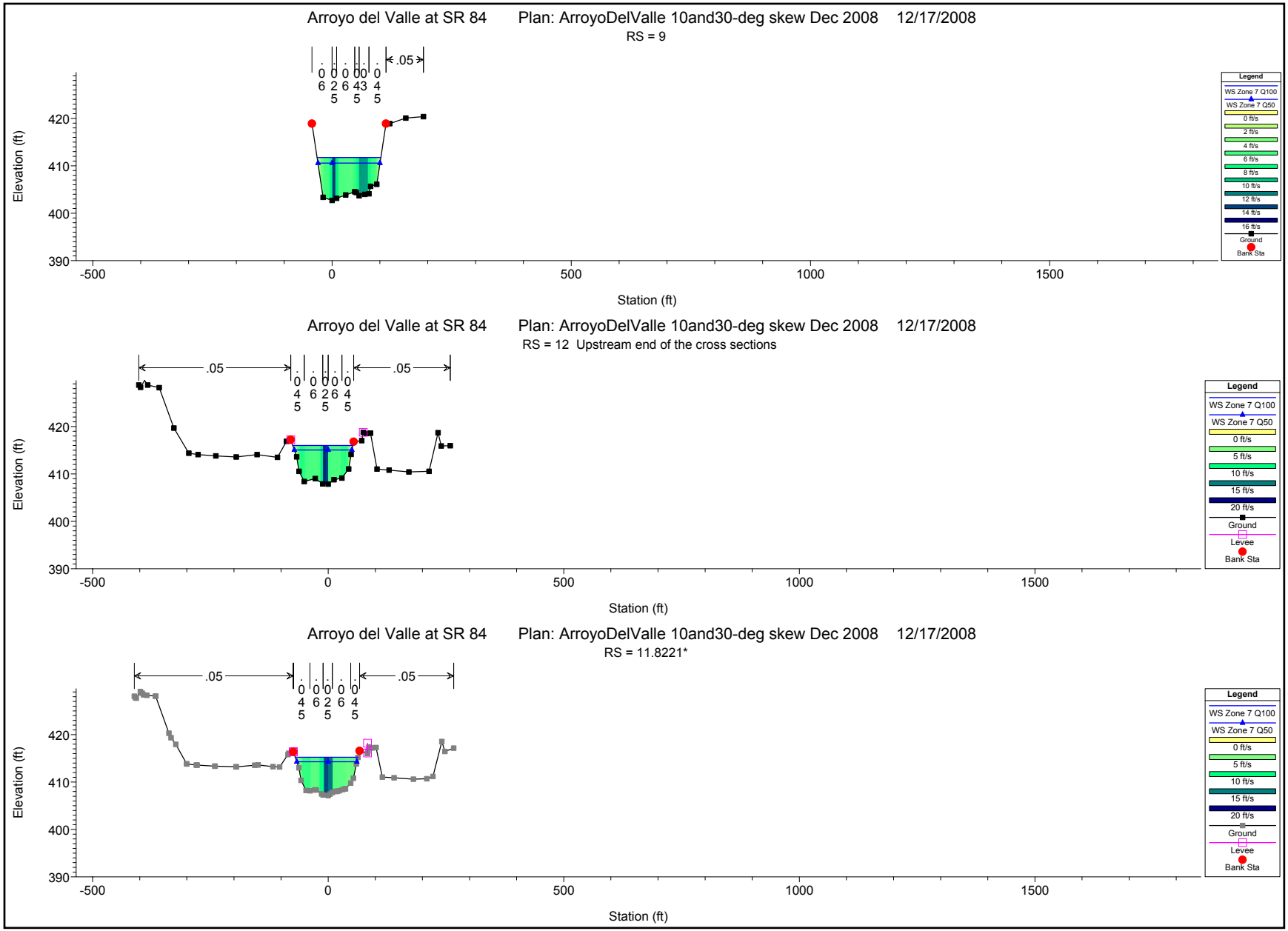
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	12	Zone 7 Q100	7000.00	407.86	416.00	414.01	417.17	0.008116	8.71	804.13	127.57	0.61	6.15	100.00
1	12	Zone 7 Q50	5400.00	407.86	415.04	413.20	416.01	0.007847	7.88	685.33	122.30	0.59	5.34	100.00
1	11.8221*	Zone 7 Q100	7000.00	407.16	415.22	413.31	416.37	0.007793	8.61	812.82	133.06	0.61	6.15	100.00
1	11.8221*	Zone 7 Q50	5400.00	407.16	414.29	412.52	415.23	0.007566	7.81	691.42	127.51	0.59	5.36	100.00
1	11.6441*	Zone 7 Q100	7000.00	406.47	414.52	412.61	415.62	0.006906	8.41	831.90	138.67	0.61	6.14	100.00
1	11.6441*	Zone 7 Q50	5400.00	406.47	413.60	411.83	414.51	0.006689	7.63	707.32	132.84	0.58	5.36	100.00
1	11.4662*	Zone 7 Q100	7000.00	405.77	413.98	411.90	414.98	0.005510	8.02	872.94	144.97	0.58	6.13	100.00
1	11.4662*	Zone 7 Q50	5400.00	405.77	413.08	411.13	413.89	0.005248	7.25	745.00	138.97	0.55	5.36	100.00
1	11.2883*	Zone 7 Q100	7000.00	405.07	413.57	411.16	414.44	0.004530	7.47	937.27	152.06	0.53	6.09	100.00
1	11.2883*	Zone 7 Q50	5400.00	405.07	412.69	410.41	413.39	0.004207	6.70	806.08	145.89	0.50	5.34	100.00
1	11.1104*	Zone 7 Q100	7000.00	404.37	413.56	410.42	413.99	0.002328	5.62	1548.07	436.38	0.38	6.05	62.10
1	11.1104*	Zone 7 Q50	5400.00	404.37	412.40	409.69	412.98	0.003318	6.10	885.92	153.49	0.45	5.32	62.10
1	11	Zone 7 Q100	7000.00	403.94	413.48	409.95	413.84	0.001851	5.18	1691.47	447.85	0.35	6.01	352.70
1	11	Zone 7 Q50	5400.00	403.94	412.26	409.21	412.77	0.002772	5.72	944.73	158.49	0.41	5.27	352.70
1	10	Zone 7 Q100	7000.00	402.77	411.82	409.02	412.78	0.004893	7.85	892.09	123.03	0.51	6.25	0.50
1	10	Zone 7 Q50	5400.00	402.77	410.65	408.19	411.46	0.004989	7.20	749.92	119.52	0.51	5.42	0.50
1	9.5		Bridge											
1	9	Zone 7 Q100	7000.00	402.71	411.74		412.58	0.004667	7.35	952.23	133.24	0.48		25.90
1	9	Zone 7 Q50	5400.00	402.71	410.57		411.28	0.004776	6.76	798.48	129.73	0.48		25.90
1	8.5	Zone 7 Q100	7000.00	401.81	411.45	409.15	412.43	0.005712	7.94	882.14	139.97	0.56	7.34	0.50
1	8.5	Zone 7 Q50	5400.00	401.81	410.24	408.31	411.12	0.006347	7.54	716.64	132.73	0.57	6.50	0.50
1	6		Bridge											
1	5.5	Zone 7 Q100	7000.00	400.10	409.85		411.77	0.010708	11.10	630.55	100.04	0.78		45.50
1	5.5	Zone 7 Q50	5400.00	400.10	409.00		410.52	0.009880	9.88	546.30	97.40	0.74		45.50
1	5	Zone 7 Q100	7000.00	399.65	410.62	406.42	410.76	0.001149	3.08	2275.64	358.32	0.22	6.77	53.90
1	5	Zone 7 Q50	5400.00	399.65	409.57	406.04	409.70	0.001216	2.83	1905.04	352.97	0.22	6.39	53.90
1	4	Zone 7 Q100	7000.00	399.53	408.91		410.47	0.012652	10.04	699.90	137.63	0.76		39.60
1	4	Zone 7 Q50	5400.00	399.53	408.21		409.44	0.011540	8.88	607.93	125.56	0.71		39.60
1	3	Zone 7 Q100	7000.00	399.61	408.71		409.94	0.009697	8.90	786.32	154.88	0.70		476.80
1	3	Zone 7 Q50	5400.00	399.61	407.99		408.97	0.008727	7.95	679.08	145.76	0.65		476.80
1	2	Zone 7 Q100	7000.00	395.50	404.56	403.62	405.36	0.008988	7.19	973.25	272.92	0.67	8.12	611.30
1	2	Zone 7 Q50	5400.00	395.50	404.01	402.97	404.67	0.008899	6.54	825.28	264.24	0.65	7.47	611.30

HEC-RAS Plan: proposed1208 River: Arroyo del Valle Reach: 1 (Continued)

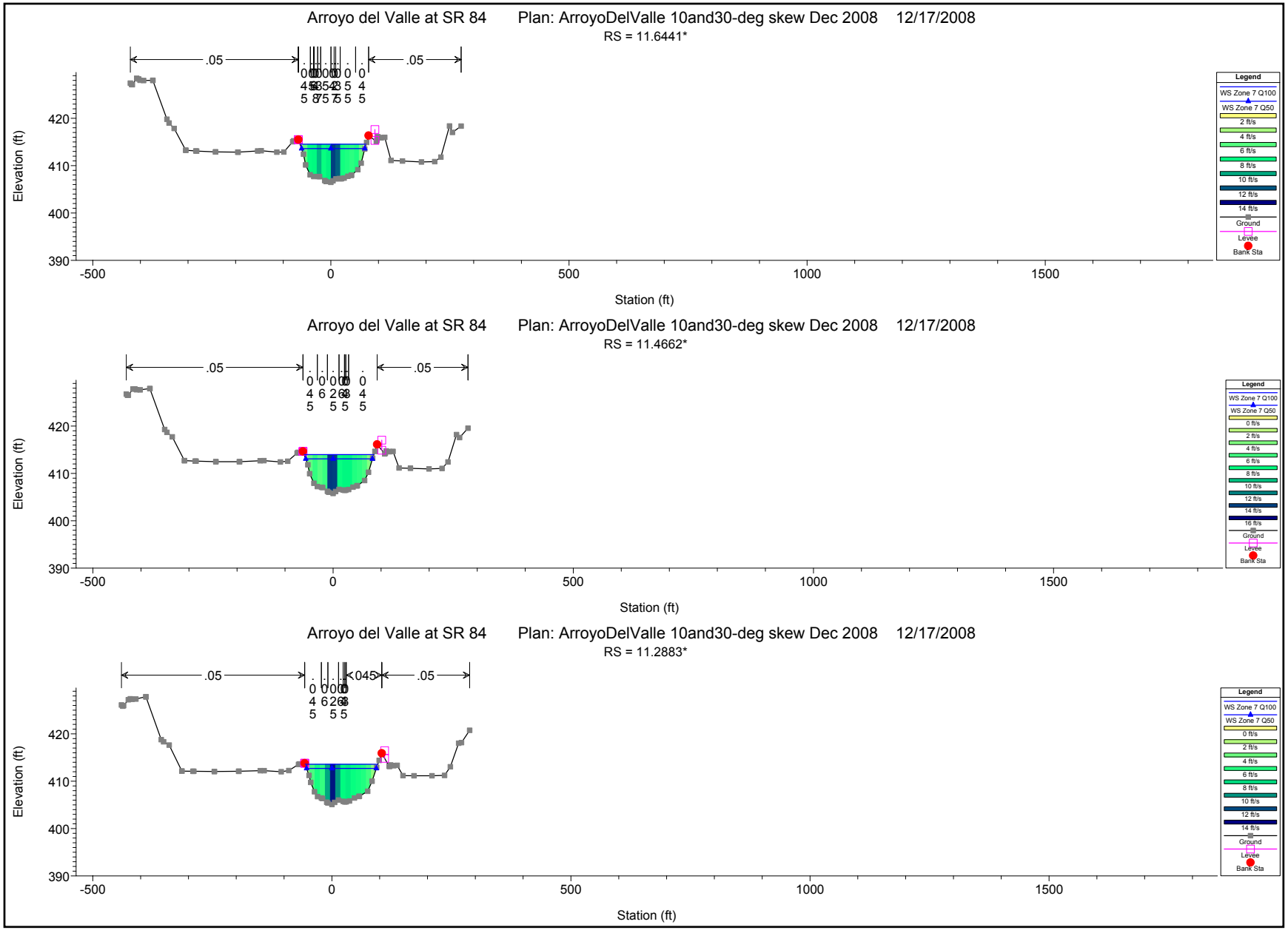
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	1	Zone 7 Q100	7000.00	390.15	400.46	399.06	401.00	0.005604	5.89	1187.73	312.18	0.53	8.91	
1	1	Zone 7 Q50	5400.00	390.15	399.91	398.66	400.35	0.005602	5.32	1014.42	310.93	0.52	8.51	



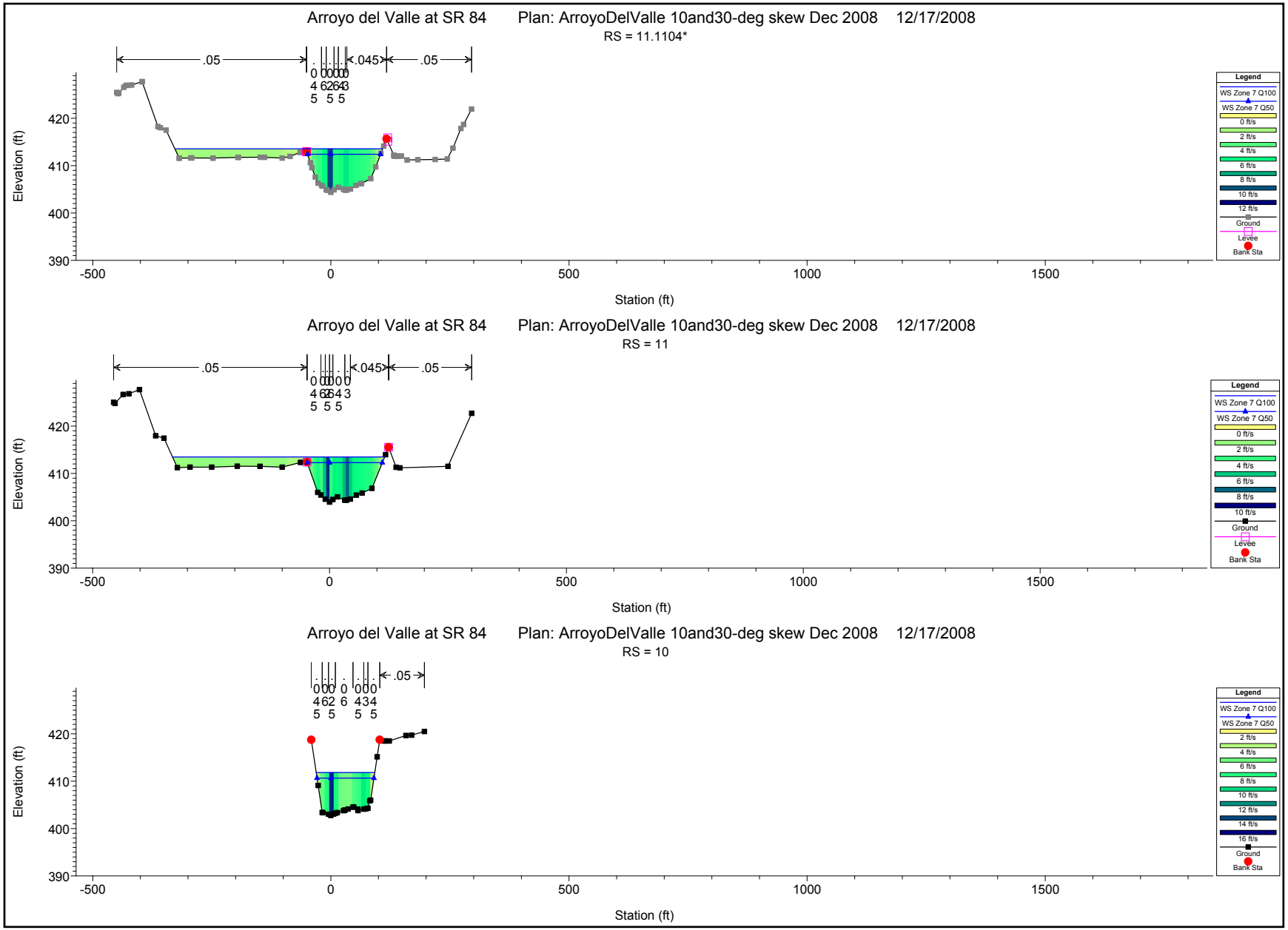
1 in Horiz. = 400 ft 1 in Vert. = 6 ft



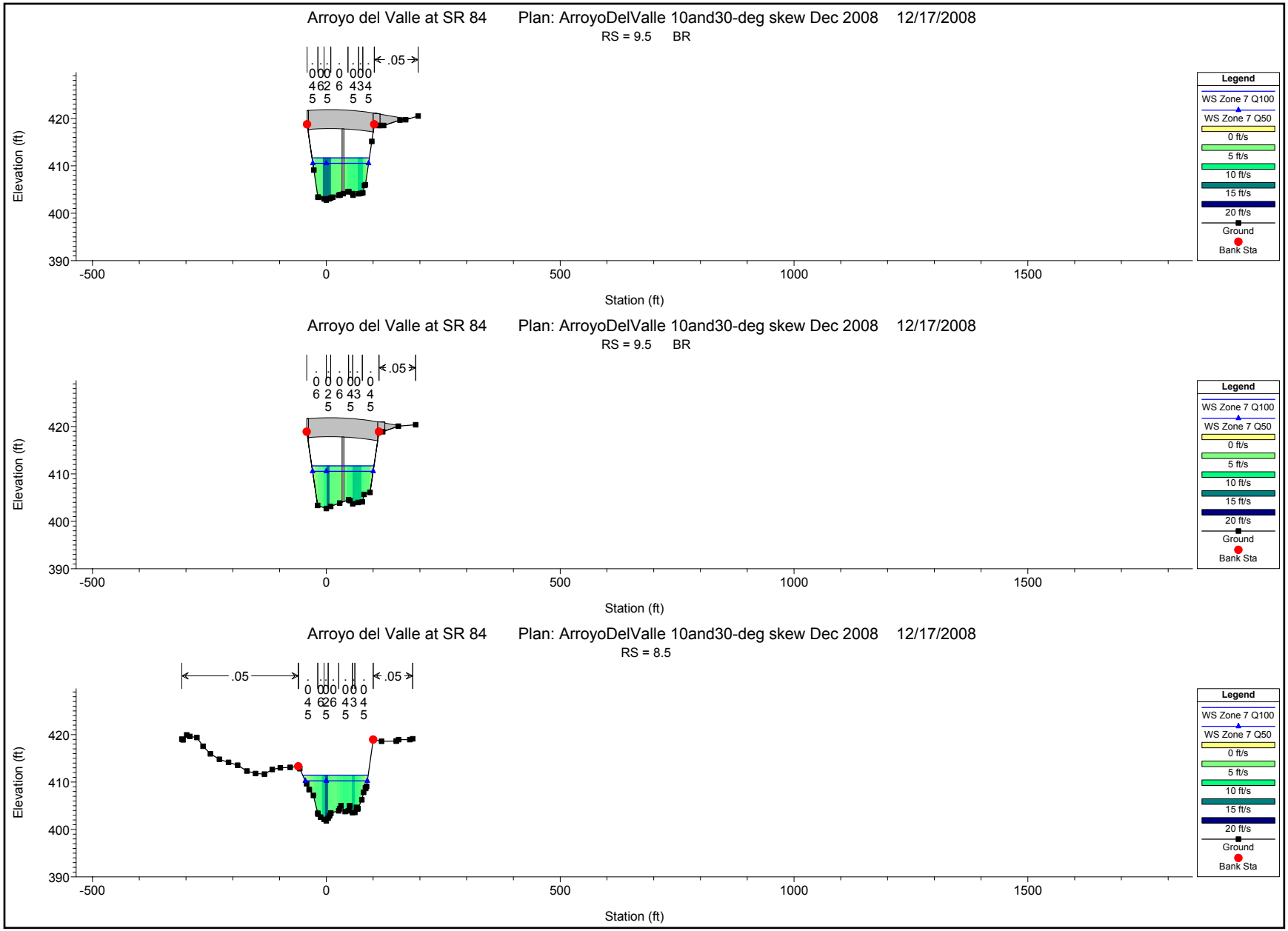
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



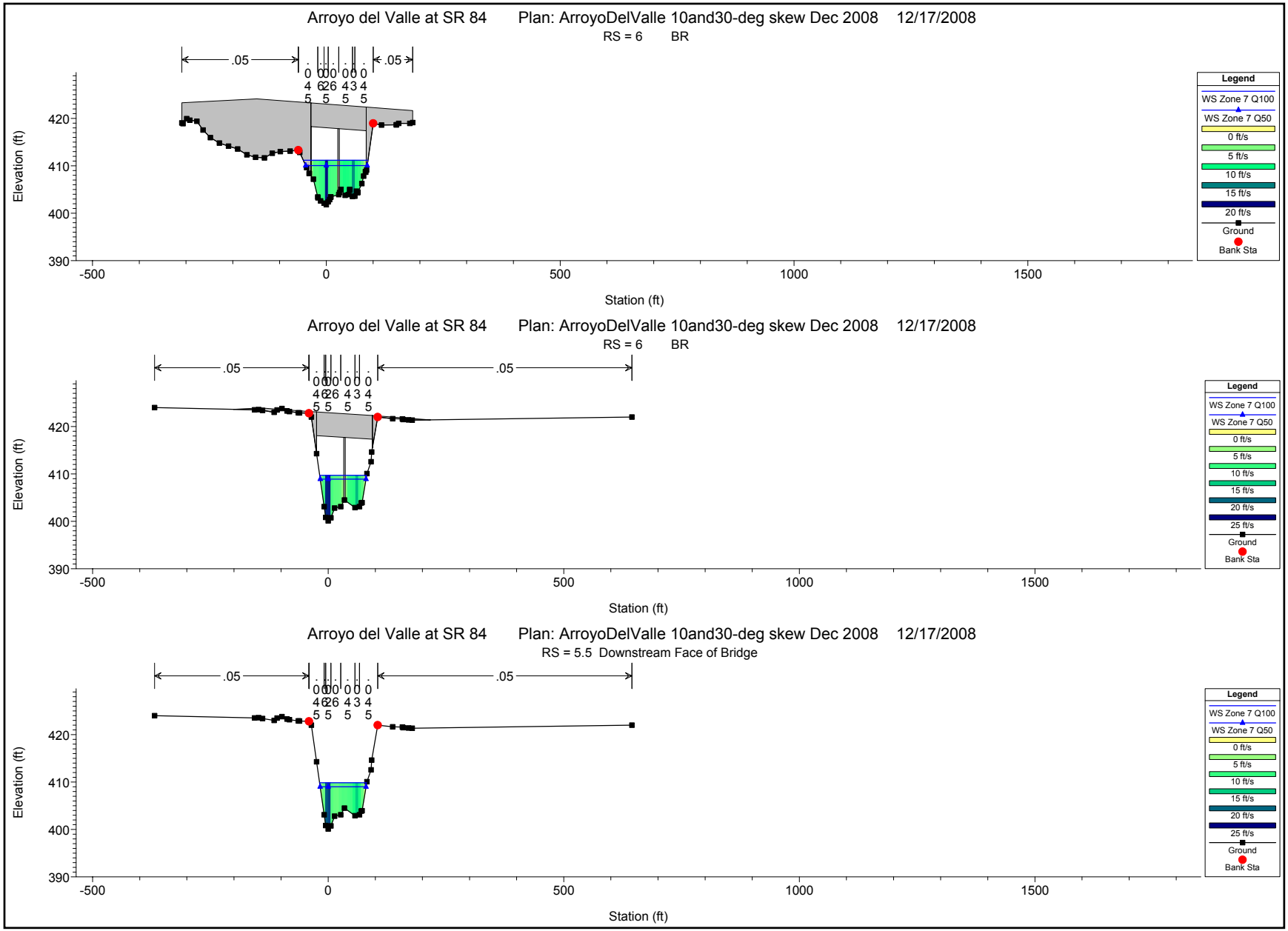
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



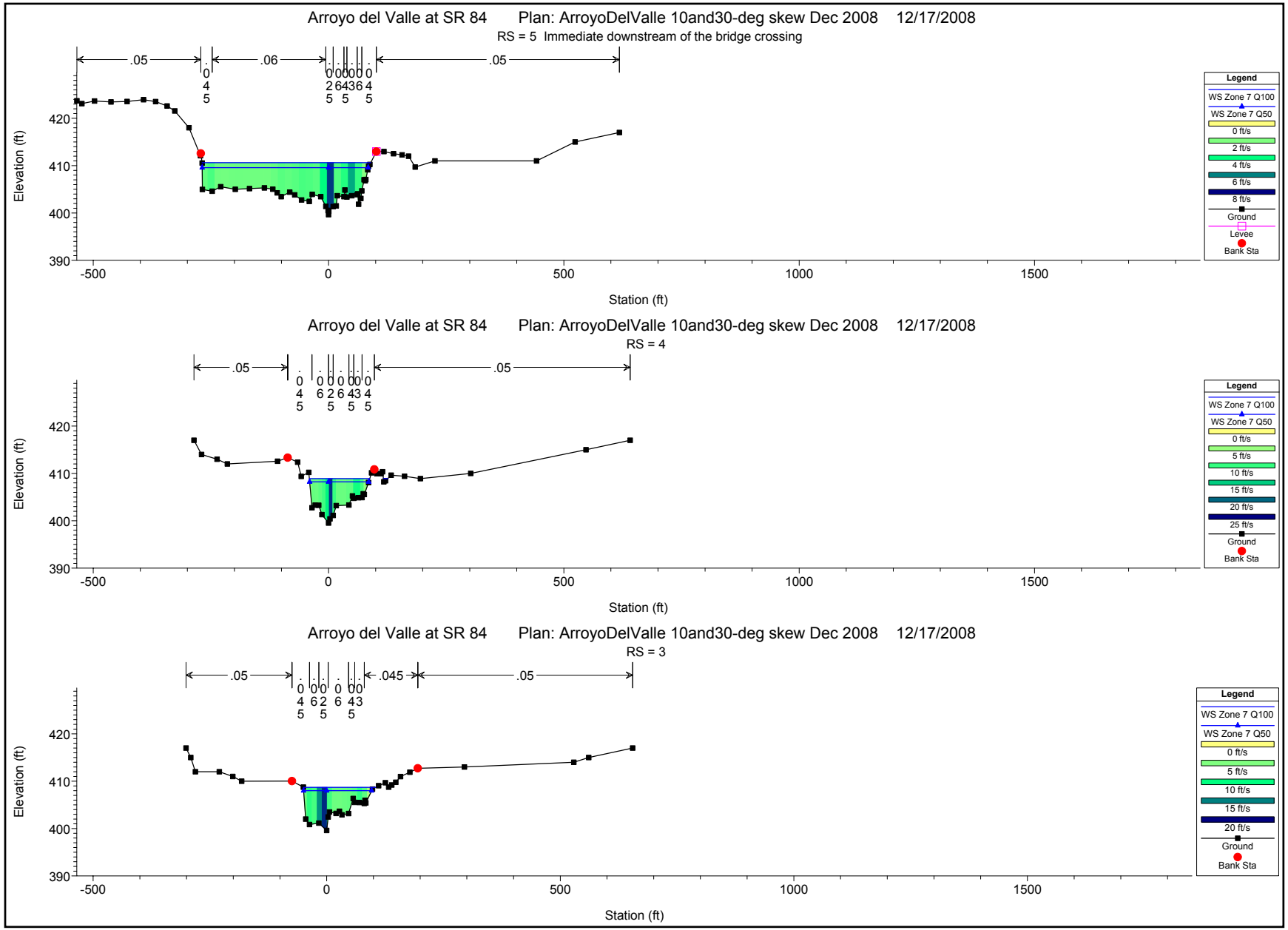
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



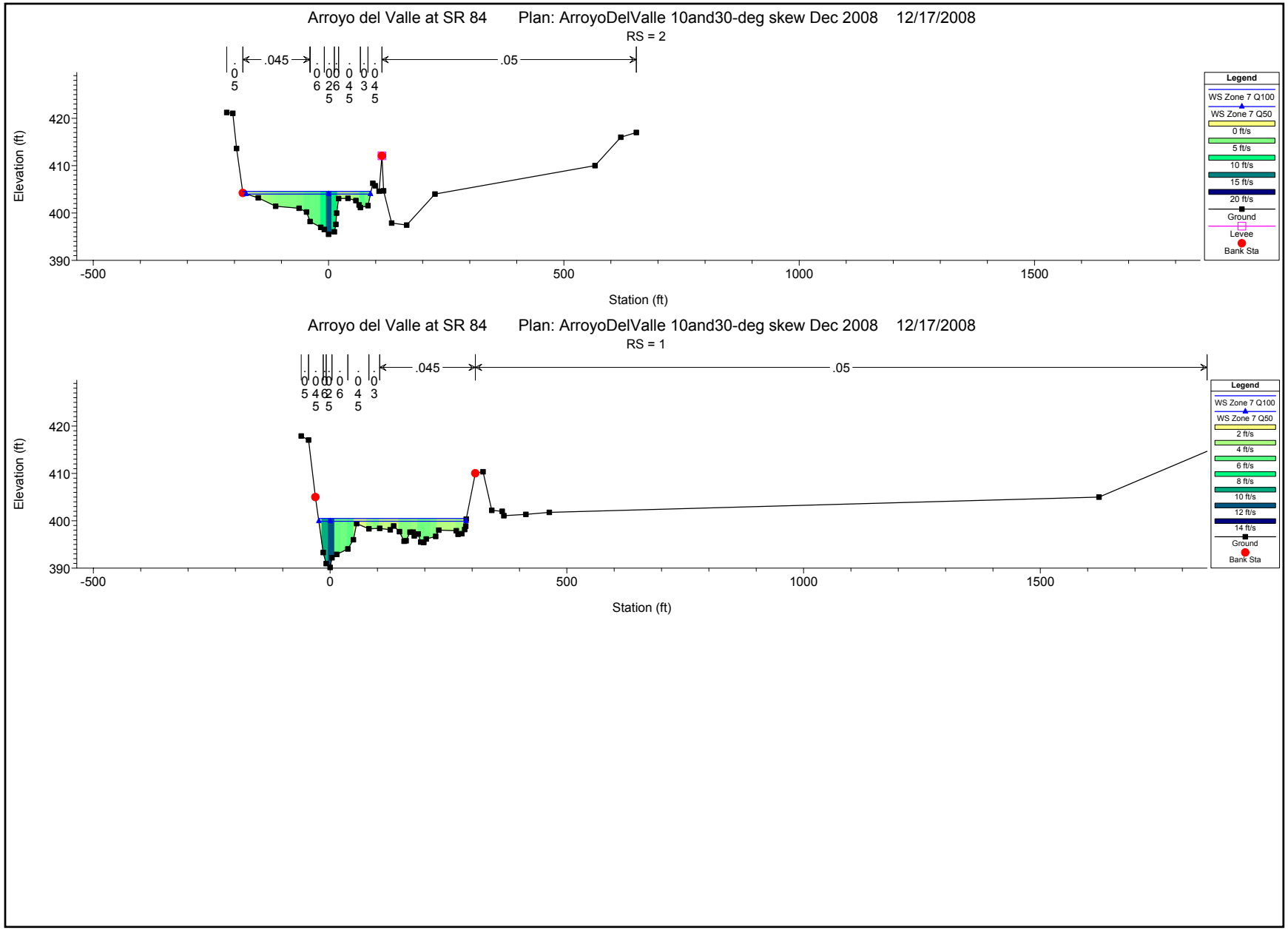
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



1 in Horiz. = 300 ft 1 in Vert. = 30 ft



1 in Horiz. = 300 ft 1 in Vert. = 30 ft



1 in Horiz. = 300 ft 1 in Vert. = 30 ft

Plan: proposed1208 Arroyo del Valle 1 RS: 9.5 Profile: Zone 7 Q100

E.G. US. (ft)	412.78	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	411.82	E.G. Elev (ft)	412.74	412.61
Q Total (cfs)	7000.00	W.S. Elev (ft)	411.67	411.71
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.14	408.92
Q Weir (cfs)		Max Chl Dpth (ft)	8.90	9.00
Weir Sta Lft (ft)		Vel Total (ft/s)	8.31	7.64
Weir Sta Rgt (ft)		Flow Area (sq ft)	842.19	916.63
Weir Submerg		Froude # Chl	0.55	0.50
Weir Max Depth (ft)		Specif Force (cu ft)	5027.56	5162.91
Min El Weir Flow (ft)	420.14	Hydr Depth (ft)	7.11	7.10
Min El Prs (ft)	417.85	W.P. Total (ft)	138.26	148.92
Delta EG (ft)	0.20	Conv. Total (cfs)	119377.1	166124.3
Delta WS (ft)	0.08	Top Width (ft)	118.47	129.04
BR Open Area (sq ft)	1606.57	Frctn Loss (ft)	0.04	0.00
BR Open Vel (ft/s)	8.31	C & E Loss (ft)	0.08	0.03
Coef of Q		Shear Total (lb/sq ft)	1.31	0.68
Br Sel Method	Energy only	Power Total (lb/ft s)	10.87	5.21

Plan: proposed1208 Arroyo del Valle 1 RS: 9.5 Profile: Zone 7 Q50

E.G. US. (ft)	411.46	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.65	E.G. Elev (ft)	411.43	411.31
Q Total (cfs)	5400.00	W.S. Elev (ft)	410.52	410.55
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.32	408.14
Q Weir (cfs)		Max Chl Dpth (ft)	7.75	7.84
Weir Sta Lft (ft)		Vel Total (ft/s)	7.62	7.03
Weir Sta Rgt (ft)		Flow Area (sq ft)	708.22	768.58
Weir Submerg		Froude # Chl	0.54	0.50
Weir Max Depth (ft)		Specif Force (cu ft)	3610.20	3701.45
Min El Weir Flow (ft)	420.14	Hydr Depth (ft)	6.16	6.12
Min El Prs (ft)	417.85	W.P. Total (ft)	131.82	142.40
Delta EG (ft)	0.17	Conv. Total (cfs)	92420.4	127615.8
Delta WS (ft)	0.08	Top Width (ft)	115.03	125.55
BR Open Area (sq ft)	1606.57	Frctn Loss (ft)	0.04	0.00
BR Open Vel (ft/s)	7.62	C & E Loss (ft)	0.07	0.03
Coef of Q		Shear Total (lb/sq ft)	1.15	0.60
Br Sel Method	Energy only	Power Total (lb/ft s)	8.73	4.24

Plan: proposed1208 Arroyo del Valle 1 RS: 6 Profile: Zone 7 Q100

E.G. US. (ft)	412.43	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	411.45	E.G. Elev (ft)	412.40	411.83
Q Total (cfs)	7000.00	W.S. Elev (ft)	411.18	409.71
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.21	408.91
Q Weir (cfs)		Max Chl Dpth (ft)	9.37	9.61
Weir Sta Lft (ft)		Vel Total (ft/s)	8.89	11.68
Weir Sta Rgt (ft)		Flow Area (sq ft)	787.67	599.57
Weir Submerg		Froude # Chl	0.60	0.83
Weir Max Depth (ft)		Specif Force (cu ft)	4787.11	4602.42
Min El Weir Flow (ft)	421.67	Hydr Depth (ft)	6.83	6.22
Min El Prs (ft)	418.27	W.P. Total (ft)	137.52	112.20
Delta EG (ft)	0.67	Conv. Total (cfs)	136051.4	57665.5
Delta WS (ft)	1.60	Top Width (ft)	115.27	96.40
BR Open Area (sq ft)	1477.86	Frctn Loss (ft)	0.49	0.00
BR Open Vel (ft/s)	11.68	C & E Loss (ft)	0.09	0.06
Coef of Q		Shear Total (lb/sq ft)	0.95	4.92
Br Sel Method	Energy only	Power Total (lb/ft s)	8.41	57.39

Plan: proposed1208 Arroyo del Valle 1 RS: 6 Profile: Zone 7 Q50

E.G. US. (ft)	411.12	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.24	E.G. Elev (ft)	411.10	410.56
Q Total (cfs)	5400.00	W.S. Elev (ft)	410.06	408.90
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.37	407.95
Q Weir (cfs)		Max Chl Dpth (ft)	8.25	8.80
Weir Sta Lft (ft)		Vel Total (ft/s)	8.20	10.34
Weir Sta Rgt (ft)		Flow Area (sq ft)	658.86	522.36
Weir Submerg		Froude # Chl	0.60	0.77
Weir Max Depth (ft)		Specif Force (cu ft)	3421.42	3342.95
Min El Weir Flow (ft)	421.67	Hydr Depth (ft)	5.72	5.56
Min El Prs (ft)	418.27	W.P. Total (ft)	133.05	107.59
Delta EG (ft)	0.61	Conv. Total (cfs)	103282.3	47066.7
Delta WS (ft)	1.24	Top Width (ft)	115.27	93.89
BR Open Area (sq ft)	1477.86	Frctn Loss (ft)	0.48	0.00
BR Open Vel (ft/s)	10.34	C & E Loss (ft)	0.06	0.04
Coef of Q		Shear Total (lb/sq ft)	0.85	3.99
Br Sel Method	Energy only	Power Total (lb/ft s)	6.93	41.25

Appendix D Arroyo Mocho

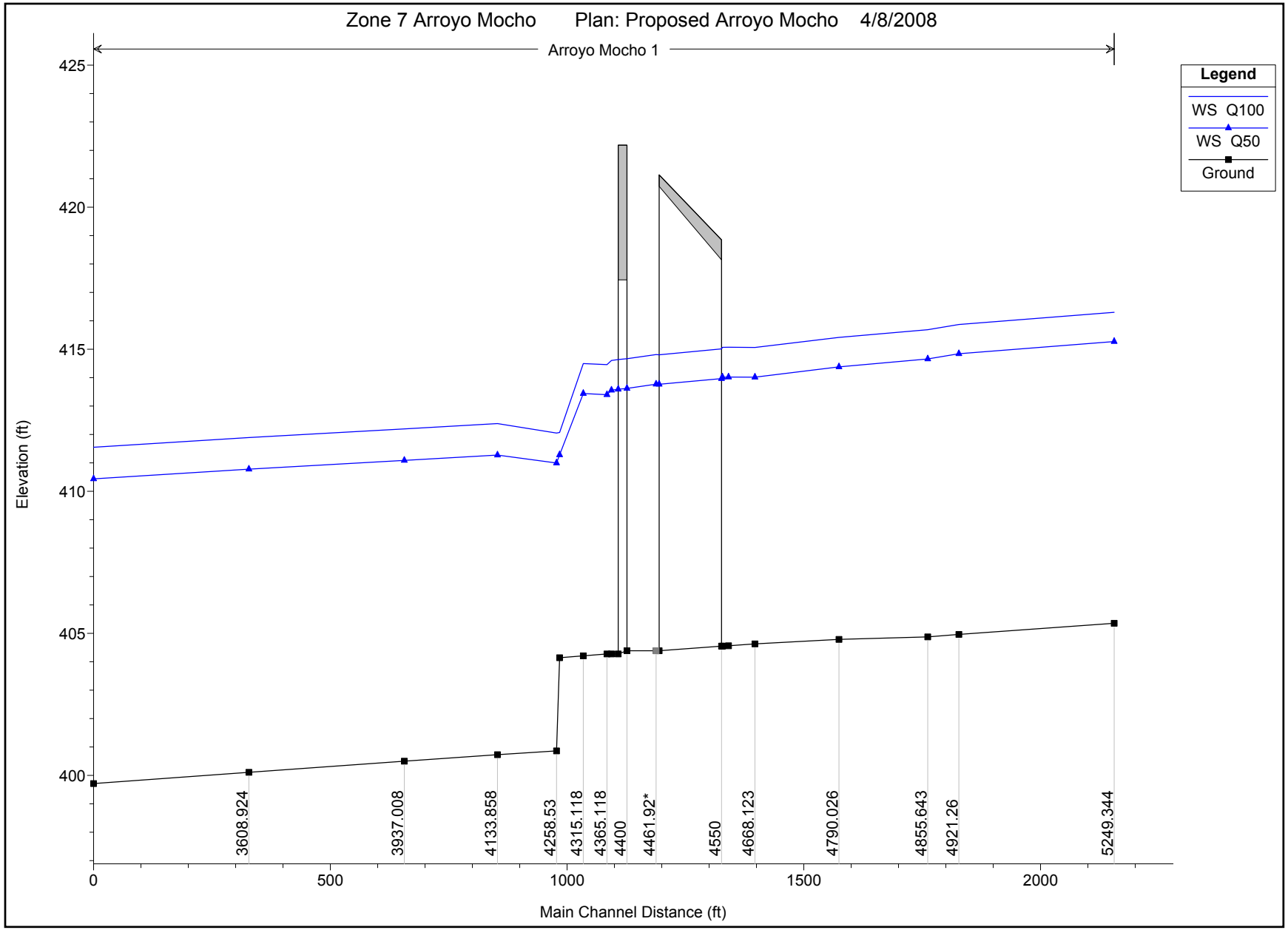
HEC-RAS Results: Proposed Condition

HEC-RAS Plan: Proposed River: Arroyo Mocho Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	5249.344	Q100	4800.00	405.35	416.30		416.80	0.001278	5.68	844.46	113.31	0.37		328.08
1	5249.344	Q50	3900.00	405.35	415.27		415.71	0.001281	5.34	730.69	108.17	0.36		328.08
1	4921.26	Q100	4800.00	404.96	415.87		416.38	0.001295	5.71	840.66	113.14	0.37		65.62
1	4921.26	Q50	3900.00	404.96	414.84		415.29	0.001301	5.37	726.90	108.00	0.36		65.62
1	4855.643	Q100	4800.00	404.88	415.69		416.27	0.001620	6.15	780.14	111.32	0.41		187.52
1	4855.643	Q50	3900.00	404.88	414.66		415.18	0.001655	5.83	668.66	105.23	0.41		187.52
1	4790.026	Q100	4800.00	404.79	415.42		415.96	0.001595	5.91	811.88	112.35	0.39		177.57
1	4790.026	Q50	3900.00	404.79	414.38		414.86	0.001622	5.59	698.16	107.10	0.39		177.57
1	4668.123	Q100	4800.00	404.63	415.06		415.64	0.002043	6.08	790.05	111.36	0.40		55.67
1	4668.123	Q50	3900.00	404.63	414.02		414.53	0.002115	5.77	676.34	106.06	0.40		55.67
1	4612.454	Q100	4800.00	404.56	415.07		415.59	0.000254	5.79	828.88	114.88	0.38		12.72
1	4612.454	Q50	3900.00	404.56	414.02		414.49	0.000262	5.48	711.09	109.63	0.38		12.72
1	4599.738	Q100	4800.00	404.55	415.07	411.03	415.59	0.000253	5.78	830.11	114.93	0.38	6.49	2.00
1	4599.738	Q50	3900.00	404.55	414.02	410.43	414.48	0.000260	5.48	712.23	109.68	0.38	5.88	2.00
1	4550		Bridge											
1	4461.92*	Q100	4800.00	404.38	414.81	411.07	415.40	0.001786	6.18	777.02	109.61	0.41	6.69	61.50
1	4461.92*	Q50	3900.00	404.38	413.77	410.45	414.30	0.001837	5.86	665.71	104.42	0.41	6.06	61.50
1	4400		Bridge											
1	4374.534	Q100	4800.00	404.27	414.60		415.21	0.001854	6.26	766.98	109.17	0.42		9.42
1	4374.534	Q50	3900.00	404.27	413.56		414.11	0.001922	5.95	655.32	103.93	0.42		9.42
1	4365.118	Q100	4800.00	404.27	414.46		415.16	0.002745	6.75	711.53	107.62	0.46		50.00
1	4365.118	Q50	3900.00	404.27	413.40		414.05	0.002926	6.49	601.26	101.38	0.47		50.00
1	4315.118	Q100	4800.00	404.21	414.49		415.10	0.000305	6.22	771.36	110.04	0.41		50.03
1	4315.118	Q50	3900.00	404.21	413.44		413.98	0.000319	5.93	658.01	104.76	0.42		50.03
1	4265.092	Q100	4800.00	404.14	412.07	412.07	414.85	0.001987	13.37	359.04	64.79	1.00	7.93	6.56
1	4265.092	Q50	3900.00	404.14	411.28	411.28	413.76	0.002050	12.63	308.71	62.42	1.00	7.14	6.56
1	4258.53	Q100	4800.00	400.86	412.05		413.06	0.000470	8.07	594.98	76.70	0.51		124.67
1	4258.53	Q50	3900.00	400.86	410.99		411.88	0.000467	7.56	515.77	73.26	0.50		124.67
1	4133.858	Q100	4800.00	400.73	412.38		412.80	0.000980	5.18	926.48	116.87	0.32		196.85
1	4133.858	Q50	3900.00	400.73	411.28		411.64	0.000986	4.88	799.98	111.33	0.32		196.85

HEC-RAS Plan: Proposed River: Arroyo Mocho Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	3937.008	Q100	4800.00	400.50	412.20		412.61	0.000966	5.15	931.30	117.08	0.32		328.08
1	3937.008	Q50	3900.00	400.50	411.09		411.45	0.000971	4.85	804.42	111.53	0.32		328.08
1	3608.924	Q100	4800.00	400.11	411.89		412.29	0.000936	5.10	941.61	117.52	0.32		328.08
1	3608.924	Q50	3900.00	400.11	410.78		411.13	0.000938	4.79	814.09	111.96	0.31		328.08
1	3280.84	Q100	4800.00	399.71	411.55	406.33	411.95	0.001200	5.07	947.62	117.77	0.31	6.62	
1	3280.84	Q50	3900.00	399.71	410.44	405.71	410.79	0.001201	4.76	819.75	112.21	0.31	6.00	



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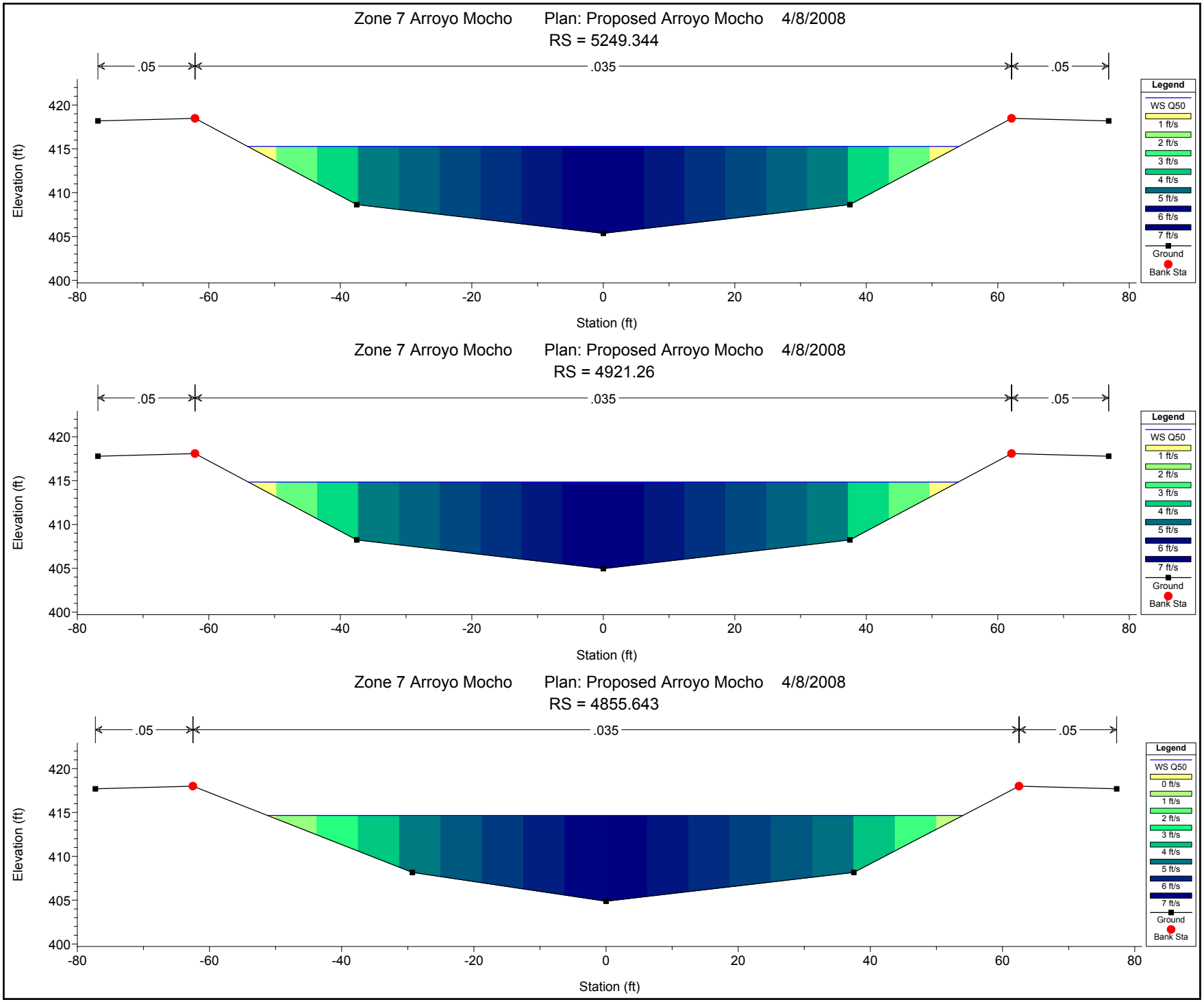

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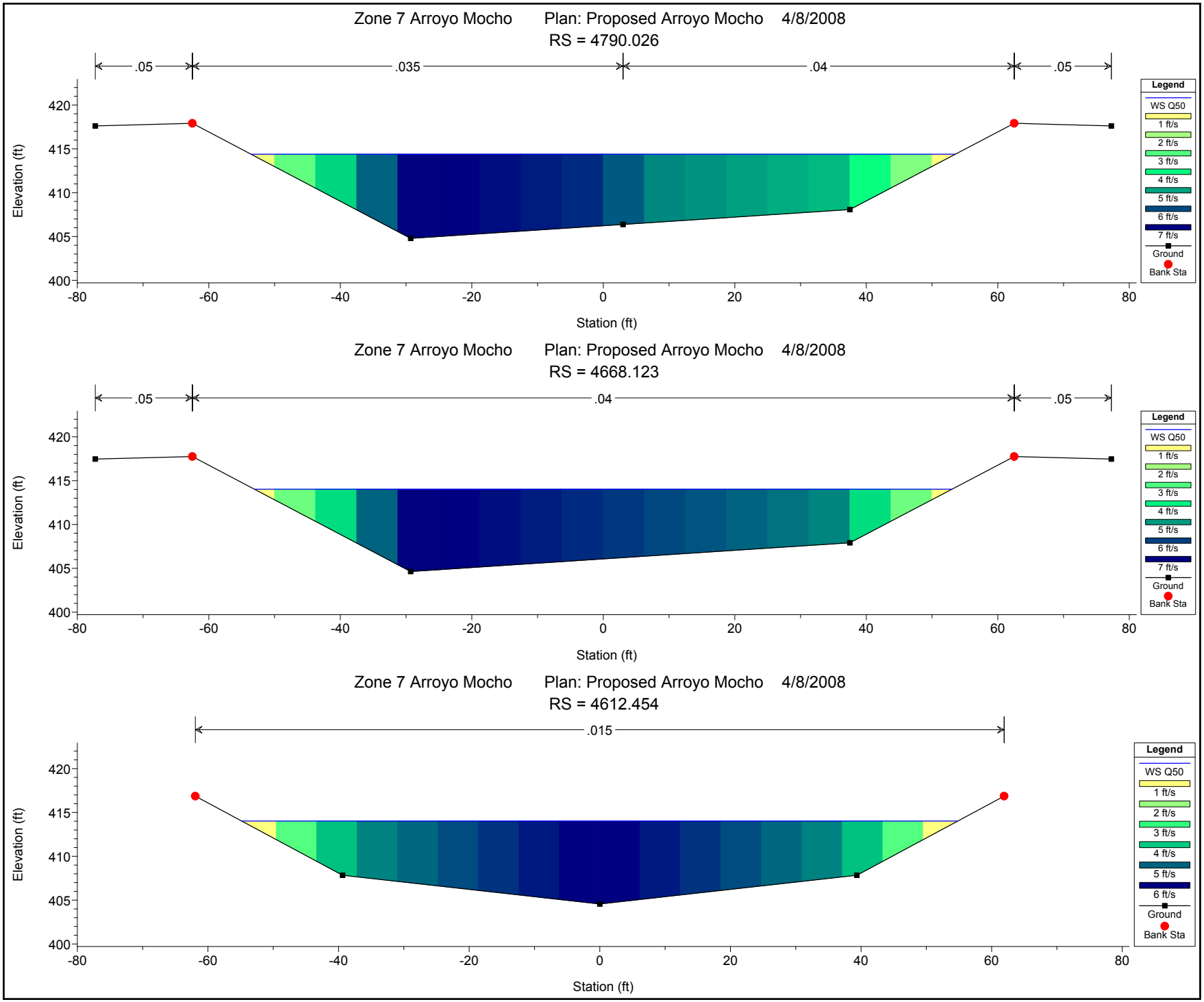

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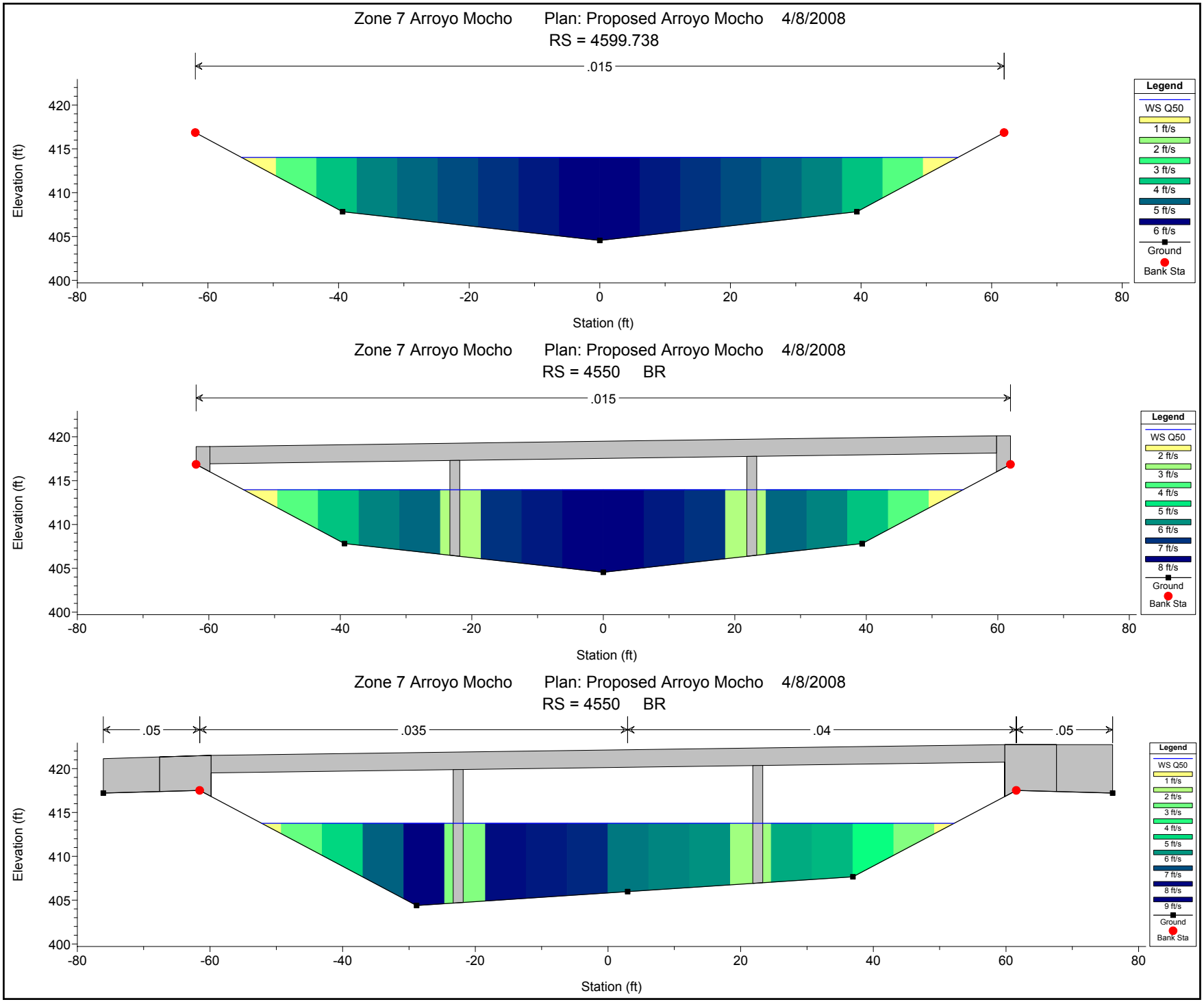
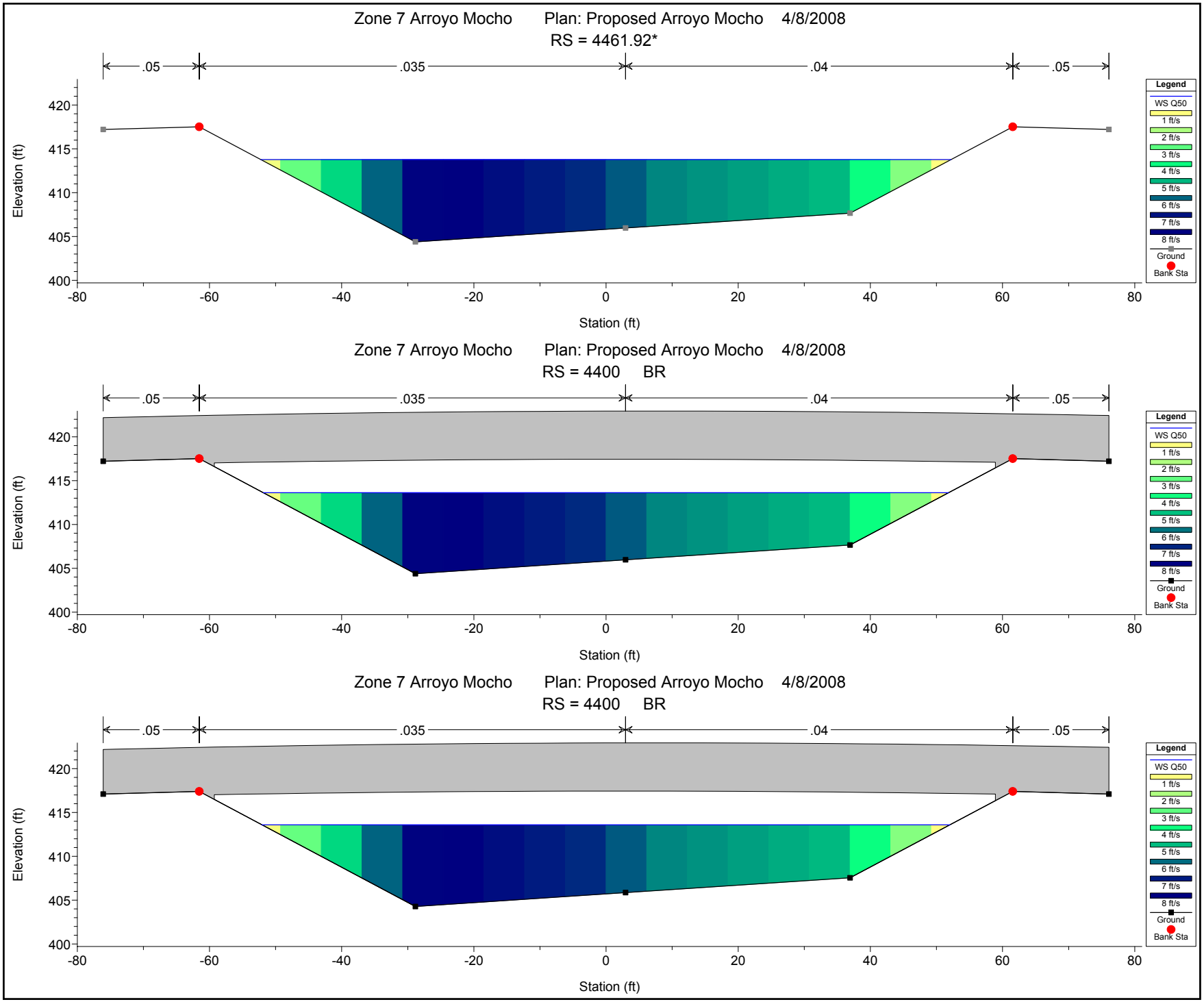
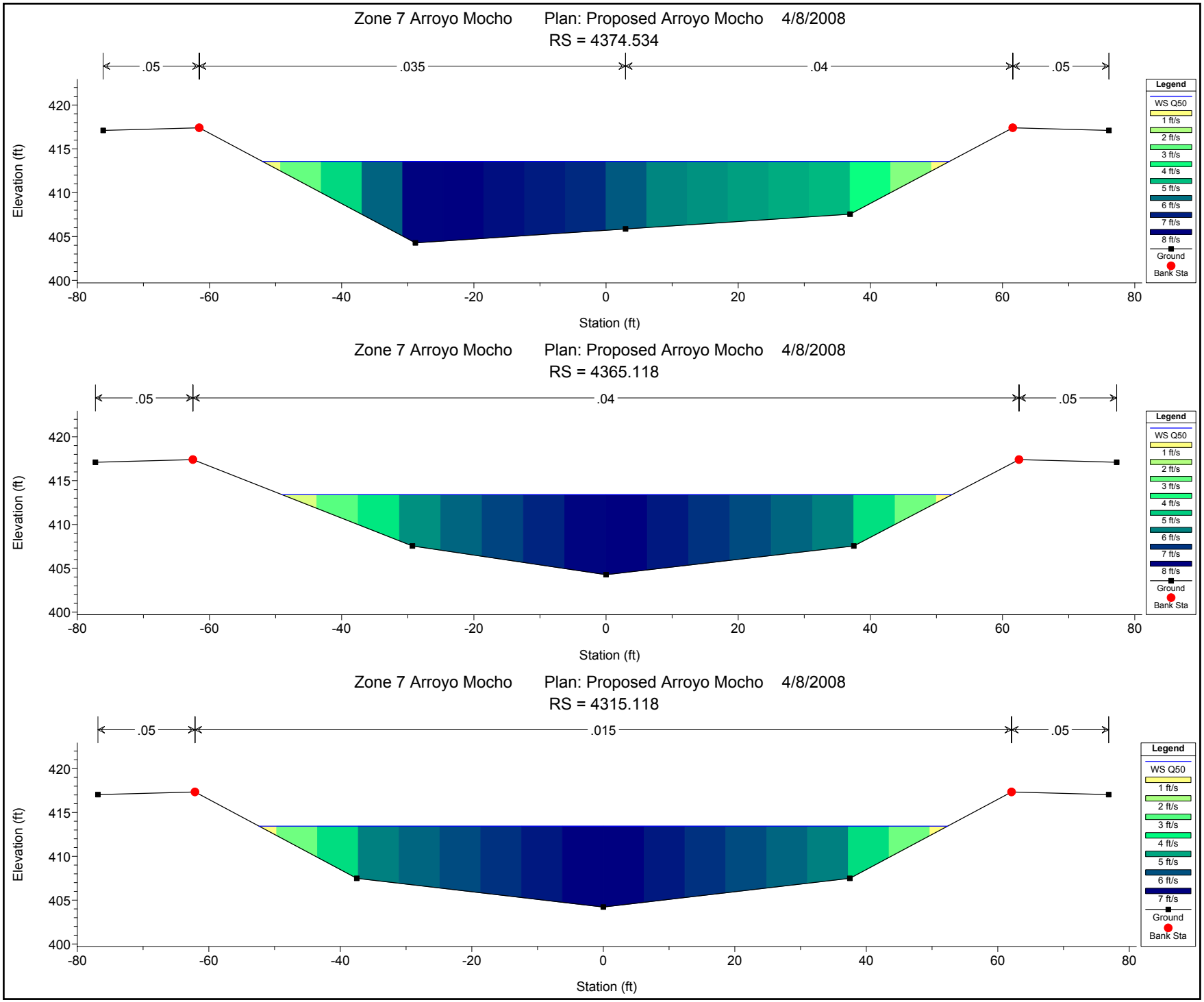


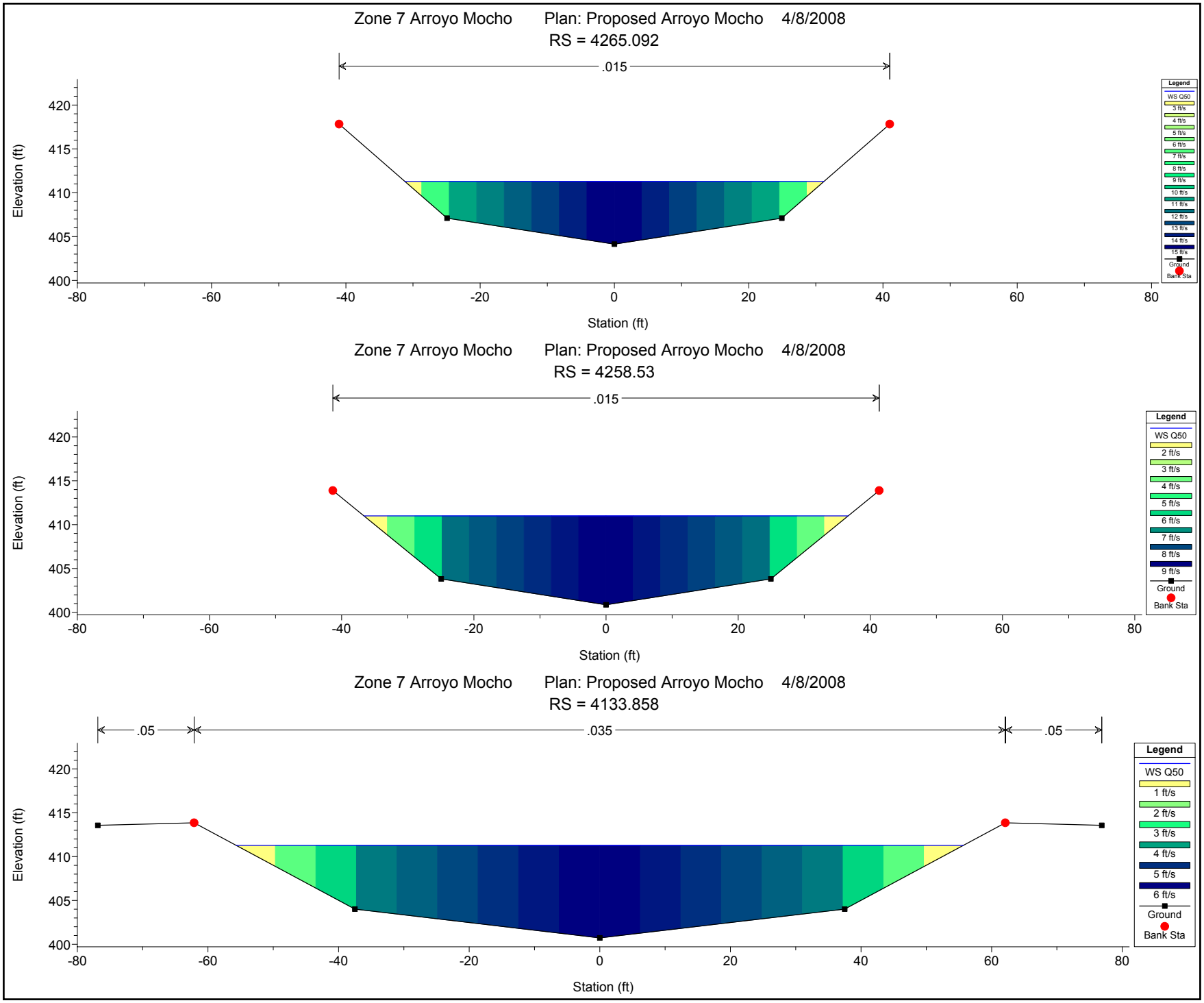
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



1 in Horiz. = 20 ft 1 in Vert. = 15 ft

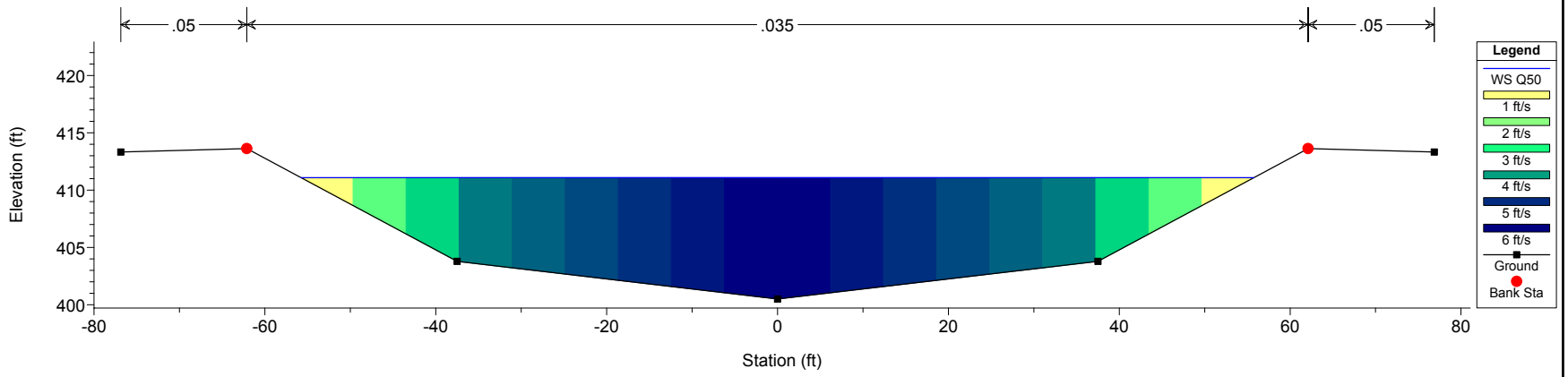


1 in Horiz. = 20 ft 1 in Vert. = 15 ft

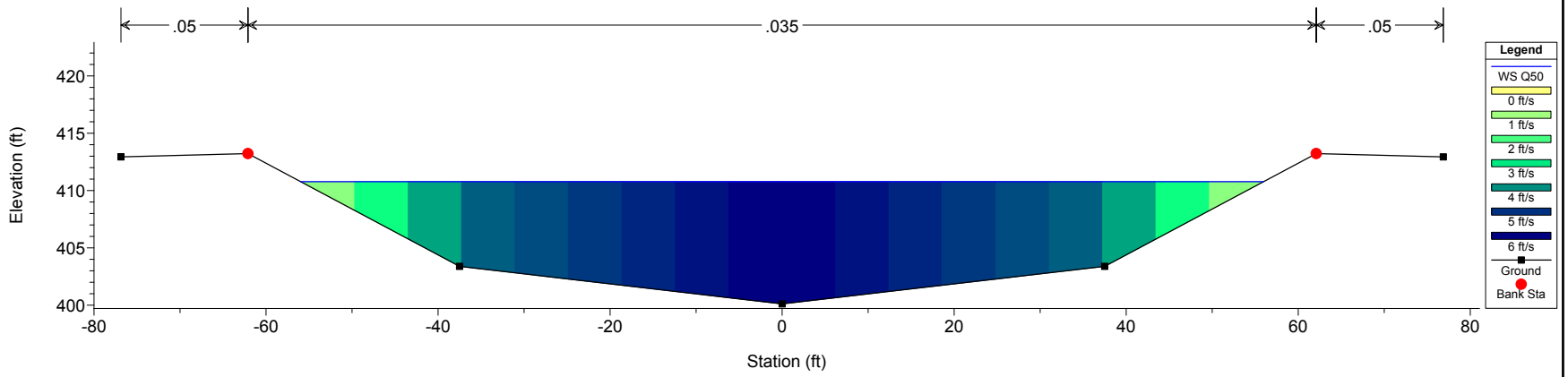


1 in Horiz. = 20 ft 1 in Vert. = 15 ft

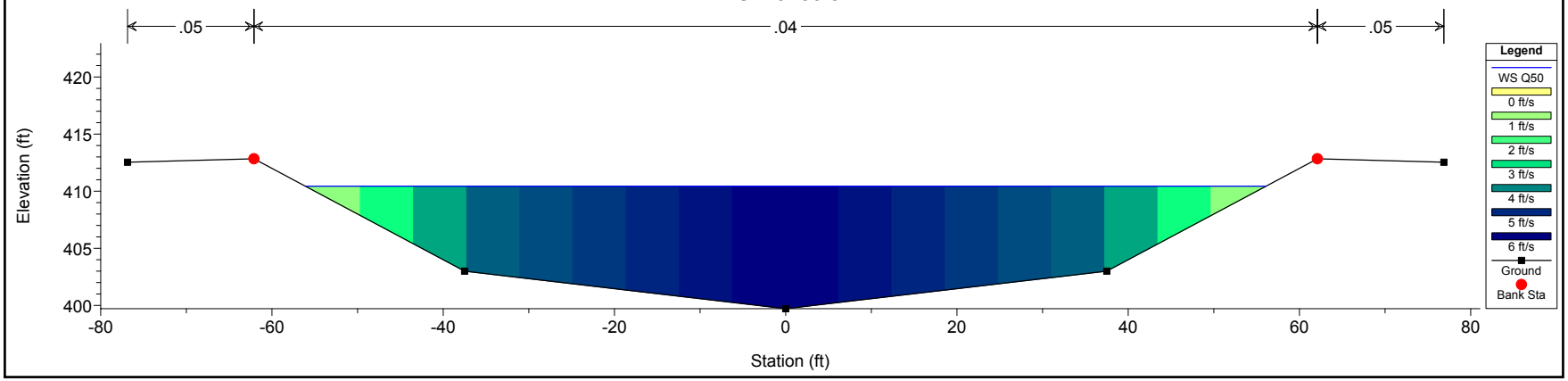
Zone 7 Arroyo Mocho Plan: Proposed Arroyo Mocho 4/8/2008
RS = 3937.008



Zone 7 Arroyo Mocho Plan: Proposed Arroyo Mocho 4/8/2008
RS = 3608.924



Zone 7 Arroyo Mocho Plan: Proposed Arroyo Mocho 4/8/2008
RS = 3280.84



1 in Horiz. = 20 ft 1 in Vert. = 15 ft

Plan: Proposed Arroyo Mocho 1 RS: 4550 Profile: Q100

E.G. US. (ft)	415.59	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	415.07	E.G. Elev (ft)	415.57	415.44
Q Total (cfs)	4800.00	W.S. Elev (ft)	415.01	414.80
Q Bridge (cfs)	4800.00	Crit W.S. (ft)	411.15	411.22
Q Weir (cfs)		Max Chl Dpth (ft)	10.46	10.42
Weir Sta Lft (ft)		Vel Total (ft/s)	6.02	6.41
Weir Sta Rgt (ft)		Flow Area (sq ft)	797.92	749.25
Weir Submerg		Froude # Chl	0.40	0.43
Weir Max Depth (ft)		Specif Force (cu ft)	4194.90	4016.09
Min El Weir Flow (ft)	421.15	Hydr Depth (ft)	7.15	7.03
Min El Prs (ft)	418.14	W.P. Total (ft)	149.01	145.95
Delta EG (ft)	0.18	Conv. Total (cfs)	241935.2	90952.6
Delta WS (ft)	0.26	Top Width (ft)	111.65	106.57
BR Open Area (sq ft)	1089.45	Frctn Loss (ft)	0.11	0.01
BR Open Vel (ft/s)	6.41	C & E Loss (ft)	0.02	0.02
Coef of Q		Shear Total (lb/sq ft)	0.13	0.89
Br Sel Method	Energy only	Power Total (lb/ft s)	0.79	5.72

Plan: Proposed Arroyo Mocho 1 RS: 4550 Profile: Q50

E.G. US. (ft)	414.48	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	414.02	E.G. Elev (ft)	414.47	414.34
Q Total (cfs)	3900.00	W.S. Elev (ft)	413.97	413.76
Q Bridge (cfs)	3900.00	Crit W.S. (ft)	410.54	410.57
Q Weir (cfs)		Max Chl Dpth (ft)	9.42	9.38
Weir Sta Lft (ft)		Vel Total (ft/s)	5.70	6.08
Weir Sta Rgt (ft)		Flow Area (sq ft)	683.95	641.29
Weir Submerg		Froude # Chl	0.40	0.43
Weir Max Depth (ft)		Specif Force (cu ft)	3214.86	3076.25
Min El Weir Flow (ft)	421.15	Hydr Depth (ft)	6.43	6.32
Min El Prs (ft)	418.14	W.P. Total (ft)	139.20	136.22
Delta EG (ft)	0.18	Conv. Total (cfs)	195822.7	73565.7
Delta WS (ft)	0.25	Top Width (ft)	106.43	101.39
BR Open Area (sq ft)	1089.45	Frctn Loss (ft)	0.11	0.01
BR Open Vel (ft/s)	6.08	C & E Loss (ft)	0.02	0.02
Coef of Q		Shear Total (lb/sq ft)	0.12	0.83
Br Sel Method	Energy only	Power Total (lb/ft s)	0.69	5.02

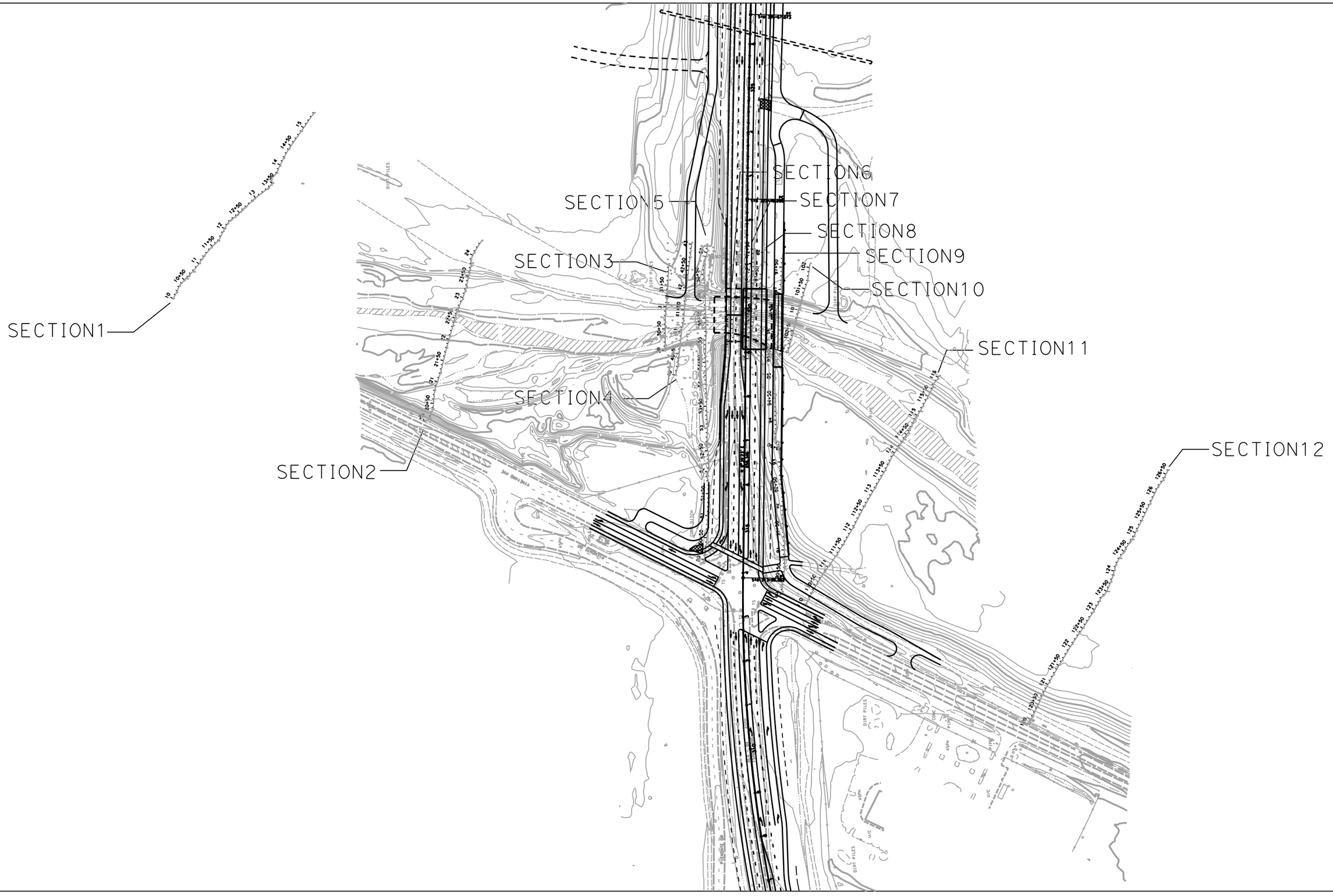
Plan: Proposed Arroyo Mocho 1 RS: 4400 Profile: Q100

E.G. US. (ft)	415.40	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	414.81	E.G. Elev (ft)	415.28	415.24
Q Total (cfs)	4800.00	W.S. Elev (ft)	414.66	414.64
Q Bridge (cfs)	4800.00	Crit W.S. (ft)	411.07	410.96
Q Weir (cfs)		Max Chl Dpth (ft)	10.28	10.37
Weir Sta Lft (ft)		Vel Total (ft/s)	6.31	6.23
Weir Sta Rgt (ft)		Flow Area (sq ft)	761.11	770.64
Weir Submerg		Froude # Chl	0.42	0.41
Weir Max Depth (ft)		Specif Force (cu ft)	4017.96	4072.98
Min El Weir Flow (ft)	422.19	Hydr Depth (ft)	6.99	7.05
Min El Prs (ft)	417.44	W.P. Total (ft)	112.30	112.78
Delta EG (ft)	0.19	Conv. Total (cfs)	110267.1	112236.6
Delta WS (ft)	0.21	Top Width (ft)	108.88	109.33
BR Open Area (sq ft)	1065.08	Frctn Loss (ft)	0.03	0.03
BR Open Vel (ft/s)	6.31	C & E Loss (ft)	0.01	0.00
Coef of Q		Shear Total (lb/sq ft)	0.80	0.78
Br Sel Method	Energy only	Power Total (lb/ft s)	5.06	4.86

Plan: Proposed Arroyo Mocho 1 RS: 4400 Profile: Q50

E.G. US. (ft)	414.30	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	413.77	E.G. Elev (ft)	414.18	414.13
Q Total (cfs)	3900.00	W.S. Elev (ft)	413.62	413.59
Q Bridge (cfs)	3900.00	Crit W.S. (ft)	410.44	410.34
Q Weir (cfs)		Max Chl Dpth (ft)	9.24	9.32
Weir Sta Lft (ft)		Vel Total (ft/s)	6.00	5.92
Weir Sta Rgt (ft)		Flow Area (sq ft)	650.03	658.95
Weir Submerg		Froude # Chl	0.42	0.41
Weir Max Depth (ft)		Specif Force (cu ft)	3067.50	3113.73
Min El Weir Flow (ft)	422.19	Hydr Depth (ft)	6.27	6.33
Min El Prs (ft)	417.44	W.P. Total (ft)	106.68	107.15
Delta EG (ft)	0.20	Conv. Total (cfs)	87936.6	89672.1
Delta WS (ft)	0.21	Top Width (ft)	103.67	104.11
BR Open Area (sq ft)	1065.08	Frctn Loss (ft)	0.04	0.03
BR Open Vel (ft/s)	6.00	C & E Loss (ft)	0.01	0.00
Coef of Q		Shear Total (lb/sq ft)	0.75	0.73
Br Sel Method	Energy only	Power Total (lb/ft s)	4.49	4.30

Appendix E Surveyed Cross-Sections


SECTION1
SECTION2
SECTION3
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SECTION8
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SECTION10
SECTION11
SECTION12

Appendix F Scour Calculations and Rip Rap Sizing

12/17/08 P0728: SR84 Widening

Trail Bridge Scour Calcs

Contraction Scour

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$$\frac{y_2}{6.96} = \left(\frac{7000}{5907}\right)^{6/7} \left(\frac{163.92}{119.57}\right)^{0.69} = 10.01'$$

(1.157 and 1.243)

$y_s = y_2 - y_o$

$W_1 = 163.92$, $W_2 = 119.57$, $y_1 = 6.96$

$y_s = y_2 - y_o = 10.01 - 7.11 = \boxed{2.90'}$

Pier Scour

$$\frac{y_s}{a} = 2 k_1 k_2 k_3 k_4 \left(\frac{y_1}{a}\right)^{0.35} F_r^{0.43}$$

$a = 3$, $K_1 = 1.1$, $K_2 = 2.44$, $K_3 = 1.1$, $K_4 = 1.0$, $F_r = 0.889$, $y_1 = 8.92$

$y_s = (3)(1)(2.44)(1.1)(1)\left(\frac{8.92}{3}\right)^{0.35}(0.889)^{0.43}(3)$

$= (5.37)(1.464)(0.951)(3)$

$= \boxed{22.43'}$

Embankment Scour (Abutment Scour)

$$\frac{y_s}{y_a} = 2.27 K_1 K_2 \left(\frac{L'}{y_a}\right)^{0.43} F_r^{0.61} + 1 \qquad F_r = \frac{V}{\sqrt{g y_a}}$$

Left Embankment: $K_1 = 1$, $K_2 = 0.95$, $L' = 50$, $y_a = 4.13$, $F_r = 0.52$

$y_s = \left[2.27(1)(0.95)\left(\frac{50}{4.13}\right)^{0.43}(0.52)^{.61} + 1\right] 4.13$

$= [(2.16)(2.92)(0.67) + 1]\, 4.13$

$= \boxed{21.58'}$

Right Embankment: $K_1 = 1$, $K_2 = 1.04$, $L' = 30'$, $y_a = 3.69$, $F_r = 0.78$

$y_s = \left[2.27(1)(1.04)\left(\frac{30}{3.69}\right)^{0.43}(0.78)^{.61} + 1\right] 3.69$

$= [2.36)(2.46)(0.859) + 1]\, 3.69$

$= \boxed{22.09'}$

12/17/08 P0728: SR 84 Widening

SR 84 Bridge Scour Calcs

Contraction Scour

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7}\left(\frac{W_1}{W_2}\right)^{K_1}$$

$$\frac{y_2}{13.65} = \left(\frac{7000}{7000}\right)^{1}\left(\frac{133.24}{115.47}\right)^{1.104} = 15.07'$$

$y_s = y_2 - y_0$

$W_1 = 133.24$, $W_2 = 115.47$, $y_1 = 13.65$

$y_s = y_2 - y_0 = 15.07' - 13.92' = \boxed{1.15'}$

Pier Scour

$$\frac{y_s}{a} = 2\,K_1 K_2 K_3 K_4 \left(\frac{y_1}{a}\right)^{0.35} F_r^{0.43}$$

$a = 3.2$, $K_1 = 1$, $K_2 = 2$, $K_3 = 1.1$, $K_4 = 1$, $y_1 = 7.54$, $F_r = 0.44$

$y_s = (2)(1)(2)(1.1)(1)\left(\frac{7.54}{3.2}\right)^{.35}(0.44)^{.43}(3.2)$

$= (4.4)(1.35)(0.703)(3.2)$

$= \boxed{13.37'}$

Abutment Scour

$$\frac{y_s}{y_a} = 2.27\,K_1 K_2 \left(\frac{L'}{y_a}\right)^{0.43} F_r^{0.61} + 1$$

$$F_r = \frac{V}{\sqrt{g\,y_a}}$$

Left Abutment $K_1 = 1$, $K_2 = 0.98$, $L' = 20$, $y_a = 3.44$

$y_s = \left[(2.27)(1)(0.98)\left(\frac{20}{3.44}\right)^{.43}(0.40)^{.61} + 1\right]3.44$

$= \left[(2.22)(2.13)(.57) + 1\right]3.44$

$= \boxed{12.74'}$

Right Abutment $K_1 = 1$, $K_2 = 1.01$, $L' = 5$, $y_a = 2.11$

$y_s = \left[(2.27)(1)(1.01)\left(\frac{5}{2.11}\right)^{.43}(0.43)^{.61} + 1\right]2.11$

$= \left[(2.29)(1.45)(0.6) + 1\right]2.11$

$= \boxed{6.31'}$

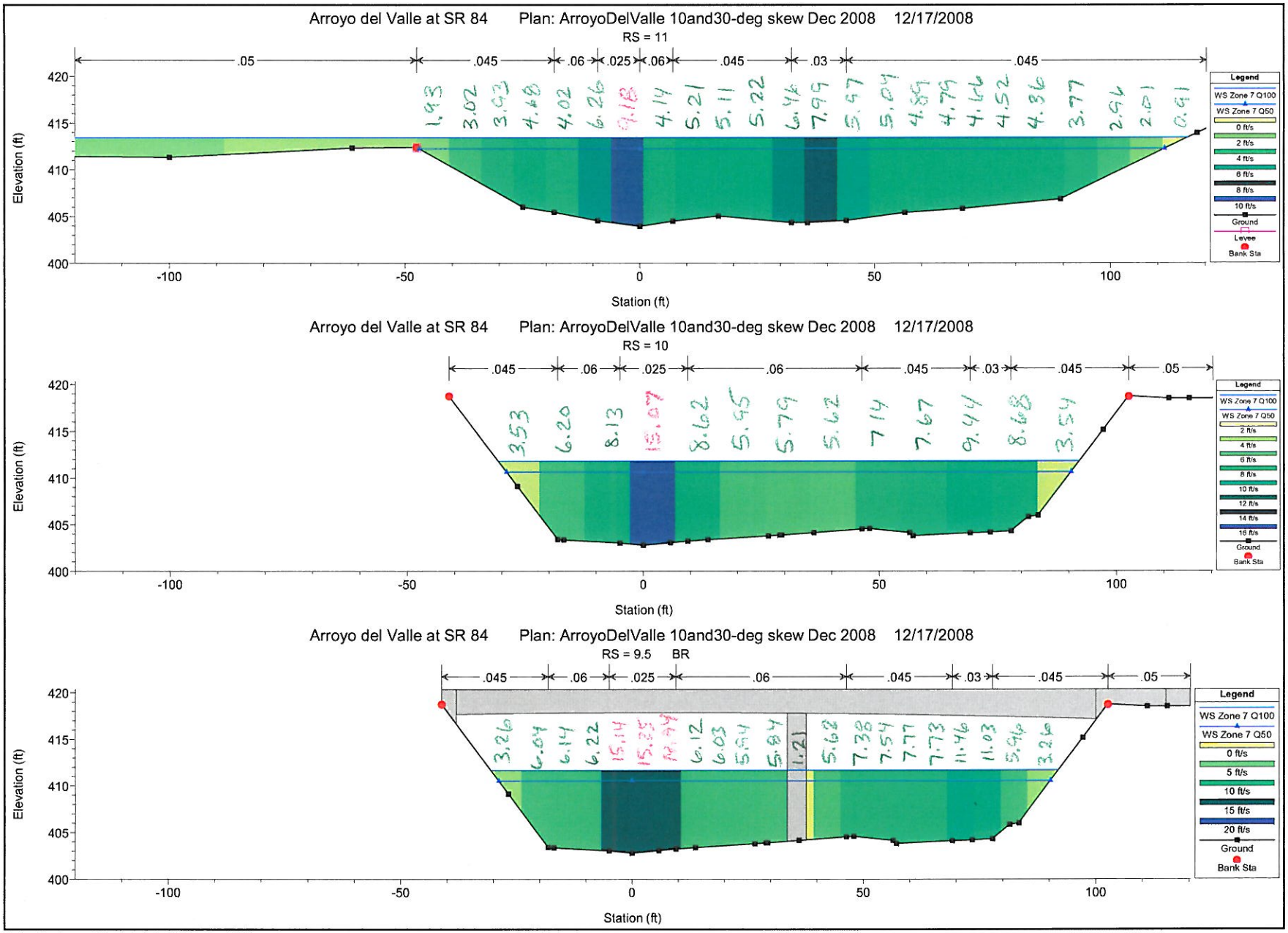
12/18/08 P0728 : SR 84 Widening

Riprap Sizing

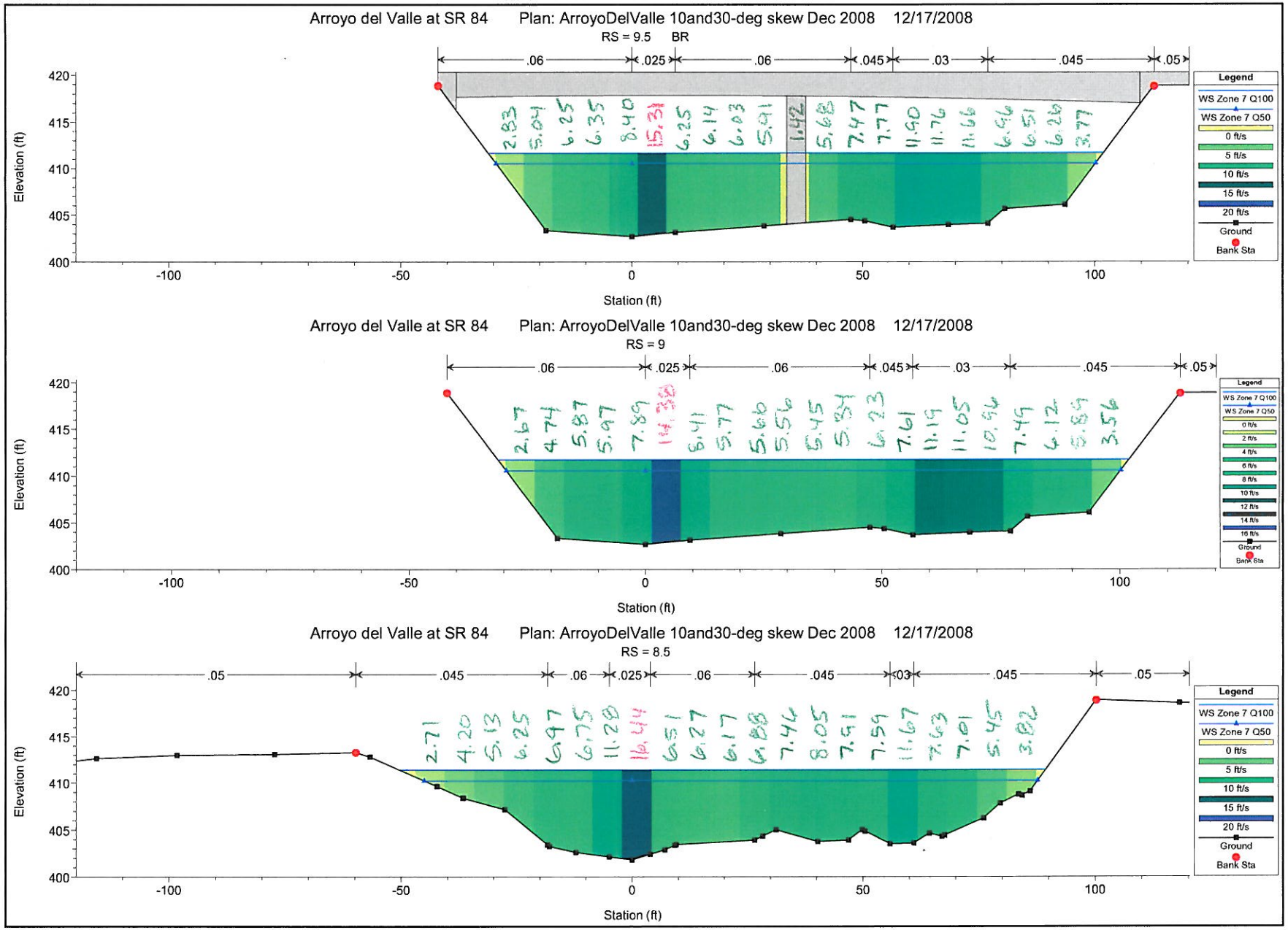
Isbash formula $D_{50} = \frac{0.692\,(KV)^2}{(2g(S_s - 1))}$

		D_{50}	
U/S of Trail Bridge (RS 10)	$V = 8.68$ ft/s	0.5'	Facing
U/S face of Trail Bridge	$V = 11.03$ ft/s	0.79'	Facing
D/S face of Trail Bridge	$V = 6.96$ ft/s	0.32'	Facing
D/S of Trail Bridge (RS 9)	$V = 7.49$ ft/s	0.37'	Facing
U/S of SR 84 Bridge (RS 8.5)	$V = 11.67$ ft/s	0.89'	Facing
U/S face of SR84 Bridge	$V = 14.34$ ft/s	1.34'	¼-ton
D/S face of SR84 Bridge	$V = 23.28$ ft/s	3.53'	1-ton
D/S of SR84 Bridge	$V = 20.62$ ft/s	2.77'	1-ton

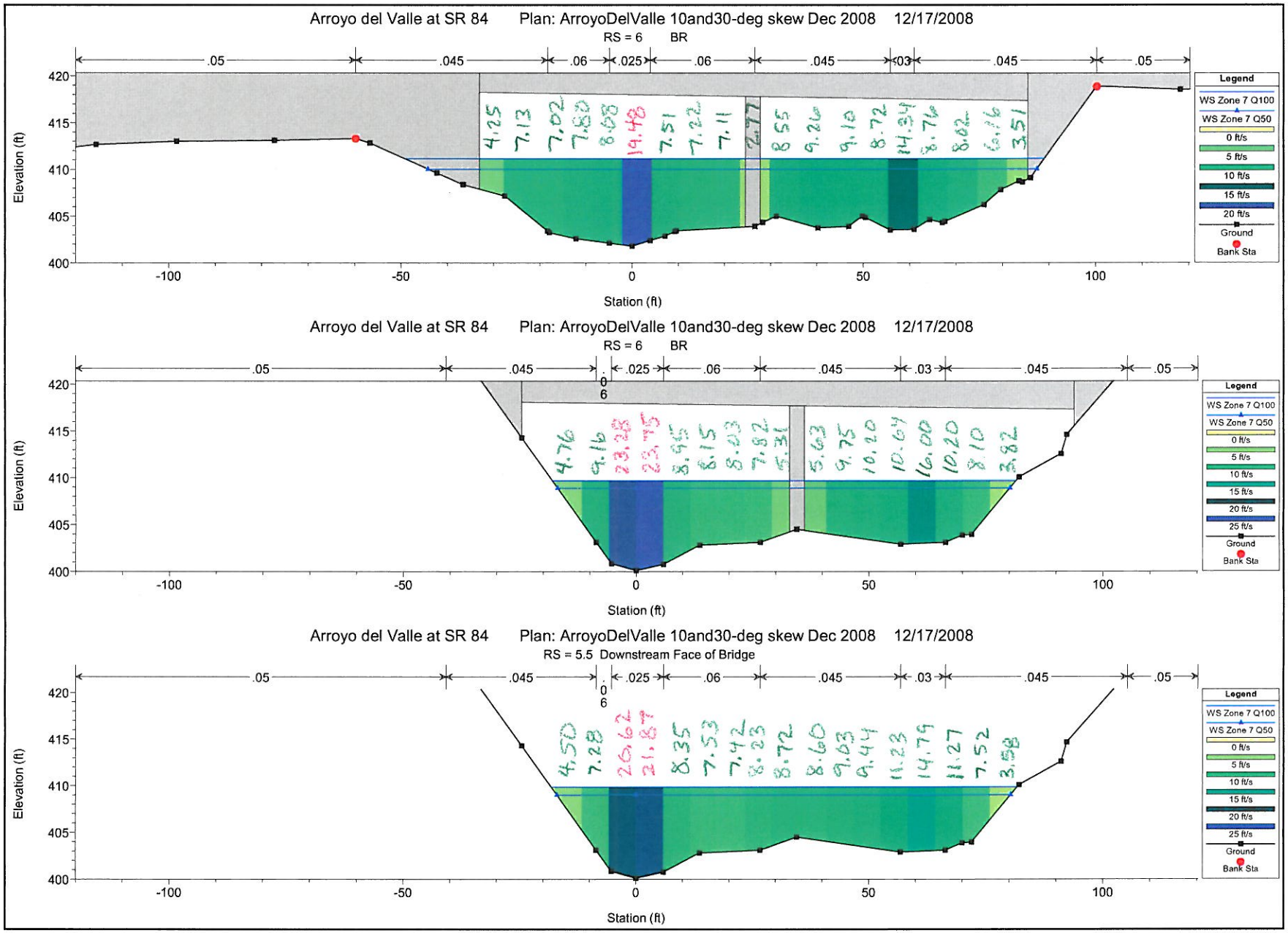
$$D_{50} = \frac{0.692\,((1)(V))^2}{106.26}$$



1 in Horiz. = 30 ft 1 in Vert. = 15 ft



1 in Horiz. = 30 ft 1 in Vert. = 15 ft



1 in Horiz. = 30 ft 1 in Vert. = 15 ft

Appendix G Project Correspondence and Meeting Minutes

WRECO

DRAFT Meeting Minutes

Date: June 19, 2008

Time: 12:00 to 1:30 pm

Project: SR 84 Widening Project

Subject: SR 84 Arroyo del Valle Bridge Scour Countermeasures

Location: SR 84 Arroyo del Valle Bridge Site, Livermore, CA

Attendees: Steve Ng, Kevin Flora, and Scott Davis – Caltrans HQ
Han-Bin Liang and Jeff Tudd – WRECO

Minutes taken by: Jeff Tudd

Issues Discussed

Existing Bridge
The existing bridge is considered scour critical. Existing foundations for abutments and piers are both on spread footings. It was discussed that:
Deeper foundations are needed.

- The rock on abutments seem adequate, but the toe rocks have been displaced by flows.
- The (center) pier does not have adequate protection.
- The channel bed material is erodible.
- The gravel piles installed by gravel mining operation will not provide any scour protection.

Chain-of-Lakes
The proposed bridge will be in between 2 future groundwater recharge lakes. The gravel mining would go down about 240 feet. The groundwater level is about 60 feet below ground. Currently there is not much information of the lakes available, including the size, shape and the relationship with the Arroyo del Valle low flow channel. ACTIA may want to negotiate with the gravel mining operation not to excavate too close to the bridge site.

Bridge Scour Countermeasures
There are 3 approaches to address the scour issues:

<u>Alternative 1 – Line the channel bed with adequately sized rocks.</u>

- Apply adequately sized rocks across the whole channel under the bridge.
- The gravel mining road is only an easement (temporary construction). Proper slope protection is needed. Rocks should also be placed under the truck path under the north span.
- Keys should be provided at the toes on both sides of the channel and upstream and downstream of the bed rock slab.
- The proposed project will not need to restore the creek bed to the existing grade at the bridge site. We cannot restore the creek bed only locally, because we will also have to grade upstream and downstream.
- Concrete lining is undesirable due to the environmental concerns.

<u>Alternative 2 – Line the channel bed with adequately sized rocks with fish passage.</u>

- Use rock weirs in the channel bed as the grade control structure. The grade control structure is needed to stabilize the degrading channel.
- Fish is not an issue for Arroyo del Valle bridge site, and if it is, rock weirs would not be more than 12 inches for adults and 6 inches for juveniles.

- Toe rocks for abutments are still required.

Alternative 3 – Apply toe rocks for the abutments and outrigger for center pier.

- Outrigger can be used to provide scour protection of the pier.
- The existing pier wall can be removed or remained after the outrigger is constructed.
- If the outrigger is used for the center pier, will the abutments require the same outrigger design? The bridge engineer should determine this.

New foundation vs. Rock Protection

Steve indicated that the solution using rocks is cost-effective, but outrigger (or providing deeper foundation) can provide a stronger long-term solution for the bridge. If rock protection is chosen, a monitoring program should be in place.

Bridge Scour Calculations

WRECO provided CT a copy of the bridge layout and topo with the Microsoft Visual Earth. Kevin asked when the aerial photos were taken and Jeff stated he did not know but Google Earth states it on their maps.

Even with the constriction at the bridge site, the channel flow does not seem to be high. Scott stated that he calculated it to be about 5 ft/s.

FEMA's study started from immediate downstream of the Arroyo del Valle bridge site. Downstream of the bridge site, FEMA did not have any detailed study and only studied the reach of Arroyo del Valle downstream of the bridge site by Approximate Method.

WRECO will revisit the bridge scour calculations by considering 1) a smaller skew angle (about 10°) and 2) bed armoring effect. WRECO will also look into the velocities under the bridge.

Action Items:

- WRECO will recalculate the bridge scour to take into account the skew angle and bed armoring.
- WRECO will prepare a tech memo summarizing the two scour countermeasure alternatives, and submit the memo to CT for review.

MEMORANDUM

To: Overcomer Hor, Caltrans DES OSFP

From: Tim Lee, Consultant Project Manager

Date: September 22, 2008 (Revised December 2008)

Subject: 04-Ala-84, PM 22.5/27.3, EA 04-297601
ACTIA Route 84 Expressway Widening Project
Arroyo del Valle Bridge – Scour Countermeasure Options

Overcomer:

Subsequent to the Type Selection Meeting on 6/4/08, additional studies were conducted to identify scour countermeasure options for the Arroyo del Valle Bridge widening. The study findings are summarized in this memorandum and the Draft Bridge Design Hydraulic Study Report (prepared by Wreco, and dated September 2008). Caltrans review and comment of both documents is requested at this time followed by a coordination meeting (or conference call) to reach consensus on the preferred scour countermeasure option.

Active mining of gravel quarries each side of the Arroyo del Valle Bridge crossing will be ongoing until 2030 at which time a reclamation plan will convert their use to percolation ponds and flood management facilities. Quarry operators have permits to mine up to 50 feet from existing State right-of-way and up to depths of 240 feet. As part of the Reclamation Plan a spillway will be constructed at the Arroyo del Valle Bridge crossing to create separate lakes (Lakes A and B) each side of Route 84.

According to the Bridge Inspection Report (dated March 2006) there was 5.9 foot of channel degradation between 1983 and 1999. This was attributed to in-stream gravel mining. The thalweg (lowest point of the channel) is estimated to be only 2 foot above the pier footing. The existing foundations for the bridge abutments and pier are on spread footings. The bridge is classified by Caltrans as a “scour critical” location.

Caltrans HQ Hydraulics and Wreco conducted field visits and coordination meetings to further discuss scour concerns at the bridge crossing. Scour analysis was revised and documented in the Draft Bridge Design Hydraulic Study Report (dated September 2008).

The report identified that the total scour (contraction and local) at the bridge pier is estimated at 15 foot (Q100). Four design options were investigated as scour countermeasures and summarized as follows:

(1) Pier Retrofit (CIDH piles) - existing footing is expanded beyond deck footprint and connected to footing of bridge widening and supported on pile foundations. Estimated additional cost is $591,000.

(2) Pier Retrofit (sheet piles) – construct sheet pile cofferdam around footing of bridge widening (assuming pile embedment of 20 foot) and connect to existing footing. Estimated additional cost is $500,000.

(3) Reconstruct Bridge – existing bridge is reconstructed and widened with pile foundations. Estimated additional cost is $1,442,000.

(4) Concrete Lined Channel – construct RC slab to provide a continuous monolithic lining of the channel and abutments beneath the bridge. Estimated additional cost is $445,000 including biological mitigation.

Analysis of Scour Countermeasure Options

The added cost for reconstructing the existing bridge (Option 3) is significantly higher than the other options. No structural deficiencies have been identified with the existing bridge and reconstructing it would not provide any significant benefits over the other options. Option 3 is therefore not considered cost effective and is rejected.

The added costs for Options 1, 2 and 4 are similar and therefore not a basis for rejection.

Concrete lining of the channel and abutment slopes would result in significant environmental impacts to riparian areas of the creek. This option is anticipated to be rejected by the permitting agencies (USACOE and CDFG) since there are other feasible solutions available. Furthermore, scour effects could undermine the RC slab over time. This option is rejected since it causes the most significant environmental impacts.

The pier retrofit with sheet piling (Option 2) would not protect the existing pier from scour since there is inadequate vertical clearance under the superstructure. Furthermore, driving sheet piles could be difficult due to the presence of gravel deposits in the soil structure. This option is rejected since scour protection is inferior to Option 1 and may not be constructible.

Based on the above analysis, **Option 1** is considered to be the preferred scour countermeasure.

Additional Measures to Limit Scour

The abutment and pier of the new trail bridge, upstream of the roadway bridge, will be founded on CIDH piles.

RSP on the existing bridge abutments appears to be substandard, and the toe rocks have been displaced by creek flows. The RSP should be removed and replaced with RSP meeting current standards in HEC-23.

The channel alignment is skewed upstream of the bridge which exacerbates the effects of scouring. Realigning the channel to reduce the skew was considered but rejected since this would result in significant environmental impacts.

Pile Foundation Design

Based on subsurface conditions encountered at Arroyo Del Valle and Caltrans Bridge Design Specifications (Section 4), we estimate the design tip elevations for the proposed 36-inch diameter CIDH piles to be El. 324 and 311 for abutments and center pier, respectively. The estimated tip elevations exclude the contribution of shaft resistance in the upper 22 feet due to scour. The table below summarizes the pile data for the proposed CIDH piles:

Location / Elevation below Scour	Pile Type	Nominal Compressive Resistance	Estimated Design Tip
Abutment 1 / El. 395	36-inch CIDH	900 kips	324
Pier 2 / El. 382	36- inch CIDH	900 kips	311
Abutment 3 / El. 395	36-inch CIDH	900 kips	324

The above estimates assume deeper subsurface conditions are similar to those revealed in the December 2007 exploratory borings terminated at El. 350 and El. 340 for Abutment 1 and 3, respectively. Therefore, if piles with load demand listed in the above table are proposed, 3 additional borings (one at each support location) extending to a depth of 120 feet will be required, or to El. 300. However, borings at the abutments will require only sampling from El. 350 to El. 300.

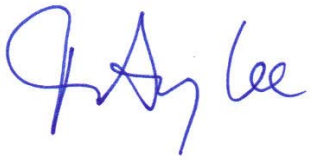
Other Issues

Restoring the 5.9 feet of channel degradation attributed to in-stream gravel mining would result in significant environmental impacts and is considered out of the scope of the highway widening project. This matter should be referred to Zone 7 for further action.

Option 1 would not preclude construction of the future spillway. Since the future spillway could block fish passage, its construction may be prohibited by the environmental resource agencies. This issue should be further investigated by Zone 7.

If you have any questions or need additional information on this matter please contact me at (415) 806-7500 or timlee@wmhcorporation.com .

Regards



Tim Lee, P.E.
Consultant Project Manager

cc. Kevin Flora, Steve Ng, Scott Davis (Caltrans HQ Hydraulics)
Issa Bouri, Caltrans District 4
Nestor Perez, Caltrans District 4
Kevin Melanephy, Caltrans Biology
Michele Bellows (ACTIA)
Ben Razeghi (URS)
Han Bin Liang (WRECO)
Bob Sennett/Guoping Xu (MGE)
File

		Responses Prepared By:	**Tim Lee**

REVIEW COMMENTS MATRIX

TECHNICAL COMMENT REVIEW AND RESPONSE
Comments dated 10/1/08

Title: **Route 84 Expressway Widening Project** | Submittal: **Draft Bridge Hydrology Report and Scour Countermeasure Options Memo**

CODE: A-Will Comply; B-Consultant to Evaluate; C-Will Not Incorporate; D-Agency to Evaluate; E-No Action Required

No.	Page No.	Review Comments	Design Responses	Proposed Action:	Final Action:
MEMORANDUM SUMMARY REPORT (Kevin Flora comments)					
1		Is Option 1 driven piles or CIDH piles?	CIDH piles are proposed for Pier 2 on the bridge widening and new trail bridge. Abutments will remain on spread footings and be protected by RSP. Memo and report will be revised accordingly	**A**	**A**
	2	From the details of Pier 2 shown in Figure 1 from MGE Engineering, we are concerned with the pile connection at the existing spread footing? Will the structure stay intact if the footing is undermined?	The footing retrofit will be designed to carry all bridge loads under a condition where the soil below the footing is no longer present due to scour.	**A**	**A**
		On Page 2, RSP at Pier 2 is recommended which may indicate that the design for Pier Retrofit would not allow for the footing/pilecap to be undermined? If this is the case, then the stability of the bridge is dependent on the rip rap which is not an acceptable long-term strategy	RSP is not needed at the pier in conjunction with the footing retrofit.	**E**	**E**
2		The new widen foundation should be lower than the existing foundation such that it will not become exposed by scour.	Due to constructability issues, the new widening footing will need to be located at the same elevation as the existing. Additionally, it is not desirable from a structural point of view to have two piers connected with different stiffnesses.	**C**	**C**
3		Option 1 was never discussed in Draft Hydraulic Report; therefore, it is not clear if the effects of the retrofit on hydraulics and scour potential have been addressed.	Option 1 has been added to the Final Bridge Design Hydraulic Report. This option addresses scour concerns	**A**	**A**
4	3	On Page 3, 3rd paragraph, the memo indicates that the existing access road should be lowered to provide more conveyance. I did not find an adequate discussion of this issue in the Draft Hydraulic Report. How much will the road be lowered? From the Draft Hydraulic Report, it does not appear that flow capacity is a problem, so why is this needed?	This recommendation has been withdrawn. There is sufficient flow capacity provided.	**A**	**A**

		Responses Prepared By:	**Tim Lee**

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No.	Page No.	Review Comments	Design Responses	Proposed Action:	Final Action:
5	3	On Page 3, last paragraph, why is Option 2 being discussed with respect to a future spillway if this option was rejected on Page 2?	Will revise memo to state Option 1	**A**	**A**
6		The General Plan shows a 30-degree skew for the Trail Bridge, but the scour evaluation was based on a 10-degree hydraulic skew. This contradiction needs to be explained.	Bridge has skew of 30 degrees at crossing. Channel approach to bridge has a skew of 10 degrees. This will be clarified in the Final Bridge Design Hydraulic Report.	**E**	**E**
7		We do not agree with the statement "RSP on the existing bridge appears to be adequate." In fact, the RSP appears to be substandard. We recommend that it be removed and replaced with RSP meeting current standards in HEC-23, not just keyed in at the toe as proposed.	Will revise memo and Final Bridge Design Hydraulic Report to state that the existing RSP will be removed and replaced with new RSP meeting current standards in HEC-23	**A**	**A**
8		The ground surface shown in the proposed footing retrofit plan does not accurately represent current channel conditions. The existing ground is much lower than shown, with the top of the proposed footing 1 ft above the thalweg elevation (top of footing 399.5 vs. thalweg 398.4).	Will revise GP such that ground surface shown represents current channel conditions	**A**	**A**
DRAFT BRIDGE DESIGN HYDRAULIC REPORT – HEC RAS Model Issues (Kevin Flora comments)					
1		To understand the HEC-RAS model, please provide a plan view showing the cross-section locations.	Will revise Final Bridge Design Hydraulic Report to include this exhibit	**A**	**A**
2	Table 9	Table 9 – Why will the widening and the new Trail bridge cause the WSEL to be lower upstream of the proposed bridges (XS 11 and 12)? This would not be expected and may indicate a problem with the model.	Intermediate cross sections have been added to the HEC-RAS model to more accurately model the water surface elevations.	**A**	**A**
3	Table 9	Table 9 – Why would the 50-year discharge create more backwater at the U/S SR 84 Bridge cross-section than the 100-year? This appears to indicate a modeling error.	The HEC-RAS model will be revised to address the backwater issue.	**A**	**A**

		Responses Prepared By:	**Tim Lee**

REVIEW COMMENTS MATRIX

TECHNICAL COMMENT REVIEW AND RESPONSE
Comments dated 10/1/08

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No.	Page No.	Review Comments	Design Responses	Proposed Action:	Final Action:
4	Figure 8	Figure 8 – The cross-section used in HEC-RAS at the upstream face of Rte 84 Bridge shows an approximately 5-foot high berm in the channel. In reality, the berm is aligned with the bridge pier; however, Figure 8 shows it to be offset. Furthermore, immediately under the bridge, the berm does not exist as shown in a recent Caltrans bridge cross-section (see attached). This should be accounted for in the RAS model and subsequent scour analysis.	Complied. The HEC-RAS model has been revised to delete the berm on the upstream face of the SR 84 Widening Bridge.	**A**	**A**
1	28	The scour analysis explicitly neglects future degradation due to the use of a "grade control structure"; however, such a structure is not described in the draft report. Moreover, in the Memorandum from Tim Lee it is noted that such a structure may not be built due to environmental concerns. Therefore, we have concerns about the potential for degradation, especially with the possibility of pit capture by the stream of any of the deep gravel pits near the bridge.	Reference to a grade control structure will be removed from the report since it is not part of the ACTIA Project and there is no guarantee it will be built in the future. If the structure is constructed in the future as part of the Zone 7 Reclamation Plan, the permitee would be required to provide justification that further degradation would not occur and the integrity of the bridge would be maintained.	**A**	**A**
2		Detailed scour data needs to be provided for both the abutment and pier scour calculations in order to check the proposed scour depths.	Abutment and pier scour calculations have been provided for the SR 84 Widening Bridge. Only pier scour calculations were provided on the Trail Bridge and abutment scour was not calculated, because the 100-year water surface elevations did not reach the abutments.	**E**	**E**
3	31	Page 31 – Sheet pile pier protection "would extend from the foundations to the pier to the expected depths of degradation." Does "degradation" refer to the maximum scour depth since degradation was neglected (see 5 above)? Embedment beyond scour is not needed?	This option has been eliminated and report updated accordingly.	**E**	**E**
4		Was the additional width of the sheet piling included in the scour calculations?	This option has been eliminated and report updated accordingly.	**E**	**E**

		Responses Prepared By:	**Tim Lee**

REVIEW COMMENTS MATRIX

TECHNICAL COMMENT REVIEW AND RESPONSE
Comments dated 10/1/08

Title: **Route 84 Expressway Widening Project** | Submittal: **Draft Bridge Hydrology Report and Scour Countermeasure Options Memo**

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No.	Page No.	Review Comments	Design Responses	Proposed Action:	Final Action:
GEOTECHNICAL REVIEW (EDUARDO ORTEGA)					
1		We are in agreement with Design Option No.1 – Pier Retrofit (driven piles).	Comment noted. Correction will be made to state that Option 1 is "Pier Retrofit (CIDH piles)	**A**	**A**
2		In order to evaluate the proposed CIDH piles tip elevation we have to review the Geotechnical/Foundation Report. Piles calculations should follow WSD method for Abutments and LRFD method for Center Pier.	Will comply. Foundation Report will be updated to provide this information. Please note that only Pier 2 of the bridge widening will have CIDH pile foundations. The abutments will be spread footings.	**A**	**A**

Appendix H Bridge Inspection Reports

DEPARTMENT OF TRANSPORTATION
Structure Maintenance & Investigations

Bridge Number : 33 0710
Facility Carried: STATE ROUTE 84
Location : 04-ALA-084-R25.45-LVMR
City : LIVERMORE
Inspection Date : 09/17/2008

Bridge Inspection Report

Inspection Type

Routine	FC	Underwater	Special	Other
☐	☐	☐	☐	☒

STRUCTURE NAME: ARROYO DEL VALLE CREEK

CONSTRUCTION INFORMATION

Year Built : 1983
Year Widened: N/A
Length (m) : 37.5
Skew (degrees): 0
No. of Joints : 0
No. of Hinges : 0

Structure Description: 2-span continuous RC "T" Beams (5) on RC wall pier and closed end diaphragm abutments; all on spread footings

Span Configuration : 2 @ 18.3 m

LOAD CAPACITY AND RATINGS

Design Live Load: MS-18 OR HS-20
Inventory Rating: 32.6 metric tons Calculation Method: LOAD FACTOR
Operating Rating: 53.5 metric tons Calculation Method: LOAD FACTOR
Permit Rating : PPPPP
Posting Load : Type 3 N/A Type 3S2 N/A Type 3-3 N/A

DESCRIPTION ON STRUCTURE

Deck X-Section: 0.5 m br, 11.3 m, 0.5 m br
Total Width: 12.2 m Net Width: 11.3 m No. of Lanes: 2
Rail Description: Metal tube on concrete Rail Code : 1110
Min. Vertical Clearance: Unimpaired

DESCRIPTION UNDER STRUCTURE

Channel Description: Gravel bed with rock slope protection under the bridge. Low flows confined to Span 1 due to man-made berm upstream of bridge.

CONDITION TEXT

INTRODUCTION
A Structure Maintenance & Investigations Peer Review was conducted on July 29, 2008 to discuss the scour critical status of the bridge and to determine what course of action to take in implementing countermeasures to protect the structure. This report outlines the history at the bridge, summarizes the Peer Review discussion and presents recommendations for addressing the problem.

HISTORY
The bridge was built by Alameda County in 1983 and was transferred to the State in 2003 with the re-alignment of Route 84. According to the plans, the embankment slopes and channel bed under the bridge were lined with a 2.5 ft thick layer of rock, and the area surrounding Pier 2 was covered with a 5 ft thick layer. The channel degraded 6 ft between 1983 and 1999, then stabilized. The degradation was attributed to gravel mining. As a result, the thalweg was less than 1 ft above the top of the spread footing at Pier 2, and the rock slope protection (RSP) in Span 1 was beginning to fail due to undermining and lack of fabric underlayment. Although some rock protection remained around Pier 2, the majority of the rock lining in the bed was no longer visible and was presumed gone. In 1999 the bridge was designated scour critical and was assigned an NBIS Item 113 rating of 3 (foundations determined to be unstable for assessed or calculated scour conditions, scour below spread footing base) due to the potential for undermining of the Abutment 1

CONDITION TEXT

spread footing, which was thought to have less than 2 ft of cover. New data gathered in 2006 revealed that the abutment footing had over 4.5 ft of cover, but the bridge remained scour critical due to increased concerns about conditions at Pier 2, where the degree of protection was uncertain.

The area surrounding the bridge has been intensively mined for aggregate over an extended period. Currently there is active mining downstream of the bridge in the form of deep pits in the flood plain, and there are residual pits upstream from prior mining. The long-term reclamation plan for the area includes converting the pits into interconnected lakes and installing a grade control/drop structure under bridge to stabilize the channel, but it is uncertain when this will be implemented, what form it will ultimately take or whether it will mitigate the scour problem at the bridge.

There is a currently a widening project on Route 84 that is in the planning stages. The project is being developed by the Alameda County Transportation Improvement Authority (ACTIA) in conjunction with private engineering firms and includes widening Bridge #33-0710 at Arroyo Del Valle. As part of the widening, the design consultant made an initial proposal to line the channel bed with rock to mitigate scour at the existing structure.

PEER REVIEW SUMMARY

Attendees from the Office of Structure Maintenance & Investigations included Design and Analysis Chief Anthony Gugino, Senior Bridge Engineers Kevin Flora and George Huang, HQ Bridge Program Advisor Takako Fujioka, Hydraulics Engineer Scott Davis and Area Bridge Maintenance Engineer (ABME) Thanh Le. Attendees from the Division of Engineering Services Structures Hydraulics Office included Senior Bridge Engineer Steve Ng and Hydraulics Engineer John Pham.

After a discussion of the history of the bridge and surrounding area and a review of potential hydraulic and scour conditions, it was agreed that the scour critical rating of the bridge is appropriate due to the vulnerable pier footing and substandard slope protection, that scour countermeasures are needed, and that waiting to address the problem during the reclamation of the mining area is unacceptable. Furthermore, concern was expressed that the scour countermeasures being proposed by ACTIA's consultant for the bridge widening might not adequately address the scour problems at the existing structure.

RECOMMENDATIONS

Structure Maintenance & Investigations recommends the following scour countermeasures. At Pier 2, construct deeper foundations (suggested alternatives include deeper spread footing or outrigger bent on CIDH piles) or construct a grade control structure to raise the channel bed to an elevation that will accommodate the anticipated scour conditions. At the abutments, remove the existing RSP (rock slope protection) on both sides of the channel within the State right-of-way and rebuild it per the specifications in Hydraulic Engineering Circular No. 23 (Publication No. NHI 01-003, "Bridge Scour and Stream Instability Countermeasures, 2nd Edition, March 2001). Based on the outrigger bent option, the preliminary estimated cost is $1,000,000.

REVISIONS

A Work Recommendation has been added for Action 25 - Sub Scour Mitigate, Work by 5 - STRAIN.

WORK RECOMMENDATIONS

RecDate: 09/17/2008
Action : Sub-Scour Mitigate
Work By: STRAIN
Status : PROPOSED

EstCost: $1,000,000
StrTarget: 2 YEARS
DistTarget:
EA:

The bridge is scour critical due to channel degradation that has undermined the RSP in Span 1 and has significantly reduced the cover over Pier 2 spread footing, resulting in the potential for undermined spread footings. The Office of Structure Maintenance & Investigations recommends the following countermeasures:

1. At Pier 2, construct deeper foundations (suggested alternatives include deeper spread footing or outrigger bent on CIDH piles) or construct a grade control structure to raise the channel bed to an elevation that will accommodate the anticipated scour conditions.

2. Remove the existing RSP (rock slope protection) on both sides of the channel within the State right-of-way and rebuild it per the specifications in Hydraulic Engineering Circular No. 23 (Publication No. NHI 01-003, "Bridge Scour and Stream Instability Countermeasures, 2nd Edition, March 2001).

Based on the outrigger bent alternative, the preliminary estimated cost is $1,000,000

RecDate: 11/07/2007
Action : Deck-Methacrylate
Work By: MAINT. CONTRACT
Status : PROGRAMMED

EstCost: $8,500
StrTarget: 2 YEARS
DistTarget:
EA: 1E4300

Treat the deck with methacrylate.

Cost estimate:

424 m^2 x $20/m^2 = $8480 use $8500

RecDate: 11/07/2007
Action : Bridge-Paint ID
Work By: BRIDGE CREW
Status : PROPOSED

EstCost:
StrTarget: 2 YEARS
DistTarget:
EA:

Paint the Bridge Id on the right side of Abutment 1 and the left side of Abutment 3.

Arroyo Del Valle Creek
33 0710
ALA 84
PM R25.45

Inspected By : SH.Davis

Scott H Davis

Registered Civil Engineer

DEPARTMENT OF TRANSPORTATION
Structure Maintenance & Investigations

Bridge Number : 33 0713
Facility Carried: STATE ROUTE 84
Location : 04-ALA-084-R27.1-LVMR
City : LIVERMORE
Inspection Date : 03/02/2006

Bridge Inspection Report

Inspection Type

Routine	FC	Underwater	Special	Other
☐	☐	☐	☐	☒

STRUCTURE NAME: ARROYO MOCHO

CONSTRUCTION INFORMATION

Year Built : 2003
Year Widened: N/A
Length (m) : 37.8
Skew (degrees): 0
No. of Joints : 2
No. of Hinges : 0

Structure Description: RC slab on RC pierwalls and RC diaphragm abutments. All are founded on HP10x57 steel piles.

Span Configuration : 1 @ 11.75 m (38.5'), 1 @ 14.25 m (46.75'), 1 @ 11.75 m (38.5')

LOAD CAPACITY AND RATINGS

Design Live Load: MS-18+MOD OR HS-20+MOD
Inventory Rating: 32.4 metric tons Calculation Method: LOAD FACTOR
Operating Rating: 43.1 metric tons Calculation Method: LOAD FACTOR
Permit Rating : PPPPP
Posting Load : Type 3 N/A Type 3S2 N/A Type 3-3 N/A

DESCRIPTION ON STRUCTURE

Deck X-Section: 0.535 m br, 3.0 m sh, 3.6 m, 1.20 m med, 3.6 m, 3.0 m sh, 0.435 m br, 3.0 m ped/blane, 0.300 m br

Total Width: 18.7 m Net Width: 14.4 m No. of Lanes: 2
Rail Description: Type 25 left, Type 27 w/ tubular handrail, Type 26 (mod) right. Rail Code : 1111

Min. Vertical Clearance: Unimpaired

DESCRIPTION UNDER STRUCTURE

Channel Description: Concrete lined

CONDITION TEXT

SCOUR
The bridge was built in 2003 and was initially assigned an Item 113 "Scour Critical Bridges" code of 6 (scour evaluation not yet made). This inspection was conducted by the Hydraulics Branch to record a cross-section and to determine the appropriate 113 code.

By visual inspection and by use of a probe it was determined that the channel banks and bed are fully lined with PCC under the bridge. Additionally, the banks upstream and downstream are well armored with RSP. There is a concrete drop structure 100 meters downstream of the bridge that is maintaining the channel bed elevation at the bridge. The bridge is not vulnerable to scour with the channel in its current state.

Based on current Caltrans policy, the appropriate NBIS Structure Inventory & Assessment Item 113 code for the bridge is 8, "Bridge foundations determined to be stable for assessed or calculated scour condition. Scour is determined to be above top of footing by assessment, by calculation or by installation of properly designed countermeasures."

A channel cross-section was recorded on the upstream side of the bridge. A plot of the cross-section and photographs of the site are included with this report.

REVISIONS
The Item 113 "Scour Critical Bridges" code has been changed from 6 to 8.

ClibPDF - www.fastio.com

CHANNEL X-SECTION

Side : Upstream
Measured From : Deck surface

X-Section Date: 03/02/2006

Location	Horiz(m)	Vert(m)	Comments
Abutment 1	0.00	0.90	Top of PCC slope @ face of abutment
	8.40	3.72	Toe of PCC slope
Pier 2	11.15	13.19	PCC invert
	18.57	4.52	PCC invert
	22.87	4.62	PCC invert
Pier 3	25.40	4.72	PCC invert
	26.32	4.72	Toe of PCC slope
Abutment 4	36.55	0.80	Top of PCC slope @ face of abutment

Inspected By : Scott H. Davis

Scott H. Davis

Registered Civil Engineer

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FOR CONTRACT NO. 297614

DRAINAGE/HYDRAULIC INFORMATION

DRAINAGE REPORT FINAL PS&E SUBMITTAL

DATED 01/2011

State Route 84 Expressway Widening Project
Cities of Livermore and Pleasanton, Alameda County, California

Drainage Report
Final PS&E Submittal

Prepared for:

Caltrans

ACTIA
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY

URS

Prepared by:

WRECO

January 2011

04-ALA-84
PM 22.9/27.1
EA 04-297601

State Route 84 Expressway Widening Project
Cities of Livermore and Pleasanton, Alameda County, California

Drainage Report
Final PS&E Submittal

Submitted to:

California Department of Transportation and
Alameda County Transportation Improvement Authority

This report has been prepared by or under the supervision of the following Registered Engineer. The Registered Civil Engineer attests to the technical information contained herein and has judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

Analette Ochoa

Analette Ochoa, P.E.
Registered Civil Engineer

4/12/11
Date

January 2011

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Executive Summary

This document is the Drainage Report for the proposed State Route 84 (SR 84) Expressway Project (Project) located in the cities of Pleasanton and Livermore, Alameda County, California. The purpose of this report is to present the drainage design effort and clarify the procedures, methodologies, and criteria used in the drainage analysis and design. It also summarizes the proposed improvements to the existing drainage systems and explains the basis for the design of the on-site storm water collection and treatment systems.

The Project proposes to widen and upgrade SR 84 in Alameda County to expressway standards (55 mph), between Ruby Hill Drive and Jack London Boulevard, within the cities of Pleasanton and Livermore. The purpose of the Project is to 1) improve SR 84 as a regional route to be consistent with other committed projects on the route; 2) improve local traffic circulation; 3) upgrade SR 84 to an expressway facility with access control; and 4) improve bicycle and pedestrian access.

There were outstanding R/W and design issues in the southern portion of the Project after the 95% PS&E phase. Due to time and funding constraints, ACTIA and Caltrans have decided to split the Project into two segments such that the northern portion could meet the deadline for the Corridor Mobility Improvement Account (CMIA) funding. Segment A, the northern segment, would begin at station (Sta) “A2” 364+00 and ends at Sta "A3" 447+77.79 (PM 25.5 to PM 27.1); and Segment B, the southern segment, would begin at Sta "A1" 226+97.10 and ends at Sta "A2" 367+01 (PM 22.9 to PM 25.7). Project plan sheets would be submitted under two separate contracts in the 100% PS&E phase. This report covers both segments of the Project.

The existing drainage systems within the Project limits consist of roadside ditches, cross culverts, asphalt concrete (AC) dikes, AC overside drains, inlets, and longitudinal drainage systems. There are three major drainage trunk lines within the Project limits in the existing condition: 1) a 42-inch (in.) drainage trunk line that drains combined flows from SR 84 and the city of Livermore to Arroyo Del Valle; 2) a 36-in. drainage trunk line that drains flows from SR 84 to the pumping plant north of Stanley Boulevard; and 3) a 24-in. drainage trunk line that drains flows from SR 84 and connects to a 36-in. drainage system at the northern Project limit.

The principal features of the Project improvements that would impact the existing drainage facilities are the widening of SR 84, the addition of the concrete barriers at the median and at the edge of shoulders, and the construction of new retaining walls at the edge of the shoulders. The two existing bridges would be widened, and a new trail bridge and an access bridge would be constructed over Arroyo Del Valle and Arroyo Mocho. Refer to the *Bridge Design Hydraulic Study* for additional information pertaining to the bridge improvements (WRECO, 2009). Drainage design improvements would be proposed to accommodate the increase in flow for any undersized culverts. Also, with the addition of concrete barriers, retaining walls, and shoulder widening, additional inlets, longitudinal systems, and modifications to existing drainage systems would be proposed.

Flow diversion would be kept to the minimum extent practicable. The proposed drainage systems within the Project limits would be designed to intercept storm water runoff from SR 84 and areas adjacent to Caltrans' right-of-way (R/W), including areas from the city of Pleasanton and the city of Livermore.

There would be impacts on local drainage systems. An existing unpaved ditch, which currently conveys flows from an existing basin from the Ruby Hill development in the city of Pleasanton, would be impacted by the Project. Flows at this location would be piped to an existing outfall on the east side of SR 84. Also, the 42-in. longitudinal system that currently drains combined flows from SR 84 and the city of Livermore would be replaced with two separate systems, which would separate the on-site flows from the off-site flows. The replacement system for the city of Livermore would require a new outfall at Arroyo Del Valle. Local agency requirements, as well as regulatory requirements, will be met for any proposed drainage improvements that would affect local drainage systems and any work in jurisdictional areas.

Retaining walls and concrete barriers would be installed along the highway median and shoulders to improve safety. The proposed retaining walls at the SR 84/Stanley Boulevard intersection would be designed to accommodate the existing pumping plant. WRECO performed a study to verify the existing condition of the pumping plant and analyze the impacts from the proposed roadway widening and modifications. A summary can be found in the *State Route 84 Expressway Widening Project Pumping Plant Memo* (WRECO, 2011).

In general, this Project would not significantly affect existing drainage patterns. The Project would modify existing drainage systems to accommodate the new widened highway and would adhere to current design standards. The Project addresses the increased roadway runoff from the proposed widening by increasing the capacity of existing drainage systems, where needed, and by implementing outlet protection at the drainage outfalls. Additional flows would not be significant when compared to the overall watersheds of the receiving water bodies of the Project. In addition, the Project also considers water quality measures, or Best Management Practices (BMPs), to address potential temporary and permanent water quality impacts from the Project. The implementation of BMPs is further discussed in the *Storm Water Data Report* (WRECO, 2011).

However, because the Project would result in more than 1 acre (ac) of added impervious area, and the receiving watercourses downstream of the Project are unlined channels, a hydromodification analysis is required to address flow control (i.e., hydrograph modification mitigation) requirements due to added runoff flow and volume associated with the proposed improvements. Detailed analysis and mitigation requirements are further discussed in the Project's *Hydromodification Report* (WRECO, 2011).

Acronyms

AC	Asphalt concrete
ACCMA	Alameda County Congestion Management Agency
ACTIA	Alameda County Transportation Improvement Authority
APC	Alternative Pipe Culvert
BMP	Best Management Practice
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
CMP	Corrugated Metal Pipe
CRZ	Clear Recovery Zone
ESA	Environmentally Sensitive Area
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
HDM	Highway Design Manual
HEC	Hydraulic Engineering Circular
HSG	Hydrologic Soil Group
IDF	Intensity-Duration-Frequency
NAVD 88	North American Vertical Datum of 1988
NB	Northbound
NGVD 29	National Geodetic Vertical Datum of 1929
NRCS	Natural Resources Conservation Service
PA/ED	Project Approval and Environmental Document
PDS	Project Development Support
PDT	Project Development Team
PM	Post Mile
PSR	Project Study Report
PS&E	Plans, Specifications, and Estimates
RCP	Reinforced Concrete Pipe
R/W	Right of Way
SB	Southbound
SR	State Route
Sta	Station
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WSS	Web Soil Survey

1 GENERAL INFORMATION

1.1 Project Description

The State Route 84 Expressway Project (Project) proposes to widen and upgrade State Route (SR) 84 in Alameda County to expressway standards (55 mph) between Ruby Hill Drive and Jack London Boulevard. The purpose of this Project is to improve SR 84 as a regional route, consistent with other committed projects on the route; improve local traffic circulation; upgrade SR 84 to an expressway facility with access control; and improve bicycle and pedestrian access.

This Project has been assigned to the Project Development Category 4A because it requires new right-of-way and an increase in traffic capacity, but the Project does not require a new route adoption. Controlled Access Highway Agreements with the Alameda County, the City of Livermore, and the City of Pleasanton would be required.

The Project proposes to widen SR 84 to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment. The improvements include widening the Arroyo del Valle and Arroyo Mocho bridges; widening and upgrading signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Discovery Drive, and Jack London Boulevard; relocating existing private driveway access to signalized intersections on SR 84; and constructing new bridge crossings over Arroyo Mocho and Arroyo del Valle for private and recreational access.

The roadway cross sections would consist of 12-ft-wide traveled lanes and 10-ft-wide shoulders, divided by a concrete median barrier. Where practical, side slopes would be 4:1 (H:V) or flatter to provide a Clear Recovery Zone (CRZ) for errant vehicles. Outside the CRZ, side slopes would be 2:1 (H:V) or flatter. The roadway median at the intersections would be locally widened up to 36 ft to accommodate left-hand turn lanes.

1.2 Need for Project

The objectives of this Project are to:

- Improve SR 84 as a regional connection between Interstate 680 (I-680) and Interstate 580 (I-580) using expressway standards to the maximum extent feasible. This would be consistent with other programmed projects, assisting the completion of a continuous four- to six-lane facility between Pigeon Pass and the I-580/Isabel Avenue interchange.
- Improve local traffic circulation through added capacity on SR 84 and intersection improvements, thereby attracting regional traffic currently using local streets onto the SR 84 corridor.

- Complete the statutory designation of this section of SR 84 as an expressway facility by providing partial access control and relocating private utilities out of state's right-of-way.
- Improve pedestrian and bicycle access along this section of SR 84 by connecting multi-use trails.

1.3 Project History

Beginning in March 2005, the development of the SR 84 Widening Project was under the management of the Alameda County Transportation Improvement Authority (ACTIA) and the city of Livermore's sponsorship. Monthly Project Development Team (PDT) meetings provided the forum for coordination, issue resolution, and feedback from ACTIA, the cities of Livermore and Pleasanton, the California Department of Transportation (Caltrans), the Alameda County Congestion Management Agency (ACCMA), Alameda County, Zone 7 Water Agency (Zone 7), and other affected agencies. Traffic studies were closely coordinated with the ACCMA Tri-Valley Triangle Traffic Study to ensure consistency in regional planning efforts. Extensive design studies were performed on the Project Study Report (PSR)/PDS alternatives to help reduce environmental impacts, identify right-of-way, and find cost saving refinements for the proposed improvements. Additional design options were investigated including a new alignment between Ruby Hill Drive and Vallecitos Road; a modified Stanley Boulevard intersection in lieu of a full interchange facility; and other Vallecitos/Isabel intersection options.

1.4 Reference Documents

Base drawings for the Project (including topographic surveys, right-of-way, roadway layout, roadway profiles, roadway superelevation diagrams, and roadway cross sections) were provided by URS Corporation.

1.4.1 Planned or Proposed Developments in the Regional Area

1. *Orchid Ranch, City of Livermore, Alameda County, California* (Center Line, 2007)
2. *Oaks Business Park, Construction Plans for Isabel Avenue (SR 84) Widening* (Mark Thomas Company, Inc., 2008)
3. *Project Plans for Construction on State Highway, in Alameda County, in Livermore, on Route 84 from Jack London Boulevard to 0.3 km North of Airway Boulevard* (Caltrans Contract No. 04-171314)

1.4.2 As-built Record Documents

WRECO utilized as-built record drawings, the city of Livermore's *Storm System Facilities* maps, and the Project-specific survey file and cross sections from URS Corporation to estimate elevations of the existing drainage facilities for the design of drainage systems. The as-built record drawings used are as follows:

1. City of Pleasanton

- *Project Plans for Ruby Hill Community Park and Storm Drain Line Ext. from Community Park to Detention Pond #3 dated September 18, 1995.*

2. City of Livermore
    - *Project Plans for Construction on Isabel Avenue–Phase 1 In Alameda County, in Livermore, From 0.75 km south of Concannon Boulevard to 0.1 km north of Airway Boulevard to be supplemented by Standard Plans dated July, 1997, February 26, 1998 Final Submittal.*
    - *Project Plans for Construction on Isabel Avenue Extension–Phase 2, In Alameda County in Livermore From 1.0 km south of Concannon Blvd to Airway Blvd* (2002).
    - *Improvement Plan, Isabel Avenue - Phase I* (Ruggeri, Jensen, Azar & Associates, 1999)
    - *City of Livermore Storm System Facilities* (City of Livermore, 2003)
    - *Isabel Avenue/Vallecitos Road Intersection Realignment Project* (BKF, 2005)
    - *Discovery Drive, Oaks Business Park - Tract 7300* (Kier & Wright, 2007)
    - *Oaks Business Park - Track 7300, Construction Plans for Isabel Avenue (SR 84) Widening* (Mark Thomas & Company, Inc., 2008)
    - *Isabel Avenue Pump Station Field Verification* (URS Corporation, 2008)

3. Caltrans:
    - *1998 Isabel Avenue Phase I (EA 233051)*
    - *1999 Isabel Avenue Phase II (EA 233054)*
    - *2004 Isabel Avenue Vallecitos Project #1999-13*
    - *2006 Pigeon Pass (EA 04-172401)*

1.4.3 Previous Reports

WRECO reviewed the city of Livermore's *Storm Drain Master Plan* for flows currently discharging into the existing 42-in. storm drain system that conveys flow from SR 84 and the city of Livermore between the Ida Holm Park area and Arroyo Del Valle (Schaaf and Wheeler Consulting Civil Engineers, 2004).

WRECO prepared the *Location Hydraulic Study Report* (2005), *Water Quality Study Report* (2007), *Storm Water Data Report* (2007), and *Drainage Report* (2006) for the PA/ED phase of this Project. These reports provided information and recommendations for the Project drainage design. A *Bridge Design Hydraulic Study Report* was also prepared for this Project (2009).

1.4.4 Geographical References

The vertical controls for the references provided are based on the National Geodetic Vertical Datum of 1929 (NGVD 29). The survey for this Project is based on the North American Vertical Datum of 1988 (NAVD 88).

Using the Orthometric Height Conversion from the National Geodetic Survey website, the datum shift (from NGVD 29 to NAVD 88) was calculated based on each location of interest along SR 84. The north latitudes and west longitudes were obtained from Google Earth (Google, Jan. 31, 2007). The calculated datum shifts are summarized in Table 1.

Table 1. Datum Shifts

Location	Latitude	Longitude	Datum Shift	
			(m)	(ft)
Ruby Hill Drive	37°37'58" N	121°48'07" W	0.827	2.71
Arroyo Del Valle	37°39'14" N	121°48'20" W	0.821	2.69
West of Ida Holm Park	37°39'56" N	121°48'20" W	0.817	2.68
Jack London Boulevard	37°41'21" N	121°48'20" W	0.808	2.65

Elevations obtained from the sources listed in Section 1.4.1 and 1.4.2 were adjusted by adding the datum shift to convert from the NGVD 29 datum to the NAVD 88 datum. For example, the elevations near Arroyo Del Valle were adjusted by adding 2.69 ft to convert from the NGVD 29 datum to the NAVD 88 datum.

1.5 Topography

The terrain along the Project corridor is generally flat with gentle to moderate slope grades. There is a depressed section along SR 84 where the highway undercrosses Stanley Boulevard at approximately Sta "A3" 401+00.

The topography along the existing roadway ranges in elevation form approximately 410 to 420 ft between Jack London Boulevard at Sta "A3" 448+00 to the drainage crossing of Arroyo Del Valle at Sta "A1" 320+00. The incised Arroyo Del Valle and Arroyo Mocho drainage crossings are at about elevation 400 ft at the channel bottom. South of the Arroyo Del Valle crossing, the road alignment gradually climbs a gentle alluvial fan, rising to about elevation 590 ft south of Ruby Hill Drive at Sta "A1" 227+00. South of the intersection with Vallecitos Road, the road alignment is surrounded by low rolling hills as it enters the mouth of a canyon (URS, 2009).

1.6 Soil Characteristics

Geologic conditions along the Project alignment were evaluated in the *Geotechnical Design Report and Materials Report* prepared by URS (URS Corporation, 2009). WRECO used the NRCS, Web Soil Survey (WSS) to determine Hydrologic Soil Groups (HSGs) for the off-site watershed areas within the Project area. HSGs are divided into four groups, identified as A, B, C, and D. Three HSGs (Group A, Group B, and Group D) were found to be predominant in the pervious watershed areas, which drain to the Project area.

The following is a summary of characteristics of each group:

- Group A soils have characteristically low runoff potential due to high infiltration rates even when thoroughly wetted. These soils consist primarily of deep, well to

excessively drained sands and gravels with high water transmission rates (at approximately 0.30 in./hr).

- Group B soils have characteristically moderately low runoff potential due to moderate infiltration rates when thoroughly wetted. These soils consist primarily of moderately deep to deep, and moderately well to well-drained soils. These soils have moderate water transmission rates (at approximately 0.15–0.30 in./hr).

- Group D soils have characteristically high runoff potential due to very slow infiltration rates. These soils consist primarily of clays with high swelling potential, soils with permanently high water tables, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material. These soils have very low water transmission rates (at approximately 0–0.05 in./hr).

Soils underlying the Project, with reaches identified by intersections, are listed in Table 2. The identified soil properties include the soil types, soil groups, permeability ranges, and percent slopes.

Table 2. Soil Properties

Location	Soil Symbol	Soil Type	Soil Group	Permeability Range	Slope	Erosion Hazard	Shrink/Swell Potential	Corrosivity	Prime and Other Important Farmlands
W Jack London Boulevard to Stanley Boulevard	Lg	Livermore gravelly loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Prime if Irrigated
	Lm	Livermore very gravelly coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	Rh	Riverwash	A	10 in./hr	---	None	Low	High	---
	YmA	Yolo loam	A	0.8 to 2.5 in./hr	0 to 3%	Moderate	Low	High	Prime if Irrigated
	Yr	Yolo gravelly loam	A	0.8 to 2.5 in./hr	0 to 3%	Moderate	Low	Moderate	Prime if Irrigated
	Za	Zamora silt loam	A	0.2 to 0.8 in./hr	0 to 4%	Very High	Low-Moderate	High	Prime if Irrigated
Stanley Boulevard to Lilienthal Road	Gp	Gravel Pits	A	-	---	Moderate	Low	Moderate	---
	Lg	Livermore gravelly loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Prime if Irrigated
	Lm	Livermore very gravelly coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	PtB2	Positas gravelly loam, thick surface	D	<0.05 to 10 in./hr	2 to 10%	High	High	High	---
	Rh	Riverwash	A	10 in./hr	---	None	Low	High	---
	Za	Zamora silt loam	A	0.2 to 0.8 in./hr	0 to 4%	Very High	Low-Moderate	High	Prime if Irrigated
Lilienthal Road to Ruby Hill Drive	Gp	Gravel Pits	A	-	---	Moderate	Low	Moderate	---
	Lm	Livermore very gravely coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	PgA	Pleasanton gravelly loam	B	0.2 to 0.8 in./hr	0 to 3%	Moderate-High	Moderate	High	Prime if Irrigated
	PoC2	Positas gravelly loam	D	0.8 to 2.5 in./hr	2 to 20%	High	High	High	---
	Rh	Riverwash	A	10 in./hr	---	None	Low	High	---
	YmA	Yolo loam	A	0.8 to 2.5 in./hr	0 to 3%	Moderate	Low	High	Prime if Irrigated
Ruby Hill Drive to Vallecitos Road	Lm	Livermore very gravelly coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	PgA	Pleasanton gravelly loam	B	0.2 to 0.8 in./hr	0 to 3%	Moderate-High	Moderate	High	Prime if Irrigated
	PgB	Pleasanton gravelly loam	A	0.2 to 0.8 in./hr	3 to 12%	Moderate-High	Moderate	Moderate	Statewide Importance
	PoC2	Positas gravelly loam	D	<0.05 to 10 in./hr	2 to 20%	High	High	High	---
	PoE2	Positas gravelly loam	D	<0.05 to 10 in/hr	20 to 40%				
	Sa	San Ysidro Loam	D	<0.05 in/hr	---				

Source: AGS, Inc. and NCRS, WSS

1.7 Land Use

1.7.1 Existing Condition

In the Project vicinity, the land use is residential with some commercial use within the City of Livermore. Aerial photographs indicate that the east side of SR 84, from the northern project limits to Alden Lane, is residential. The Ruby Hill Development in the City of Pleasanton is located on the west side of SR 84, from Vineyard Road to the southern Project limits. The land use from Alden Lane to the southern end of the Project limits (on the west side of SR 84) is agricultural. There are two gravel mining facilities along Arroyo Del Valle on both sides of the freeway, operated by Cemex and Vulcan; these activities are located adjacent to the western side of SR 84, between Arroyo Del Valle and Stanley Boulevard.

1.7.2 Future Land Use

Expansion of the Cemex and Vulcan gravel mining operations is planned to occur on both sides of SR 84 between Vineyard Avenue and Stanley Boulevard. However, these operations are independent of the proposed highway improvements. Mining operations would take place within 50 ft of the existing R/W limits. Significant mining operations of up to depths of 240 ft are planned. After mining is completed in approximately 25 years, an adopted Zone 7 *Reclamation Plan* would be initiated. This plan specifies the formation of basins—collectively referred to as the Chain of Lakes—to create seasonal water storage, flood water detention, and conveyance of both local and imported waters (see Attachments). The Chain of Lakes would be located between the Cities of Livermore and Pleasanton; when completed, it would consist of a series of reclaimed gravel quarry pits converted into nine linked lakes. More information can be found in the *Storm Water Data Report* (WRECO, 2010).

1.8 Creeks, Streams, and River Crossings

Two major creeks cross SR 84 within the Project limits: Arroyo Del Valle and Arroyo Mocho. Arroyo Del Valle crosses SR 84 underneath a bridge just north of the SR 84/Vineyard Avenue intersection, between Sta “A1” 319+10 and Sta “A1” 320+55. Arroyo Mocho crosses SR 84 underneath a bridge between Stanley Boulevard and Discovery Drive, between Sta “A3” 413+90 to Sta “A3” 415+15. Both bridges would be widened as part of this Project. Arroyo Las Positas, which is located approximately 0.5 mile north of the Project limits, is also a receiving water body for the Project. The locations of these creeks are shown in Figure 2.

One new trail bridge and one access bridge would be constructed also as part of the Project. The trail bridge at Arroyo Del Valle would be located 19 ft upstream of the proposed SR 84/Arroyo Del Valle bridge; and the access bridge at Arroyo Mocho would be located approximately 64 ft downstream of the proposed SR 84/Arroyo Mocho bridge. Both bridges would be located outside of Caltrans’ R/W. Detailed hydrologic and hydraulic analyses for the bridges proposed for the Project are discussed in the *Draft Bridge Design Hydraulic Study Report* (WRECO, 2009).

1.9 Existing Drainage and Drainage Design Issues

The existing drainage systems within the Project limits consist of roadside ditches, cross culverts, longitudinal culverts, asphalt concrete (AC) dikes and concrete curbs with inlets to collect storm water at shoulders, and AC overside drains. There is also a pump facility just north of the Stanley Boulevard overcrossing.

Currently, most of the storm water within the Project area discharges to Arroyo Del Valle and Arroyo Mocho. A portion of the runoff, toward the northern end of the Project, discharges to Arroyo Las Positas, which is approximately 0.5 mi away from the northern Project limit. Arroyo Las Positas is a tributary of Arroyo Mocho. Storm water flows from Arroyo Del Valle and Arroyo Mocho, eventually discharging into Arroyo de la Laguna (approximately 9 mi from the Project limits).

The principal features of the proposed improvements, which would impact the existing drainage facilities, are the widening of SR 84, the addition of the median concrete barriers, and the construction of new dikes, concrete barriers, and retaining walls along the edge of the shoulders. The two bridges over Arroyo Del Valle and Arroyo Mocho would also be widened. At these locations, culverts in serviceable condition would be extended to address the proposed widening. Undersized culverts would be replaced with larger size culverts and additional inlets and new longitudinal systems would need to be proposed to meet the current drainage design requirements (time of concentration of 5 minutes [min]). Existing drainage systems at the edge of shoulders would need to be relocated or adjusted, or new systems would need to be proposed to address new concrete barriers and retaining walls. There are also proposed drainage improvements outside of Caltrans' right of way (R/W).

In general, this Project would not significantly affect the existing drainage patterns and would address the increased roadway runoff from the proposed widening by implementing outlet protection, velocity dissipation devices, and possible peak flow attenuation facilities. The increased runoff would not be significant compared to the overall watershed of the receiving water bodies of the Project. The Project design goal is to maintain the existing flow patterns and to minimize the increased flow volume to the maximum extent practicable.

The following summarizes the existing drainage conditions and the basis of the drainage design:

1.9.1 Segment A (PM 25.5 to PM 27.1)

1. Roadway runoff between the Ida Holm Park area, in the south, and just south of the Arroyo Mocho Bridge, in the north, would drain to the existing Isabel Pumping Plant adjacent to the Stanley Boulevard overcrossing prior to being discharged to Arroyo Mocho. The proposed retaining walls along the edge of shoulders of SR 84 near Stanley Boulevard would be designed to accommodate the existing pumping plant, including the existing junction structures and storage bays. The existing 24-in culvert along NB SR 84 that connects from the north to

the existing junction box at approximately Sta "A3" 402+60 would be impacted by the proposed retaining walls along NB SR 84 (RW 400N). New culvert connections to the existing storage structures would be proposed.

Inlet bases were pre-constructed for future widening at the time the pumping plant was constructed. However, these inlet bases do not line up with the Project's edge of shoulders. Modifications to these inlet bases would require structural modifications to the existing junction box and storage bay, and would be included in the Project's structure plans.

2. WRECO performed a study to verify the existing condition of the pumping plant and analyze the impacts from the proposed roadway widening. The capacity of existing pumping plant and storage bays were verified to handle the proposed Project's runoff. A summary can be found in the *State Route 84 Expressway Widening Project Pumping Plant Capacity Memo* (WRECO, 2011).

3. There is an existing inlet located at a low point along the southbound side of SR 84 at approximately Sta "A3" 400+96 that ties into the underlying 96 in. x 96 in. reinforced concrete box storage bay. Due to the proposed Project widening, the inlet grate location will be located in the middle of the southbound shoulder, approximately 3.5 ft offset from the edge of shoulder. Because of the underlying storage bay structural connection, as well as the shallow depth to the top of the storage bay, the inlet grate location could not be moved to the edge of shoulder. In order to minimize ponding at this location, two slotted pipes were proposed to the north and south of this inlet. These slotted pipes would serve as flanking inlets to add additional capacity to avoid any spread problems. The slotted pipes were sized to a non-standard 12 in. diameter due to the shallowness of the underlying storage bay. The use of the 12 in. diameter slotted pipes was approved by Caltrans District 4 Hydraulics (email from Carlos Mora, January 6, 2011).

4. Flows from north of the Arroyo Mocho Bridge to the end of the Project limits, at Jack London Boulevard, would drain north and connect to the existing City of Livermore storm drain systems designed by Mark Thomas and Company, Inc. as part of a separate project (Caltrans Contract No. 04-171314).

5. There are currently gutter spread problems at Discovery Drive within Caltrans' R/W in the existing condition. Large offsite runoff is currently conveyed along existing curbs and gutters that drain east into Caltrans' R/W. At least two lanes would be proposed on each traffic direction of Discovery Drive. However, because no shoulder would be provided in the proposed condition, the drainage design assumed an allowable spread width of the combined width of the gutter and the rightmost lane on both sides of Discovery Drive. Additional inlets were proposed at the Project limit to improve surface flow and to reduce gutter spread width. Gutter spreads are significantly minimized at both sides of Discovery Drive when compared to the existing condition.

6. The proposed roadway consists of reaches at superelevation with very shallow longitudinal and cross slopes and no high-side gutter. Slotted drain pipes were proposed at some of these locations where inlets alone are found not sufficient to handle the resulting water spread. However, for maintenance and safety concerns, no slotted drain pipes would be proposed along the median shoulder.

7. Some cross culverts would be impacted by the proposed roadway widening. In general, culverts in good condition would remain unless they are undersized or adjustments to the invert elevations are required. In addition, cross culverts that would not be used in the proposed condition would be abandoned as opposed to being removed in order to minimize impacts to the existing roadway operations. All abandoned culverts will be back-filled with sand.

8. The proposed roadway connection between the access bridge over Arroyo Mocho and the Voyager Street extension (line "AC2") will be constructed over an existing ditch. This ditch will not be replaced in the proposed Project due to easement restrictions; however the proposed roadway embankment on the right side of line "AC2" will create a small undefined gutter due to the existing ground topography and the proposed grading. This undefined gutter will be relieved via a cross culvert at approximately Sta "AC2" 220+75. The cross culvert will outfall into the space between lines "AC2" and "AC3" and the area will be graded to drain toward an existing inlet that connects to a drainage system along Voyager Street and Discovery Drive.

1.9.2 Segment B (PM 22.9 to PM 25.7)

1. Large offsite runoff from Ruby Hill Drive is currently conveyed along existing curbs and gutters that drain east into Caltrans' R/W. At least two lanes would be proposed on each traffic direction of Ruby Hill Drive. However, because no shoulder would be proposed in the proposed condition, the drainage design assumed an allowable spread width of the combined width of the gutter and the rightmost lane on both sides of Ruby Hill Drive. Although the Project would not increase the drainage areas to inlets at Ruby Hill Drive, additional inlets would be proposed at the Project limit to reduce the current gutter spread width and to minimize the by-pass flows across SR 84 at the Ruby Hill Drive intersection. Gutter spreads are significantly minimized at both sides of Ruby Hill Drive when compared to the existing condition.

2. Flow from an existing basin at the Ruby Hill Development in the city of Pleasanton is currently conveyed through culverts and a ditch that crosses SR 84 at Sta "A1" 242+50, approximately. The ditch would be covered entirely by the proposed roadway widening. Culverts and manholes would be proposed to convey flow from the existing 24-in. RCP to the existing 42-in. corrugated metal pipe (CMP). The existing outfall at the end of the 42" CMP on the east side of SR 84 would remain.

3. Offsite runoff from residential developments in the city of Pleasanton currently flows into Caltrans' R/W from Cabonia Court (approximately at Sta "A1" 271+05) and Sangro Court (approximately at Sta "A1" 267+60) through two separate 15-in. RCPs. These culverts discharge into the existing ditch on the left side of SR 84. According to field investigation, substantial soil erosion occurs at both outfall locations. The existing eroded ditch would be replaced by a concrete lined gutter, and flared end sections would be proposed at both pipe outfalls.

   Although as-built records indicate that both culverts are designed as emergency overflows, no further information was obtained for the basis of the original design to determine the actual discharges. Based on the existing conditions observed, proposed gutter on the left side of SR 84 and the downstream culvert system were designed to accommodate the 25-year recurrence interval design storm for these two tributary areas in addition to the on-site highway flows.

4. Flows between Sta "A1" 319+00 to Sta "A2" 362+00 that drain to Arroyo Del Valle are currently conveyed through existing 42-in. RCPs, which combine on-site runoff from SR 84 with a significant amount of off-site runoff from the city of Livermore. Per Caltrans' direction, this existing system would need to be replaced with two separate systems, which would separate Caltrans runoff from city of Livermore's runoff.

   All existing lateral connections from the city of Livermore to the existing 42-in. system are currently connecting from the east. Therefore, the new city's replacement system would be proposed on the east side of SR 84. The upstream end of this longitudinal drainage system would connect to the existing city of Livermore storm drain system at the Ida Holm Park area (at approximately Sta "A2" 356+80), where it begins to merge into the combined system within Caltran's R/W in the existing condition. This new longitudinal system would drain south roughly parallel to SR 84 outside of Caltran's R/W beneath the trail path, collecting runoff from all existing laterals from the residential areas on the east side of SR 84, and it would outfall at Arroyo Del Valle on the east side of SR 84. This system would contain runoff solely from city of Livermore and would be maintained by the city.

   Another longitudinal drainage system would be proposed within Caltrans' R/W, which would convey only on-site runoff. This system would also drain south and outfall separately at Arroyo Del Valle on the west side of SR 84.

9. Large offsite runoff from Concannon Boulevard is currently conveyed along existing curbs and gutters that drain west into Caltrans' R/W. At least two lanes would be proposed on each traffic direction of Concannon Boulevard. The drainage design assumed an allowable spread width of the combined width of the shoulder and the rightmost lane on both sides of Concannon Boulevard.

10. The proposed roadway consists of reaches at superelevation with very shallow longitudinal and cross slopes and no high-side gutter. Slotted drain pipes were proposed at some of these locations where inlets alone are found not sufficient to handle the resulting water spread. However, for maintenance and safety concerns, no slotted drain pipes would be proposed at the median shoulder.

11. Some cross culverts would be impacted by the proposed roadway widening. In general, culverts in good condition would remain unless they are undersized or adjustments to the invert elevations are required. In addition, cross culverts that would not be used in the proposed condition would be abandoned as opposed to being removed in order to minimize impacts to the existing roadway operations. All abandoned culverts will be back-filled with sand.

1.10 Drainage Design Criteria

The drainage design for the Project adheres to the methodologies as specified in the *Highway Design Manual* (HDM) published by Caltrans; the Hydraulic Engineering Circular Number 22 (HEC-22) publication for highway pavement drainage published by the U.S. Department of Transportation, Federal Highway Administration (FHWA); the city of Livermore's *1995 Facilities Planning Guidelines*; and the city of Pleasanton's *Design Guide* (1984), depending upon the jurisdiction for which the proposed drainage system is located.

There would be impacts to local drainage systems due to the Project development. In general, drainage systems that convey offsite flows from the west side of SR 84 are under the jurisdiction of the city of Pleasanton, and drainage systems that convey offsite flows from the east side of SR 84 are under the jurisdiction of the city of Livermore. All proposed drainage systems within Caltrans' right-of-way would be designed per the HDM.

1.11 Special Circumstances

Environmentally sensitive areas (ESAs) exist within the Project limits. ESAs have been confirmed as the areas at creek crossings and on the east side of SR 84, between Ruby Hill Drive (at approximately Sta "A1" 234+50) and the Project limit at Vallecitos Road (at approximately "V" 115+00). Between Ruby Hill Drive and Vallecitos Road, SR 84 would be realigned to avoid encroachment onto the ESA on the east side. Impacts to these areas would be minimized to the maximum extent practicable.

1.12 Agencies Impacting Design

The Project is located in the city of Pleasanton and the city of Livermore, Alameda County, California. Any drainage improvements proposed for local roads and/or any other off-site drainage systems impacted by the Project will conform to the local agencies' requirements.

The Project is under the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (SBRWQCB) (Region 2), United States Army Corps of Engineers

(USACE), Federal Emergency Management Agency (FEMA), California Department of Water Resources, and the Zone 7 Water Agency. Although work within ESAs would be minimized, it is still anticipated that permits with regulatory agencies would be necessary.

Permits from the following agencies are anticipated:

- USACE (404)
- California Department of Fish and Game (1602)
- SFBRWQCB (401)
- City of Livermore (encroachment)
- City of Pleasanton (encroachment)
- Zone 7 Water Agency (encroachment)

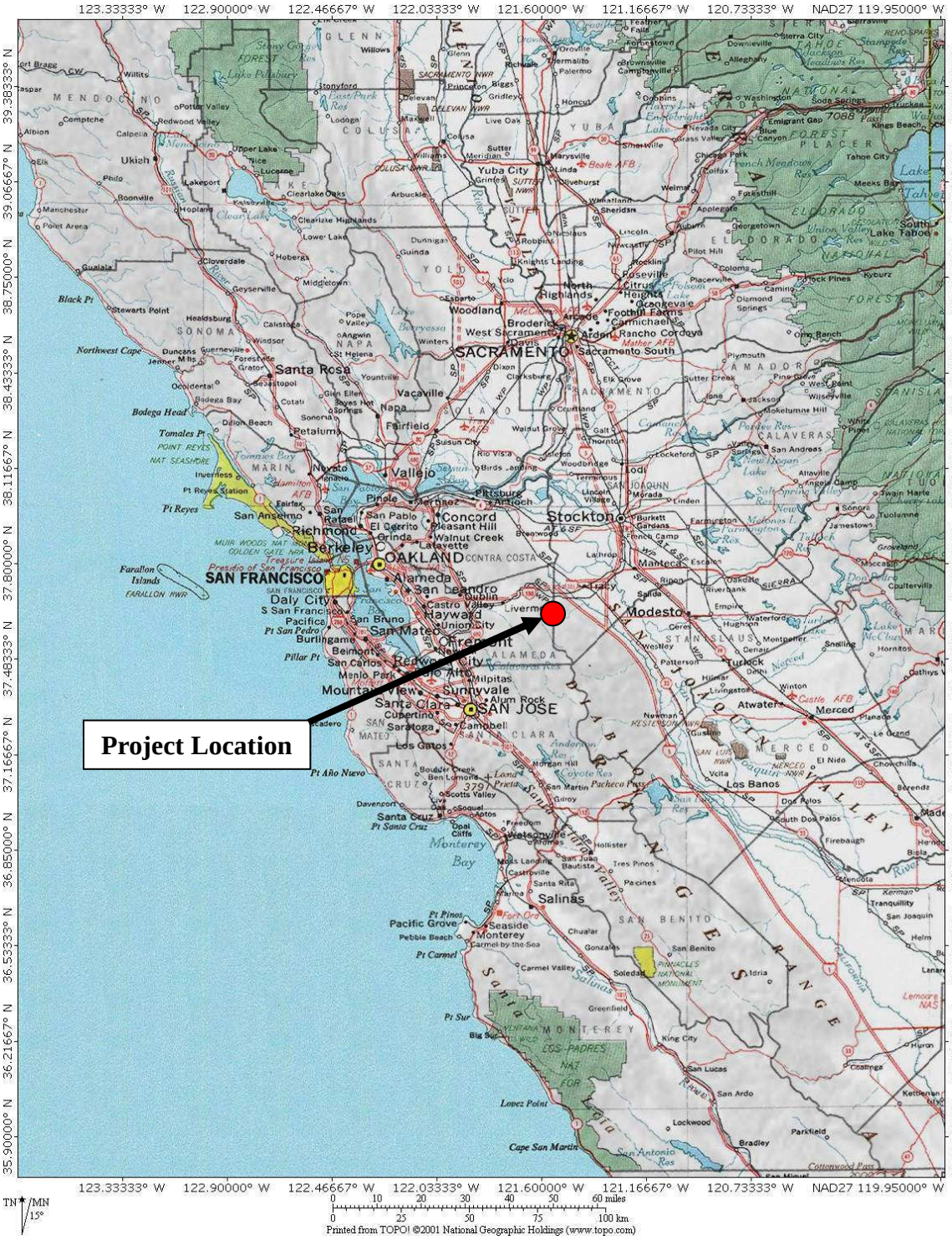

Figure 1. Location Map

Source: United States Geological Survey (USGS)

Figure 2. Vicinity Map

Source: URS Corporation

2 OFF-SITE HYDROLOGY

Off-site hydrology for the city of Pleasanton was based on as-built records and topographic survey, and the analysis would be based on procedures presented in the *Design Guide* from the city of Pleasanton. Runoff from Ruby Hill Drive would flow into Caltrans' R/W on the left side of SR 84. Drainage from residential properties in the city of Pleasanton would flow into Caltrans' right-of-way from Cabonia Court and Sangro Court through two separate 15-in. RCPs (emergency overflows).

Flows from an existing basin, from the Ruby Hill Development in the city of Pleasanton, are currently conveyed through a 24-in. RCP, which outfalls into a ditch and flows under SR 84 through a 42-in. CMP at approximate Sta "A1" 240+24. The roadway widening would impact this drainage ditch. The ditch would be replaced with two 42-in. alternative pipe culverts (APC), which would connect the existing 24-in. and 42-in. culverts.

Off-site hydrology for the city of Livermore was based on information provided in the city of Livermore's *Storm Drain Master Plan* developed by Schaaf and Wheeler Consulting Civil Engineers (2004). The report documented existing drainage information and provided drainage design standards in five subsections of the city of Livermore: Northeast, Southwest, East, Downtown, and Northwest. This Project is within the Southwest subsection.

2.1 Watershed and Basin Characteristics

In the city of Pleasanton, the land use of the watershed is composed of single family residential developments. Off-site watersheds from the city of Pleasanton were delineated from local topography and verified from field investigations.

The watersheds east of SR 84, in the city of Livermore between the Arroyo Del Valle Bridge and Stanley Boulevard, are primarily residential. Further details are provided in the *Storm Drain Master Plan* (Schaaf and Wheeler Consulting Civil Engineers, 2004).

2.2 Estimating Design Discharge

The *Storm Drain Master Plan* (Schaaf and Wheeler Consulting Civil Engineers, 2004) provides design discharges of off-site flows from the city of Livermore. Discharges were estimated using the MOUSE model. The southwest subsection of the city of Livermore, where the Project is located, was modeled as an independent drainage system.

Design discharges at each drainage node in the model included: full and maximum pipe capacity discharges; existing (undeveloped) land use planning conditions; and, ultimate (developed) land use planning conditions. The maximum pipe capacity discharges for the ultimate land use planning condition were used in WRECO's calculations. Refer to the *Storm Drain Master Plan* for further details.

The city of Pleasanton does not have sufficient information regarding their storm water discharge. Therefore, design discharges of off-site flows from the city of Pleasanton would be estimated using rational method as specified in the city of Pleasanton's *Design Guide*. According to the *Design Guide,* the runoff coefficient should be 0.4 for "single family residential" development. This number would be multiplied by a factor of 1.1 to obtain the runoff coefficient for the 25-year recurrence interval.

2.3 Rainfall Data and Intensities

Per the city of Livermore's design criteria, runoff calculations for drainage systems in their R/W were based on a 10-year recurrence interval design storm, 24-hour rainfall data from the Alameda County Hydrology and Hydraulics Manual. A frequency factor of 3.211 was applied for the 100-year recurrence interval design storm. Further details are provided in the *Storm Drain Master Plan* (Schaaf and Wheeler Consulting Civil Engineers, 2004).

The design rainfall intensities, for the discharges from the city of Pleasanton, were based on the methodologies provided in the city of Pleasanton's *Design Guide*. The intensity for a 25-year recurrence interval design storm, 5-minute storm event was estimated to be 2.919 in./hr.

2.4 Points of Concentration and Outfalls

Flows draining to Arroyo Del Valle are currently conveyed through an existing 42 in. pipe culvert within the Caltrans' R/W, which combines the on-site flows from SR 84 with large off-site flows from the city of Livermore. Per Caltrans' direction, this existing system would need to be replaced with two separate systems, which would separate the on-site flows from the off-site flows. The new longitudinal drainage system would be 42-in. in diameter and would convey these off-site flows from the city of Livermore, and would outfall at Arroyo Del Valle.

These off-site flows from the city of Livermore's residential areas would concentrate at culvert trunk lines, which would tie into the 42-in. diameter longitudinal drainage system through manholes spaced no more than 500 ft apart.

There is currently no new storm drain system proposed within the jurisdiction of the city of Pleasanton.

3 OFF-SITE HYDRAULICS

This section summarizes the procedures followed to develop design recommendations, including upstream and downstream inverts and culvert sizes. These procedures were used to design the 42-in. diameter longitudinal drainage system that would convey runoff from the city of Livermore. Drainage design was based on procedures specified in the *1995 Facilities Planning Guidelines* by the city of Livermore, and data provided in the *Storm Drain Master Plan*.

A capacity analysis for the inlets and pipes was performed using the *Hydraflow Storm Sewers 2008* software (Intelisolve, 2008). The upstream invert elevations, where the city of Livermore's drainage systems tie into the proposed longitudinal system, were based on elevations shown on the city of Livermore's *Storm System Facilities* maps. WRECO specified downstream invert elevations at the proposed manholes and for the outfall into Arroyo Del Valle. These invert elevations were determined based on the design criteria listed in Table 3 and the invert elevations at each existing lateral connections. The feasibility of these invert elevations would need verification and refinement.

3.1 System Controls

The new drainage systems within the City of Livermore were designed based on the city's *1995 Facilities Planning Guidelines*. Summary of design standards are listed in Table 3.

Table 3. City of Livermore Storm Drain Design Criteria

Condition	Design Criteria
New systems	10-year HGL 1.25 ft below curb
New systems	100-year HGL below curb
New outfalls	Flap-gated
Closed Conduits	Max velocity < 14 ft/sec
Closed Conduits	Min velocity > 2.5 ft/sec
Closed Conduits	Min Slope > 0.0007 ft/ft
Closed Conduits	Min Pipe Size 12-in.
Improvements	Min Pipe Size 12-in.
Manhole spacing	No farther than 500 ft apart
Gutter flow	Not to exceed 8 ft during a 10-year design storm

Source: Schaaf and Wheeler Consulting Civil Engineers, 2004

Existing culvert diameters, slopes, and elevations were determined using the city of Livermore's *Storm System Facilities* map, Caltrans' as-built drawings, and the ground survey performed for the Project.

Because the elevations of the existing lateral connections are relatively deep, the outfall of the city of Livermore's 42-in. longitudinal system at Arroyo Del Valle would be located close to the bottom of the channel. An automatic drainage gate would be

proposed to offer protection against backwater surges, and the downstream boundary control would be the elevation of the culvert soffit at the outfall at Arroyo Del Valle.

3.2 Culvert Material

Culvert material for the new longitudinal and lateral systems would be specified in the contract documents as APC Type A (any allowable pipe materials) where slopes allow, or APC Type B (designated for culvert with smooth interior wall). Manning's n roughness coefficients of 0.024 and 0.013 would be used for Type A and Type B respectively in the capacity calculations using *Hydraflow Storm Sewers 2008*.

3.3 Inlet and Outlet Treatment and Energy Dissipation

Rock slope protection and headwalls would be specified at the proposed outfall at Arroyo Del Valle to minimize potential erosion. The *California Bank and Shore Rock Slope Protection Design* manual would be used to design the rock slope protection (Caltrans, 1997).

4 ON-SITE ROADWAY DRAINAGE

URS Corporation provided roadway layouts, profiles, superelevation diagrams, and cross sections at 50 ft intervals along the length of major alignments. This information was used to determine the location of drainage structures and to estimate the top of grate elevations of the proposed inlets and cover elevations of manholes.

4.1 Recurrence Interval

This Project would upgrade SR 84 within the Project limits to expressway standards (55 mph). Since the proposed Project will be a multi-lane highway with permitted speeds of over 45 mph (75 kph), according to Table 831.3 of the HDM, runoff would be estimated based on the 25-year recurrence interval design storm. With the exception of runoff from the depressed section along SR 84, from Sta "A2" 357+00 to Sta "A3" 415+50, where flows would drain to the existing Isabel Pumping Plant just north of the Stanley Boulevard overcrossing, the 50-year recurrence interval design storm would be used.

4.2 Rainfall Data and Intensities

WRECO used the WinIDF program developed by Caltrans to estimate design rainfall intensities.

The Project area south of Ida Holm Park is within 3 mi of the Arroyo Del Valle rain gages. The estimated design rainfall intensity was obtained directly from the WinIDF program by inputting a reference point within this area.

There are currently no rain gages within 3 mi of the Project site north of Ida Holm Park. Therefore, rainfall intensity for the northern part of the Project was estimated using the quadrant method presented in the *Caltrans IDF Equation* (Gonsalves, 1999). WRECO identified the closest rain gage station in each quadrant relative to the northern part of the Project and input those into the WinIDF program. If two stations within a quadrant are about the same distance to the Project reference point, then the station with a longer record is used.

The following are the rainfall intensities used at various locations of the Project:

- From the southern end of the Project to Ida Holm Park: 3.266 in./hr (25-year, 5-min storm)
- From Ida Holm Park to Arroyo Mocho crossing: 3.524 in./hr (50-year, 5-min storm)
- From the Arroyo Mocho crossing to the northern end of Project: 3.137 in./hr (25-year, 5-min storm)

The rainfall data used in the Project was reviewed and approved by Caltrans District 4 Hydraulics. The approved rainfall intensity tables and curves can be found in Appendix B.

4.3 Points of Concentration

Storm water flows would be conveyed in roadside gutters, and along dikes, barriers, or retaining walls. The points of concentration for the on-site roadway drainage systems also include drainage inlets, manholes, and outfalls.

4.4 Time of Concentration

WRECO estimated times of concentration following the procedures in section 816.6 in the HDM. The HDM also recommends a minimum time of concentration of five minutes for paved areas and steep unpaved areas, and ten minutes for rural or undeveloped areas. All of the on-site drainage systems in the Project have relatively short flow path lengths, therefore the calculated times of concentration for those catchments would be shorter than the suggested minimums. Consequently, WRECO used a five minute time of concentration for all on-site paved catchments in the Project that drain directly to inlet. For all other locations, WRECO estimated times of concentration following the procedures in the HDM.

4.5 System Controls

WRECO specified upstream and downstream invert elevations for the proposed culverts. For proposed systems connecting to existing systems, the upstream and/or downstream invert elevations of the existing systems control the proposed culvert vertical alignments. The existing invert elevations were determined based on survey data (provided by URS Corporation), as-built drawings, the city of Livermore's *Storm System Facilities* map, and the latest drainage plans from regional planned developments in cities of Pleasanton and Livermore. For systems that discharge to open channels, the topography at the channel controls the proposed culvert vertical alignments.

4.5.1 Segment A

The downstream boundary control for drainage systems that connect to the existing Isabel Pumping Plant at Stanley Boulevard would be the post-Project water surface elevation at the pumping plant. WRECO performed an estimate on the flow depth using the post-Project required storage volume divided by the footprint of the pumping plant storage, assuming a uniform water distribution. WRECO then added the resulting depth to the flowline of the upstream storage bay to obtain an estimated headwater elevation of approximately 390.25 ft.

The downstream boundary control for the drainage system that discharges to Arroyo Mocho would be the 25-year water surface elevation at the outfall at the Arroyo Mocho. WRECO conducted a hydraulic analysis using the Hydrologic Engineering Center River Analysis System (HEC-RAS) to determine the water surface elevation. The HEC-RAS model results can be found in Appendix D.

The downstream boundary control for drainage system that connects to existing pipeline is assumed to be 1 ft below the top of grate/cover elevation at the downstream connection point, if the existing water surface elevation of the existing pipeline cannot be obtained.

4.5.2 Segment B

The downstream boundary control for the drainage system that discharges to Arroyo Del Valle would be the 25-year water surface elevation at the outfall at the Arroyo Del Valle. WRECO conducted a hydraulic analysis using the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) to determine the water surface elevation. The HEC-RAS model results can be found in Appendix D.

However, because an automatic drainage gate would be proposed for the Caltrans' 42-in. longitudinal system that discharges to Arroyo Del Valle to offer protection against backwater surges, the downstream boundary control of the system would be the elevation of the culvert soffit at the outfall at Arroyo Del Valle.

The downstream boundary control for the drainage system that connects to the existing pipeline is assumed to be 1 ft below the top of grate/cover elevation at the downstream connection point, if the existing water surface elevation of the existing pipeline cannot be obtained.

4.6 Culvert Material Design

The drainage design designated all culverts as APC rather than specifying particular pipe materials, with the exceptions of downdrains and culverts behind retaining walls. This leaves the Construction Contractor the ability to choose the appropriate material from a list of allowable materials recommended by the Project geotechnical engineer. The acceptable APC materials for the Project are specified on Project plan sheet DQ-1, the first page of the project drainage quantity sheets, prepared by WRECO.

All pipe joint types shall be standard unless otherwise noted on the Project plans. Watertight joints would be specified within the depressed section due to groundwater levels.

4.7 Hydraulic Grade Line Calculations

WRECO performed hydraulic grade line analyses for on-site systems using *Hydraflow Storm Sewers 2008*. WRECO determined invert elevations for drainage structures based on system controls. A pipe size was assigned for each drainage culvert, with a minimum diameter of 18 in. for culverts wholly or partly under the roadbed, per Table 838.4 of the HDM. For proposed systems that connect to existing upstream drainage systems, the size of the proposed downstream system would be at least the size of the upstream culvert. The *Hydraflow Storm Sewers 2008* models and results can be found in Appendix G.

4.8 Grate Interception, Bypass, Gutter Spread, and Inlet Capacity Calculations

Grate interception, bypass, gutter spread, and inlet capacity calculations were performed using WRECO's own proprietary spreadsheet-based model developed based on the methodologies and procedures presented in HEC-22 (FHWA, 2001). The calculations can be found in Appendix F.

According to Table 831.3 of the HDM, the design water spread should remain outside of the traveled way along SR 84 and ramp connections. In addition, at the depressed sections that require pumping, the design water spread should not exceed that of adjacent roadway sections. Within the Project limits, the allowable spread width is 10 ft for both travel directions along SR 84, and 8 ft at the proposed Vallecitos Road off-ramp and Stanley Connector. Along all local street connections, the allowable spread width is assumed to be the combined width of the concrete gutter, shoulder (if any), and the right-most lane, if at least two lanes are provided in a traffic direction.

According to Section 831.4 of the HDM, no more than 0.1 cubic feet per second (cfs) of concentrated flow would be allowed to flow across the roadway. At bridge crossing, inlets would be proposed at locations immediately upstream of the structural approach slab such that no more than 0.1 cfs bypass runoff would flow across the bridge.

The proposed roadway consists of reaches at superelevation with very shallow longitudinal and cross slopes and no high-side gutter. Slotted drain pipes were proposed at some of these locations where inlets alone are found not sufficient to handle the resulting water spread. However, for maintenance and safety concerns, no slotted drain pipes would be proposed at the median shoulder.

4.9 Ditches and Gutters

Segment B of the Project would include re-alignment of existing ditches and gutters along the highway and the addition of several new gutter alignments. All new or re-aligned ditches and gutters would outfall into existing ditches, unnamed streams or storm drain systems. All gutters within Caltrans' R/W would be concrete lined per Caltrans Maintenance’s recommendations.

4.10 Overside Drains

Overside drains are proposed only for Segment B of the Project and they would be hot mix asphalt (HMA) overside drains.

4.11 Underdrains

The existing SR 84 within Segment A of the Project includes underdrain systems beneath the outside shoulders within the depressed section and the left side shoulder of Stanley Connector. Per recommendations in the Project *Geotechnical Design Report and Materials Report* (URS, 2009), the Project would construct new underdrain systems at all cuts for new pavement, and replace existing underdrain systems that are affected by the roadway widening. The Project would also leave existing underdrain systems that would not be disturbed by construction, in place, provided their downstream inlet connections would not be disturbed. Sizes, locations, and elevations of underdrains would be based on information provided on the Project Typical Cross Section sheets. All underdrains would outfall into drainage structures.

4.12 Edge Drains

The existing SR 84, from north of Vallecitos Road to the northern Project limit, includes extensive edge drain systems beneath the highway median and shoulders. Both Segments of the Project would replace these systems with systems of similar hydraulic capacity, where excavation would disturb the existing system. Sizes, locations, and elevations of edge drains would be based on information provided on the Project Typical Cross Section sheets. These edge drains would outfall into drainage inlets whenever feasible, or else into other outfall structures.

5 TEMPORARY DRAINAGE

5.1 Segment A

Segment A of the Project includes the SR 84 bridge widening and a new access bridges over Arroyo Mocho. Dewatering operations may be needed during construction to protect water quality. Work would be scheduled only during the allowed construction window. To avoid storm water impacts, the Project would be phased to minimize soil-disturbing work during the rainy season.

Arroyo Mocho is perennial; therefore, both the SR 84 bridge widening and the new access bridge would be constructed during construction stage one and the work are anticipated to be completed in one allowed construction window. Proposed bridge work would require a coffer dam around proposed footing only, therefore avoiding the necessity of a temporary creek diversion.

Segment A construction would occur over a number of stages in order to minimize impacts to traffic in both directions of SR 84. Temporary drainage systems have been proposed in order to prevent construction runoff from entering any live travel lanes during construction. Most of the construction runoff will come in the form of sheet flow. In order to prevent such flow from entering into live travel lanes, temporary unlined ditches have been proposed along the edge of the construction zone to collect this flow and divert it to nearby cross culverts. These temporary ditches will be a minimum of 1 foot wide and 3 in. deep with 2:1 side slopes and will follow the topography of the proposed roadway. The contractor shall direct all water from the temporary ditches to the new or existing inlets as available. At the Arroyo Mocho bridge, a temporary inlet will be constructed to tie into the existing 24 in. cross culvert in order to allow the temporary ditch to drain. At Stanley Boulevard, because no cross culvert exists, a temporary culvert will have to be constructed at the existing low point to relieve the proposed temporary ditch. As the construction stage comes to a close, the ditches will be filled to finish any necessary grading.

5.2 Segment B

Segment B of the Project includes the SR 84 bridge widening, a new trail bridge over Arroyo Del Valle, and two new drainage outfalls at Arroyo Del Valle. Dewatering operations and temporary creek diversion would be needed during construction to protect water quality. Work would be scheduled only during the allowed construction window. To avoid storm water impacts, the Project would be phased to minimize soil-disturbing work during the rainy season.

Arroyo Del Valle is perennial; therefore, temporary creek diversion is anticipated for work at the creek. Both the SR 84 bridge widening and the new trail bridge would be constructed during construction stage one, and the work is anticipated to be completed in one allowed construction window. A lump sum cost of $10,000 is included for temporary creek diversion at Arroyo Del Valle during construction stage one. The pipe

size for the creek diversion system was determined based on the flow corresponding to the observed channel flow depth during summer time.

Project construction would occur over a number of stages in order to minimize impacts to traffic in both directions of SR 84. Temporary drainage systems have been proposed for this Project in order to prevent construction runoff from entering any live travel lanes during construction. Most of the construction runoff will come in the form of sheet flow. In order to prevent such flow from entering into live travel lanes, temporary unlined ditches or temporary slotted pipe culverts have been proposed along the edge of the construction zone to collect this flow and divert it to nearby cross culverts. Temporary ditches will be 1 foot deep with 2:1 side slopes and will follow the topography of the proposed roadway. As the construction stage comes to a close, the temporary ditches will be filled and the temporary slotted pipe culverts will be removed to finish any necessary grading.

6 WATER QUALITY ISSUES

6.1 Storm Water Best Management Practices

Guidelines for the selection of water quality BMPs are based on the storm water pollution prevention procedures developed by Caltrans and those discussed in the Project's *Storm Water Data Report* (WRECO, 2011). Refer to the report for consideration of water quality measures, including temporary construction site BMPs, design pollution prevention BMPs, and treatment BMPs.

Storm water treatment requirements for the Project would be evaluated based on the work of Segment A and Segment B combined. The proposed treatment BMP included in Segment A of the Project is an Austin vault sand filter to the south of the Stanley Boulevard connector loop ramp. The proposed treatment BMPs included in Segment B of the Project are: biofiltration swales with underdrains, biofiltration strips along the Project length (where feasible), and an Austin vault sand filter at the northwest quadrant of the Arroyo Del Valle crossing.

6.2 Hydrograph Modification

Because there is added impervious area resulting from the roadway widening and the receiving water bodies downstream of the Project are unlined channels, the downstream receiving waters are potentially susceptible to hydograph modification (hydromodification). Hydromodification requirements for the Project would be evaluated based on the work of Segment A and Segment B combined. WRECO performed a hydromodification analysis based on the Hydrograph Modification Management Plan (HMP) by the Alameda Countywide Clean Water Program (ACCWP). The report discussed the water quality impacts associated with the proposed widening and the mitigation strategy to address the hydromodification concerns. A detailed analysis can be found in the *Hydromodification Report* (WRECO, 20101).

7 FLOODPLAIN INFORMATION

7.1 Segment A

The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRMs) (Community-Panel Numbers: 060008 0005 B) and the corresponding Letter of Map Revision (LOMRs) of the City of Livermore and the Alameda County were reviewed for Segment A of the Project.

Segment A of the Project falls within FEMA-designated Zones AE and A7 in the vicinity of Arroyo Mocho. According to the LOMRs, the 100-year flood is contained within the channel at the Arroyo Mocho crossing at SR 84. Base flood elevations are shown at selected intervals along Arroyo Mocho, and the base flood elevation is 411 ft at the Arroyo Mocho crossing at SR 84. This elevation is referenced to NGVD 29.

The FIRMs and LOMRs covering Segment A of the Project can be found in Appendix C.

7.2 Segment B

The FEMA FIRMs (Community-Panel Number: 060001 0210 C) were reviewed for Segment B of the Project.

Segment B of the Project falls within FEMA-designated Zones A and AE in the vicinity of Arroyo Del Valle. These zones correspond to the 1% annual chance (100-year recurrence interval design storm) floodplains that are determined in the FEMA Flood Insurance Study (FIS) by detailed methods of analysis. Base flood elevations are shown at selected intervals along Arroyo Del Valle, and the base flood elevation is 415 ft at the Arroyo Del Valle crossing at SR 84. This elevation is referenced to NGVD 29.

The FIRMs covering Segment B of the Project can be found in Appendix C.

8 COST ESTIMATE

The estimated construction costs for the proposed drainage improvements can be found in Appendix I. Cost estimates are provided separately for Segment A and Segment B of the Project. These costs are based on unit costs from the Caltrans' Contract Cost Data Website. These cost estimates do not include costs for erosion control, or temporary construction site BMPs, which are included in the *Storm Water Data Report* (WRECO, 2011).

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Appendix A Drainage Plans

Segment A
(PM 25.5 to PM 27.1)

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
3. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.
4. CONTRACTOR IS RESPONSIBLE TO PROVIDE POSITIVE DRAINAGE FROM ALL ROADWAY AREA AT ALL TIMES.
5. LOCATIONS OF EXISTING DRAINAGE FACILITIES ARE APPROXIMATE. VERIFY LOCATION AND ELEVATION OF EXISTING DRAINAGE FACILITIES PRIOR TO MODIFYING.
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LEGEND:

- Exist STORM DRAIN
- PROPOSED STORM DRAIN
- GUTTER/DITCH FLOW LINE
- No. — DRAINAGE SYSTEM No.
- h — DRAINAGE UNIT
- GRADE TO DRAIN
- INLET
- Exist DI
- CAP DI
- AUSTIN VAULT SAND FILTER

ABBREVIATIONS:

COL	CITY OF LIVERMORE
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA
ASP	ALTERNATIVE SLOTTED PIPE
TC	TOP OF COVER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — 1/17/11
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

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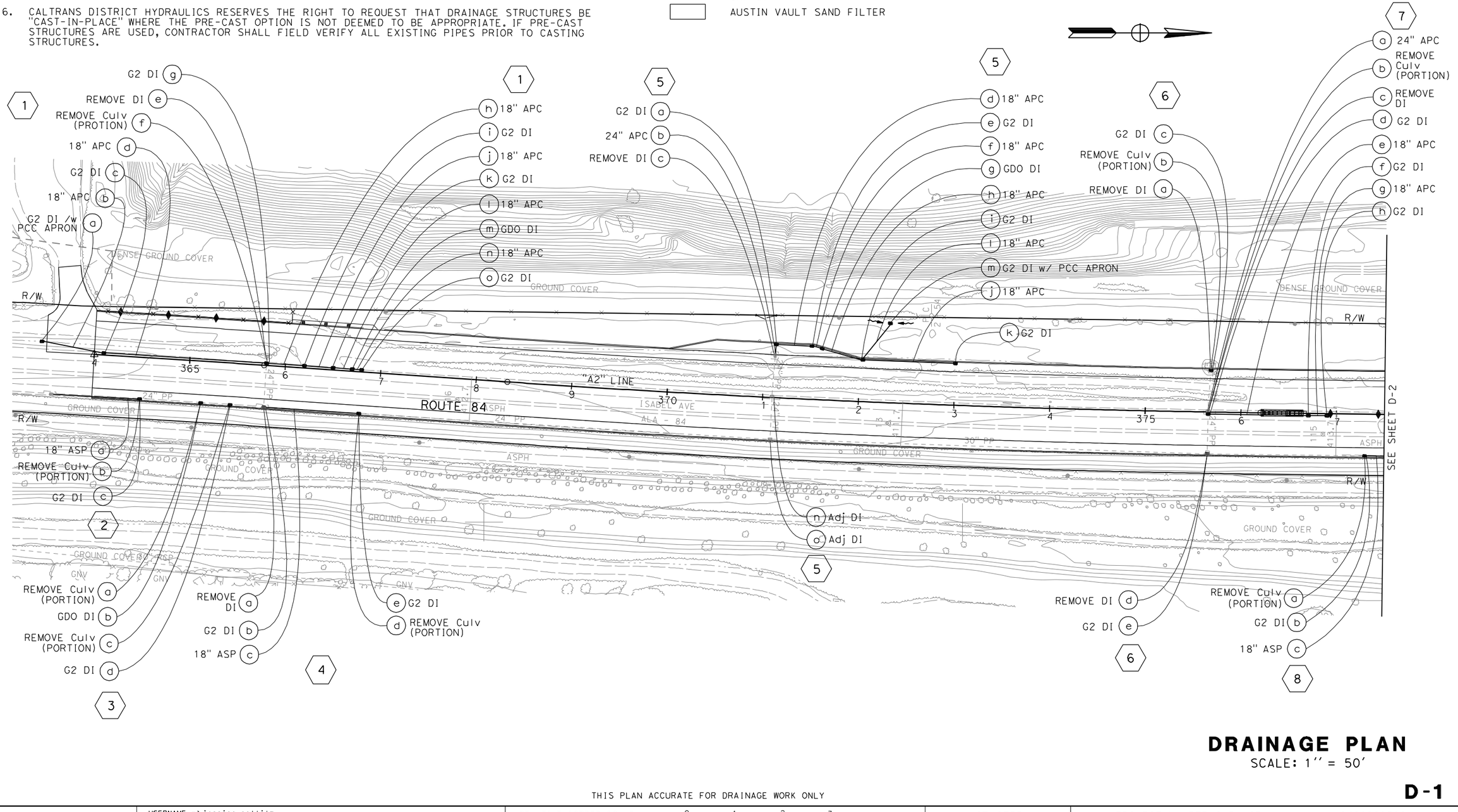

DRAINAGE PLAN

SCALE: 1'' = 50'

D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

REVISED BY	DATE REVISED
JP	1/11/11

IRENE LIU — CALCULATED-DESIGNED BY
ANALETTE OCHOA — CHECKED BY
HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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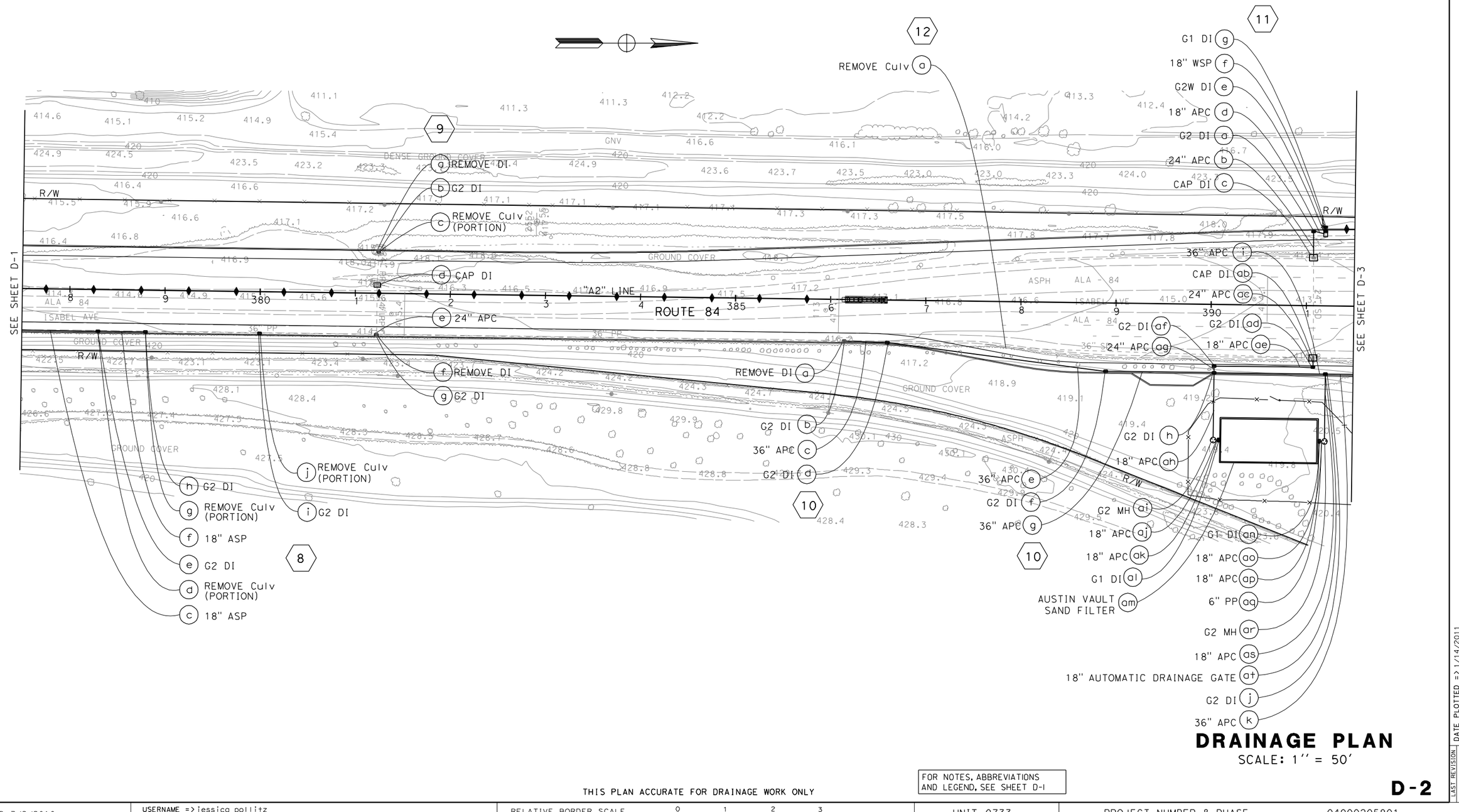

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

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CHECKED BY			
IRENE LIU	JP	1/11/11	
ANALETTE OCHOA	REVISED BY	DATE REVISED	
CONSULTANT FUNCTIONAL SUPERVISOR			
HAN-BIN LIANG			

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

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SEE SHEET D-2

R/W

ROUTE 84

"A2" LINE

"A3" LINE

"TR4" LINE

"SB" LINE

"ST" LINE

STANLEY CONNECTOR

STANLEY Blvd

E STANLEY BLVD

ASPH

GROUND COVER

CONC

DIKE

POLE

SEE SHEET D-4

(a) G2W DI
(b) 24" APC
(c) CAP DI
(d) REMOVE Culv
(e) REMOVE DI
(f) 36" APC
(g) REMOVE Culv
(h) REMOVE DI
(i) CAP DI
(j) CAP DI
(k) 36" APC
(l) GDO DI
(m) 36" APC
(n) 36" JACKED RCP
(o) 36" APC
(p) G2 DI
(q) REMOVE DI
(r) 24" APC
(s) REMOVE Culv
(t) 36" APC
(u) G2 DI
(v) 36" APC
(w) G2 DI
(x) REMOVE MH
(y) 36" APC
(z) REMOVE Culv (PORTION)
(aa) G2 DI
(ab) 12" CSP RISER
(ac) G2 DI
(ad) REMOVE Culv (PORTION)
(ae) G2 DI
(af) 18" APC
(ag) REMOVE DI
(ah) 18" APC
(ai) G2 DI
(aj) REMOVE Culv
(ak) REMOVE DI
(al) 18" APC
(am) G2 DI
(an) REMOVE Culv
(ao) REMOVE DI
(ap) 12" ASP
(aq) Adj DI (SEE CONSTRUCTION DETAILS)
(ar) 12" ASP
(as) G2 DI
(at) 18" APC
(au) G2 DI
(av) 18" APC
(aw) GDO DI
(ax) 18" APC
(ay) G2 DI
(az) REMOVE Culv
(ba) 24" APC
(bb) 18" APC
(bc) G1 DI
(bd) 12" WSP
(be) G1 DI
(bf) 12" WSP
(bg) REMOVE Culv
(bh) REMOVE DI
(bi) G1 DI w/ PCC APRON
(bj) 12" CSP RISER
(bk) G2 DI
(a) Adj MH
(b) 18" APC
(f) CAP DI
(g) CAP DI
(h) CAP DI
Exist 96" x 96" RCB STORAGE BAY
Exist JUNCTION BOX #2
Mod DI (SEE Misc DETAILS OF RW No. 400N))
Exist 96" RCP STORAGE BAY
(a) G1 DI
(b) Abn Culv
(c) REMOVE DI
(d) REMOVE Culv
(a) 12" WSP
(b) G1 DI
(c) G1 DI
(d) 12" WSP
(e) G2 DI
(f) 12" WSP
(g) G2W DI
(h) 24" APC
(i) CAP DI
(j) CAP DI
(a) 18" APC
(b) G2 DI
(c) REMOVE Culv
(d) REMOVE DI

10 10 10 12 13 14 15 15 16 17 18

DRAINAGE PLAN
SCALE: 1'' = 50'

D-3

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

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DETAILED BY
REVISED BY: JP
DATE REVISED: 1/11/11

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UNIT 0733

PROJECT NUMBER & PHASE 04000205801

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

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04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
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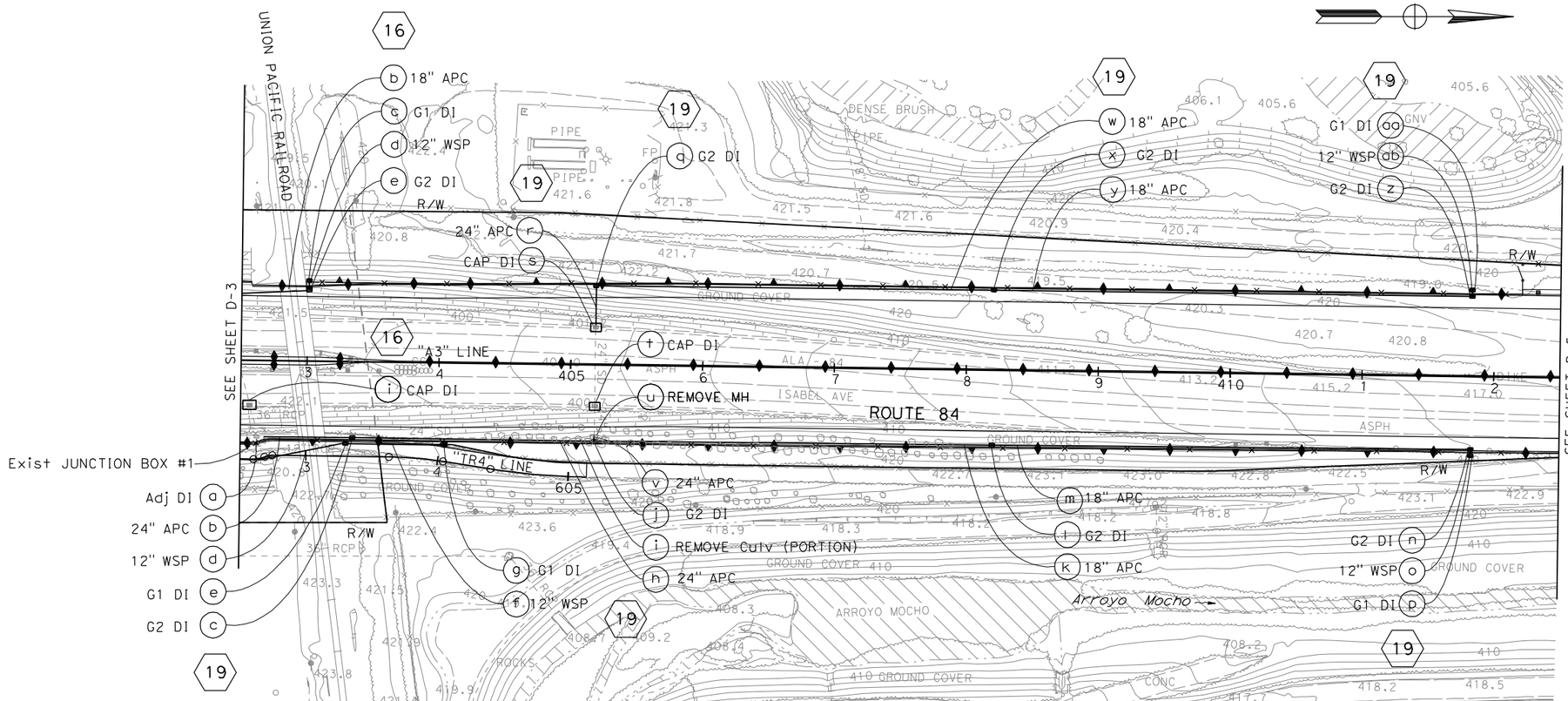

DRAINAGE PLAN

SCALE: 1'' = 50'

D-4

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CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		

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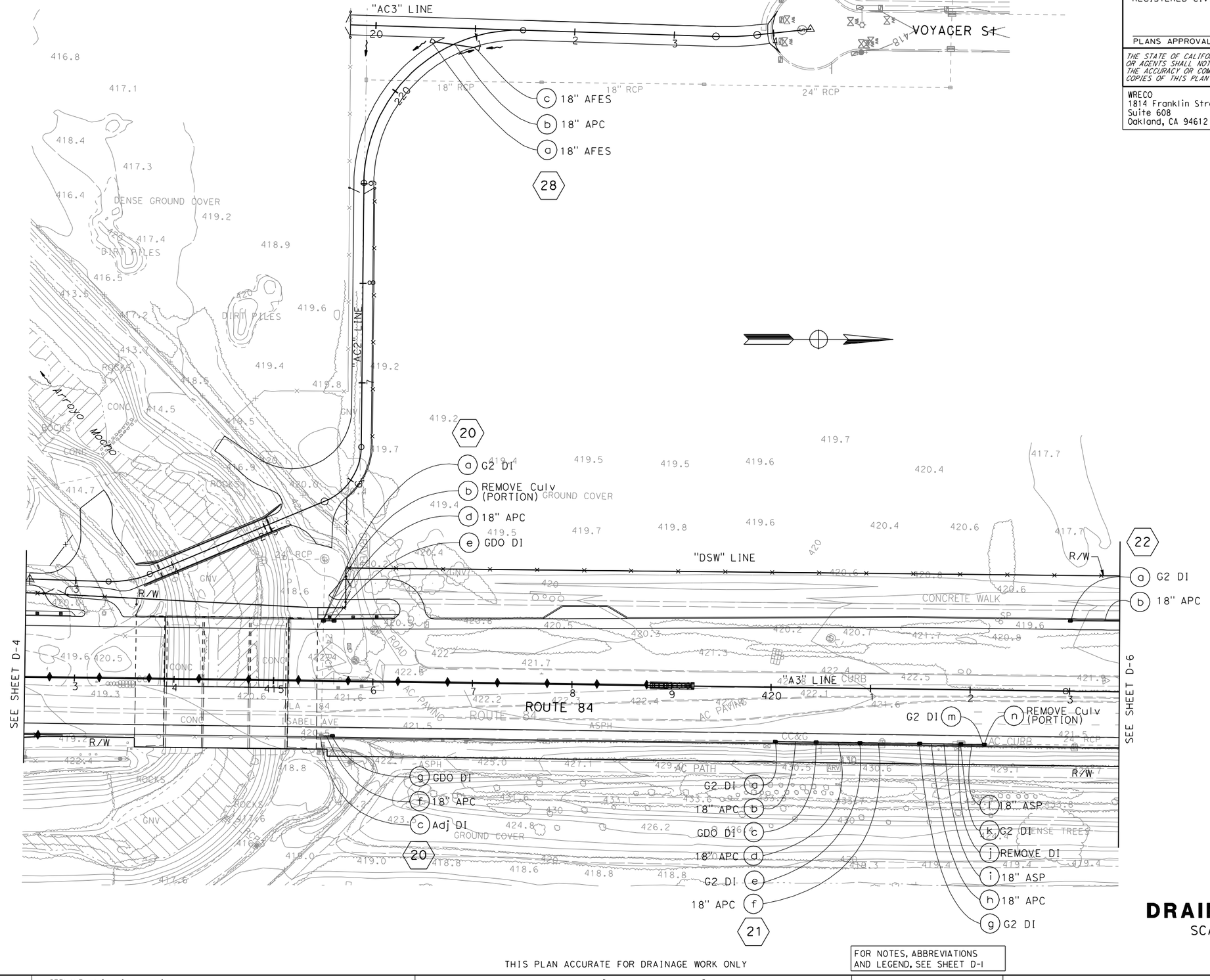

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FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1'' = 50'

D-5

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — 1/17/11
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REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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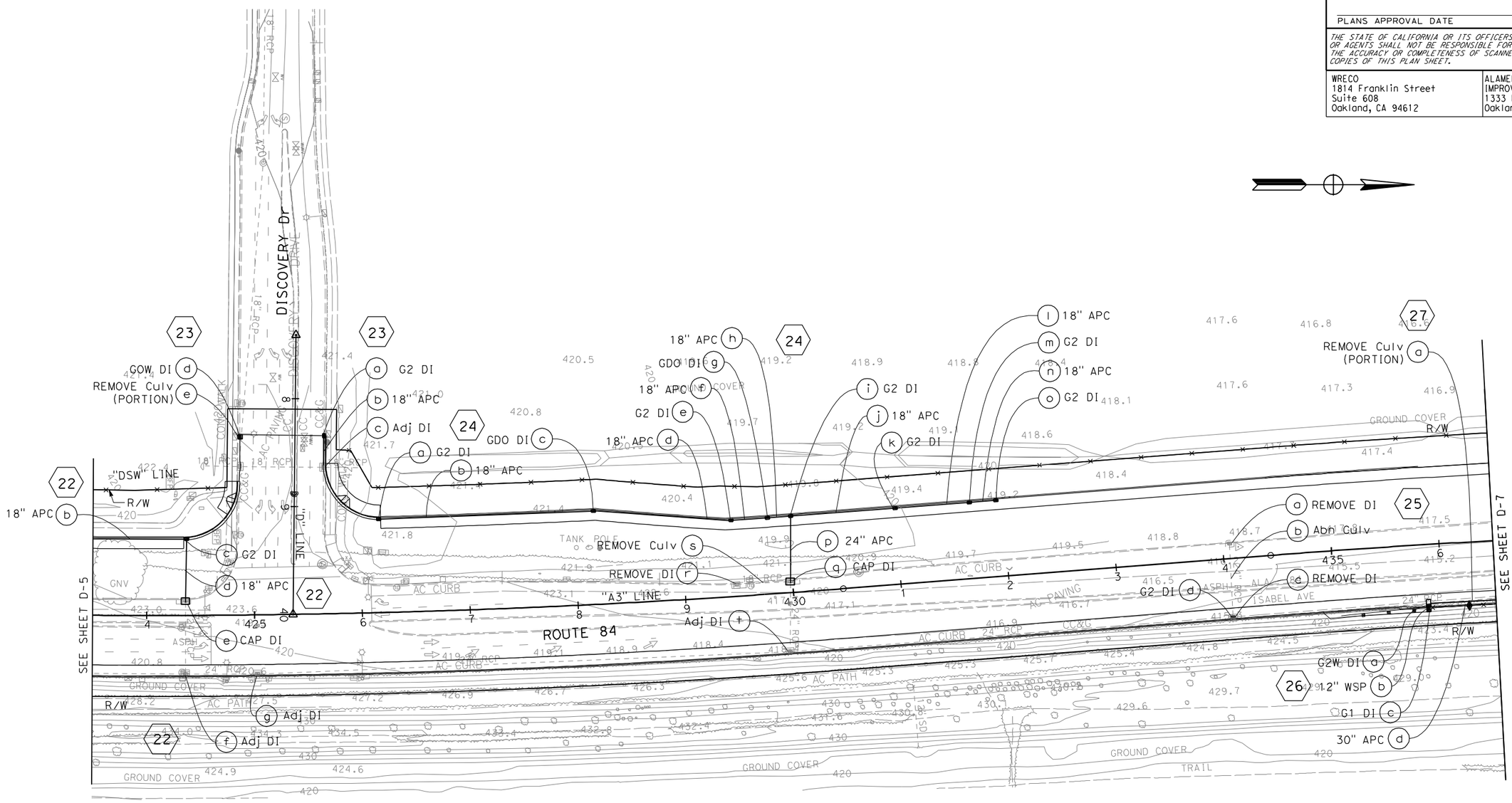

DRAINAGE PLAN

SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-6

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	JP	
CHECKED BY	ANALETTE OCHOA	DATE REVISED	1/11/11	

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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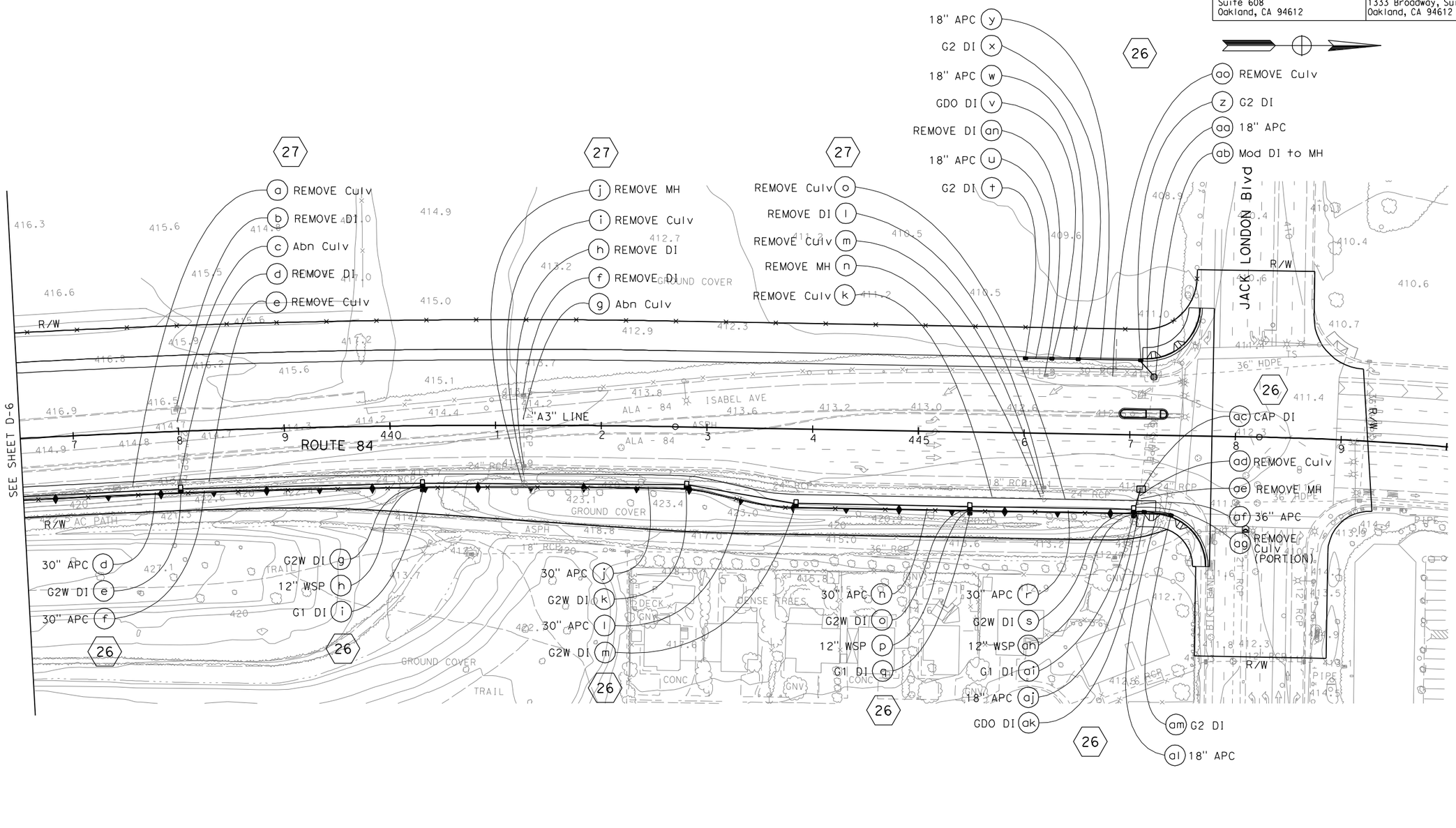

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-7

REVISED BY	JP		
DATE REVISED	1/11/11		
IRENE LIU	ANALETTE OCHOA		
CALCULATED-DESIGNED BY	CHECKED BY		
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		
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Segment B
(PM 22.9 to PM 25.7)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
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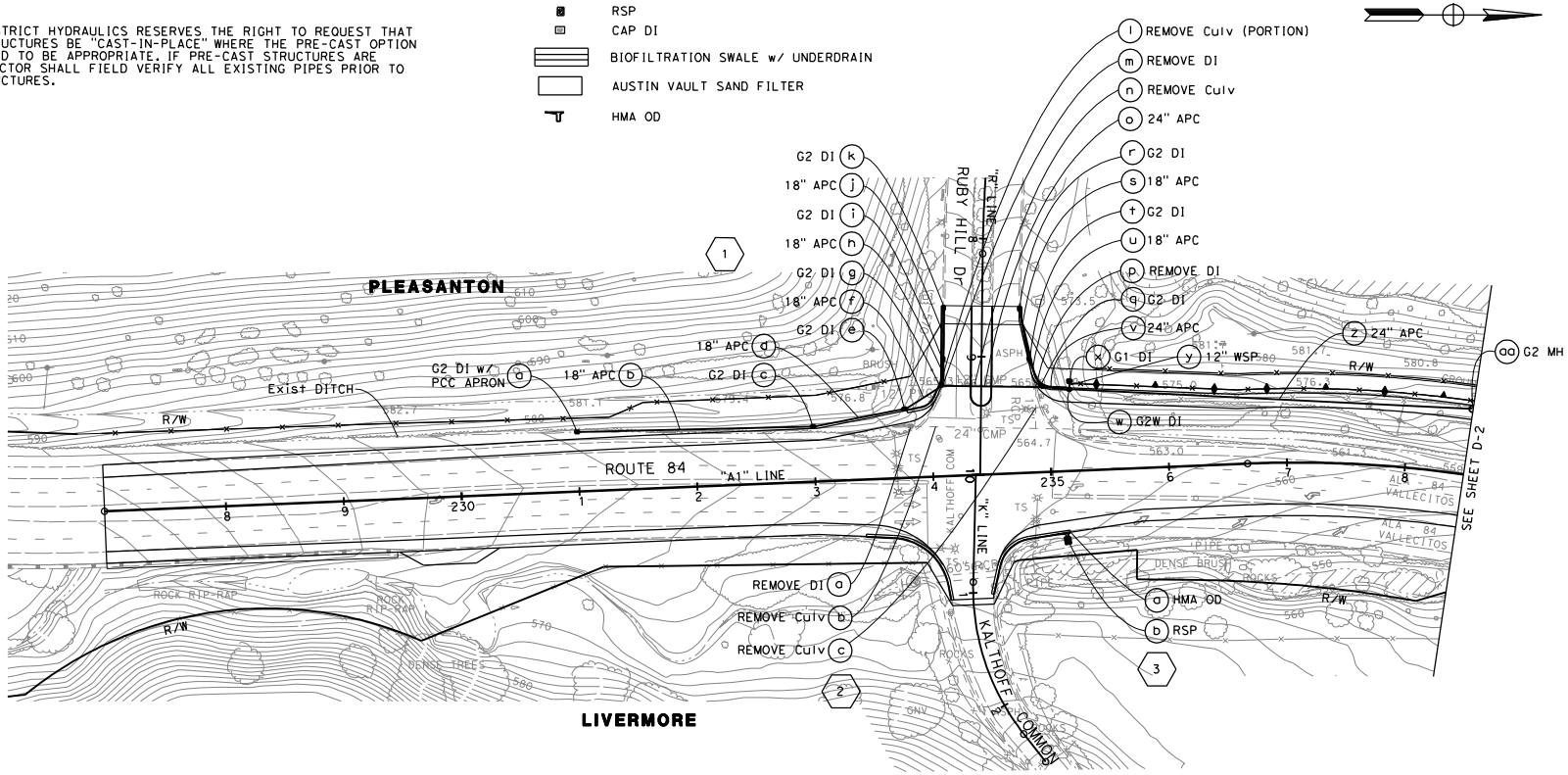
LEGEND:

- Exist STORM DRAIN
- PROPOSED STORM DRAIN
- GUTTER/DITCH FLOW LINE
- (No.) DRAINAGE SYSTEM No.
- (h) DRAINAGE UNIT
- GRADE TO DRAIN
- INLET
- OMP/GMP DI
- Exist DI
- FES
- RSP
- CAP DI
- BIOFILTRATION SWALE w/ UNDERDRAIN
- AUSTIN VAULT SAND FILTER
- HMA OD

ABBREVIATIONS:

COL	CITY OF LIVERMORE
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA
ASP	ALTERNATIVE SLOTTED PIPE
TC	TOP OF COVER
OD	OVERSIDE DRAIN



DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC	10/19/10
	HAN-BIN LIANG	CHECKED BY	DATE REVISED		
		IRENE LIU			
		ANALETTE OCHOA			

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:44:00 PM

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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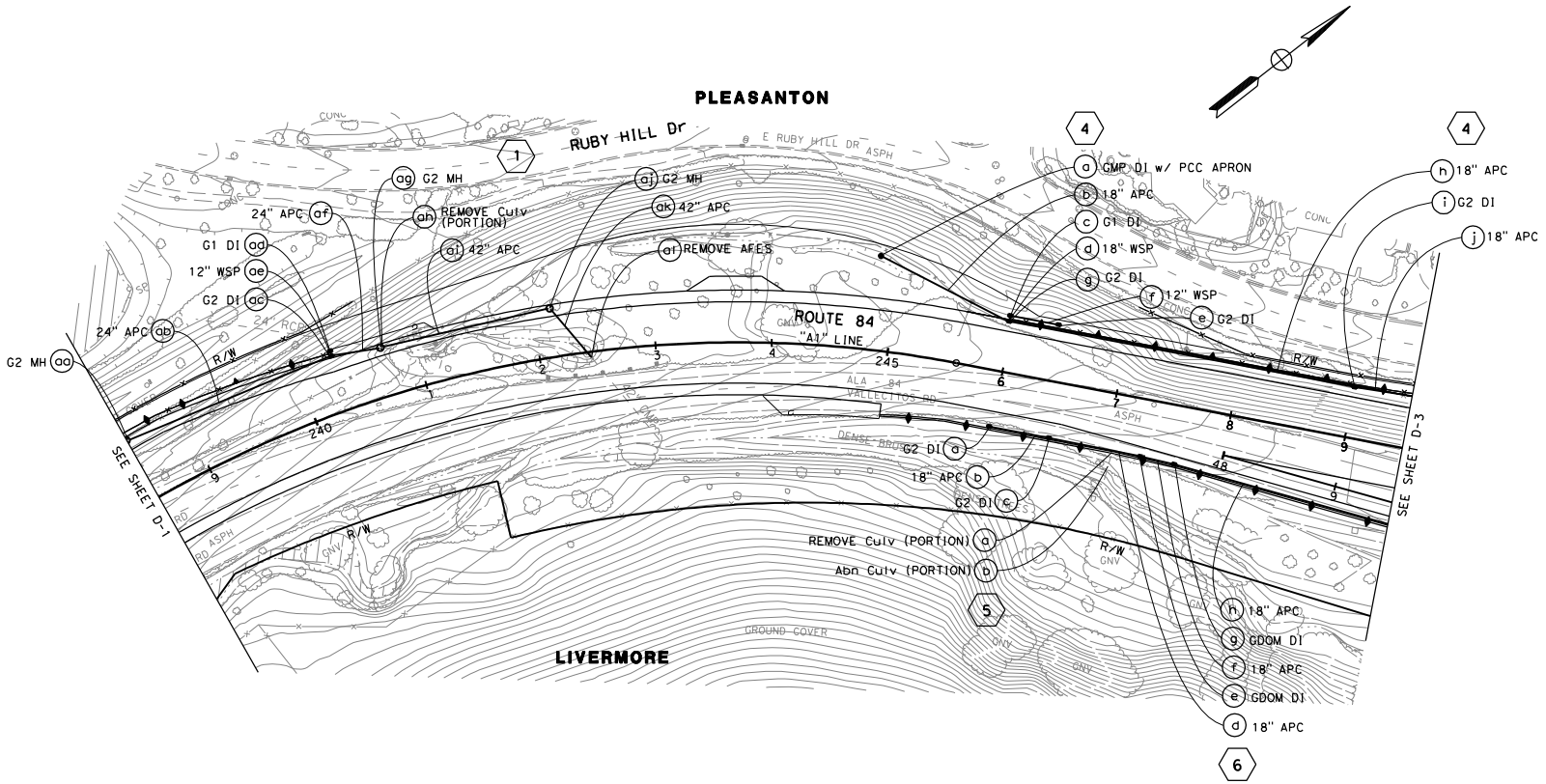

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:44:43 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia002.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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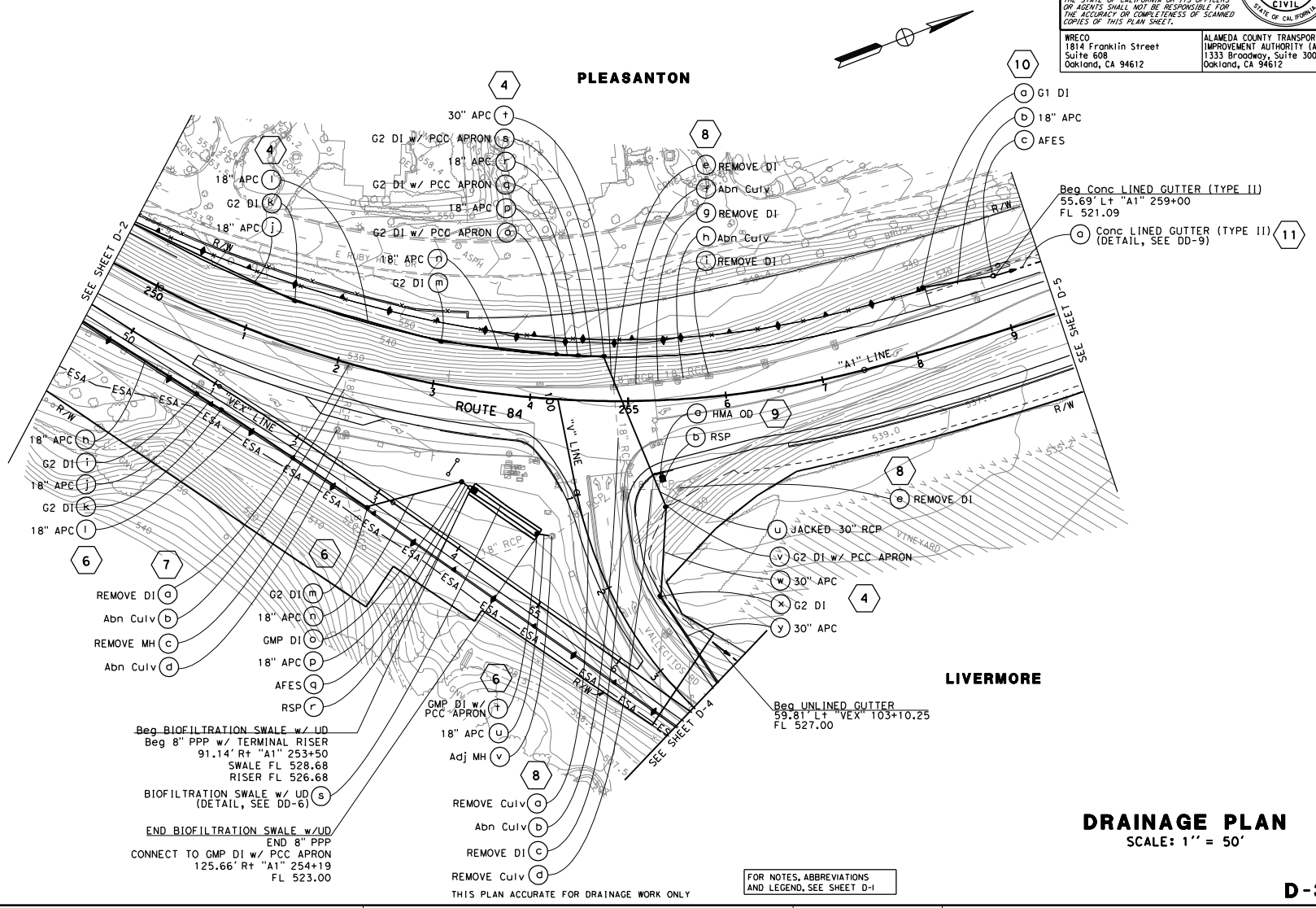

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1'' = 50'

D-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
10-19-10 TIME PLOTTED => 1:24:07 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu
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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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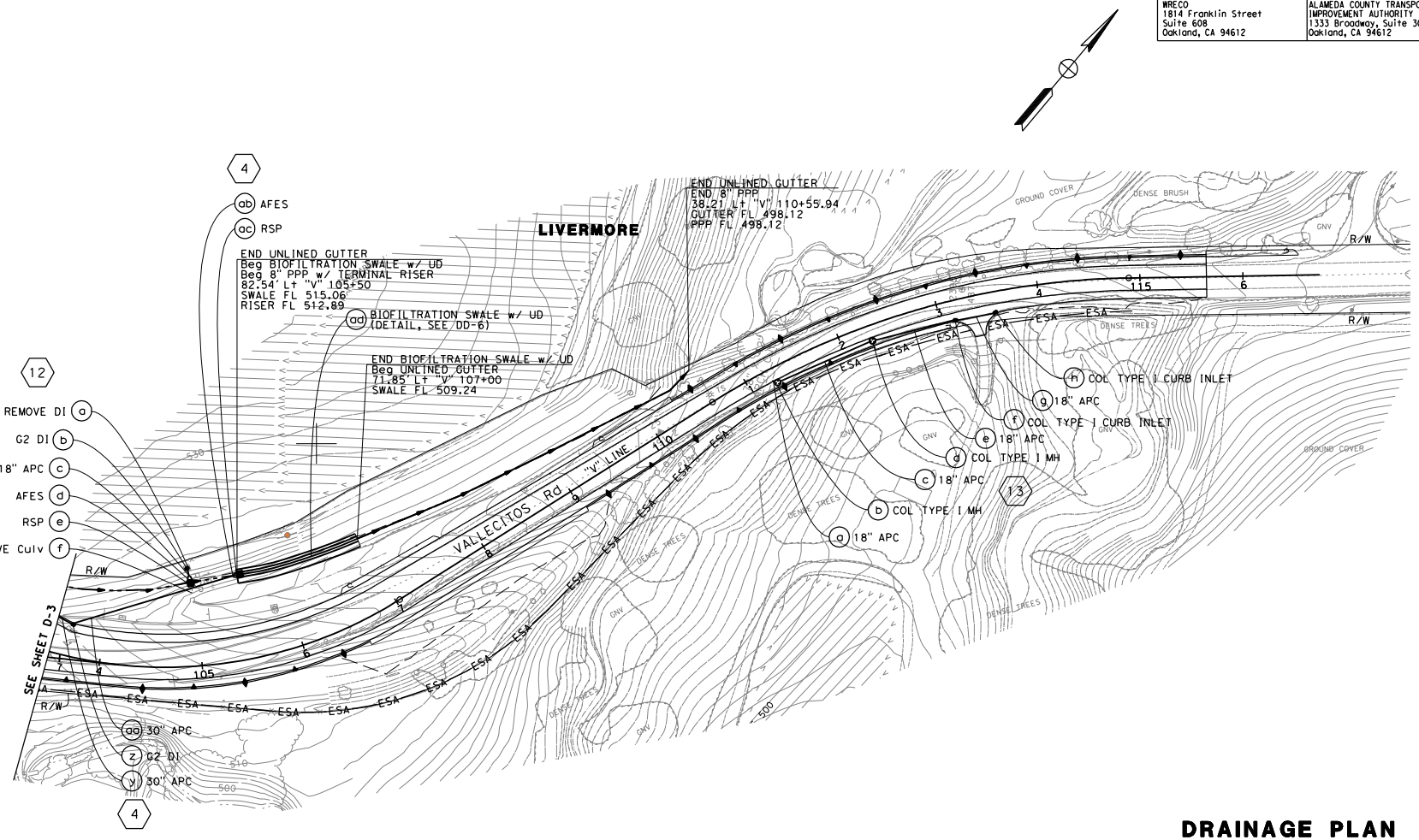

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-4

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
IRENE LIU	ANALETTE OCHOA	EC	10/19/10

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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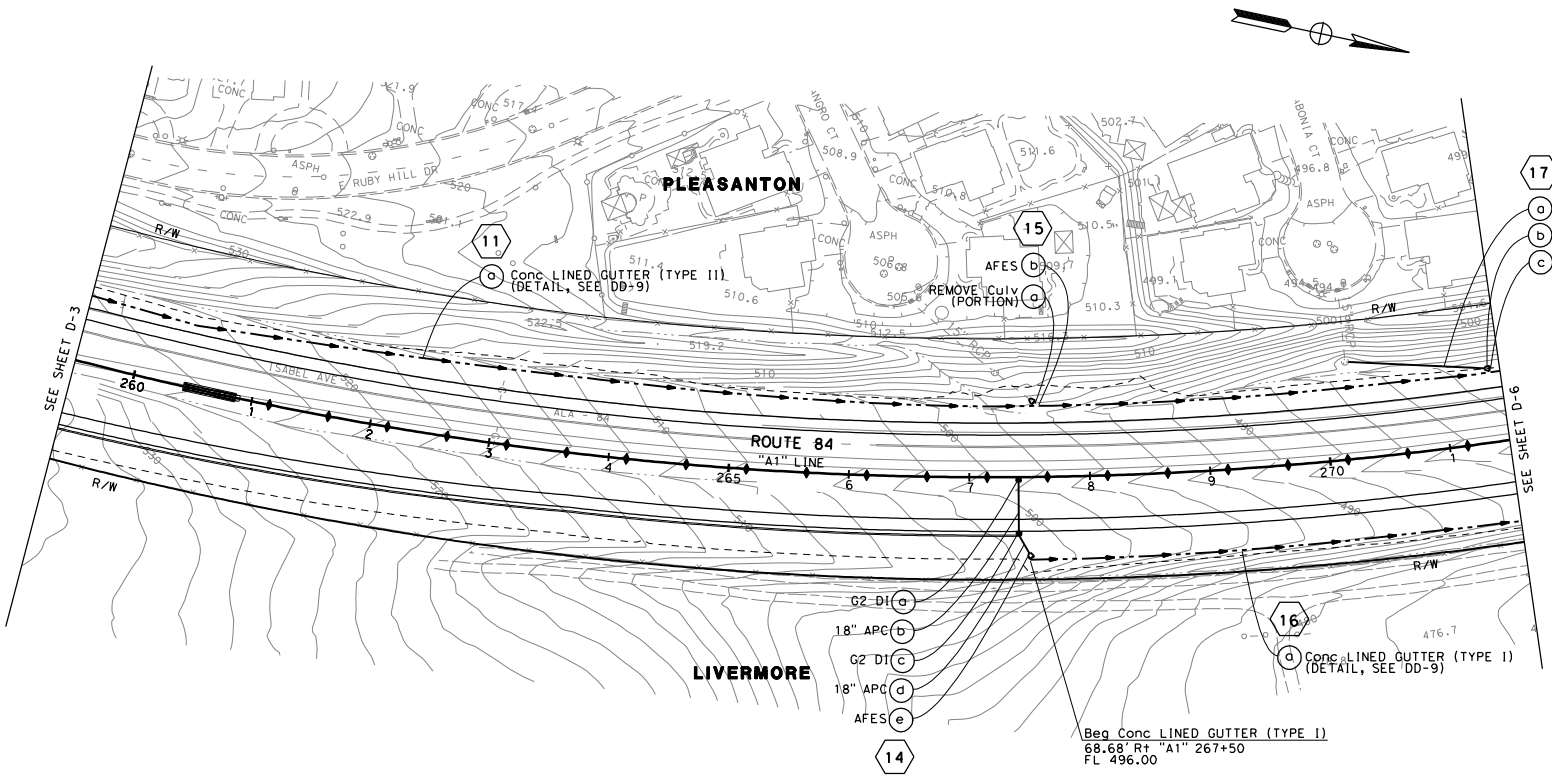

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: EC
DATE REVISED: 10/19/10

LAST REVISION: DATE PLOTTED => 10/20/2010
10-19-10 TIME PLOTTED => 11:44:13 PM

BORDER LAST REVISED 7/2/2010
USERNAME => irene_liu
DGN FILE => ...\dwg\Seg B\pl\429760ia005.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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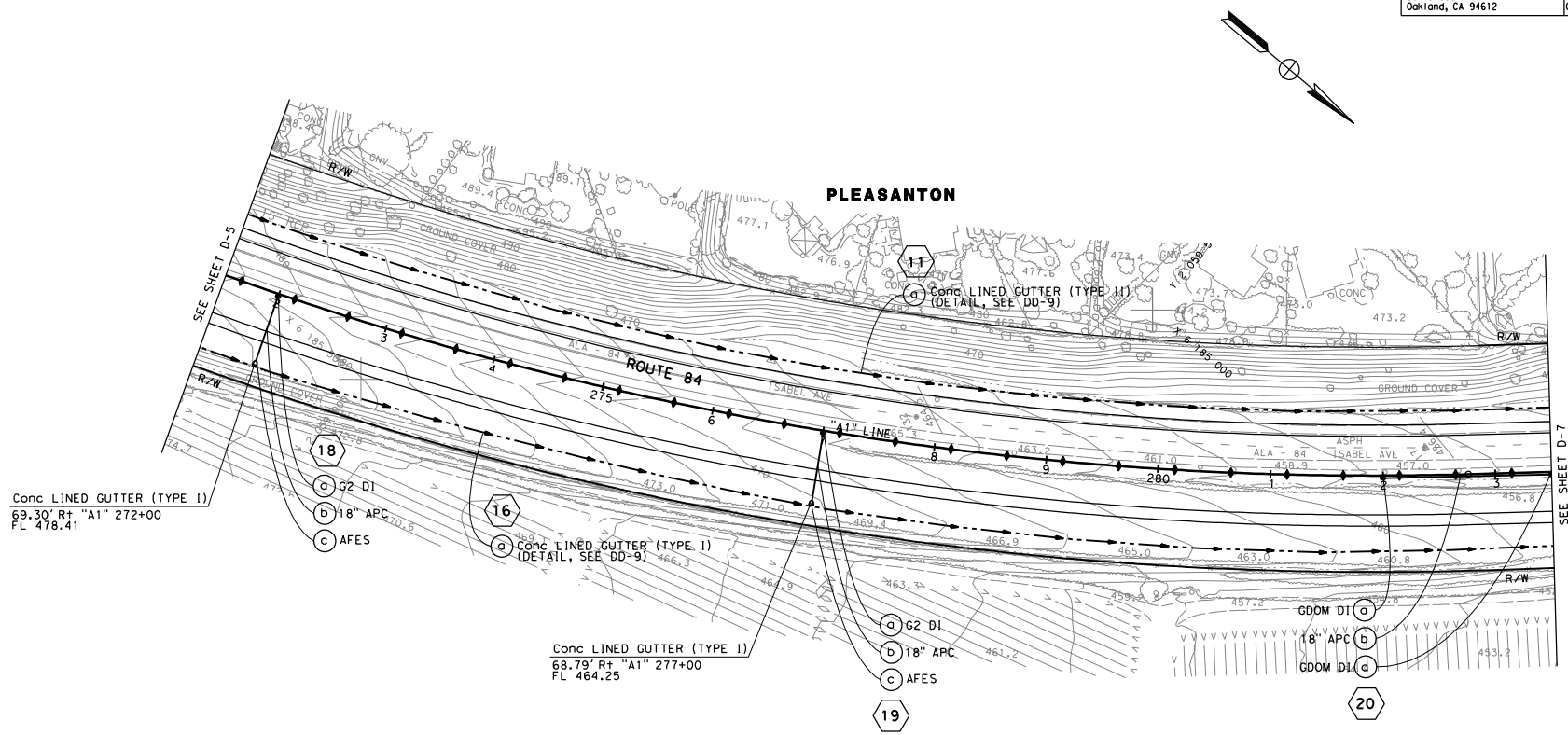

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISION | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 11:44:17 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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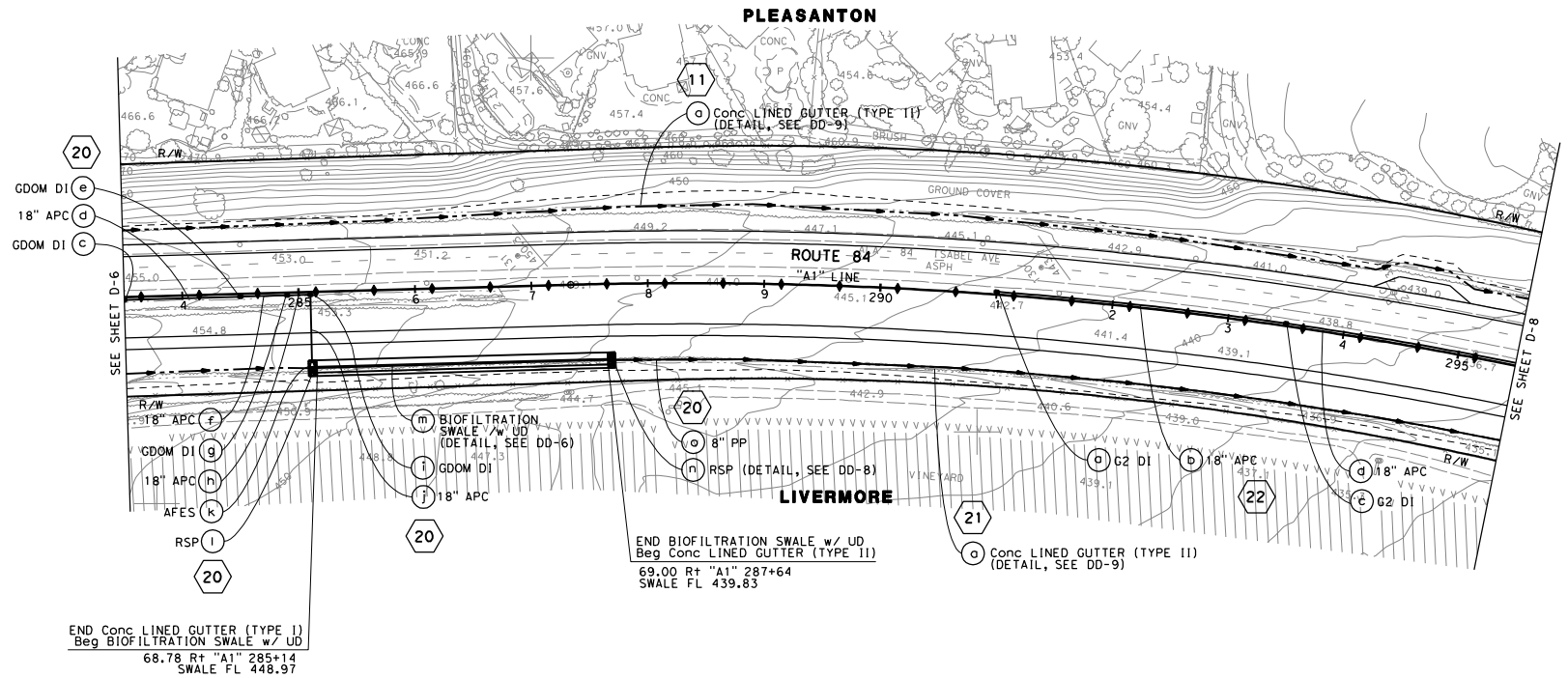

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: EC
DATE REVISED: 10/19/10

BORDER LAST REVISED 7/2/2010
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:20 PM

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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PLEASANTON

END Conc LINED GUTTER (TYPE II)
Beg BIOFILTRATION SWALE w/ UD
62.50' Lt "A1" 299+00
SWALE FL 432.33

END BIOFILTRATION SWALE w/ UD
END 8" PPP
Beg 8" PP w/ Vert RISER
Beg Conc LINED GUTTER (TYPE II)
67.81' Lt "A1" 301+50.85
SWALE FL 429.45
8" PPP FL 427.28

67.08' Rt "A1" 304+00
RISER FL 425.59

END Conc LINED GUTTER (TYPE II)
END 8" PP CONNECT TO DI
68.16' Lt "A1" 307+35
GUTTER FL 425.44

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

RSP (DETAIL, SEE DD-8)

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP (DETAIL, SEE DD-8)

18" APC

G2 DI

8" PP

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

G2 DI

18" APC

G2 DI

G2 DI w/ PCC APRON

36" APC

G2 DI

36" APC

ROUTE 84
"A1" LINE

SEE SHEET D-7

SEE SHEET D-9

END Conc LINED GUTTER (TYPE II)
65.54' Rt "A1" 295+78.80
FL 431.37

G2 DI w/ PCC APRON

30" APC

RSP BERM (DETAIL, SEE DD-8)

18" APC

AFES

RSP

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP (DETAIL, SEE DD-8)

30" APC

G2 DI

END Conc LINED GUTTER (TYPE II)
65.49' Rt "A1" 300+78.40
FL 427.00

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

G2 DI

18" APC

AFES

RSP

30" APC

G2 DI

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

G2 DI w/ PCC APRON

30" APC

RSP BERM (DETAIL, SEE DD-8)

18" APC

AFES

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP

Beg BIOFILTRATION SWALE w/ UD
68.81' Rt "A1" 296+04
SWALE FL 431.33

END BIOFILTRATION SWALE w/ UD
Beg Conc LINED GUTTER (TYPE II)
68.82' Rt "A1" 298+04
SWALE FL 429.37

END Conc LINED GUTTER (TYPE II)
Beg BIOFILTRATION SWALE w/ UD
68.84' Rt "A1" 301+04
SWALE FL 427.17

END BIOFILTRATION SWALE w/ UD
Beg Conc LINED GUTTER (TYPE II)
68.86' Rt "A1" 302+54
SWALE FL 426.11

END Conc LINED GUTTER (TYPE II)
Beg BIOFILTRATION SWALE w/ UD
68.92' Rt "A1" 306+77
SWALE FL 423.70

LIVERMORE

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG | CALCULATED-DESIGNED BY: IRENE LIU | CHECKED BY: ANALETTE OCHOA | REVISED BY: EC | DATE REVISED: 10/19/10

BORDER LAST REVISED 7/2/2010

USERNAME => Irene_liu
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

LAST REVISION DATE PLOTTED => 10/20/2010
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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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PLEASANTON

LIVERMORE

ROUTE 84 "A1" LINE

"VIN" LINE

VINEYARD Ave

PIEMONTE DR

SEE SHEET D-8

SEE SHEET D-10

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

END Conc LINED GUTTER (TYPE II)
82.18 Rt A1 312+09.75
FL 420.62

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP (DETAIL, SEE DD-8)

END BIOFILTRATION SWALE
Beg Conc LINED GUTTER
84.69 Rt "A1" 308+27
FL 422.69

30: G2 DI (o); 18" APC (p); G2 DI (g); JACKED 36" RCP (h); G2 DI (e); 36" APC (d); 36" APC (i); 36" APC (f)

33: G2 DI (e); 18" APC (d); G2 DI (c); 18" APC (b); G2 DI w/ PCC APRON (a)

33: 18" APC (w); G2 DI (v); 18" APC (u); G2 DI (t); 18" APC (h); G2 DI (g); 18" APC (f)

33: (n) REMOVE Culv (PORTION); (o) G2 MH; (p) 18" APC; (q) GO DI; (r) JACKED 18" RCP; (x) 18" APC; (y) G2 DI; (s) 18" APC; (z) 18" APC; (i) G2 DI; (j) 18" APC; (k) G2 DI; (l) 18" APC

31: (n) G2 DI; (o) 36" APC

29: (g) BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6); (h) RSP (DETAIL, SEE DD-8)

23: G2 DI w/ PCC APRON (j); 36" APC (k); G2 DI w/ PCC APRON (l); 36" APC (m); G2 DI (n); 36" APC (q)

30

32: (d) REMOVE DI; (b) REMOVE DI; (c) REMOVE Culv; (d) REMOVE Culv; (e) REMOVE DI; (f) REMOVE Culv

34: (d) REMOVE Culv; (c) REMOVE DI; (b) REMOVE Culv; (a) REMOVE DI

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

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TIME PLOTTED => 1:44:26 PM

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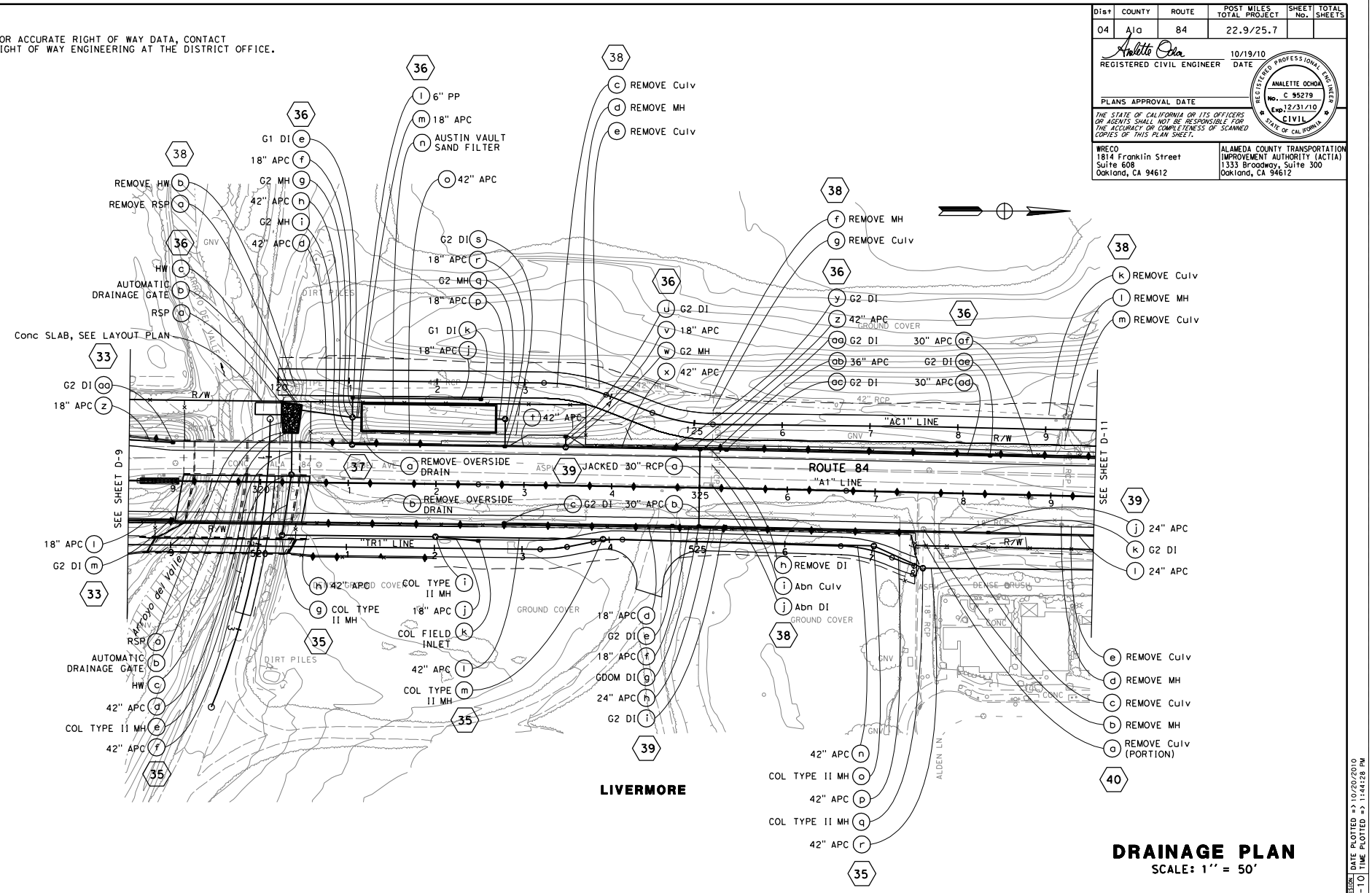

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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DRAINAGE PLAN

SCALE: 1'' = 50'

D-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

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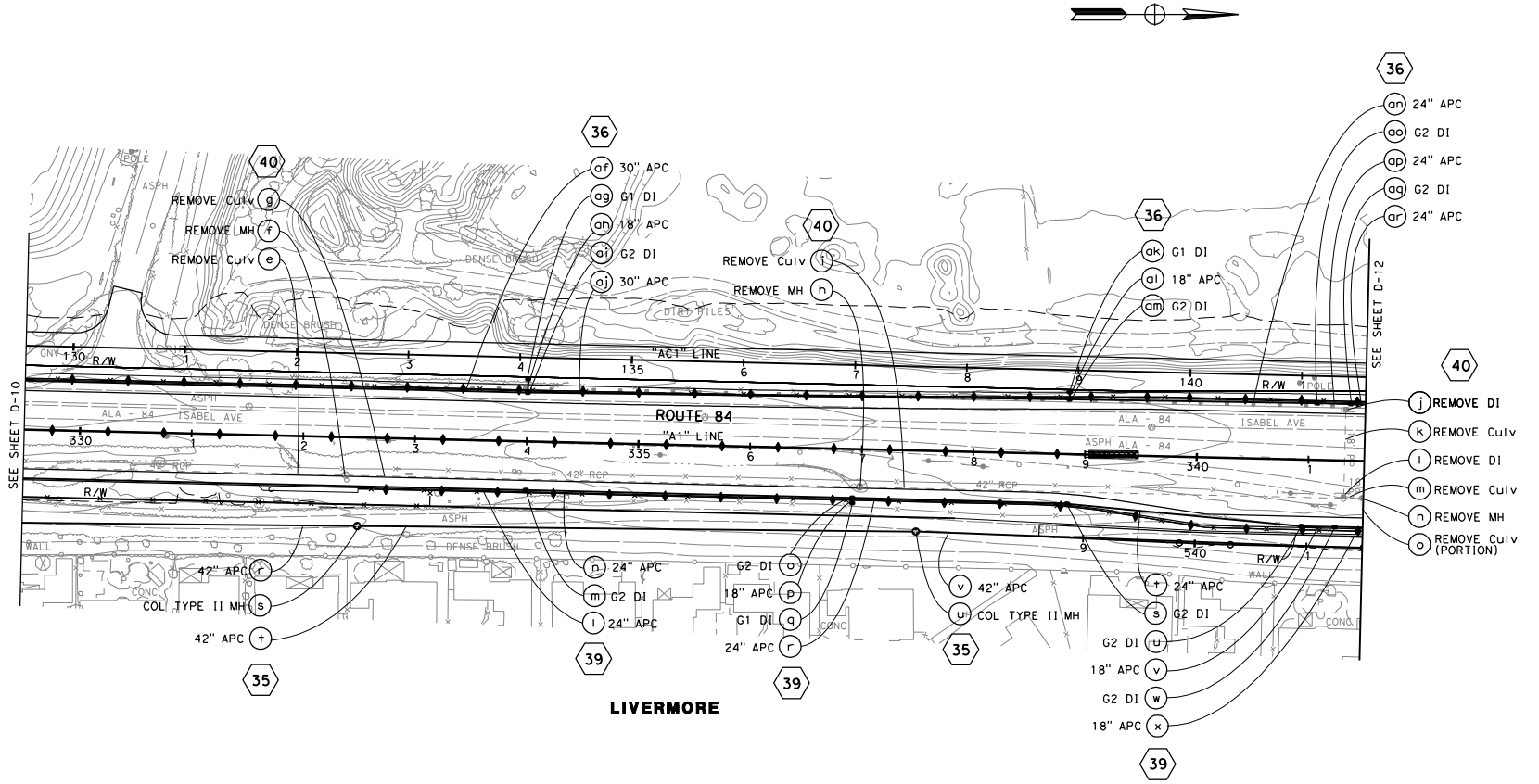

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-11

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
	HAN-BIN LIANG	IRENE LIU		
		CHECKED BY	DATE REVISED	10/19/10
		ANALETTE OCHOA		

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 11:44:51 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia011.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa 10/19/10
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PLANS APPROVAL DATE

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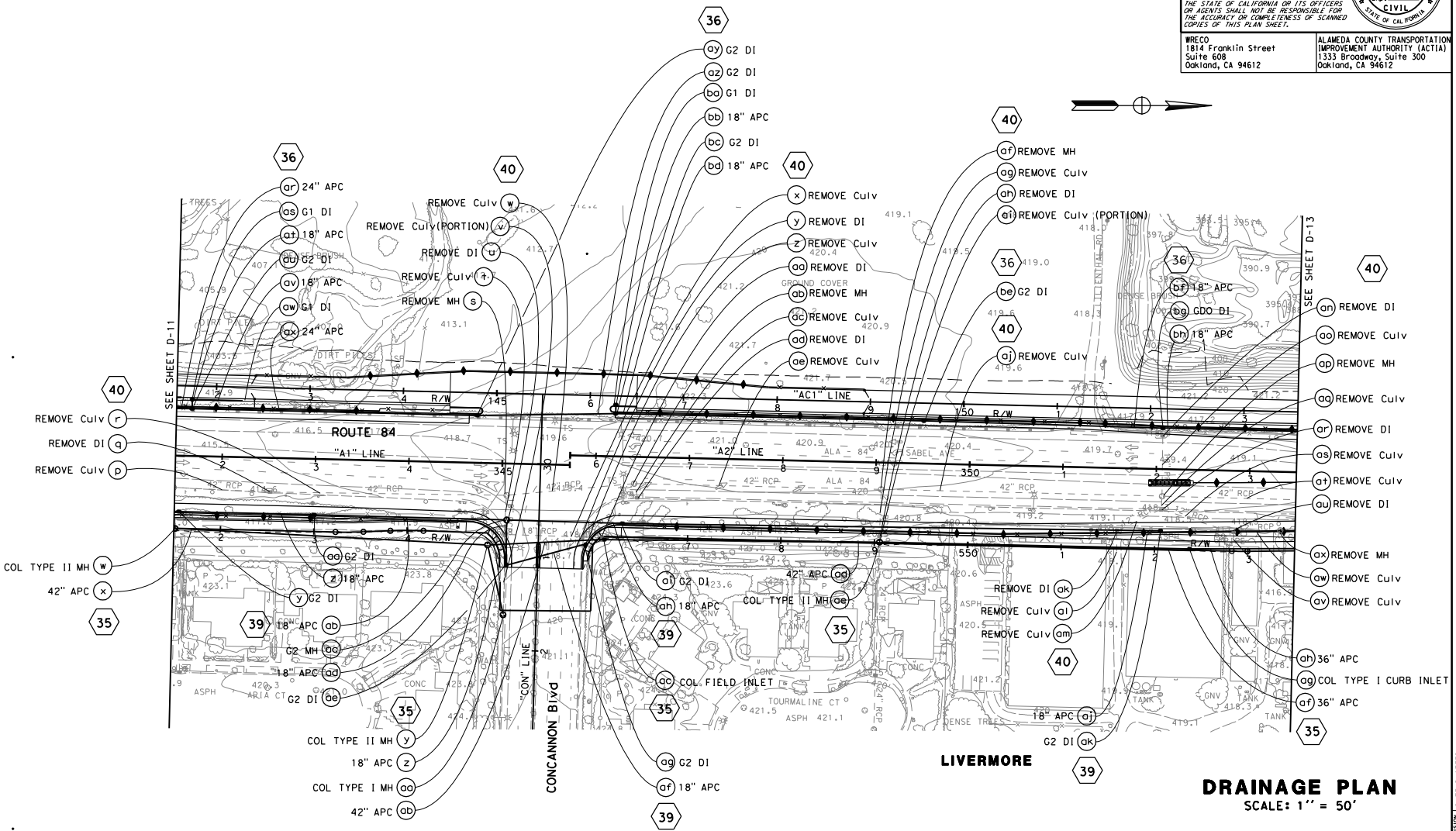

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-12

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
Caltrans	HAN-BIN LIANG	IRENE LIU	DATE REVISED	10/19/10
		ANALETTE OCHOA		
		CHECKED BY		

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:44:34 PM

BORDER LAST REVISED 7/2/2010	USERNAME => irene_liu DGN FILE => ...\dwg\Seg B\pl\429760ia012.dgn	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	UNIT 0733	PROJECT NUMBER & PHASE	04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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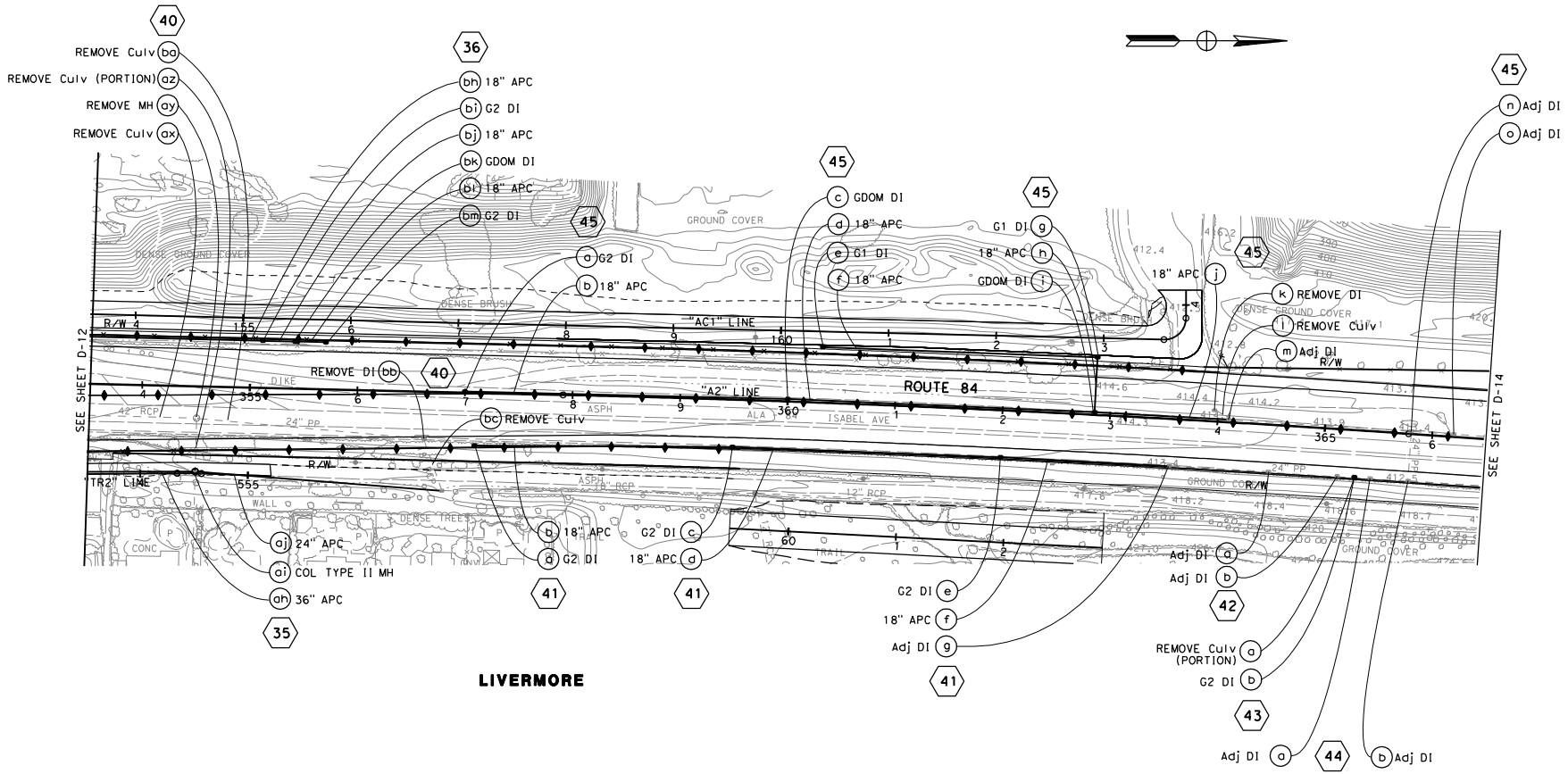

LIVERMORE

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-13

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: EC
DATE REVISED: 10/19/10

LAST REVISION
DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:38 PM

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DGN FILE => ...\dwg\Seg B\pl\429760ia013.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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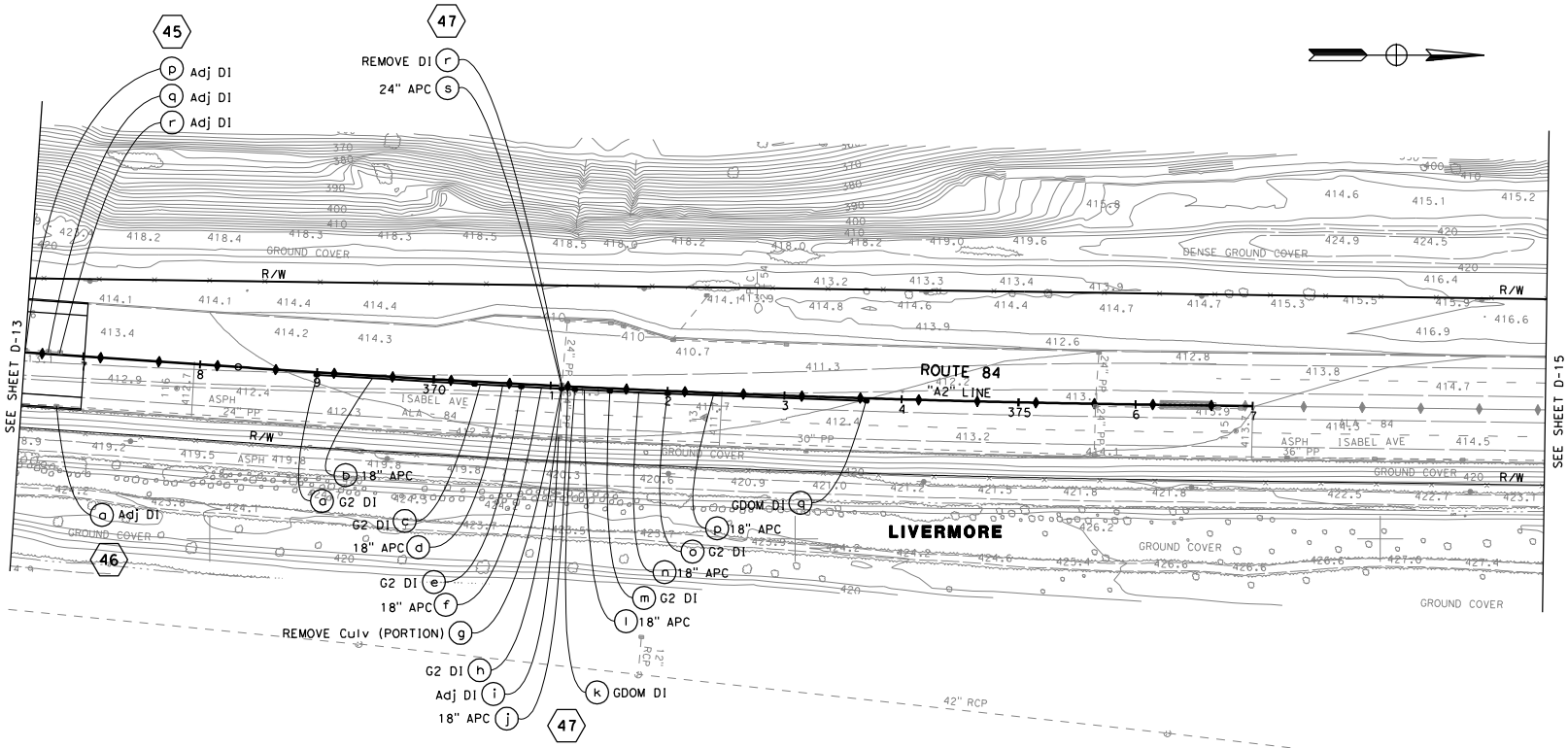

DRAINAGE PLAN
SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
	HAN-BIN LIANG	IRENE LIU	DATE REVISED	10/19/10
		CHECKED BY		
		ANALETTE OCHOA		

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:44:41 PM

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Appendix B Hydrologic Data

WINIDF 1.0 OUTPUT TABLE 3/5/2009

Input values: Lat.: 37.666 deg. Long.: 121.806 deg. Return Period: 25 yrs.

Selected Station(s)	Station ID	Elev. ft	Lat. deg.	Long. deg.	Dist. miles
ARROY DEL VALLE WATE	E500311020	640	37.631	121.784	2.70
ARROYO DEL VALLE WTP	E500310000	640	37.631	121.784	2.70

Output table (Intensities in inches/hour):

Dur.\RP	25-yr	2-yr	10-yr	25-yr	50-yr	100-yr	10000-yr
5-min	3.266	1.620	2.723	3.257	3.667	4.059	6.515
10-min	2.292	1.137	1.911	2.286	2.573	2.848	4.572
15-min	1.863	0.924	1.554	1.858	2.092	2.315	3.716
30-min	1.307	0.648	1.090	1.304	1.468	1.625	2.608
60-min	0.918	0.455	0.765	0.915	1.030	1.140	1.830
120-min	0.644	0.319	0.537	0.642	0.723	0.800	1.284
4-hr	0.452	0.224	0.377	0.451	0.507	0.561	0.901
8-hr	0.317	0.157	0.264	0.316	0.356	0.394	0.632
16-hr	0.222	0.110	0.186	0.222	0.250	0.276	0.444
24-hr	0.181	0.090	0.151	0.180	0.203	0.225	0.361

a = 0.9175 b = -0.5110 1.00 min

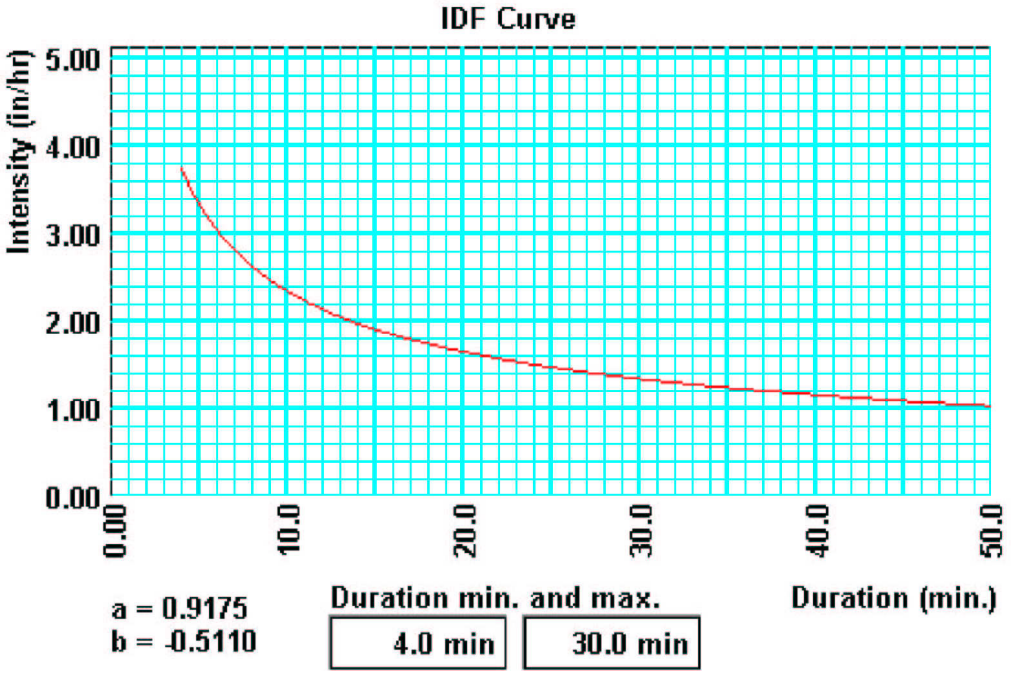

Figure B-1. WinIDF Results – Hydrologic Data used in Project area south of Ida Holm Park

WINIDF 1.0 OUTPUT TABLE 3/30/2009

Input values: Lat.: 37.676 deg. Long.: 121.805 deg. Return Period: 50 yrs.

Selected Station(s)	Station ID	Elev. ft	Lat. deg.	Long. deg.	Dist. miles
ARROYO DEL VALLE WTP	E500310000	640	37.631	121.784	3.32
LIVERMORE 2 E	E504997003	470	37.690	121.742	3.58
MOCHO WELL #1	E505735050	345	37.687	121.876	3.96

Output table (Intensities in inches/hour):

Dur./RP	50-yr	2-yr	10-yr	25-yr	50-yr	100-yr	10000-yr
5-min	3.524	1.542	2.605	3.143	3.525	3.884	6.262
10-min	2.467	1.079	1.824	2.200	2.468	2.719	4.384
15-min	2.003	0.876	1.480	1.786	2.003	2.207	3.559
30-min	1.402	0.613	1.036	1.250	1.403	1.545	2.491
60-min	0.982	0.429	0.726	0.875	0.982	1.082	1.744
120-min	0.687	0.301	0.508	0.613	0.687	0.757	1.221
4-hr	0.481	0.210	0.356	0.429	0.481	0.530	0.855
8-hr	0.337	0.147	0.249	0.300	0.337	0.371	0.598
16-hr	0.236	0.103	0.174	0.210	0.236	0.260	0.419
24-hr	0.191	0.084	0.141	0.171	0.191	0.211	0.340

a = 0.9815 b = -0.5144 1.00 min

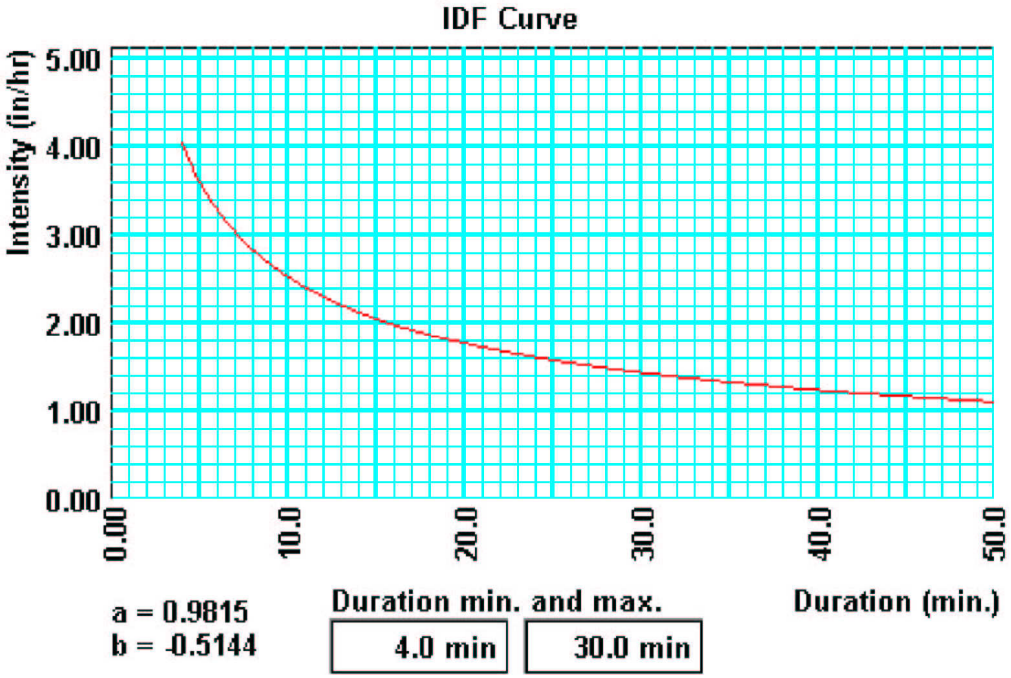

Figure B-2. WinIDF Results – Hydrologic Data for Project area within the Depressed Section

WINIDF 1.0 OUTPUT TABLE 3/30/2009

Input values: Lat.: 37.676 deg. Long.: 121.805 deg. Return Period: 25 yrs.

Selected Station(s)	Station ID	Elev. ft	Lat. deg.	Long. deg.	Dist. miles
ARROYO DEL VALLE WTP	E500310000	640	37.631	121.784	3.32
LIVERMORE 2 E	E504997003	470	37.690	121.742	3.58
MOCHO WELL #1	E505735050	345	37.687	121.876	3.96

Output table (Intensities in inches/hour):

Dur./RP	25-yr	2-yr	10-yr	25-yr	50-yr	100-yr	10000-yr
5-min	3.137	1.542	2.605	3.143	3.525	3.884	6.262
10-min	2.196	1.079	1.824	2.200	2.468	2.719	4.384
15-min	1.783	0.876	1.480	1.786	2.003	2.207	3.559
30-min	1.248	0.613	1.036	1.250	1.403	1.545	2.491
60-min	0.874	0.429	0.726	0.875	0.982	1.082	1.744
120-min	0.612	0.301	0.508	0.613	0.687	0.757	1.221
4-hr	0.428	0.210	0.356	0.429	0.481	0.530	0.855
8-hr	0.300	0.147	0.249	0.300	0.337	0.371	0.598
16-hr	0.210	0.103	0.174	0.210	0.236	0.260	0.419
24-hr	0.170	0.084	0.141	0.171	0.191	0.211	0.340

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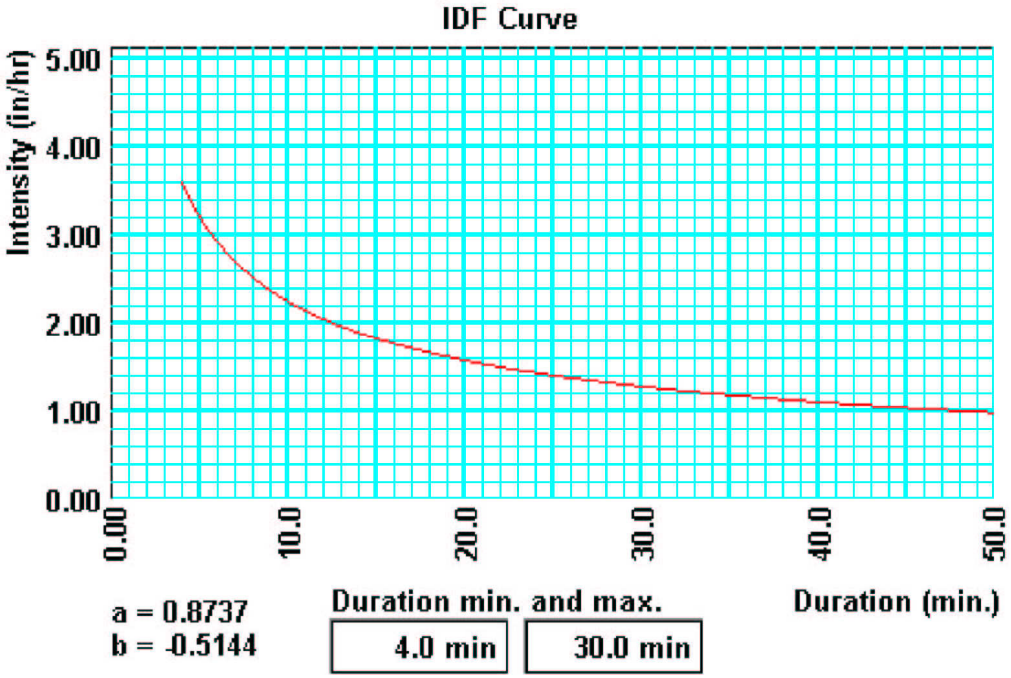
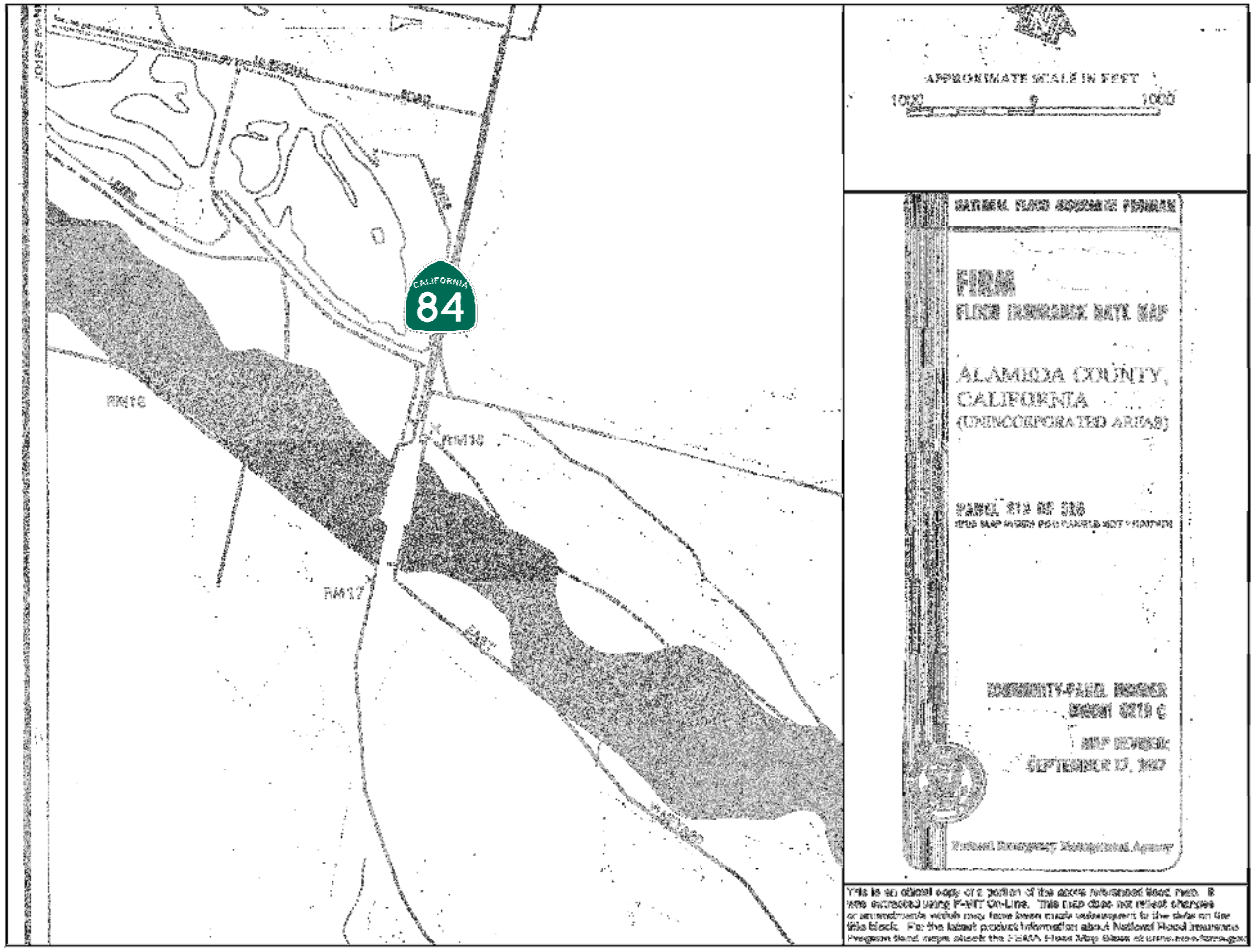


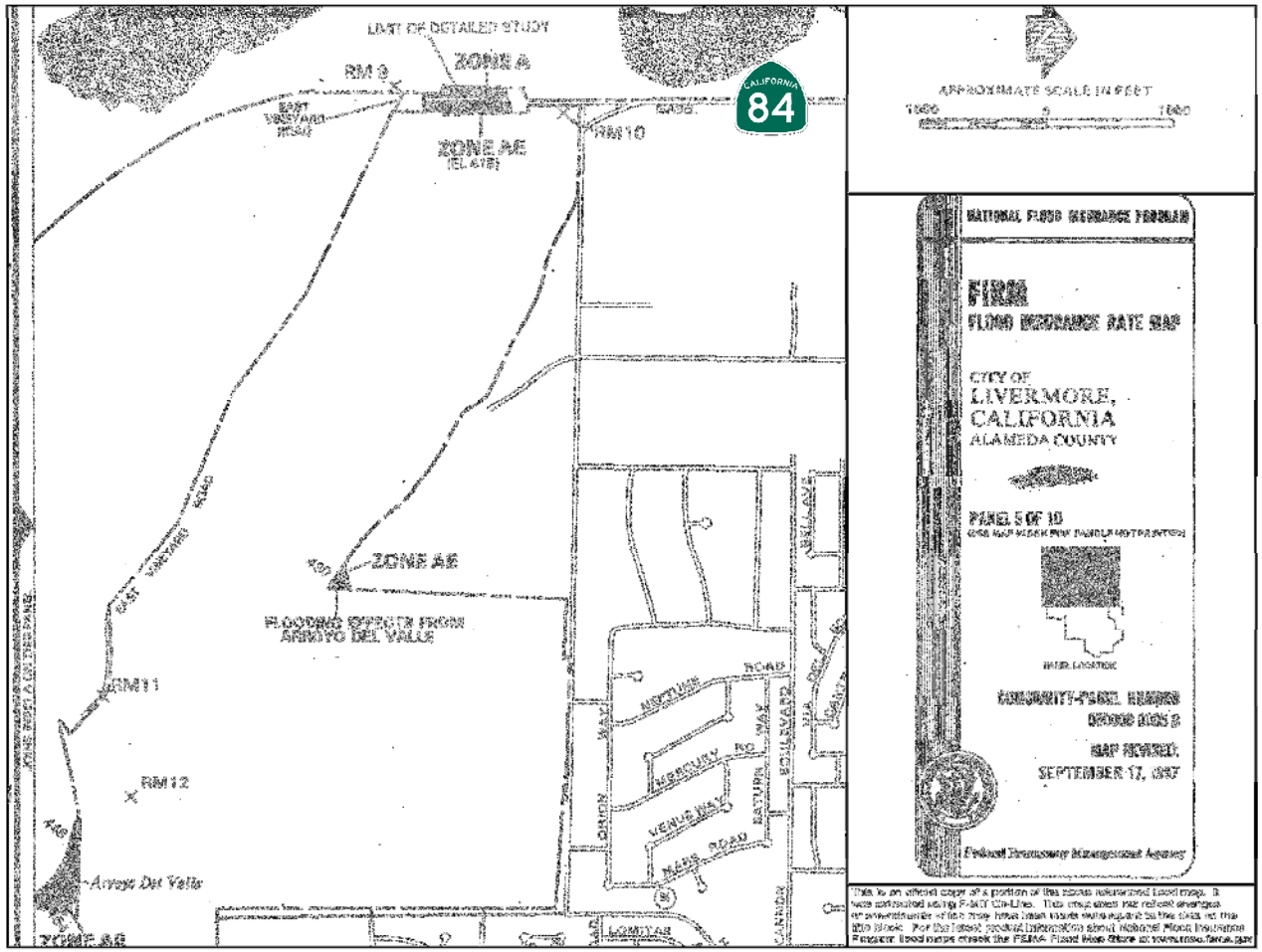
Figure B-3. WinIDF Results – Hydrologic Data for Project area north of Arroyo Mocho

Appendix C FEMA FIRMs



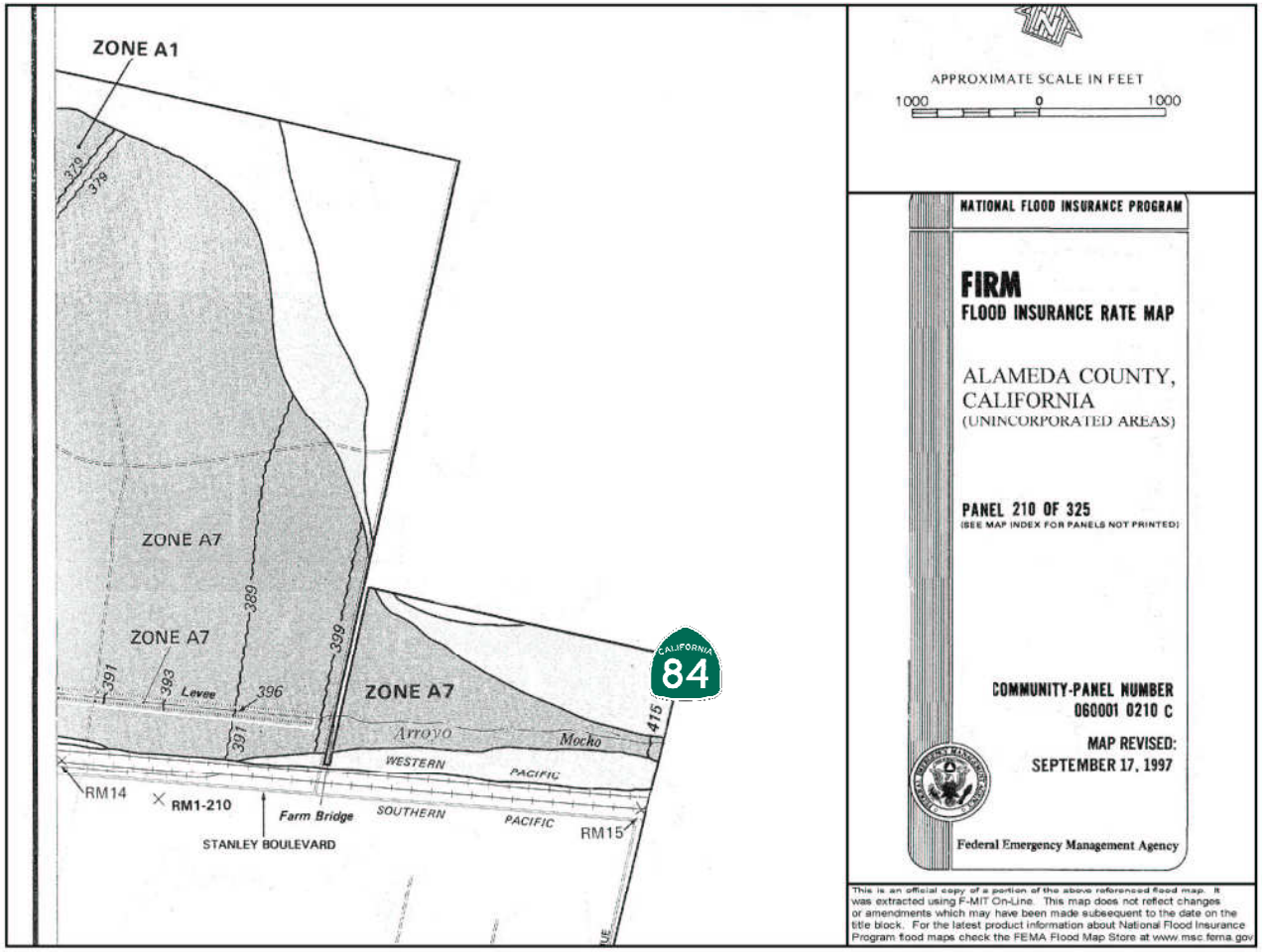
Source: FEMA

Figure C-1. Arroyo Del Valle Floodplain (Alameda County)



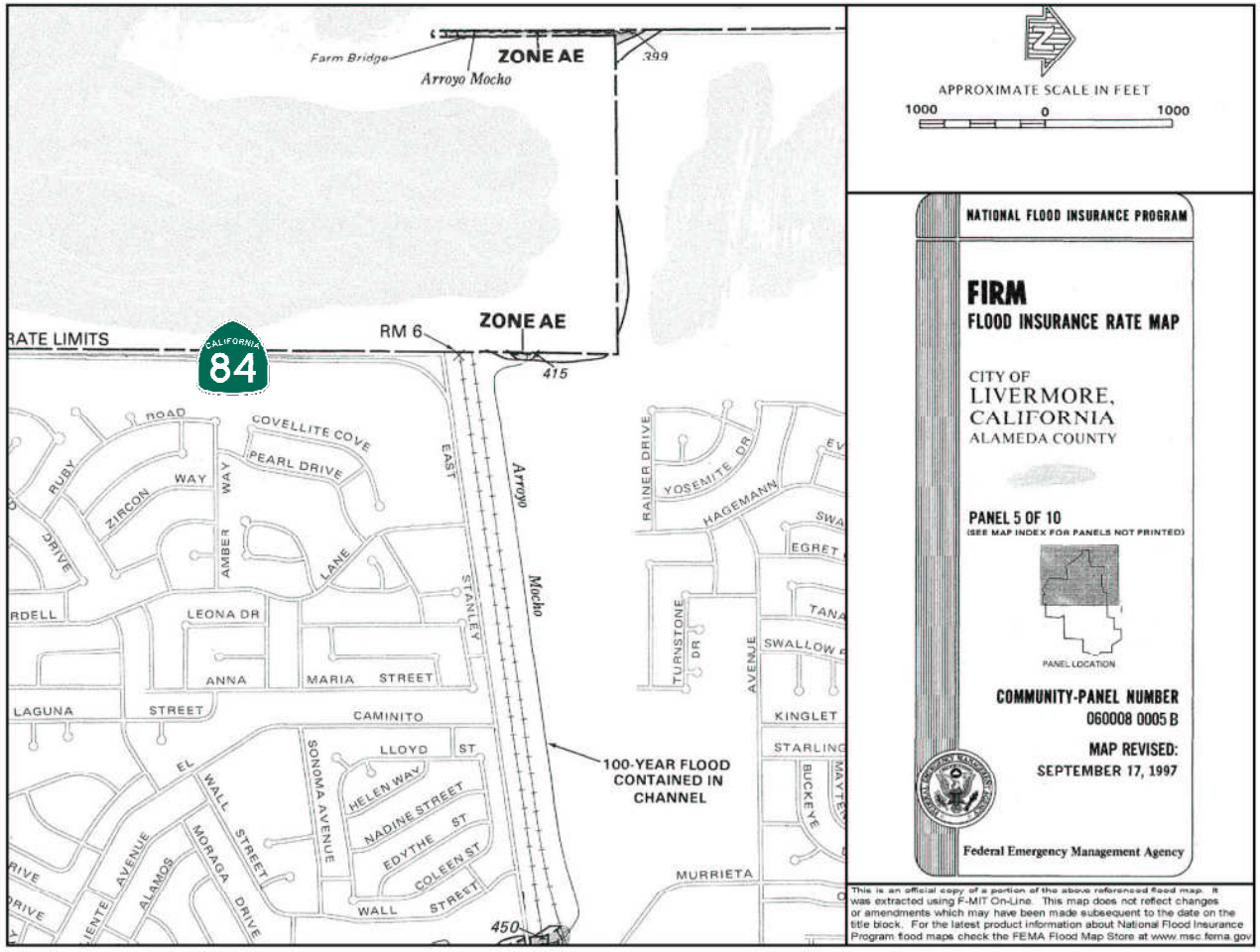
Source: FEMA

Figure C-2. Arroyo Del Valle Floodplain (City of Livermore)



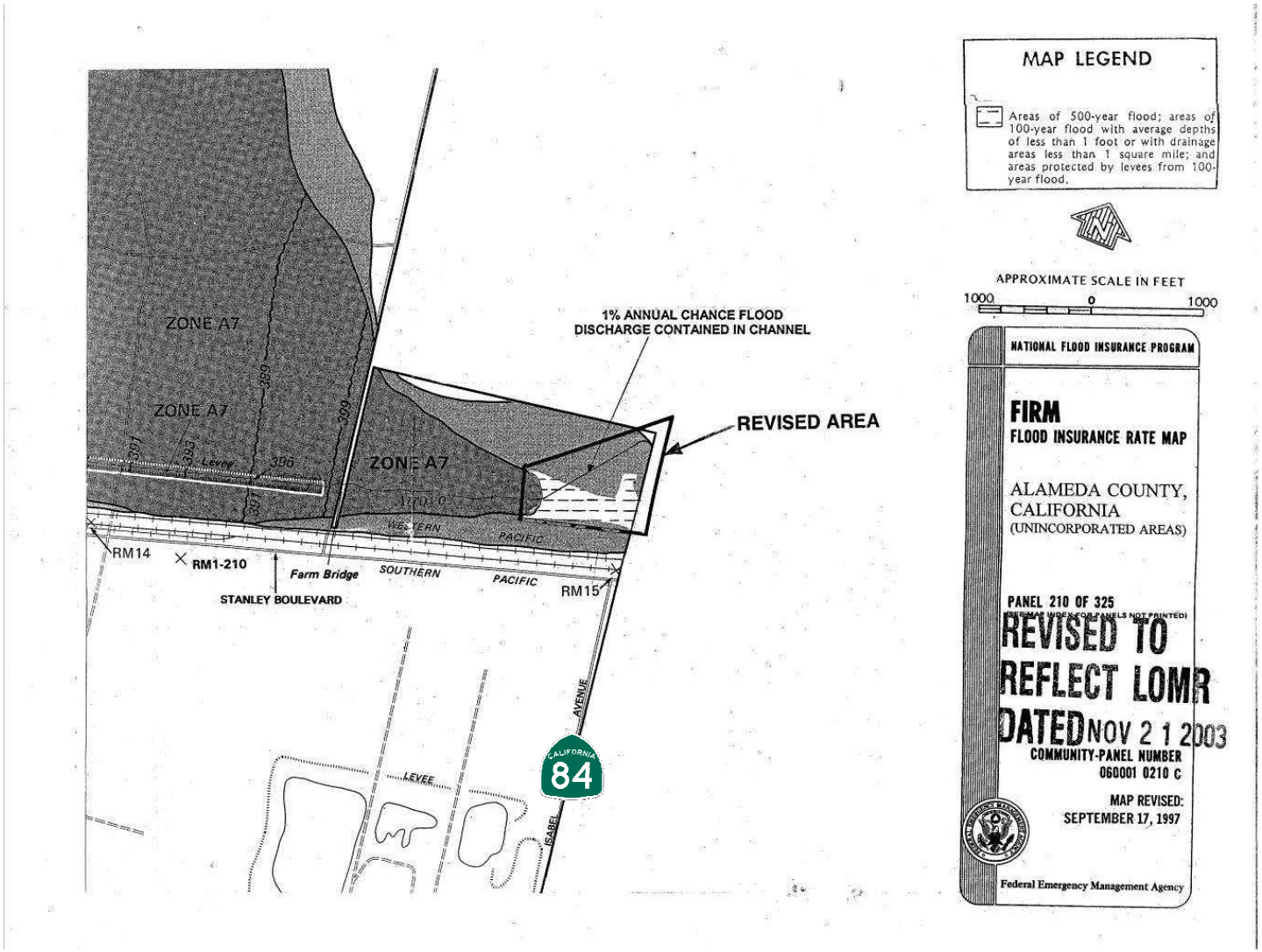
Source: FEMA

Figure C-3. Arroyo Mocho Floodplain (Alameda County)



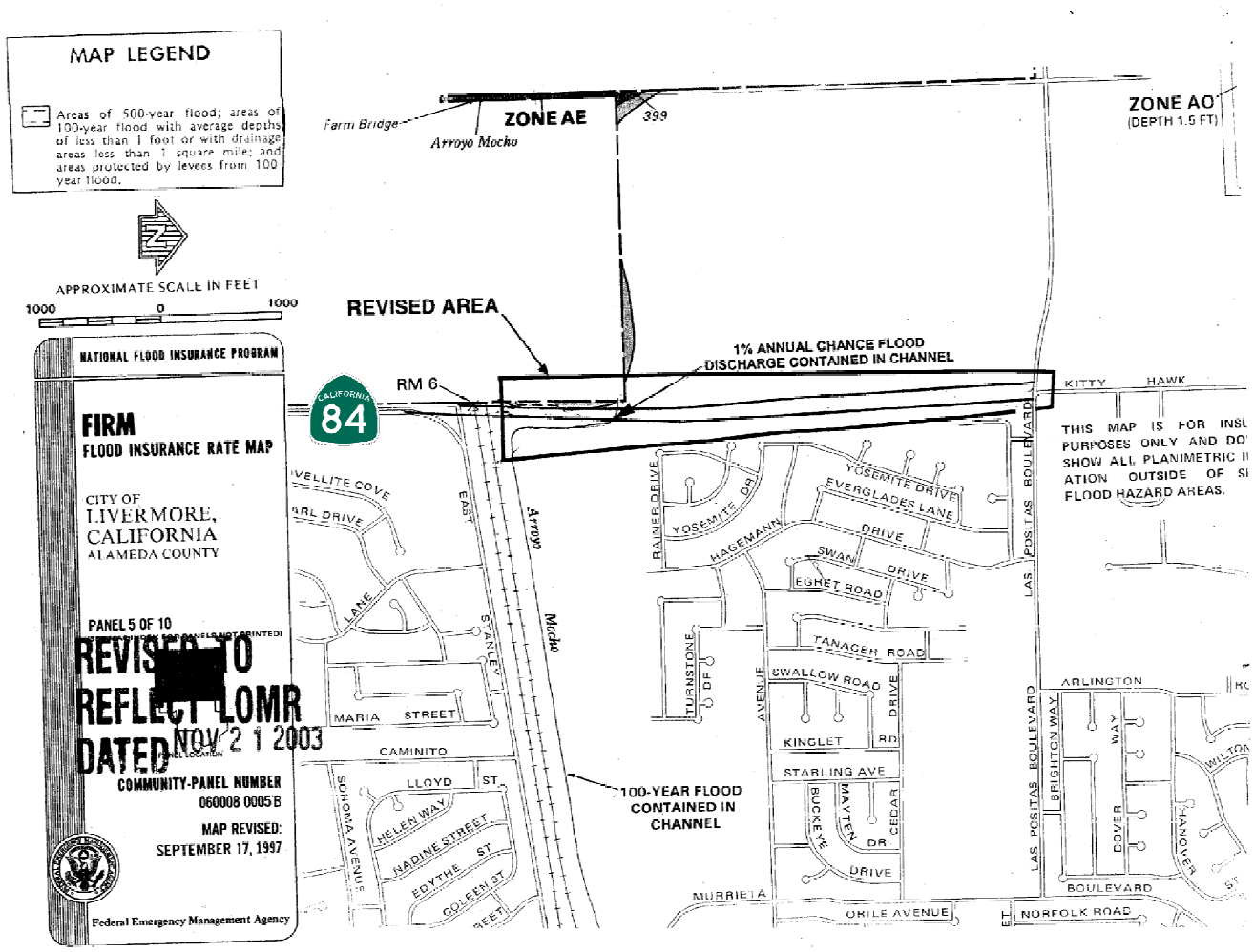
Source: FEMA

Figure C-4. Arroyo Mocho Floodplain (City of Livermore)



Source: FEMA

Figure C-5. Revised Arroyo Mocho Floodplain (Alameda County)



Source: FEMA

Figure C-6. Revised Arroyo Mocho Floodplain (City of Livermore)

Appendix D Hydraulic Analysis

Arroyo Mocho
(PM 26.6)

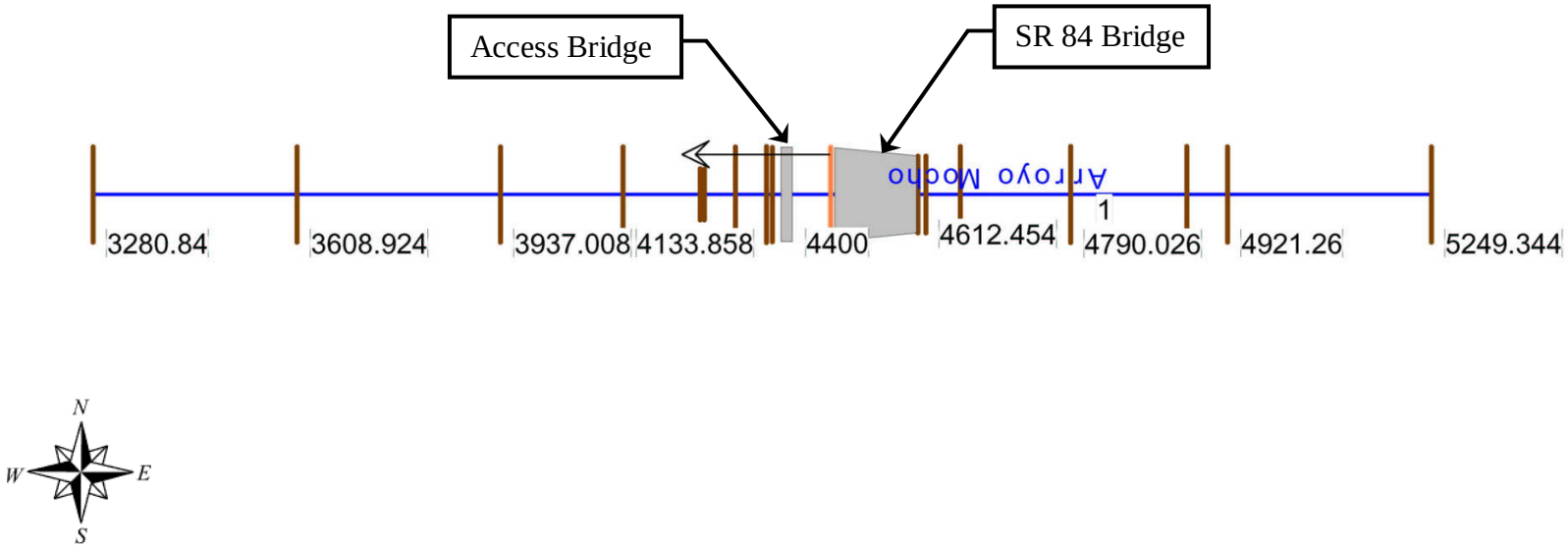


Figure D-1. Arroyo Mocho HEC-RAS Results (Plan View)

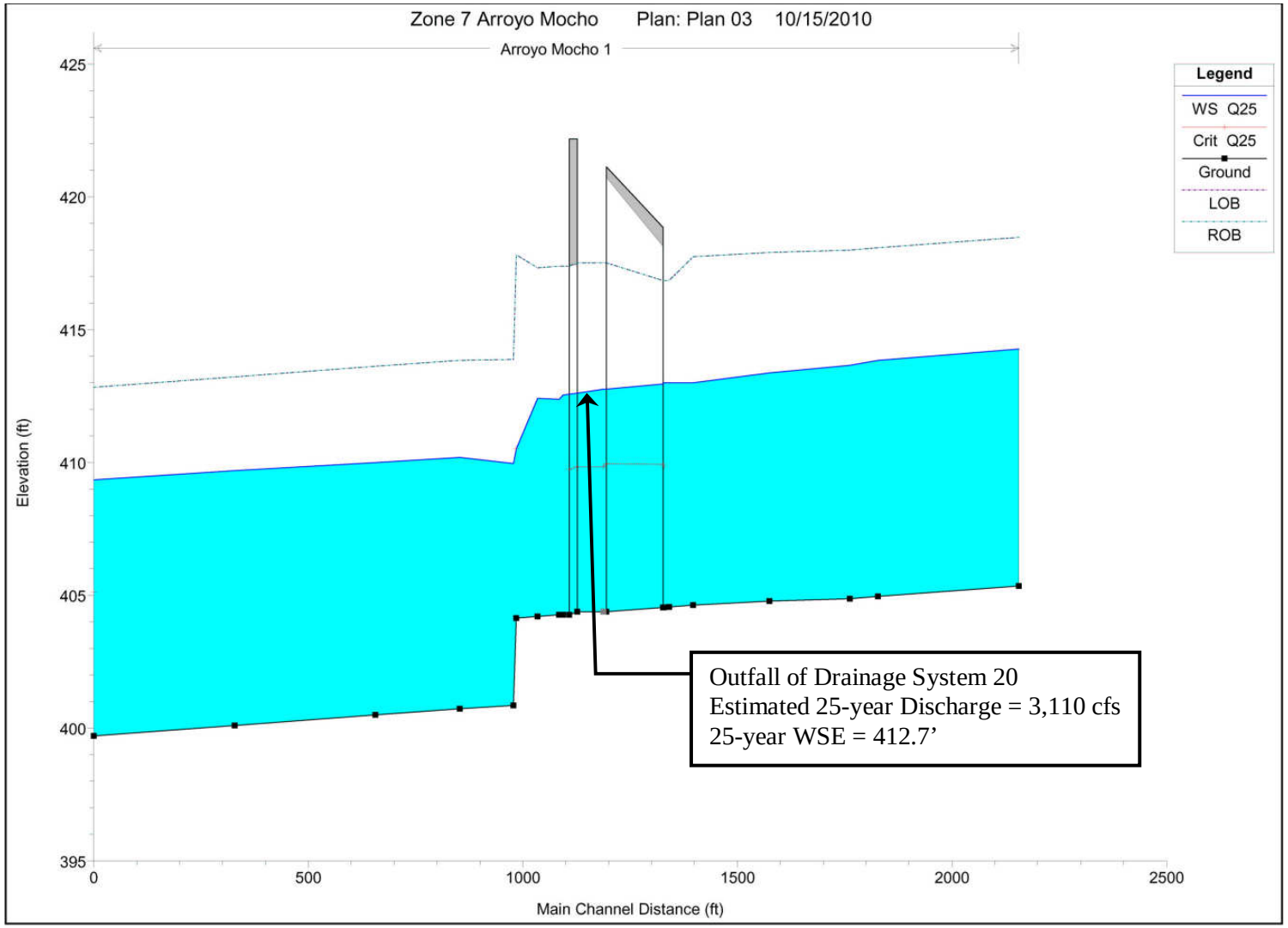


Figure D-2. Arroyo Mocho HEC-RAS Results (Profile View)

Arroyo Del Valle
(PM 24.8)

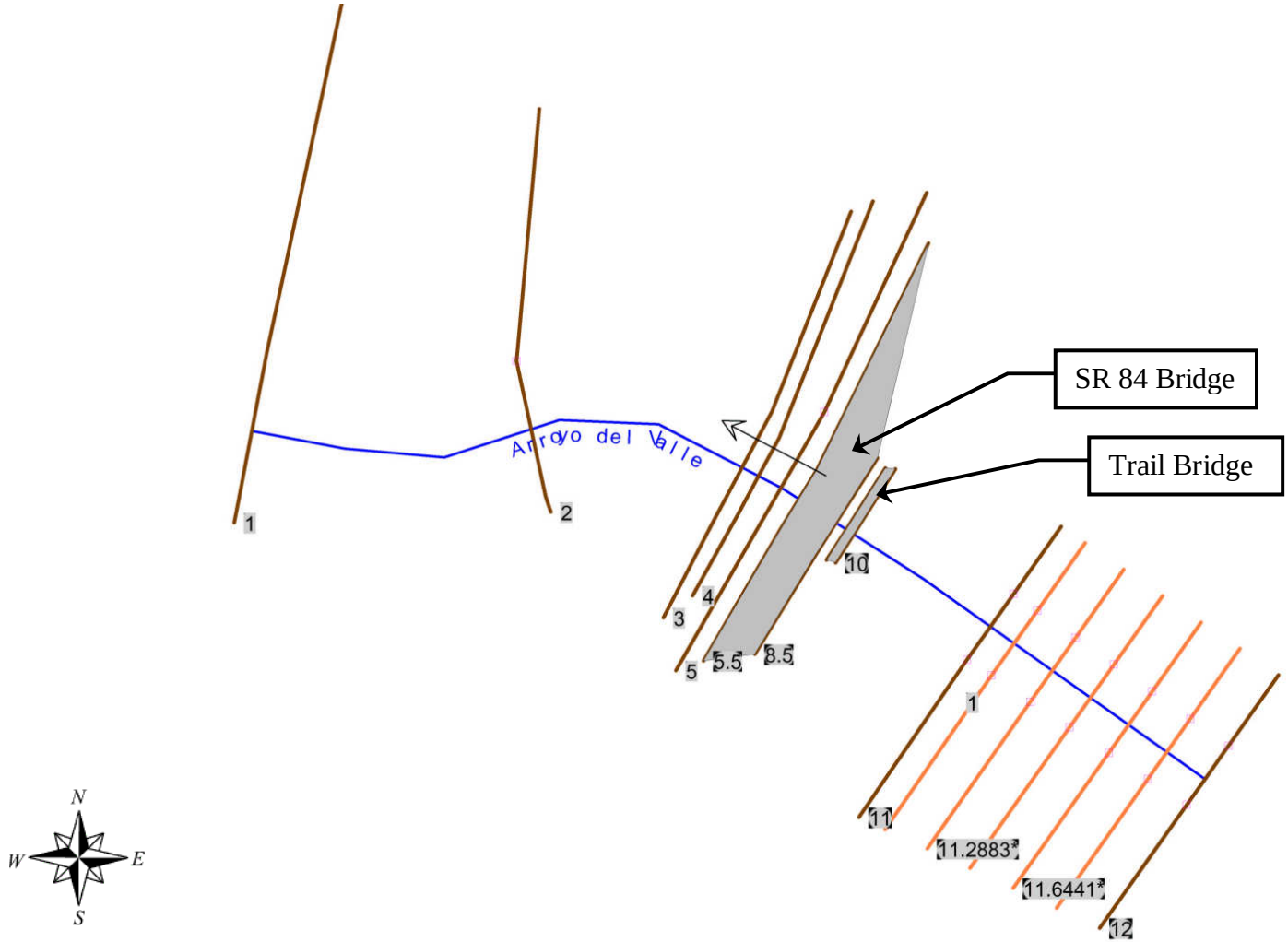


Figure D-3. Arroyo Del Valle HEC-RAS Model (Plan View)

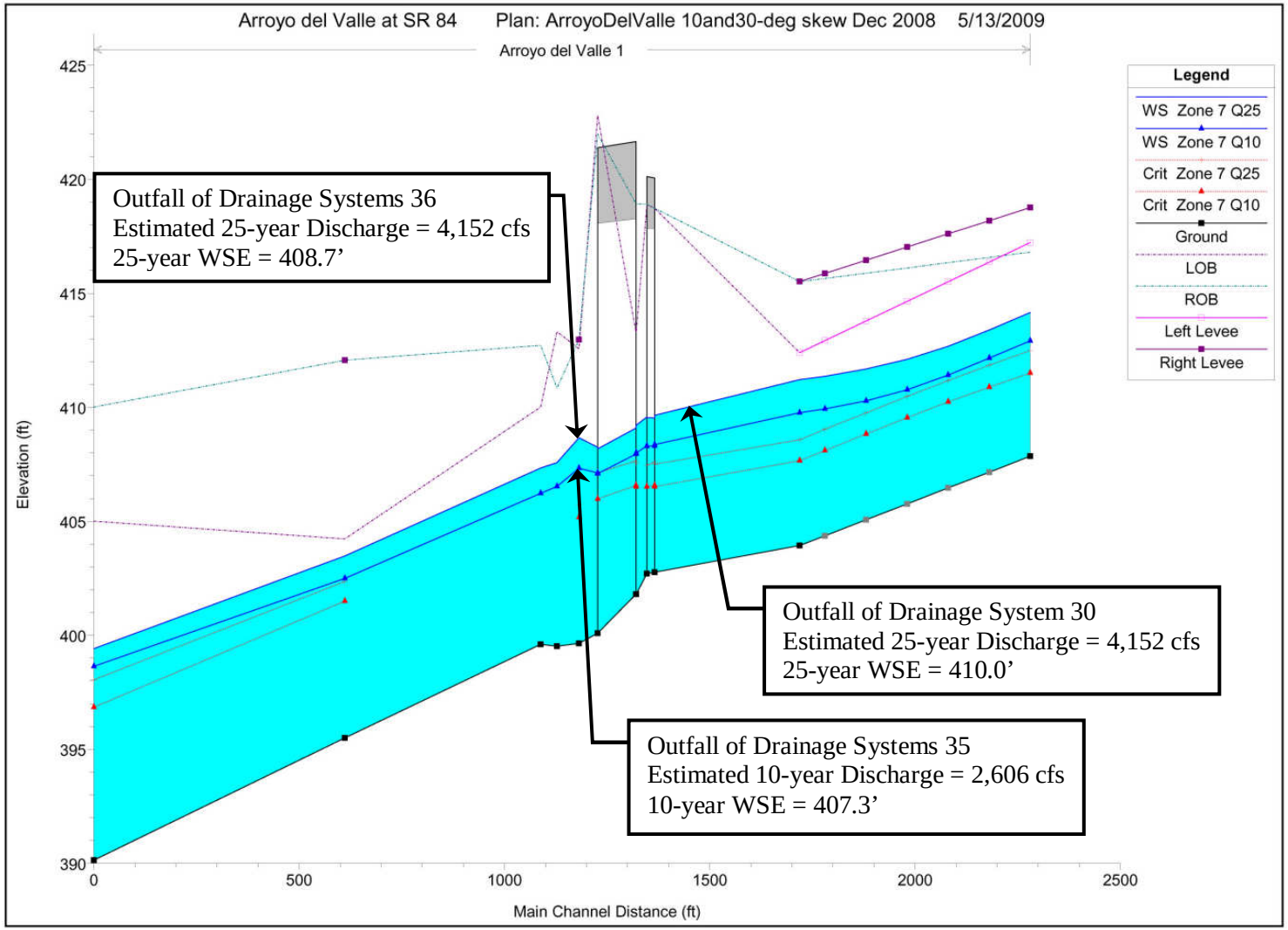


Figure D-4. Arroyo Del Valle HEC-RAS Results (Profile View)

Appendix E Watershed Maps

Segment A
(PM 25.5 to PM 27.1)

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

DRAINAGE SYSTEM UNIT
AREA (ac)

FLOW DIRECTION

PERVIOUS WATERSHED BOUNDARY

IMPERVIOUS WATERSHED BOUNDARY (TREATED)

IMPERVIOUS WATERSHED BOUNDARY (NON-TREATED)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
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No. C 55279
Exp. 12/31/12
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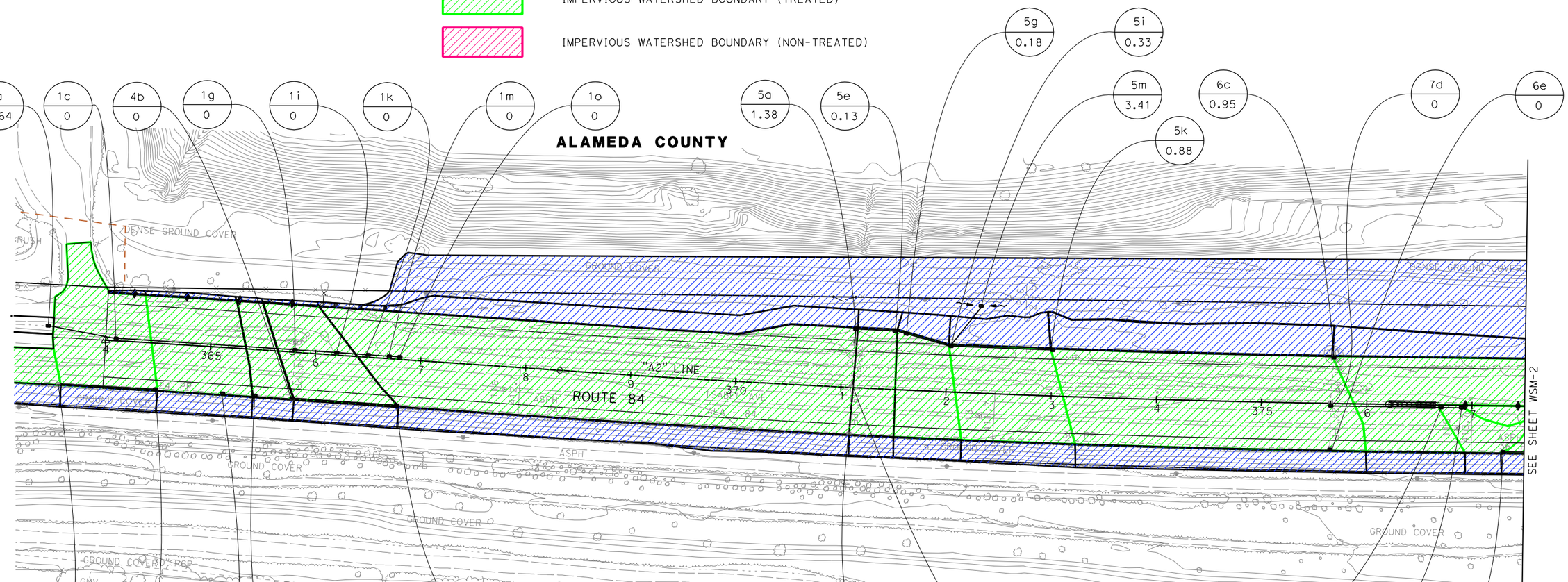

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-1

REVISED BY	DATE REVISED
IL	10/19/10

IRENE LIU — CALCULATED-DESIGNED BY
ANALETTE OCHOA — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans®

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

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Exp. 12/31/12
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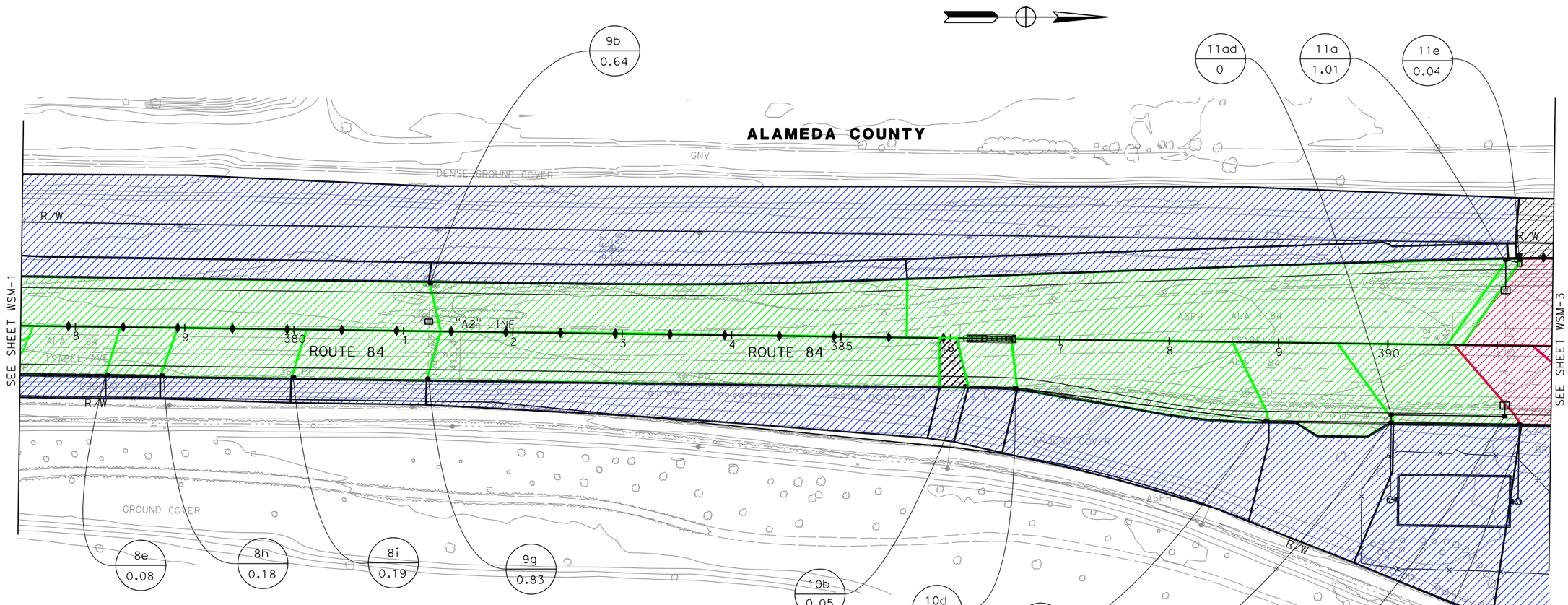

WATERSHED MAP
SCALE 1"=50'

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WSM-2

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SUPERVISOR: HAN-BIN LIANG
CONSULTANT FUNCTIONAL
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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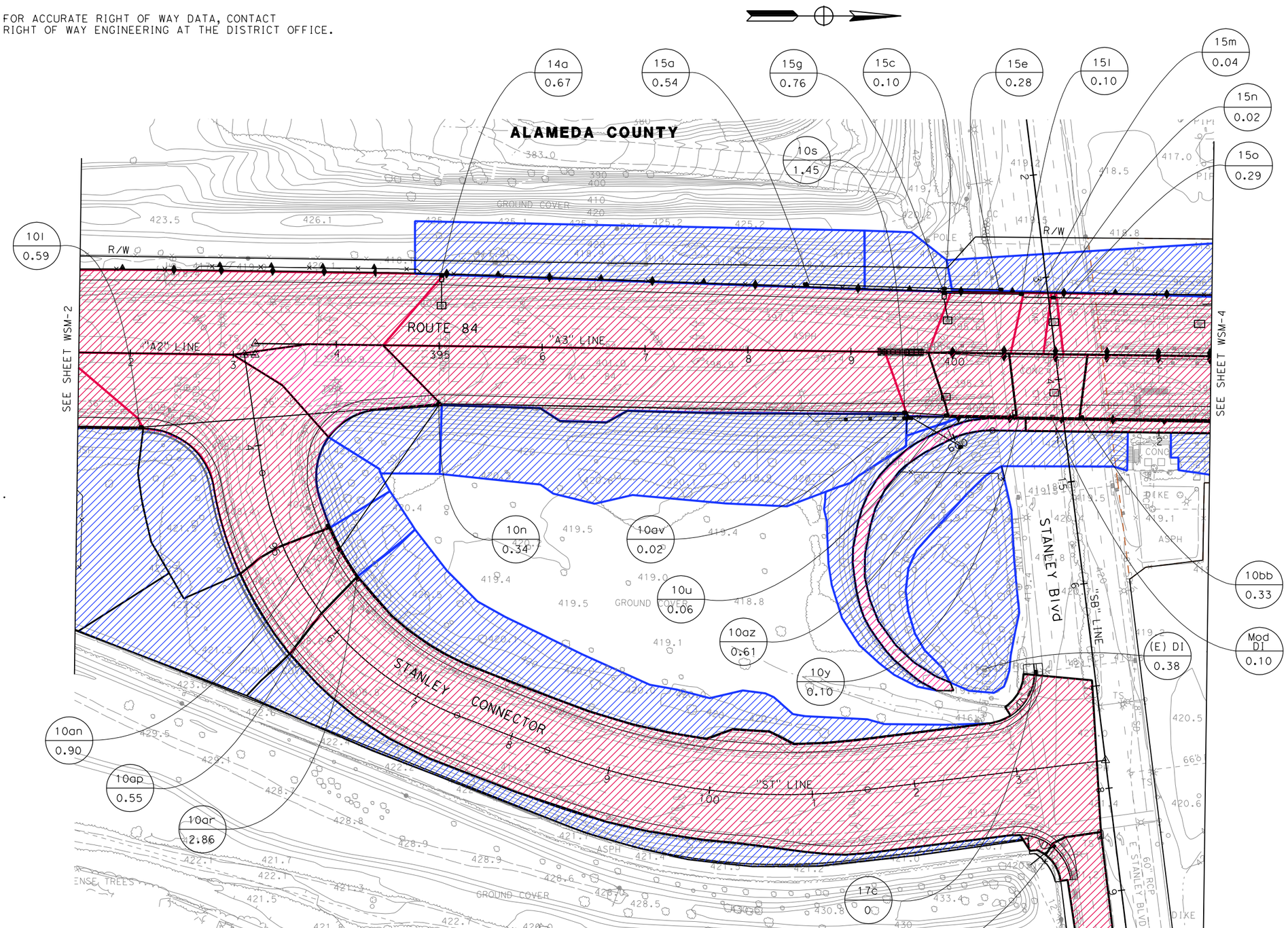

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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WATERSHED MAP

SCALE 1"=50'

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WSM-3

REVISED BY	DATE REVISED
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CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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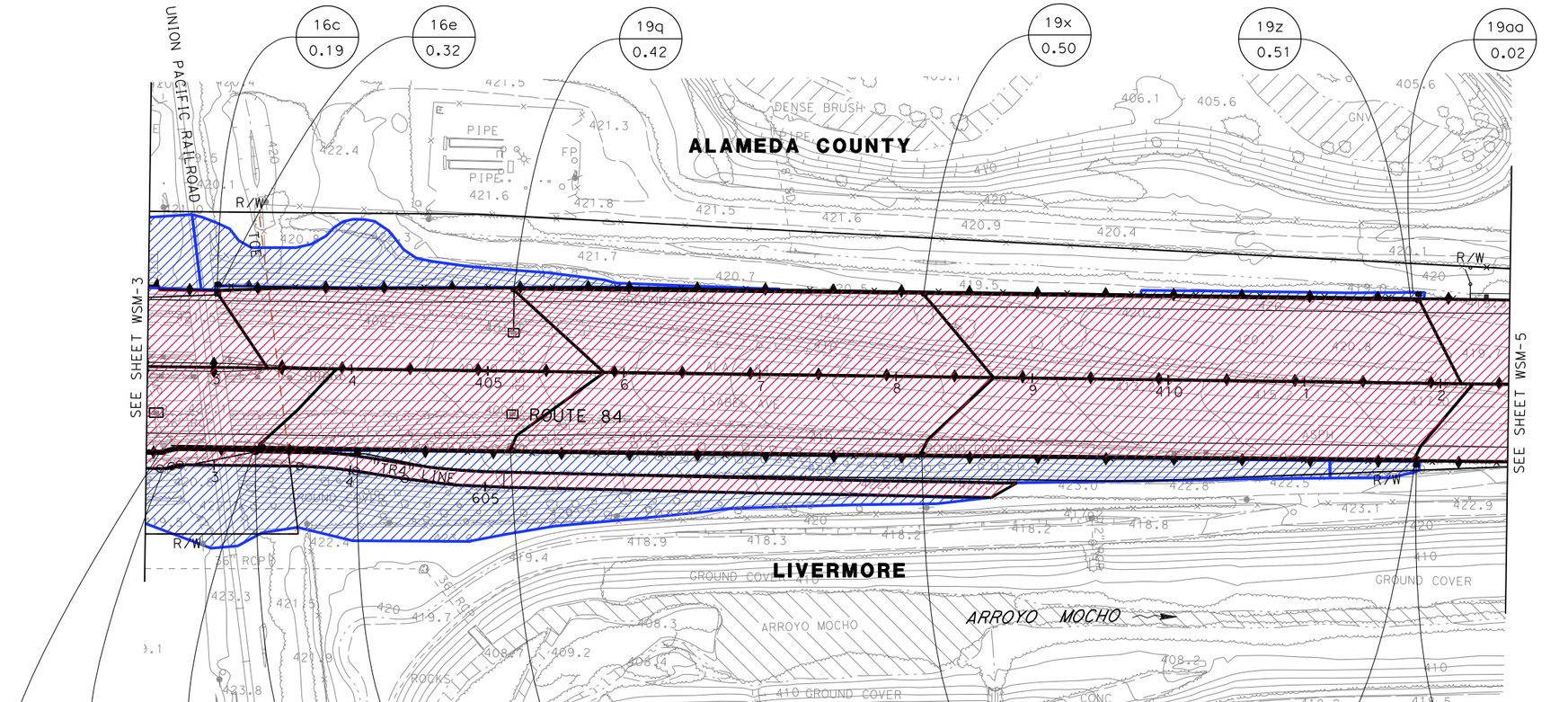

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-4

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DATE REVISED	10/19/10		
CALCULATED-DESIGNED BY	IRENE LIU		
CHECKED BY	ANALETTE OCHOA		
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans		

LAST REVISION 10-19-10
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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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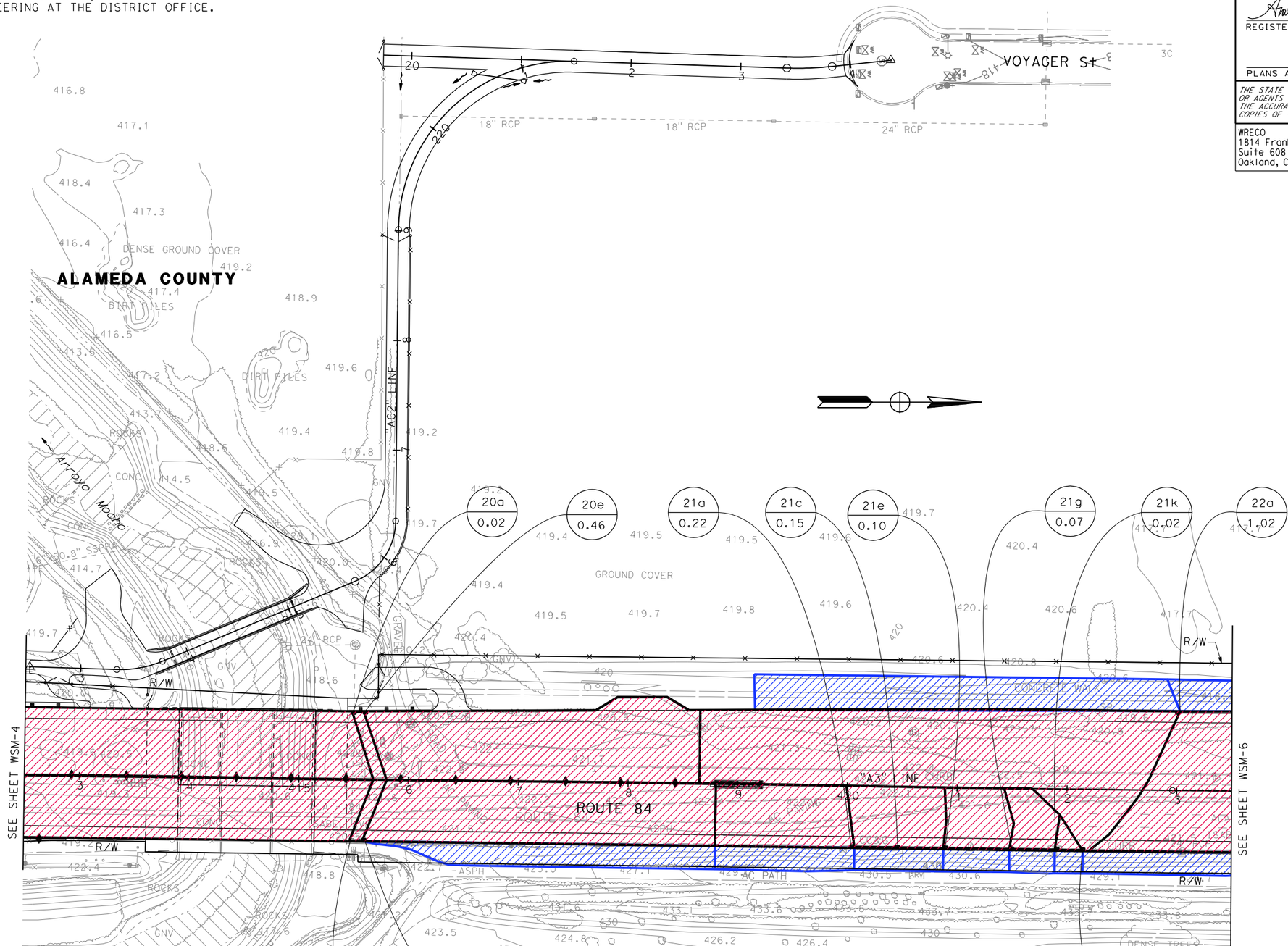

WATERSHED MAP
SCALE 1"=50'

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WSM-5

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	IL
CHECKED BY	ANALETTE OCHOA	DATE REVISED	10/19/10

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION: DATE PLOTTED => 1/14/2011
10-19-10 TIME PLOTTED => 7:14:59 PM

BORDER LAST REVISED 7/2/2010

USERNAME => wana_chiu
DGN FILE => ...\Dwg\Seg A\WSM\429760wsm005.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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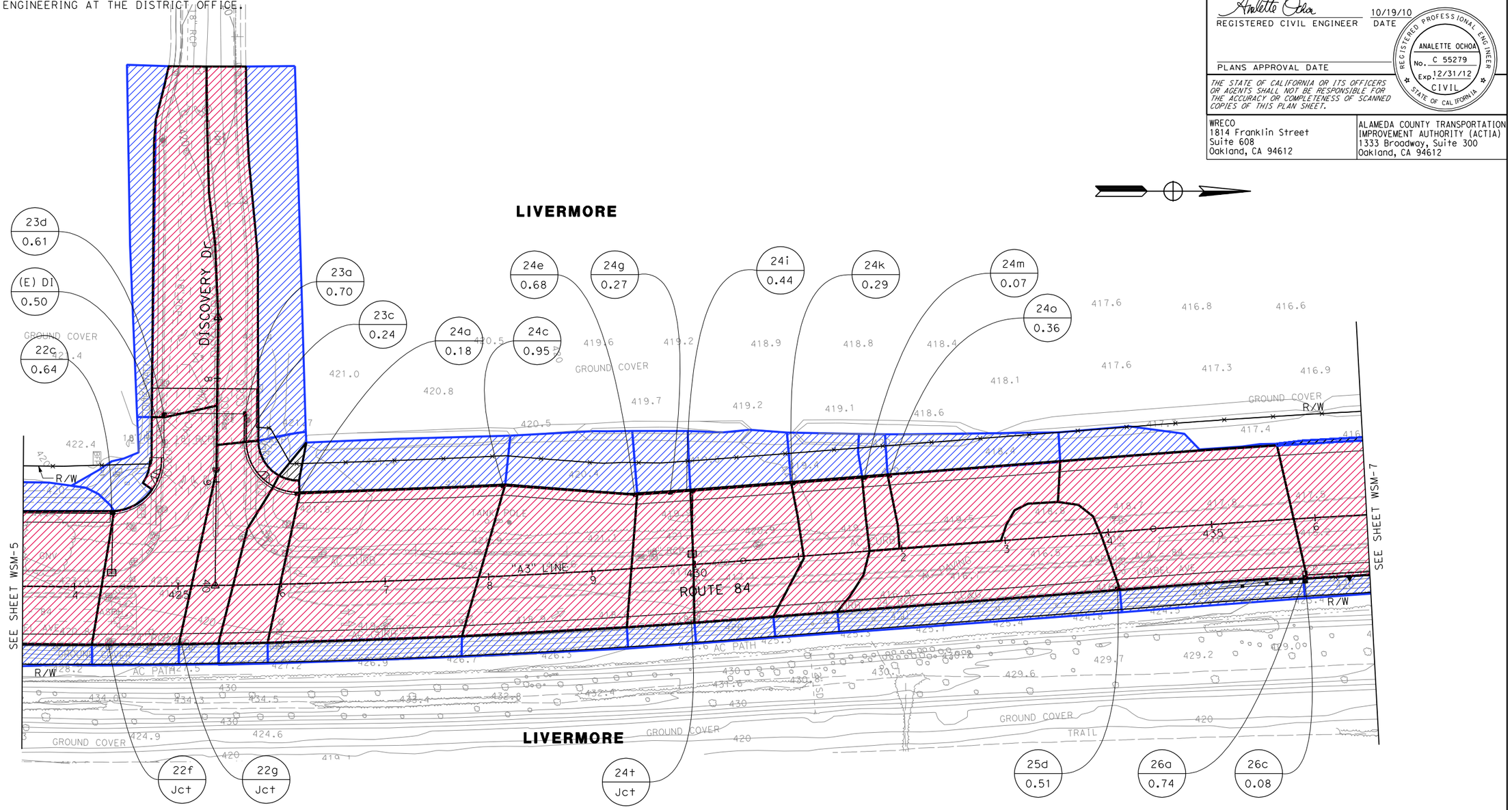

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
DATE REVISED: 10/19/10

LAST REVISION 10-19-10
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 7:15:18 PM

BORDER LAST REVISED 7/2/2010
USERNAME => wang_chiu
DGN FILE => ...\Dwg\Seg A\WSM\429760wsm006.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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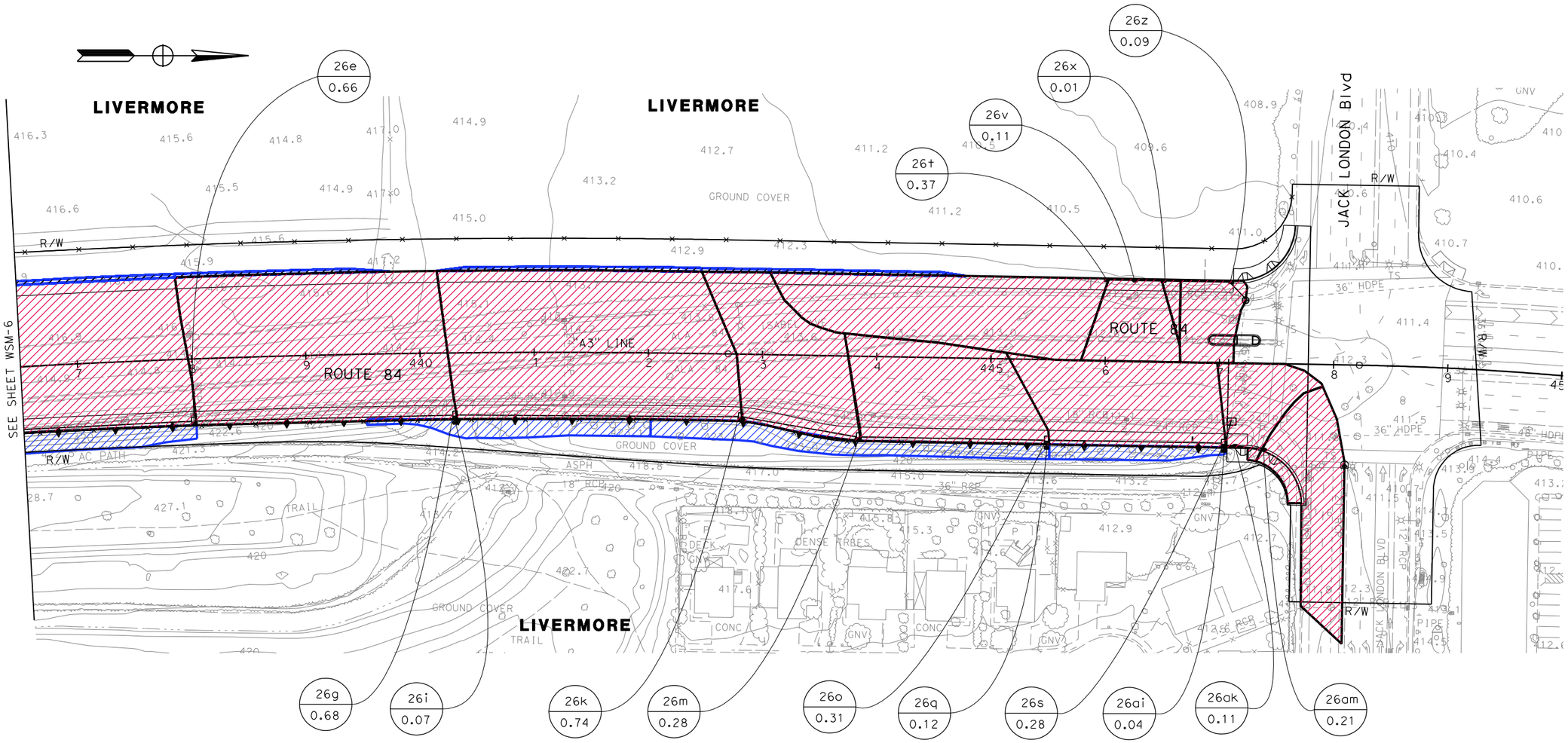


WATERSHED MAP

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-7

CALCULATED-DESIGNED BY	IRENE LIU	
CHECKED BY	ANALETTE OCHOA	
REVISED BY	IL	
DATE REVISED	10/19/10	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION DATE PLOTTED => 1/14/2011
10-19-10 TIME PLOTTED => 7:15:33 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => wana_chiu | DGN FILE => ...\Dwg\Seg A\WSM\429760wsm007.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Segment B
(PM 22.9 to PM 25.7)

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

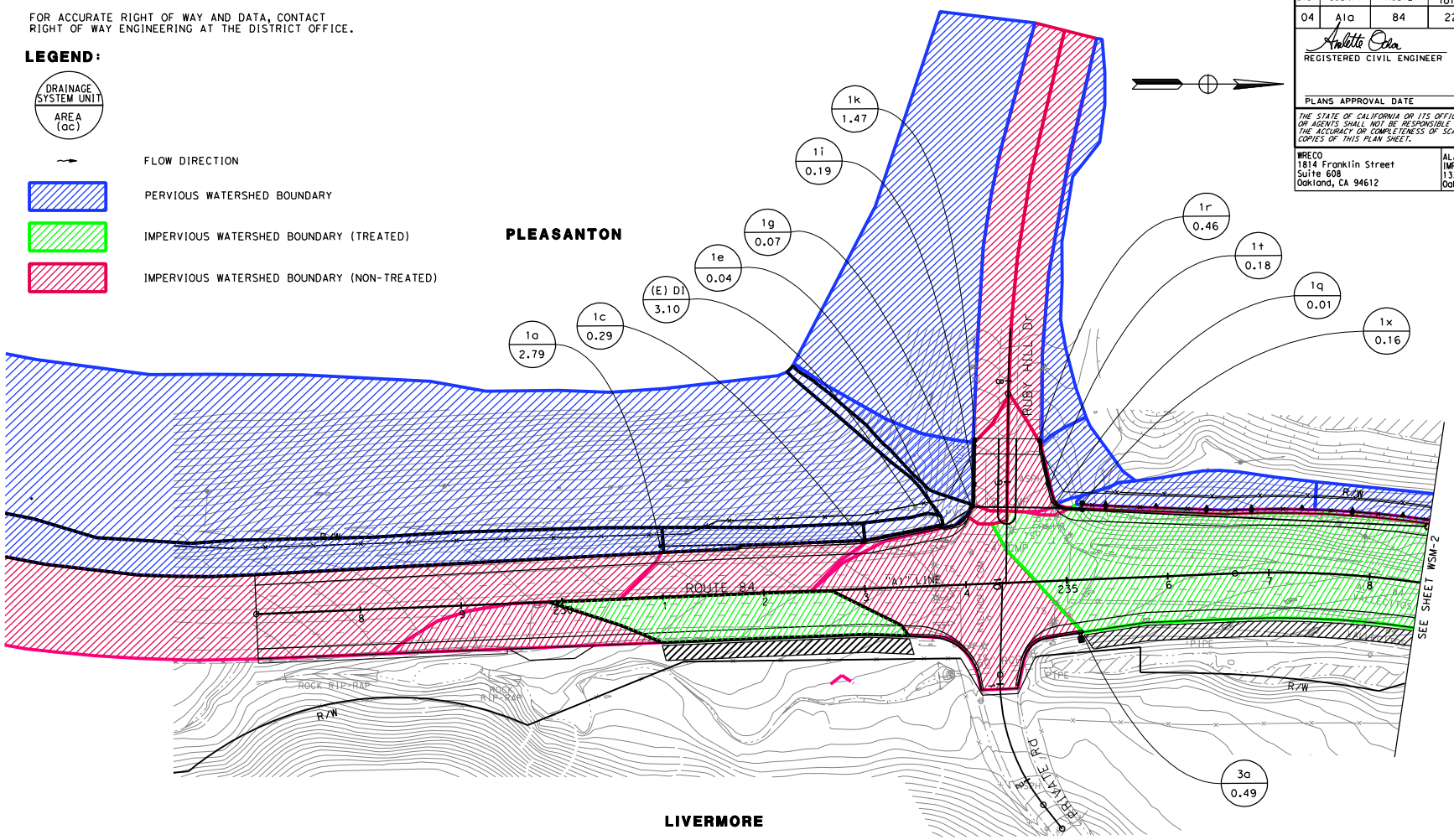
DRAINAGE SYSTEM UNIT / AREA (ac)

FLOW DIRECTION

PERVIOUS WATERSHED BOUNDARY

IMPERVIOUS WATERSHED BOUNDARY (TREATED)

IMPERVIOUS WATERSHED BOUNDARY (NON-TREATED)



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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REVISED BY	DATE REVISED
IL	10/19/10

CALCULATED-DESIGNED BY	CHECKED BY
IRENE LIU	ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

WATERSHED MAP

SCALE 1"=50'

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WSM-1

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 21:32:20 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-01.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	2	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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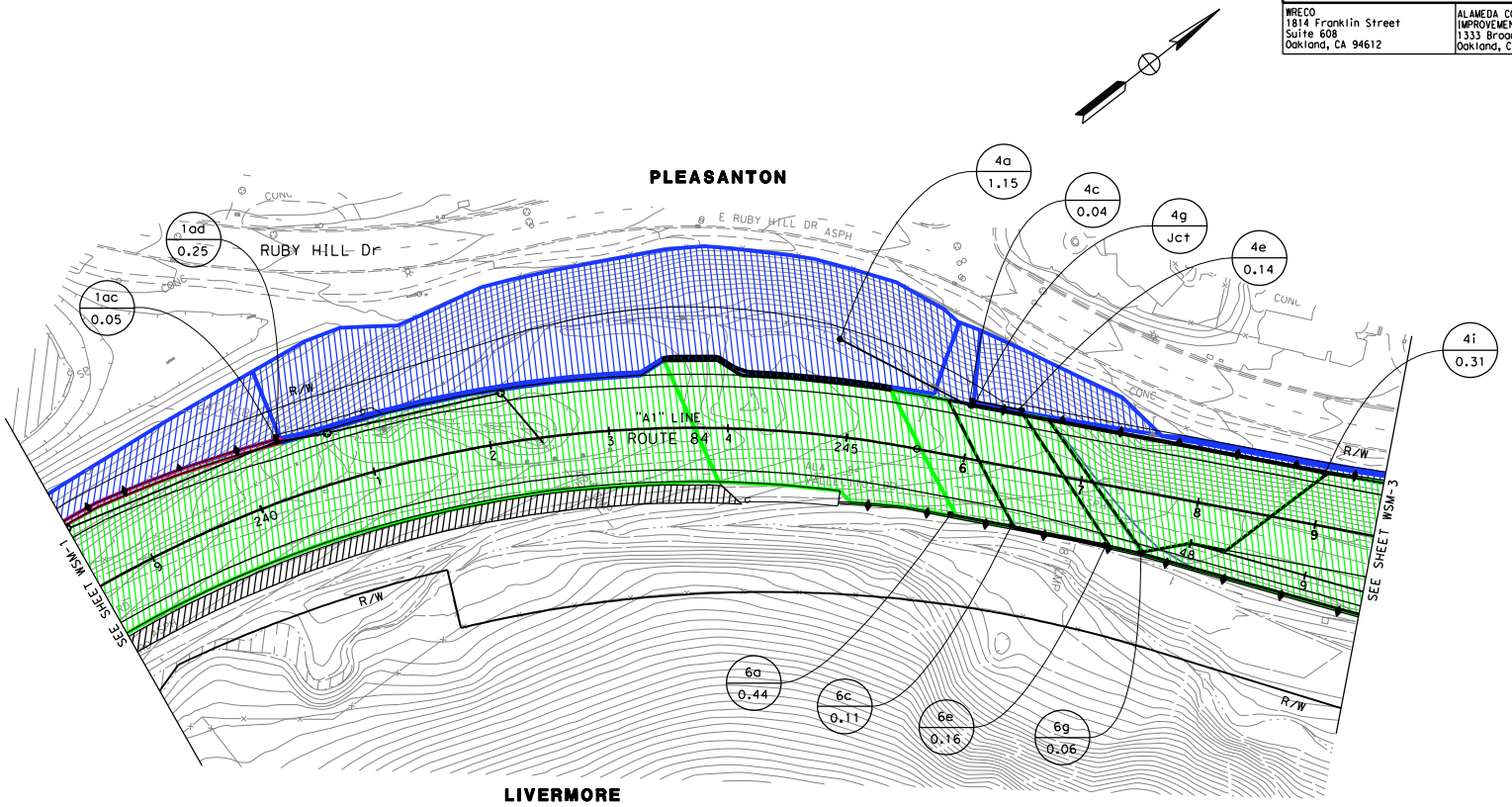

WATERSHED MAP

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
IRENE LIU	ANALETTE OCHOA	IL	10/19/10

LAST REVISION
DATE PLOTTED => 10/20/2010
TIME PLOTTED => 21:32:27 PM

BORDER LAST REVISED 7/2/2010

USERNAME => irene_liu
DGN FILE => ...\dwg\Seg B\WSM\WSM-02.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	3	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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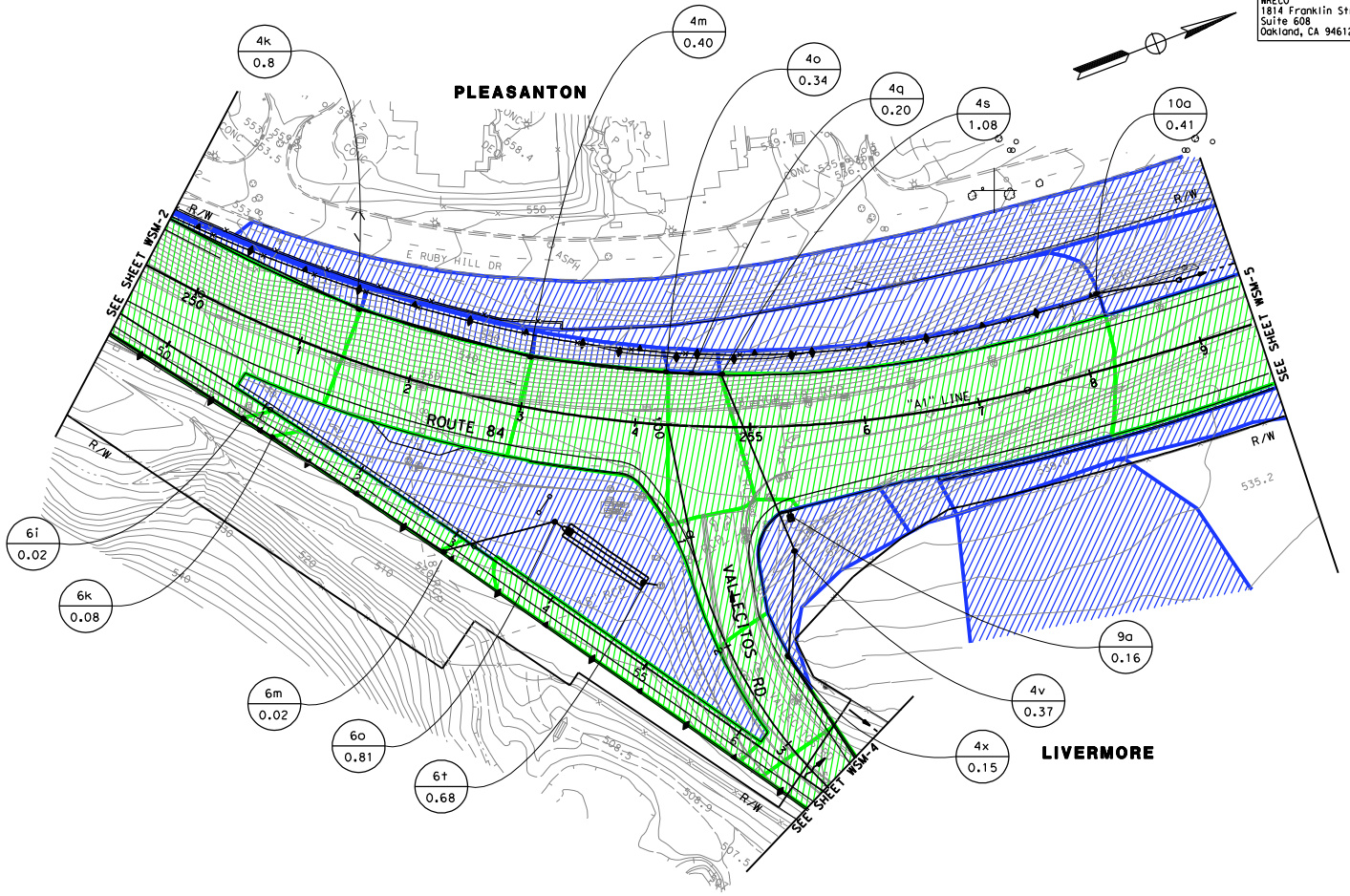

WATERSHED MAP

SCALE 1"=50'

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	IL
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 21:32:32 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-03.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	4	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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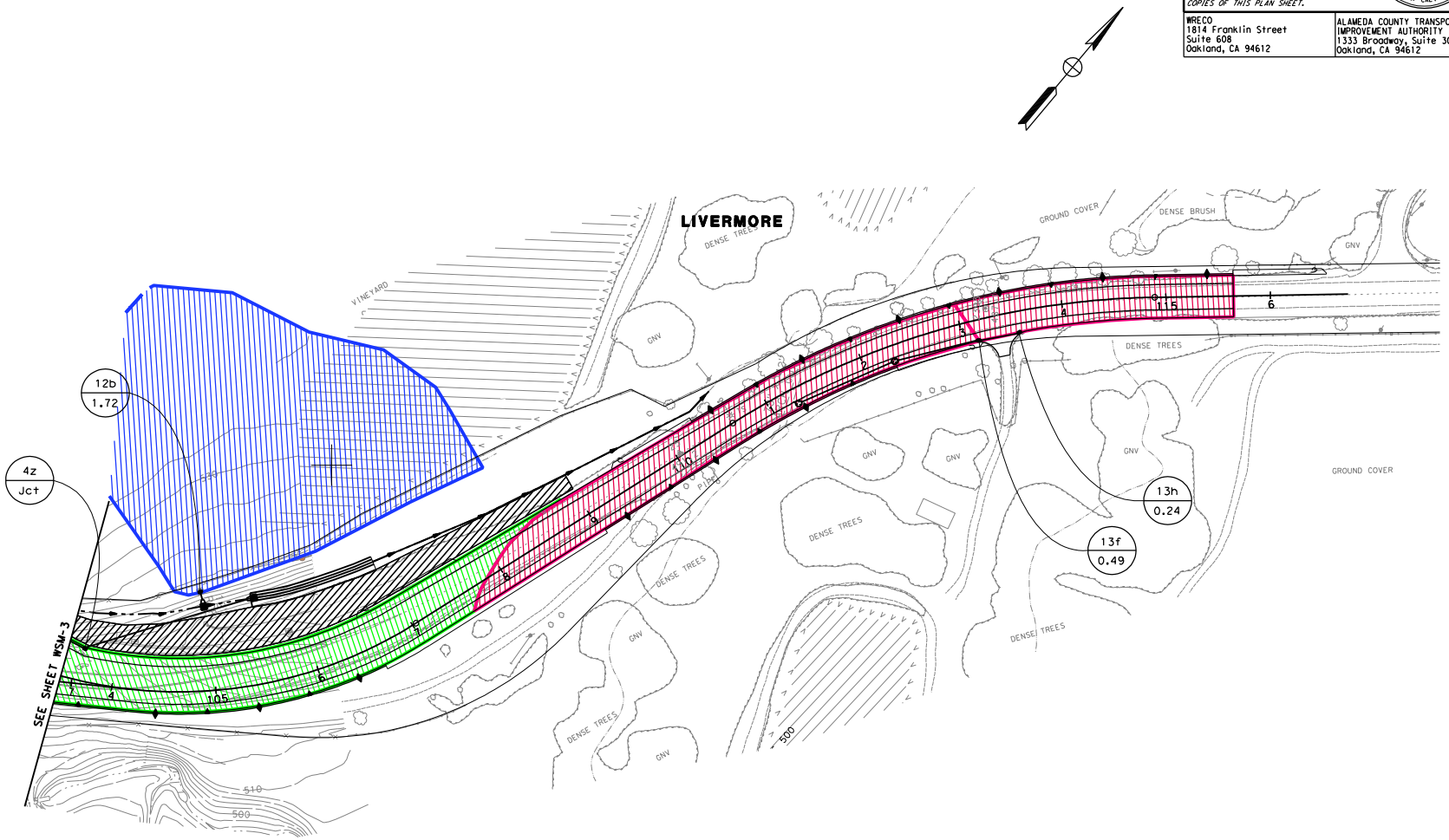

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-4

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG | CALCULATED-DESIGNED BY: IRENE LIU | CHECKED BY: ANALETTE OCHOA | REVISED BY: IL | DATE REVISED: 10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 21:32:38 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-04.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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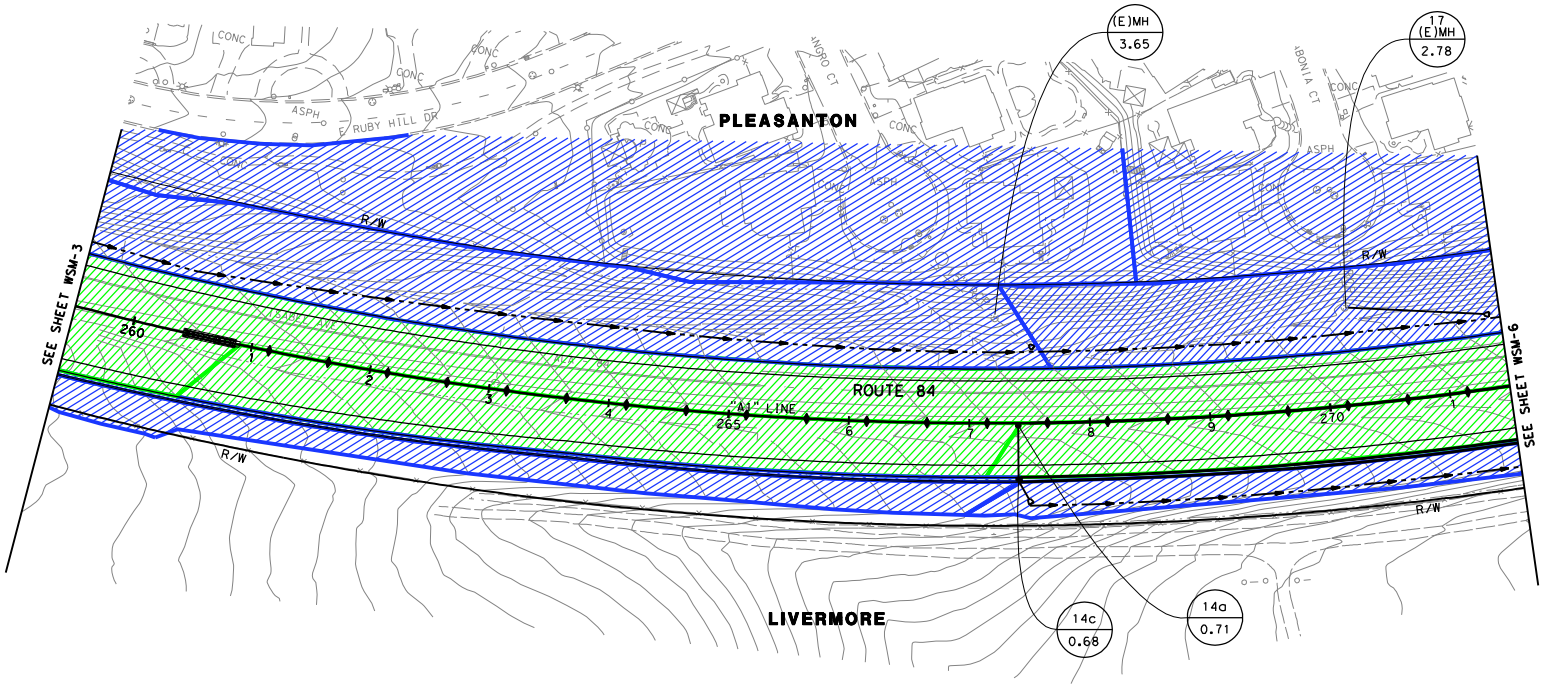

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
DATE REVISED: 10/19/10

LAST REVISION
DATE PLOTTED => 10/20/2010
TIME PLOTTED => 21:32:43 PM

BORDER LAST REVISED 7/2/2010
USERNAME => Irene_liu
DGN FILE => ...\dwg\Seg B\WSM\WSM-05.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	6	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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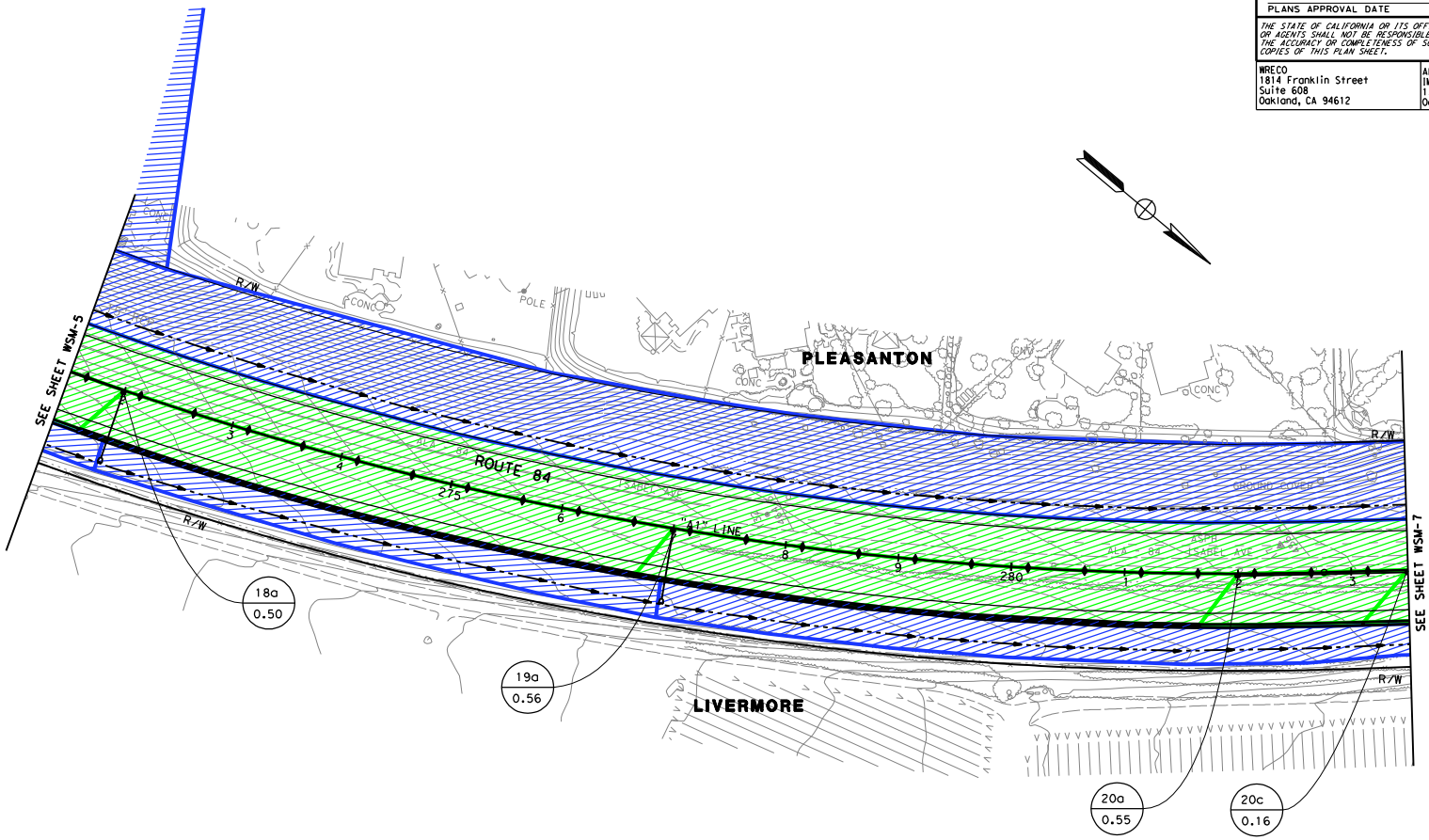

WATERSHED MAP

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	IL	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 2:32:48 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-06.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	7	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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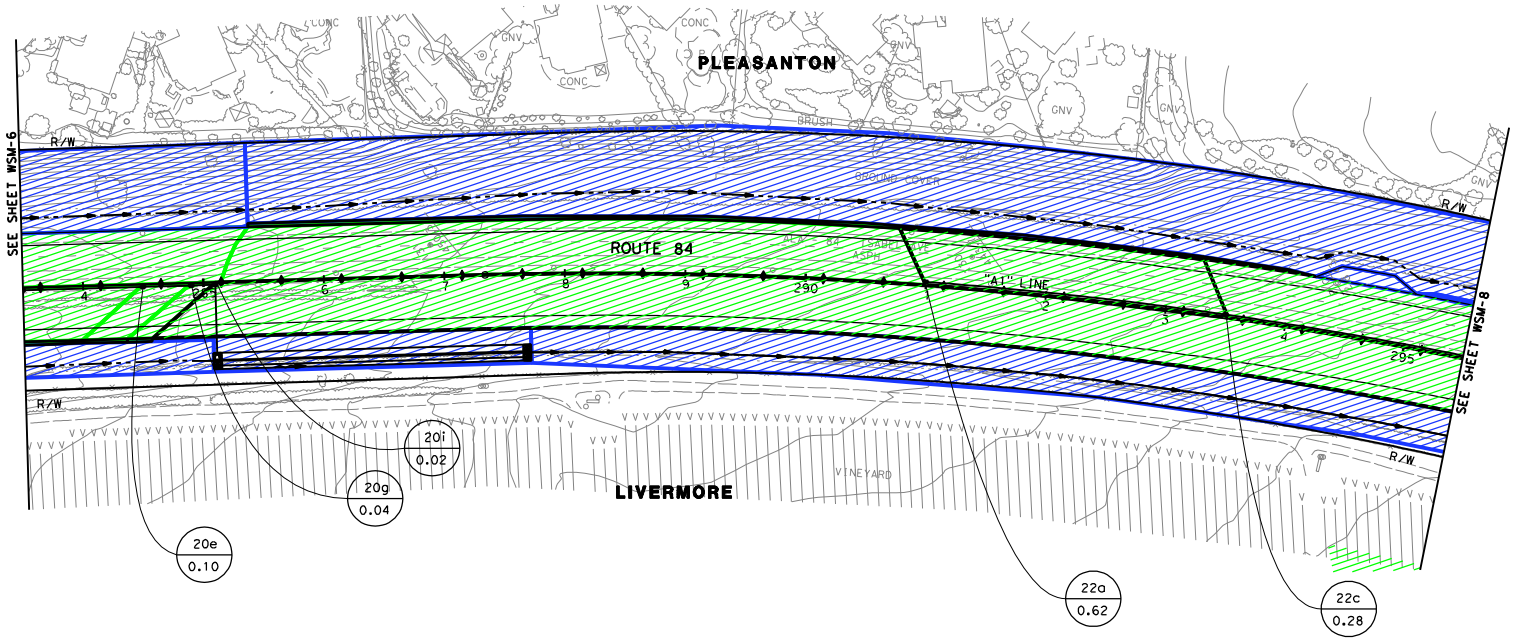

WATERSHED MAP

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY: IRENE LIU — CHECKED BY: ANALETTE OCHOA

REVISED BY: IL — DATE REVISED: 10/19/10

LAST REVISION — DATE PLOTTED => 10/20/2010 — TIME PLOTTED => 22:32:54 PM

BORDER LAST REVISED 7/2/2010

USERNAME => Irene_liu
DGN FILE => ...\dwg\Seg B\WSM\WSM-07.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	8	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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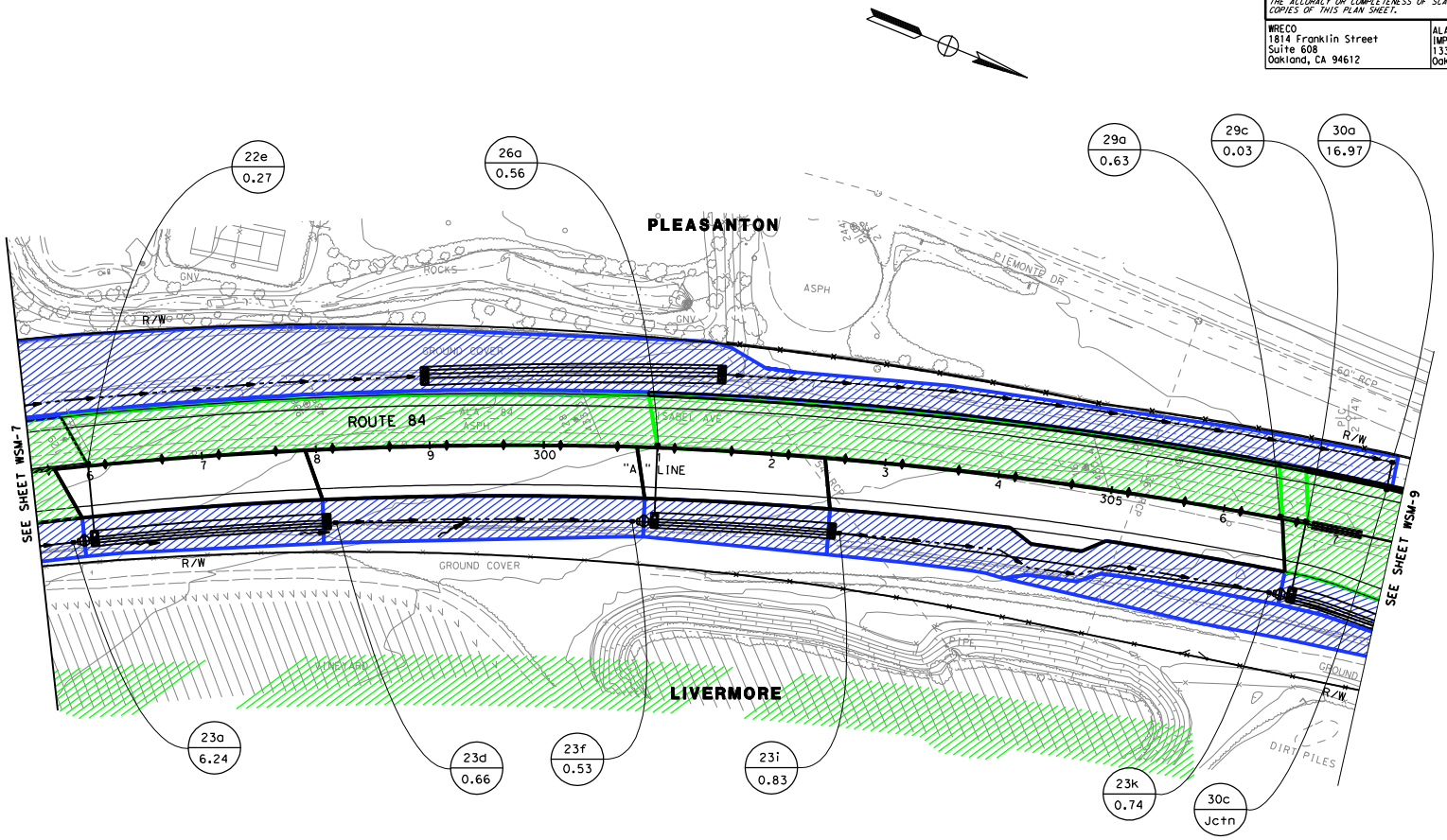

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	LAST REVISION
Caltrans	HAN-BIN LIANG	IRENE LIU	IL	DATE PLOTTED => 10/20/2010
		CHECKED BY	DATE REVISED	TIME PLOTTED => 21:32:59 PM
		ANALETTE OCHOA	10/19/10	10-19-10

BORDER LAST REVISED 7/2/2010	USERNAME => irene_liu DGN FILE => ...\dwg\Seg B\WSM\WSM-08.dgn	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	UNIT 0733	PROJECT NUMBER & PHASE	04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	9	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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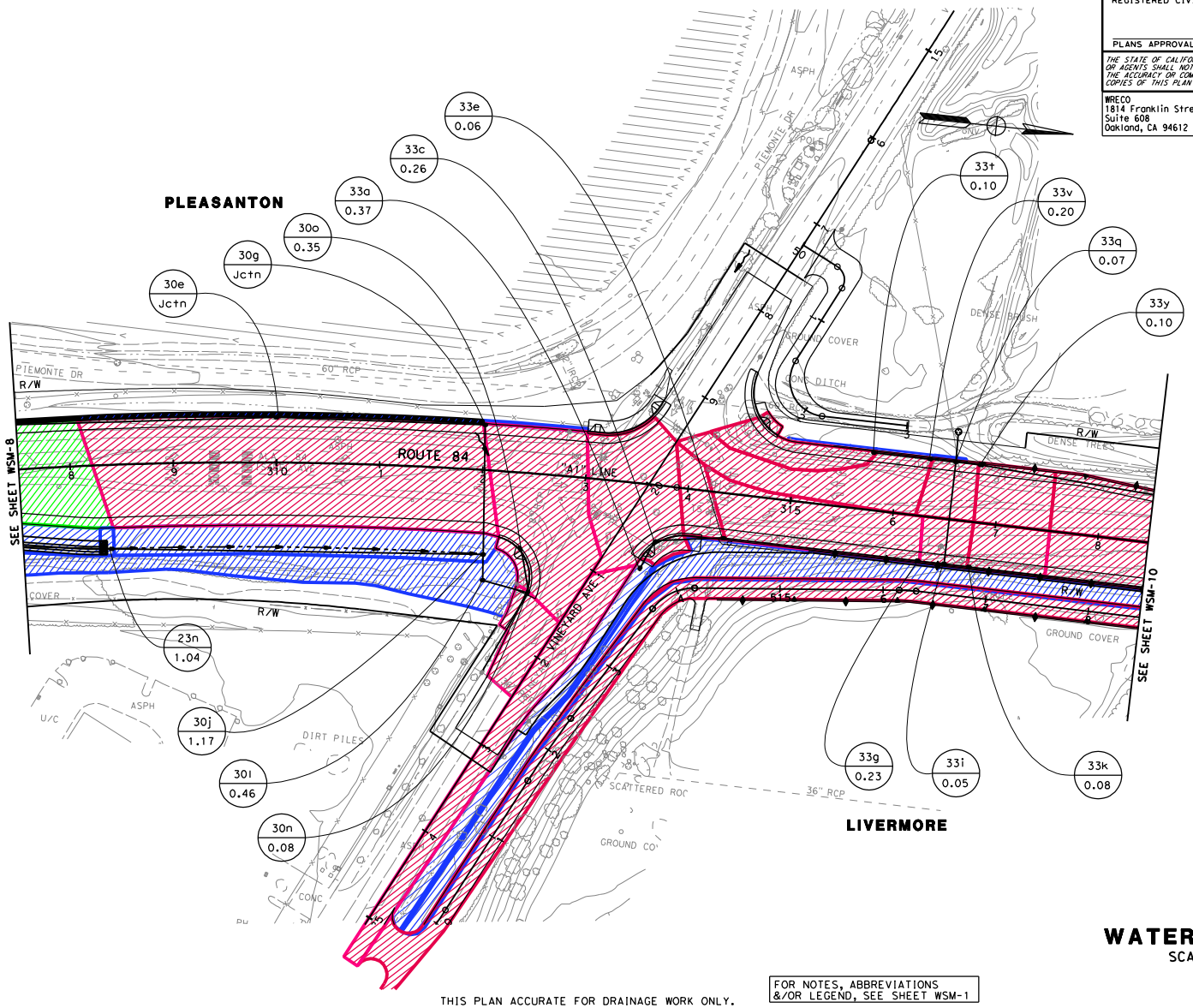

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG | CALCULATED-DESIGNED BY: IRENE LIU | CHECKED BY: ANALETTE OCHOA | REVISED BY: IL | DATE REVISED: 10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 21:35:03 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-09.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	10	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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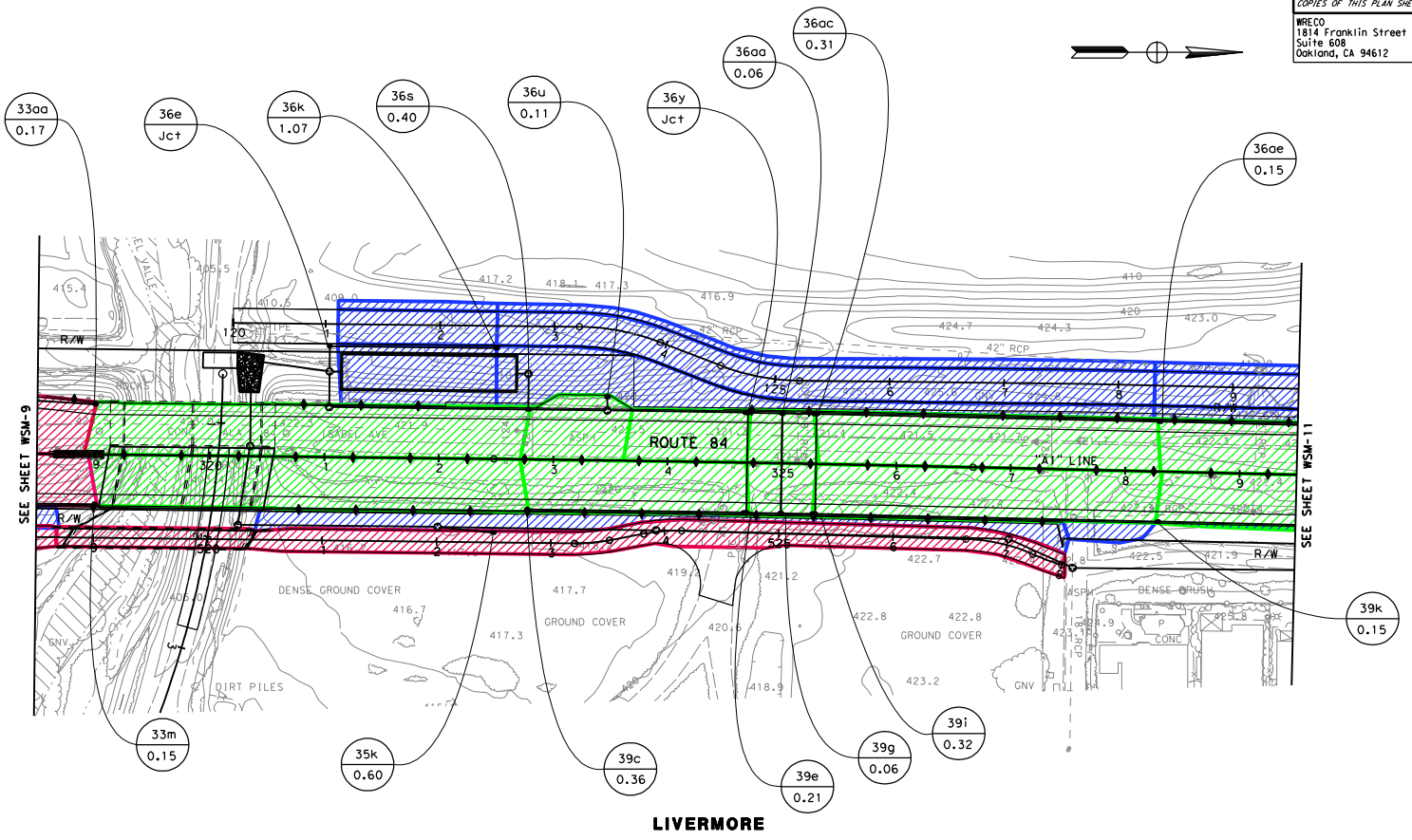

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	IL
	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 21:51:08 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-10.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	11	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

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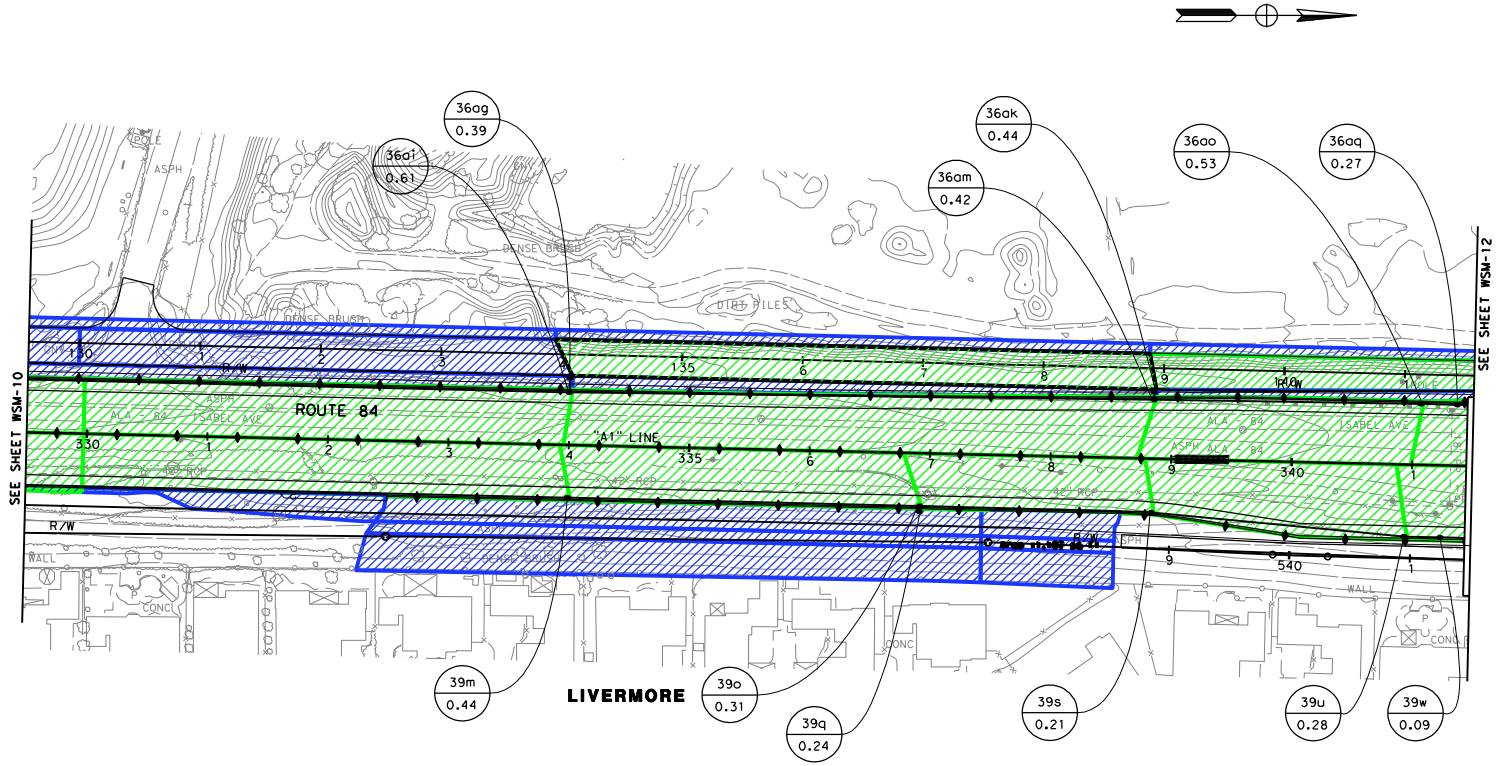

WATERSHED MAP

SCALE 1"=50'

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WSM-11

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	IL
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 21:33:13 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-11.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	12	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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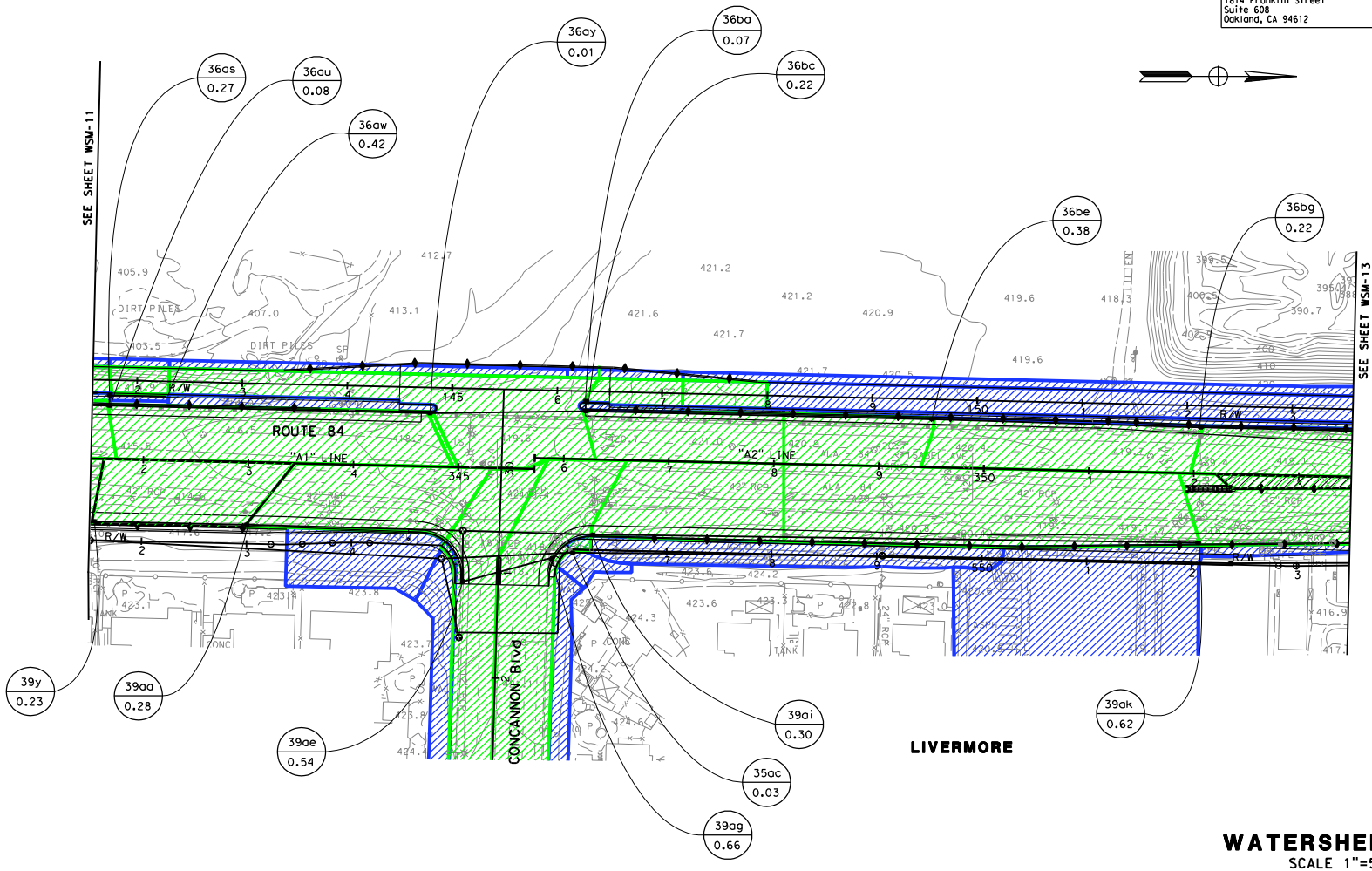

WATERSHED MAP
SCALE 1"=50'

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-12

	REVISED BY	IL
	DATE REVISED	10/19/10
CALCULATED-DESIGNED BY	IRENE LIU	
CHECKED BY	ANALETTE OCHOA	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 TIME PLOTTED => 21:31:17 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu DGN FILE => ...\dwg\Seg B\WSM\WSM-12.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	13	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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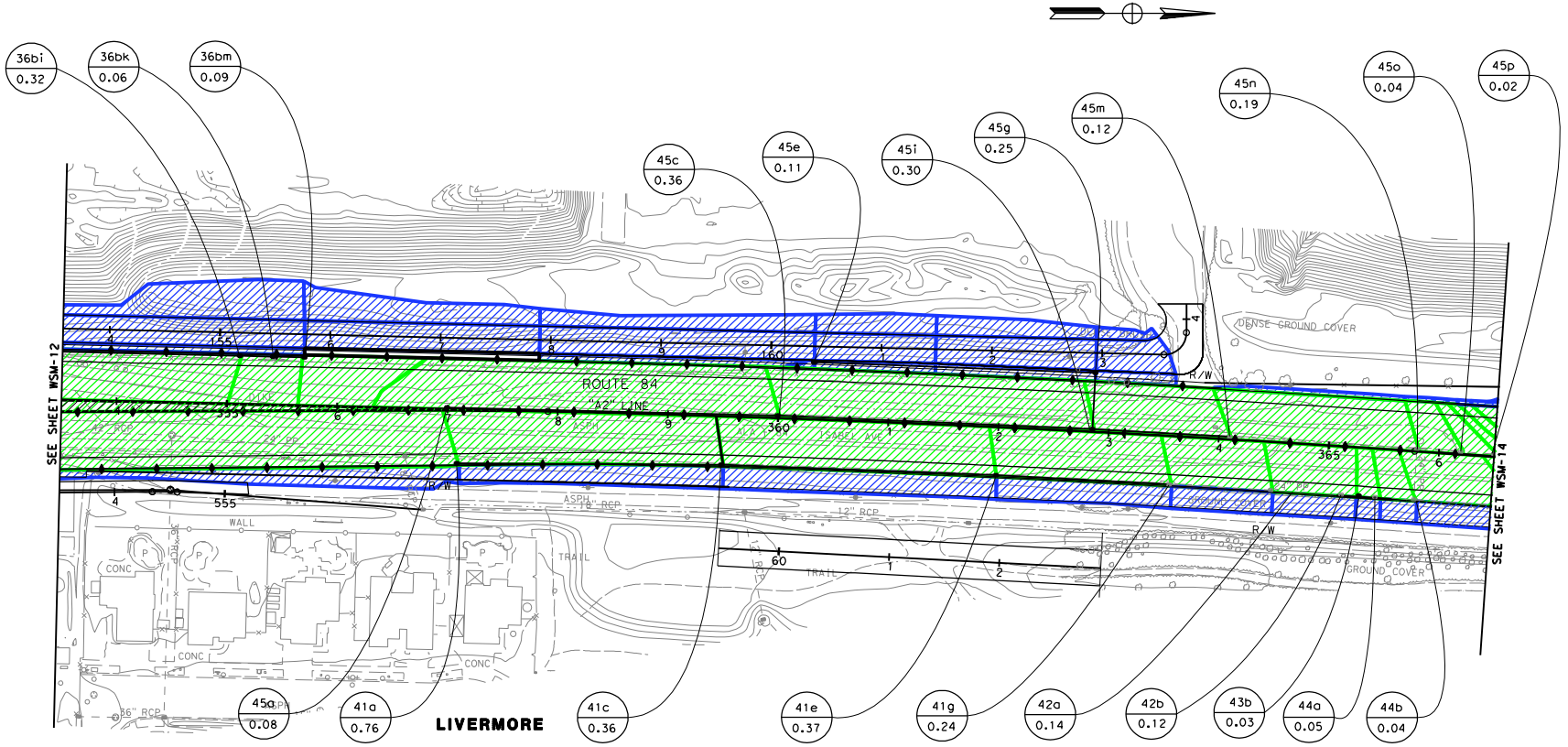

WATERSHED MAP
SCALE 1"=50'

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-13

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 21:35:12 PM

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
DATE REVISED: 10/19/10

BORDER LAST REVISED 7/2/2010
USERNAME => irene_liu
DGN FILE => ...\dwg\Seg B\WSM\WSM-13.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	14	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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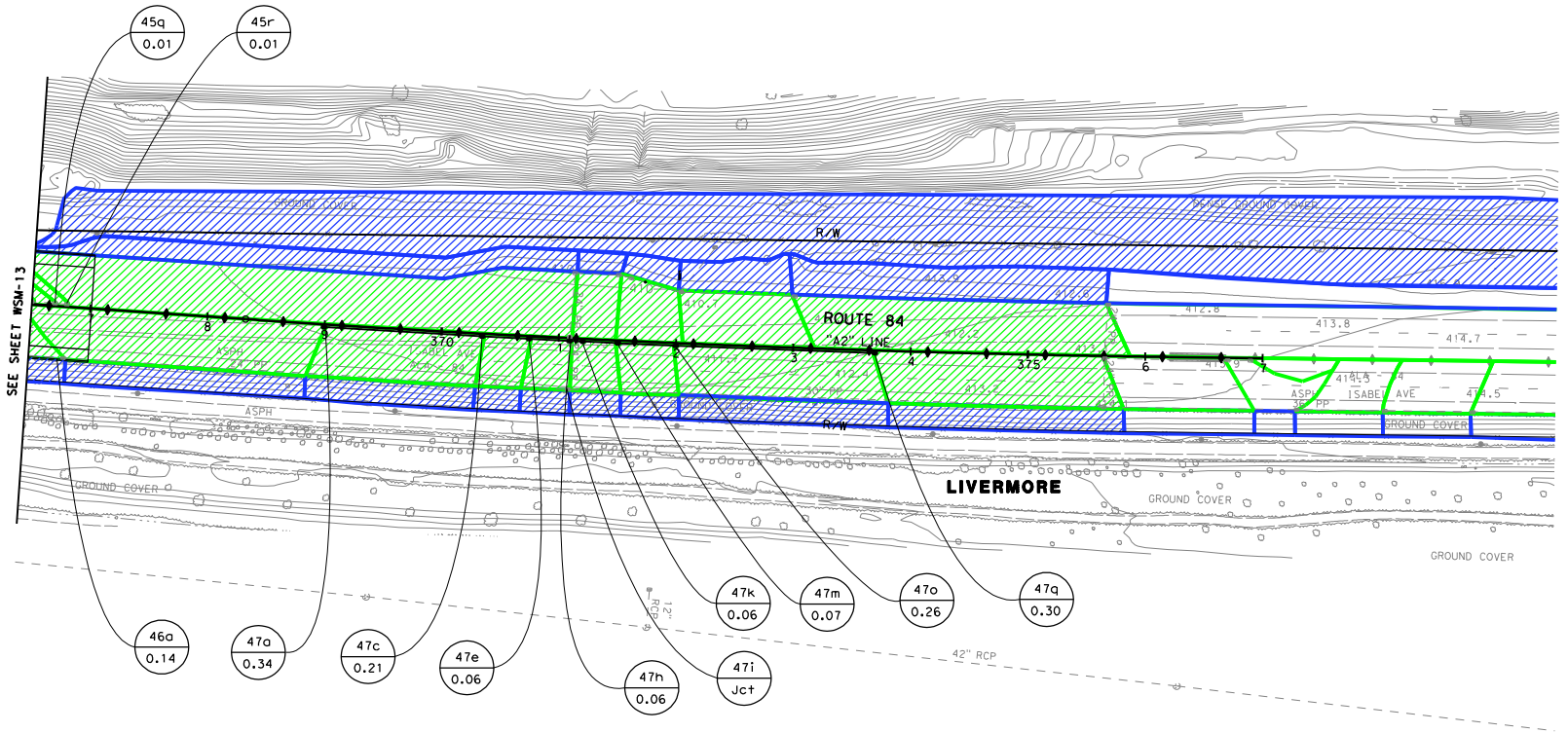

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	CHECKED BY	IRENE LIU	10/19/10
			ANALETTE OCHOA	

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 21:31:27 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\WSM\WSM-14.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Appendix F Spread Flow and Inlets Capacity Calculations

Segment A
(PM 25.5 to PM 27.1)

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

KC, IL SN — KC, IL SN — ☑ ☑ — **Date:** 2/26/2010 — **Date:** 3/1/2010

In#											
	Layout Line:		"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"
	Offset:		Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt
		(Input Data Required)								
HYDROLOGY COMPUTATION:										
	Flow direction		→	→		←	←	←	←	
St	Structure location station:	>>	370+00.	371+15	371+49	371+60.	372+03	373+00	375+65	381+23	385+60
N	Notes		Spread at Beg MVP (No DI)		Flanking DI	Sag	Flanking DI				HP
	Unpaved watershed area (acres):	>>	0.27	0.38	0.04	0.05	0.11	0.31	0.30	0.18	
	Paved watershed area (acres):	>>	0.72	1.00	0.09	0.12	0.21	0.57	0.66	0.46	
Ar	**Contributing watershed area (acres):**		**0.99**	**1.38**	**0.13**	**0.18**	**0.33**	**0.88**	**0.95**	**0.64**	
C	Composite Runoff Coefficient "C":	>>	0.95	0.95	0.95	0.94	0.93	0.93	0.94	0.95	
Ic	Precipitation intensity (in/hr):	>>	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	
Qa	Subarea discharge Q (ft^3/s):		3.34	4.64	0.43	0.59	1.07	2.88	3.17	2.16	
qq	Previous by-pass flow (ft^3/s):	>			1.35	0.69	1.21	1.10	0.54		
Qadd	Discharge added by operator (ft^3/s):	>									
Qt	**Total discharge Q (ft^3/s):**		**3.34**	**4.64**	**1.78**	**1.29**	**2.28**	**3.98**	**3.71**	**2.16**	
SHOULDER AND GUTTER CONFIGURATION:											
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>	0.004	0.001	0.000	0.000	0.002	0.004	0.006	0.004	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1	2	1	1	1	1	
ID	Inlet description:	>	G2	G2	G2	GDO	G2	G2	G2	G2	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2	2	2	
Gw	Grate width (in):	>	24.0	24.0	24.0	48.0	24.0	24.0	24.0	24.0	
Gl	Grate length (in):	>	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>	3	3	3	3	3	3	3	3	
Lco	Curb opening length provided (ft):	>									
Ls	Slotted drain length provided: (ft)	>									
Sx	Shoulder cross-slope Sx (ft/ft):	>>	**0.0390**	**0.0429**	**0.0464**	**0.0476**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	
W	Width of gutter from flowline (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.039	0.043	0.046	0.048	0.050	0.050	0.050	0.050	
	Available Flooded Width (ft)	>	10.00	22.00	22.00	19.31	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**8.87**	**11.96**	**9.44**	**-----**	**7.31**	**7.91**	**7.14**	**6.29**	
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**8.87**	**11.96**	**9.44**	**-----**	**7.31**	**7.91**	**7.14**	**6.29**	
Du/s	Depth at flowline before inlet (ft):		0.35	0.51	0.44	-----	0.37	0.40	0.36	0.31	
Au/s	Water cross-area before inlet (ft^2):		1.53	3.07	2.07	-----	1.34	1.57	1.27	0.99	
Vu/s	Velocity for total discharge before inlet (ft/s):		2.18	1.51	0.86	-----	1.71	2.54	2.91	2.18	
Eod	Ratio of gutter depression flow to total Q (Eod):		-----	-----	-----	-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):		0.039	0.043	0.046	0.048	0.050	0.050	0.050	0.050	
GRATE INLETS ON-GRADE:											
Eog	Ratio of grate frontal flow to total flow:		49%	39%	47%	-----	57%	54%	58%	64%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		1.65	1.79	0.84	-----	1.31	2.15	2.16	1.38	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		9.20	9.20	9.20	-----	9.20	9.20	9.20	9.20	
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00	-----	1.00	1.00	1.00	1.00	
Qs	Side flow in ft^3/s (Qs):		1.69	2.85	0.94	-----	0.97	1.83	1.54	0.78	
Gle	Effective grate length w/ 25% clogging (in):		30	30	30	-----	30	30	30	30	
Rs	Fraction of side flow interception (Rs):		35%	53%	77%	-----	51%	34%	29%	40%	
E	Grate Efficiency (E):		67%	71%	88%	-----	79%	70%	70%	78%	
Qi	**Total flow intercepted (ft^3/s):**		**2.23**	**3.29**	**1.56**	**-----**	**1.81**	**2.77**	**2.61**	**1.69**	
Qb	**Grate flow-by (ft^3/s):**		**1.11**	**1.35**	**0.22**	**-----**	**0.48**	**1.21**	**1.10**	**0.46**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)											
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----	-----	-----	
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----	-----	-----	
El	Efficiency for providged length L:		-----	-----	-----	-----	-----	-----	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:											
	Grate Inlets										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	0.15	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	0.18	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	3.09	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	3.76	-----	-----	-----	-----	
	Slotted drains										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
	Curb opening inlets										
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>									
g1	approach grade #1 (%):	>									
g2	approach grade #2 (%):	>									
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	-----	-----	

"A2" Lt	"A2" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt		"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt
391+07.5	391+19.5	395+01.5	399+93.2	400+65	401+67	400+96.7	401+20	403+01.24	405+17.4	408+20.	411+85	415+14.42	415+49.4	415+60
Extend (E) cross culvert	**G2W**	**Extend (E) cross culvert**	**Extend (E) cross culvert**	**Flanking DI**	**Slotted Drain**	**Sag**	**Slotted Drain (no DI)**	**Wall drain connection**	**Extend (E) cross culvert**			**Bridge End**		
0.21	0.002													
0.80	0.02	0.67	0.76	0.10	0.04	0.02	0.29	0.32	0.42	0.50	0.51		0.02	0.46
1.01	**0.03**	**0.67**	**0.76**	**0.10**	**0.04**	**0.02**	**0.29**	**0.32**	**0.42**	**0.50**	**0.51**		**0.02**	**0.46**
0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00
3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524		3.137	3.137
3.47	0.10	2.36	2.67	0.36	0.14	0.06	1.02	1.12	1.47	1.78	1.79		0.05	1.43
	0.92	0.09	0.48	0.86	0.16	0.00	0.20	0.26	0.35	0.30	0.03		0.20	
3.47	**1.01**	**2.44**	**3.15**	**1.22**	**0.30**	**0.06**	**1.22**	**1.38**	**1.81**	**2.08**	**1.82**		**0.25**	**1.43**
0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015		0.015	0.015
0.017	0.017	0.023	0.006	0.002	0.002	0.000	0.002	0.011	0.026	0.024	0.016		0.007	0.007
1	1	1	1	1	3	1	3	1	1	1	1		1	1
1	1	1	1	1	1	2	1	1	1	1	1		1	1
G2	G2W	G2W	G2W	G2	ASP	GDOM	ASP	G2	G2	G2	G2		G2	GDO
2	2	2	2	2	2	2	2	2	2	2	2		2	2
24.0	24.0	24.0	24.0	24.0	24.0	48.0	24.0	24.0	24.0	24.0	24.0		24.0	48.0
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0		40.0	40.0
3	3	3	3	3	3	3	3	3	3	3	3		3	3
					27.60		24.36							
0.0500	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**		**0.0200**	**0.0200**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050		0.020	0.020
10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	7.33	10.00	10.00	10.00		10.00	10.00
5.75	**3.62**	**4.77**	**6.77**	**5.80**	**-----**	**-----**	**-----**	**4.44**	**4.15**	**4.42**	**4.55**		**4.48**	**8.60**
5.75	**3.62**	**4.77**	**6.77**	**5.80**	**-----**	**-----**	**-----**	**4.44**	**4.15**	**4.42**	**4.55**		**4.48**	**8.60**
0.29	0.18	0.24	0.34	0.29	-----	-----	-----	0.22	0.21	0.22	0.23		0.09	0.17
0.83	0.33	0.57	1.14	0.84	-----	-----	-----	0.49	0.43	0.49	0.52		0.20	0.74
4.20	3.09	4.30	2.75	1.45	-----	-----	-----	2.81	4.20	4.25	3.51		1.26	1.93
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----
0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050		0.020	0.020
68%	88%	77%	61%	68%	-----	-----	-----	80%	83%	80%	79%		79%	81%
2.36	0.89	1.87	1.91	0.82	-----	-----	-----	1.10	1.50	1.66	1.43		0.20	1.16
9.20	9.20	9.20	9.20	9.20	-----	-----	-----	9.20	9.20	9.20	9.20		9.20	9.20
1.00	1.00	1.00	1.00	1.00	-----	-----	-----	1.00	1.00	1.00	1.00		1.00	1.00
1.11	0.12	0.57	1.24	0.39	-----	-----	-----	0.28	0.31	0.42	0.39		0.05	0.27
30	30	30	30	30	-----	-----	-----	30	30	30	30		30	30
17%	27%	17%	31%	59%	-----	-----	-----	30%	17%	17%	22%		42%	25%
74%	91%	80%	73%	87%	-----	-----	-----	86%	86%	83%	83%		88%	86%
2.55	**0.93**	**1.97**	**2.29**	**1.05**	**-----**	**-----**	**-----**	**1.19**	**1.55**	**1.73**	**1.52**		**0.22**	**1.23**
0.92	**0.09**	**0.48**	**0.86**	**0.16**	**-----**	**-----**	**-----**	**0.20**	**0.26**	**0.35**	**0.30**		**0.03**	**0.20**
-----	-----	-----	-----	-----	3.97	-----	7.11	-----	-----	-----	-----		-----	-----
-----	-----	-----	-----	-----	0.3	-----	1.2	-----	-----	-----	-----		-----	-----
-----	-----	-----	-----	-----	100%	-----	100%	-----	-----	-----	-----		-----	-----
-----	**-----**	**-----**	**-----**	**-----**	**0.0**	**-----**	**0.0**	**-----**	**-----**	**-----**	**-----**		**-----**	**-----**
-----	-----	-----	-----	-----	-----	0.02	-----	-----	-----	-----	-----		-----	-----
-----	-----	-----	-----	-----	-----	0.02	-----	-----	-----	-----	-----		-----	-----
-----	-----	-----	-----	-----	-----	0.37	-----	-----	-----	-----	-----		-----	-----
-----	-----	-----	-----	-----	-----	0.45	-----	-----	-----	-----	-----		-----	-----
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			Designed by:	KC, IL	☑	**Date:**	2/26/2010						
			Checked by:	SN	☑	**Date:**	3/1/2010						
"A3" Lt	"A3" Lt	"A3" Lt	"D" Rt	"D" Rt		"D" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt
								check detailed contours					
418+65.	423+00.	424+35.8	38+63.39	38+30.		38+33.99	38+63	426+17.17	428+18.29	429+50	429+80.00	430+02.5	431+00.
HP		Extend (E) cross culvert	(E) DI Discover Dr. Sag	G2M Discover Dr.	Discover Dr.	Discover Dr. Sag	Discover Dr. (E) DI			Flanking DI	Sag	Flanking DI	
	0.27	0.18	0.10	0.18		0.37	0.04	0.03	0.31	0.23	0.10	0.15	0.10
	0.75	0.47	0.40	0.43		0.33	0.20	0.15	0.64	0.45	0.17	0.29	0.19
	1.02	**0.64**	**0.50**	**0.61**		**0.70**	**0.24**	**0.18**	**0.95**	**0.68**	**0.27**	**0.44**	**0.29**
	0.96	0.95	0.98	0.95		0.87	0.98	0.99	0.94	0.93	0.92	0.93	0.93
	3.137	3.137	3.137	3.137		3.137	3.137	3.137	3.137	3.137	3.137	3.137	3.137
	3.06	1.92	1.54	1.82		1.90	0.75	0.56	2.78	1.99	0.80	1.29	0.86
		0.19	0.54			0.09			0.03	0.20	0.67	0.18	0.07
	3.06	**2.11**	**2.08**	**1.82**		**1.99**	**0.75**	**0.56**	**2.81**	**2.19**	**1.47**	**1.46**	**0.93**
	0.015	0.015	0.015	0.015		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
	0.010	0.009	0.000	0.006		0.000	0.007	0.006	0.003	0.002	0.000	0.001	0.004
	1	1	2	1		1	1	1	1	1	1	1	1
	1	1	2	1		2	1	1	1	1	2	1	1
	G2	G2	G2	G2M		G2	G2	G2	GDO	G2	GDO	G2	G2
	2	2	2	2		2	2	2	2	2	2	2	2
	48.0	48.0	24.0	24.0		24.0	24.0	24.0	48.0	24.0	48.0	24.0	24.0
	40.0	40.0	40.0	40.0		40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	3	3	3	3		3	3	3	3	3	3	3	3
			16.50										
	0.0439	**0.0500**	**0.0269**	**0.0227**		**0.0385**	**0.0274**	**0.0500**	**0.0500**	**0.0500**	**0.0485**	**0.0456**	**0.0325**
	0.0	0.0	18.0	18.0		18.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.044	0.050	0.060	0.060		0.140	0.140	0.050	0.050	0.050	0.049	0.046	0.033
	10.00	10.00	14.00	14.00		14.00	14.00	10.00	10.00	10.00	10.00	10.00	10.00
	6.51	**5.31**	**-----**	**8.54**		**-----**	**5.57**	**3.58**	**7.33**	**7.05**	**-----**	**7.36**	**6.14**
	6.51	**5.31**	**-----**	**8.54**		**-----**	**3.79**	**3.58**	**7.33**	**7.05**	**-----**	**7.36**	**6.14**
	0.29	0.27	-----	0.25		-----	0.27	0.18	0.37	0.35	-----	0.34	0.20
	0.93	0.71	-----	0.87		-----	0.32	0.32	1.34	1.24	-----	1.24	0.61
	3.29	2.99	-----	2.10		-----	2.31	1.76	2.09	1.76	-----	1.18	1.52
	-----	-----	-----	46%		-----	91%	-----	-----	-----	-----	-----	-----
	0.044	0.050	-----	0.040		-----	0.129	0.050	0.050	0.050	0.049	0.046	0.033
	92%	98%	-----	56%		-----	69%	89%	88%	59%	-----	57%	65%
	2.81	2.06	-----	1.02		-----	0.52	0.50	2.47	1.29	-----	0.83	0.60
	9.20	9.20	-----	9.20		-----	9.20	9.20	9.20	9.20	-----	9.20	9.20
	1.00	1.00	-----	1.00		-----	1.00	1.00	1.00	1.00	-----	1.00	1.00
	0.24	0.05	-----	0.80		-----	0.23	0.06	0.34	0.90	-----	0.63	0.33
	30	30	-----	30		-----	30	30	30	30	-----	30	30
	22%	28%	-----	37%		-----	61%	50%	42%	50%	-----	65%	46%
	94%	98%	-----	72%		-----	88%	94%	93%	79%	-----	85%	81%
	2.87	**2.07**	**-----**	**1.31**		**-----**	**0.66**	**0.53**	**2.61**	**1.74**	**-----**	**1.24**	**0.75**
	0.19	**0.04**	**-----**	**0.51**		**-----**	**0.09**	**0.03**	**0.20**	**0.45**	**-----**	**0.22**	**0.18**
	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	**-----**	**-----**	**-----**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**
	-----	-----	-----	-----	0.26	-----	-----	-----	-----	0.16	-----	-----	-----
	-----	-----	-----	-----	0.32	-----	-----	-----	-----	0.20	-----	-----	-----
	-----	-----	-----	-----	8.35	-----	-----	-----	-----	3.32	-----	-----	-----
	-----	-----	-----	-----	9.82	-----	-----	-----	-----	4.03	-----	-----	-----
	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----
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	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	-----	0.19	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	-----	0.23	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	-----	8.53	-----		-----	-----	-----	-----	-----	-----	-----	-----
	-----	-----	10.04	-----		-----	-----	-----	-----	-----	-----	-----	-----
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			Designed by:		☑	KC, IL		**Date:**	2/26/2010	
			Checked by:		☑	AO		**Date:**	3/1/2010	
"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt	"A3" Lt			
431+69.	431+93.66	433+60.	443+69.98	446+00.	446+25.00	446+50.	446+65.00	447+09.		
		Flip to Rt, HP	**Flip**		**Sag**	**Flanking**	**HP**		**End Project, 447+80**	**Jack London Blvd**
0.02	0.13			0.01						
0.05	0.23			0.37	0.11	0.01		0.09		
0.07	**0.36**			**0.38**	**0.11**	**0.01**		**0.09**		
0.93	0.92			1.00	1.00	1.00		1.00		
3.137	3.137			3.137	3.137	3.137		3.137		
0.21	1.03			1.20	0.35	0.03		0.27		
0.33					0.29					
0.54	**1.03**			**1.20**	**0.64**	**0.03**		**0.27**		
0.015	0.015			0.015	0.015	0.015		0.015		
0.001	0.008			0.005	0.000	0.004		0.006		
1	1			1	1	1		1		
1	1			1	2	1		1		
G2	G2			G2	GDO	G2		G2		
2	2			2	2	2		2		
24.0	24.0			24.0	48.0	24.0		24.0		
40.0	40.0			40.0	40.0	40.0		40.0		
3	3			3	3	3		3		
0.0233	**0.0200**			**0.0306**	**0.0341**	**0.0374**		**0.0453**		
0.0	0.0			0.0	0.0	0.0		0.0		
0.0	0.0			0.0	0.0	0.0		0.0		
0.023	0.020			0.031	0.034	0.037		0.045		
10.00	10.00			10.00	10.00	10.00		10.00		
8.13	**7.42**			**6.58**	**-----**	**1.60**		**2.88**		
8.13	**7.42**			**6.58**	**-----**	**1.60**		**2.88**		
0.19	0.15			0.20	-----	0.06		0.13		
0.77	0.55			0.66	-----	0.05		0.19		
0.70	1.87			1.81	-----	0.71		1.43		
-----	-----			-----	-----	-----		-----		
0.023	0.020			0.031	0.034	0.037		0.045		
53%	57%			62%	-----	100%		96%		
0.28	0.58			0.74	-----	0.03		0.26		
9.20	9.20			9.20	-----	9.20		9.20		
1.00	1.00			1.00	-----	1.00		1.00		
0.25	0.45			0.46	-----	0.00		0.01		
30	30			30	-----	30		30		
71%	26%			37%	-----	0%		57%		
86%	68%			76%	-----	100%		98%		
0.46	**0.70**			**0.91**	**-----**	**0.03**		**0.26**		
0.07	**0.33**			**0.29**	**-----**	**0.00**		**0.00**		
-----	-----			-----	-----	-----		-----		
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-----	**-----**			**-----**	**-----**	**-----**		**-----**		
-----	-----			-----	0.09	-----		-----		
-----	-----			-----	0.11	-----		-----		
-----	-----			-----	2.72	-----		-----		
-----	-----			-----	3.31	-----		-----		
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State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations **Designed by:** KC, IL ☐ **Date:** 2/26/2010
Checked by: SN ☐ **Date:** 3/1/2010

	Layout Line:			"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	
In#	**Offset:**			Rt	Rt	Rt	Rt	Rt	Rt	
		(Input Data Required)								
HYDROLOGY COMPUTATION:										
	Flow direction			→	→	→	→		← ▼	
St	Structure location station:	>>	348+18.75	352+06	356+62.7	363+57.	364+50.	365+14.25	365+45	365+80.
N	Notes		HP	(E) DI	(E) DI	(E) DI	Flanking (Slotted Drain)	Sag	Flanking	HP
	Unpaved watershed area (acres):	>>		0.09	0.15	0.32	0.05	0.05	0.02	
	Paved watershed area (acres):	>>		0.53	0.47	0.59	0.22	0.19	0.06	
Ar	**Contributing watershed area (acres):**			**0.62**	**0.62**	**0.91**	**0.27**	**0.24**	**0.08**	
C	Composite Runoff Coefficient "C":	>>		1.00	0.97	0.93	0.99	0.97	0.96	
Ic	Precipitation intensity (in/hr):	>>		3.266	3.524	3.524	3.524	3.524	3.524	
Qa	Subarea discharge Q (ft^3/s):			2.03	2.11	2.96	0.92	0.81	0.29	
qq	Previous by-pass flow (ft^3/s):	>			0.42	0.60	1.03	0.04		
Qadd	Discharge added by operator (ft^3/s):	>								
Qt	**Total discharge Q (ft^3/s):**			**2.03**	**2.53**	**3.56**	**1.95**	**0.85**	**0.29**	
SHOULDER AND GUTTER CONFIGURATION:										
n	Manning's n:	>>		0.015	0.015	0.015	0.015	0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>		0.004	0.004	0.004	0.000	0.000	0.001	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>		1	1	1	3	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>		1	1	1	1	2	1	
ID	Inlet description:	>		G2	G2	G2	G2	GD0	G2	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>		2	2	2	2	2	2	
Gw	Grate width (in):	>		24.0	24.0	24.0	24.0	48.0	24.0	
Gl	Grate length (in):	>		40.0	40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>		3	3	3	3	3	3	
Lco	Curb opening length provided (ft):	>								
Ls	Slotted drain length provided: (ft)	>					93.00			
Sx	Shoulder cross-slope Sx (ft/ft):	>>		0.0500	0.0500	0.0500	**0.0356**	**0.0201**	**0.0168**	
W	Width of gutter from flowline (in):	>		0.0	0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>		0.0	0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)			0.050	0.050	0.050	0.036	0.020	0.017	
	Available Flooded Width (ft)	>		10.00	10.00	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**			**6.09**	**6.79**	**7.49**	**-----**	**-----**	**7.90**	
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**			**6.09**	**6.79**	**7.49**	**-----**	**-----**	**7.90**	
Du/s	Depth at flowline before inlet (ft):			0.30	0.34	0.37	-----	-----	0.13	
Au/s	Water cross-area before inlet (ft^2):			0.93	1.15	1.40	-----	-----	0.52	
Vu/s	Velocity for total discharge before inlet (ft/s):			2.19	2.20	2.54	-----	-----	0.55	
Eod	Ratio of gutter depression flow to total Q (Eod):			-----	-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):			0.050	0.050	0.050	0.036	0.020	0.017	
GRATE INLETS ON-GRADE:										
Eog	Ratio of grate frontal flow to total flow:			65%	61%	56%	-----	-----	54%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression			1.33	1.53	2.01	-----	-----	0.15	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):			9.20	9.20	9.20	-----	-----	9.20	
Rf	Fraction of frontal flow intercepted (Rf):			1.00	1.00	1.00	-----	-----	1.00	
Qs	Side flow in ft^3/s (Qs):			0.70	1.00	1.56	-----	-----	0.13	
Gle	Effective grate length w/ 25% clogging (in):			30	30	30	-----	-----	30	
Rs	Fraction of side flow interception (Rs):			40%	40%	34%	-----	-----	73%	
E	Grate Efficiency (E):			79%	76%	71%	-----	-----	88%	
Qi	**Total flow intercepted (ft^3/s):**			**1.61**	**1.93**	**2.53**	**-----**	**-----**	**0.25**	
Qb	**Grate flow-by (ft^3/s):**			**0.42**	**0.60**	**1.03**	**-----**	**-----**	**0.04**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)										
Lt	Length required for total interception (ft):			-----	-----	-----	6.99	-----	-----	
Ci	Interception for provided length L (ft^3/s):			-----	-----	-----	2.0	-----	-----	
El	Efficiency for providged length L:			-----	-----	-----	100%	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**			**-----**	**-----**	**-----**	**0.0**	**-----**	**-----**	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:										
	Grate Inlets									
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	0.11	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	0.14	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	5.54	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	6.73	-----	
	Slotted drains									
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	
	Curb opening inlets									
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>								
g1	approach grade #1 (%):	>								
g2	approach grade #2 (%):	>								
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):			-----	-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):			-----	-----	-----	-----	-----	-----	

			☑	☑	☑	**Date:**	2/26/2010				
			☑	☑	☑	**Date:**	3/1/2010				
"A2"	"A2"		"A2"	"A2"		"A2"	"A2"	"A2"		"A2"	
Rt	Rt		Med	Med		Rt	Rt	Rt		Rt	
366+80.	367+00.		376+70.61	376+90.	377+20.49	377+30.	378+30.	378+80.	380+00.	381+23.	
Slotted Drain	**Flip**	**Flips to Lt Side**	**Beg Conc. Barrier**		**Flip**	**Slotted Drain**					
0.05	0.01		0.02			0.05	0.02	0.06	0.06	0.35	
0.16	0.02		0.05	0.02		0.09	0.05	0.12	0.13	0.48	
0.21	**0.03**		**0.07**	**0.02**		**0.13**	**0.08**	**0.18**	**0.19**	**0.83**	
0.96	0.94		0.97	1.00		0.93	0.94	0.94	0.94	0.90	
3.524	3.524		3.524	3.524		3.524	3.524	3.524	3.524	3.524	
0.70	0.10		0.23	0.07		0.44	0.25	0.60	0.63	2.65	
	0.00		0.00			0.00	0.27	0.31	0.65		
0.70	**0.10**		**0.23**	**0.07**		**0.44**	**0.52**	**0.91**	**1.28**	**2.65**	
0.015			0.015	0.015		0.015	0.015	0.015	0.015	0.015	
0.002			0.006	0.006		0.000	0.000	0.004	0.003	0.004	
3			1	1		3	3	1	1	1	
1			1	1		1	1	1	1	1	
G2			G2	G2		G2	G2	G2	G2	G2	
2			2	2				2	2	2	
24.0			24.0	24.0				24.0	24.0	24.0	
40.0			40.0	40.0				40.0	40.0	40.0	
3			3	3				3	3	3	
100.00						100.00	50.00				
0.0026			**0.0069**	**0.0041**		**0.0009**	**0.0107**	**0.0203**	**0.0300**	**0.0500**	
0.0			0.0	0.0		0.0	0.0	0.0	0.0	0.0	
0.0			0.0	0.0		0.0	0.0	0.0	0.0	0.0	
0.003			0.007	0.004		0.001	0.011	0.020	0.030	0.050	
10.00			10.00	10.00		10.00	10.00	10.00	10.00	10.00	
-----			**8.64**	**7.81**		**-----**	**-----**	**7.85**	**7.50**	**6.70**	
-----			**8.64**	**7.81**		**-----**	**-----**	**7.85**	**7.50**	**6.70**	
-----			0.06	0.03		-----	-----	0.16	0.23	0.34	
-----			0.26	0.13		-----	-----	0.63	0.84	1.12	
-----			0.89	0.58		-----	-----	1.46	1.51	2.36	
-----			-----	-----		-----	-----	-----	-----	-----	
0.003			0.007	0.004		0.001	0.011	0.020	0.030	0.050	
-----			50%	54%		-----	-----	54%	56%	61%	
-----			0.11	0.04		-----	-----	0.50	0.72	1.62	
-----			9.20	9.20		-----	-----	9.20	9.20	9.20	
-----			1.00	1.00		-----	-----	1.00	1.00	1.00	
-----			0.11	0.03		-----	-----	0.42	0.56	1.03	
-----			30	30		-----	-----	30	30	30	
-----			32%	37%		-----	-----	36%	44%	37%	
-----			66%	71%		-----	-----	71%	75%	75%	
-----			**0.15**	**0.05**		**-----**	**-----**	**0.65**	**0.96**	**2.00**	
-----			**0.08**	**0.02**		**-----**	**-----**	**0.27**	**0.31**	**0.65**	
35.16			-----	-----		21.82	5.44	-----	-----	-----	
0.7			-----	-----		0.4	0.5	-----	-----	-----	
100%			-----	-----		100%	100%	-----	-----	-----	
0.0			**-----**	**-----**		**0.0**	**0.0**	**-----**	**-----**	**-----**	
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Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: SN ☑ **Date:** 3/1/2010

"A2" Rt	"A2" Rt	"A2" Rt	"A2" Rt	"A2" Rt	"A2" Rt	"A2" Rt		"ST1" Lt	"ST1" Lt	"ST1" Lt		"ST1" Rt	"A2" Rt
	→	→	→	→	→	→	→	→		←		←	→
385+90.	386+15.	386+65.	388+90.	390+04.	391+21.	392+11.7		95+00.	95+29.3	95+70.	103+34.	103+20.	
HP							Drain to Stanley Connector	Flanking DI	Sag	Flanking DI	Flip		Drain to Stanley Connector
	0.03	0.06	0.38	0.27	0.43	0.45	0.05	0.31	0.38	0.88	0.00		
	0.02	0.05	0.31	0.19	0.19	0.14	0.06	0.58	0.17	1.99	0.00	0.14	
	0.05	**0.11**	**0.68**	**0.46**	**0.61**	**0.59**	**0.11**	**0.90**	**0.55**	**2.86**	**0.00**	**0.14**	
	0.86	0.87	0.86	0.85	0.82	0.79	0.88	0.93	0.82	0.94		1.00	
	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524		3.524	
	0.15	0.32	2.08	1.39	1.77	1.65	0.35	2.94	1.58	9.52		0.50	
		0.00	0.01	0.43	0.32	0.38	0.00	0.00	3.52	1.03	1.03		
	0.15	**0.32**	**2.09**	**1.82**	**2.08**	**2.03**	**0.36**	**2.94**	**5.10**	**10.55**	**1.03**	**0.50**	
	0.015	0.015	0.015	0.015	0.015	0.015		0.015	0.015	0.015		0.015	
	0.001	0.004	0.009	0.013	0.017	0.021		0.031	0.000	0.010		0.006	
	1	1	1	1	1	1		1	1	1		1	
	1	1	1	1	1	1		1	2	1		1	
	G2	G2	G2	G2	G2	GDO		G2	G2	G2		G2	
	2	2	2	2	2	2		2	2	2		2	
	24.0	24.0	24.0	24.0	24.0	48.0		24.0	24.0	24.0		24.0	
	40.0	40.0	40.0	40.0	40.0	40.0		40.0	40.0	40.0		40.0	
	3	3	3	3	3	3		3	3	3		3	
	0.0500	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**		**0.1000**	**0.1200**	**0.1200**		**0.0158**	
	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	
	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		18.0	
	0.050	0.050	0.050	0.050	0.050	0.050		0.100	0.120	0.120		0.050	
	10.00	10.00	10.00	10.00	10.00	10.00		8.00	8.00	8.00		7.81	
	2.96	**3.05**	**5.30**	**4.74**	**4.73**	**4.51**		**3.11**	**-----**	**5.56**		**6.86**	
	2.96	**3.05**	**5.30**	**4.74**	**4.73**	**4.51**		**3.11**	**-----**	**5.56**		**3.33**	
	0.15	0.15	0.27	0.24	0.24	0.23		0.31	-----	0.67		0.05	
	0.22	0.23	0.70	0.56	0.56	0.51		0.49	-----	1.86		0.09	
	0.69	1.39	2.97	3.23	3.73	3.99		6.06	-----	5.68		5.74	
	-----	-----	-----	-----	-----	-----		-----	-----	-----		-----	
	0.050	0.050	0.050	0.050	0.050	0.050		0.100	0.120	0.120		0.016	
	95%	94%	72%	77%	77%	100%		94%	-----	59%		-113%	
	0.14	0.31	1.50	1.40	1.60	2.02		2.75	-----	6.22		-0.57	
	9.20	9.20	9.20	9.20	9.20	9.20		9.20	-----	9.20		9.20	
	1.00	1.00	1.00	1.00	1.00	1.00		1.00	-----	1.00		1.00	
	0.01	0.02	0.59	0.42	0.48	0.01		0.19	-----	4.33		1.07	
	30	30	30	30	30	30		30	-----	30		30	
	84%	60%	28%	25%	20%	19%		18%	-----	22%		4%	
	99%	98%	80%	83%	82%	100%		95%	-----	68%		-105%	
	0.15	**0.32**	**1.66**	**1.50**	**1.70**	**2.03**		**2.79**	**-----**	**7.19**		**-0.53**	
	0.00	**0.01**	**0.43**	**0.32**	**0.38**	**0.00**		**0.16**	**-----**	**3.36**		**1.03**	
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	-----	-----	-----	-----	-----	-----		-----	4.11	-----		-----	
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Designed by: KC, IL
Checked by: SN

"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt
→	→	→	→		←	←	←	←	←	←	←	←	
395+00	399+53	399+93	400+60	400+96.7	401+25	403+35	405+18	408+20	411+83		415+49	415+60	418+80.
			Flanking DI	Sag	Flanking DI					Arroyo Mocho Bridge	(E) DI		HP
0.13	0.79											0.13	
0.21	0.66	0.06	0.10	0.10	0.33	0.25	0.40	0.47	0.46		0.02	0.40	
0.34	**1.45**	**0.06**	**0.10**	**0.10**	**0.33**	**0.25**	**0.40**	**0.47**	**0.46**		**0.02**	**0.54**	
0.92	0.87	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	0.96	
3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524		3.137	3.137	
1.10	4.42	0.21	0.36	0.34	1.15	0.89	1.40	1.66	1.62		0.05	1.62	
	0.10	1.47	0.30	0.03	0.07	0.00	0.30	0.25	0.04		0.25		
1.10	**4.52**	**1.68**	**0.66**	**0.37**	**1.22**	**0.89**	**1.70**	**1.92**	**1.66**		**0.30**	**1.62**	
0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015		0.015	0.015	
0.019	0.009	0.007	0.002	0.000	0.002	0.014	0.027	0.025	0.016		0.008	0.007	
1	1	1	1	1	1	1	1	1	1		1	1	
1	1	1	1	2	1	1	1	1	1		1	1	
G2	G2	G2	GDOM	G4	GDOM	G2	GDOM	G2	G2		G2	GDO	
2	2	2	2	2	2	2	2	2	2		2	2	
24.0	24.0	24.0	48.0	48.0	48.0	24.0	48.0	24.0	24.0		24.0	48.0	
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0		40.0	40.0	
3	3	3	3	3	3	3	3	3	3		3	3	
0.0500	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**		**0.0200**	**0.0200**	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050		0.020	0.020	
10.00	10.00	12.52	13.00	13.00	13.00	10.00	12.00	12.15	10.55		10.00	10.00	
3.65	**7.16**	**5.19**	**4.59**	**-----**	**6.03**	**3.55**	**4.03**	**4.28**	**4.39**		**4.73**	**8.94**	
3.65	**7.16**	**5.19**	**4.59**	**-----**	**6.03**	**3.55**	**4.03**	**4.28**	**4.39**		**4.73**	**8.94**	
0.18	0.36	0.26	0.23	-----	0.30	0.18	0.20	0.21	0.22		0.09	0.18	
0.33	1.28	0.67	0.53	-----	0.91	0.32	0.41	0.46	0.48		0.22	0.80	
3.31	3.53	2.49	1.25	-----	1.34	2.81	4.18	4.18	3.46		1.35	2.02	
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0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050		0.020	0.020	
88%	58%	73%	100%	-----	95%	89%	100%	81%	80%		77%	79%	
0.97	2.63	1.22	0.66	-----	1.15	0.79	1.70	1.56	1.34		0.23	1.28	
9.20	9.20	9.20	9.20	-----	9.20	9.20	9.20	9.20	9.20		9.20	9.20	
1.00	1.00	1.00	1.00	-----	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
0.13	1.89	0.46	0.00	-----	0.07	0.10	0.00	0.36	0.33		0.07	0.33	
30	30	30	30	-----	30	30	30	30	30		30	30	
24%	22%	35%	65%	-----	62%	30%	17%	17%	23%		39%	24%	
91%	67%	82%	100%	-----	98%	92%	100%	85%	85%		86%	84%	
1.00	**3.05**	**1.38**	**0.66**	**-----**	**1.19**	**0.82**	**1.70**	**1.62**	**1.41**		**0.26**	**1.36**	
0.10	**1.47**	**0.30**	**0.00**	**-----**	**0.03**	**0.07**	**0.00**	**0.30**	**0.25**		**0.04**	**0.25**	
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			☑	**Date:**	2/26/2010			**Designed by:**	KC, IL			☑		**Date:**	2/26/2010			
			☑	**Date:**	3/1/2010			**Checked by:**	SN			☑		**Date:**	3/1/2010			
	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt	"A3" Rt
	420+05.	420+46.10	420+90	421+50	421+92.	422+15.	434+04.47	435+88.	438+00	440+35	442+82.	443+85.	445+50	447+05	447+15.49	447+40		
	Flanking	**Sag**	**Flanking**	**Slotted Drain**		**HP**								**Flanking**	**Sag**	**Flanking**	**End Project, 447+80**	**Jack London Blvd**
	0.06	0.04	0.03	0.02	0.01		0.13	0.16	0.02	0.01	0.02	0.00						
	0.16	0.11	0.08	0.05	0.01		0.37	0.58	0.65	0.68	0.74	0.28	0.31	0.28	0.11	0.21		
	0.22	**0.15**	**0.10**	**0.07**	**0.02**		**0.51**	**0.74**	**0.66**	**0.69**	**0.75**	**0.29**	**0.31**	**0.28**	**0.11**	**0.21**		
	0.95	0.96	0.96	0.95	0.86		0.96	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
	3.137	3.137	3.137	3.137	3.137		3.137	3.137	3.137	3.137	3.137	3.137	3.137	3.137	3.137	3.137		
	0.67	0.45	0.31	0.21	0.06		1.53	2.26	2.09	2.18	2.36	0.90	0.96	0.89	0.33	0.66		
		0.22	0.00	0.00				0.38	0.64	0.66	0.71	0.81	0.31	0.19	0.18			
	0.67	**0.67**	**0.31**	**0.21**	**0.06**		**1.53**	**2.65**	**2.73**	**2.84**	**3.07**	**1.70**	**1.28**	**1.08**	**0.51**	**0.66**		
	0.015	0.015	0.015	0.015	0.015		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015		
	0.003	0.000	0.003	0.001	0.001		0.006	0.004	0.003	0.003	0.003	0.004	0.003	0.003	0.000	0.005		
	1	1	1	3	3		1	1	1	1	1	1	1	1	1	1		
	1	2	1	1	1		1	1	1	1	1	1	1	1	2	1		
	G2	GDO	G2	G2	G2		G2	G2W	G2W	G2W	G2W	G2W	G2W	G2W	GDO	G2		
	2	2	2	2	2		2	2	2	2	2	2	2	2	2	2		
	24.0	48.0	24.0	24.0	24.0		24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	48.0	24.0		
	40.0	40.0	40.0	40.0	40.0		40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0		
	3	3	3	3	3		3	3	3	3	3	3	3	3	3	3		
				42.00	23.00													
	0.0200	**0.0200**	**0.0141**	**0.0061**	**0.0007**		**0.0344**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**	**0.0500**		
	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	0.020	0.020	0.014	0.006	0.001		0.034	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050		
	10.00	10.00	10.00	10.00	10.00		10.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	11.00		
	7.57	**-----**	**7.29**	**-----**	**-----**		**6.49**	**6.92**	**7.25**	**7.36**	**7.44**	**5.78**	**5.45**	**5.11**	**-----**	**3.89**		
	7.57	**-----**	**7.29**	**-----**	**-----**		**6.49**	**6.92**	**7.25**	**7.36**	**7.44**	**5.78**	**5.45**	**5.11**	**-----**	**3.89**		
	0.15	-----	0.10	-----	-----		0.22	0.35	0.36	0.37	0.37	0.29	0.27	0.26	-----	0.19		
	0.57	-----	0.37	-----	-----		0.72	1.20	1.31	1.35	1.38	0.84	0.74	0.65	-----	0.38		
	1.16	-----	0.83	-----	-----		2.11	2.21	2.08	2.10	2.22	2.04	1.72	1.65	-----	1.75		
	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
	0.020	0.020	0.014	0.006	0.001		0.034	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050		
	56%	-----	57%	-----	-----		63%	60%	58%	57%	57%	68%	70%	73%	-----	85%		
	0.37	-----	0.18	-----	-----		0.96	1.58	1.57	1.62	1.74	1.15	0.90	0.79	-----	0.57		
	9.20	-----	9.20	-----	-----		9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	-----	9.20		
	1.00	-----	1.00	-----	-----		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-----	1.00		
	0.29	-----	0.13	-----	-----		0.57	1.07	1.15	1.22	1.33	0.55	0.38	0.29	-----	0.10		
	30	-----	30	-----	-----		30	30	30	30	30	30	30	30	-----	30		
	46%	-----	52%	-----	-----		33%	40%	42%	42%	40%	43%	51%	53%	-----	50%		
	76%	-----	79%	-----	-----		75%	76%	76%	75%	74%	82%	85%	87%	-----	93%		
	0.51	**-----**	**0.25**	**-----**	**-----**		**1.14**	**2.00**	**2.06**	**2.13**	**2.26**	**1.39**	**1.09**	**0.94**	**-----**	**0.61**		
	0.16	**-----**	**0.06**	**-----**	**-----**		**0.38**	**0.64**	**0.66**	**0.71**	**0.81**	**0.31**	**0.19**	**0.14**	**-----**	**0.05**		
	-----	-----	-----	11.15	18.89		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
	-----	-----	-----	0.2	0.1		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
	-----	-----	-----	100%	100%		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
	-----	**-----**	**-----**	**0.0**	**0.0**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**		
	-----	0.10	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	0.08	-----		
	-----	0.12	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	0.10	-----		
	-----	4.78	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	1.60	-----		
	-----	5.81	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	1.94	-----		
	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
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Segment B
(PM 22.9 to PM 25.7)

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: **Designed by:** KC, IL ☑ **Date:** **Date:** 2/26/2010
Checked by: **Checked by:** AO, SN ☑ **Date:** **Date:** 3/1/2010

In#	Layout Line:		"A1"	"A1"	"A1"	"A1"	"A1"	"R"		"A1"	"A1"	"A1"	"R"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"
	Offset:		Lt	Lt	Rt	Lt	Rt	Lt		Rt	Rt	Lt	Lt	Rt	Rt	Rt	Rt	Rt	Lt	Lt	Lt	Lt	
	(Input Data Required)																						
HYDROLOGY COMPUTATION:																							
	Flow direction:		→	→	→	1c	→	1e		3a	→	1x	1ac		6a	6c	6e	6g	→	4i	4k	4m	4o
St	Structure location station:	>>				233+00	233+27	233+77.91		235+10		235+18.17	240+31		245+98	246+50	247+30	247+60	247+82	249+00.	251+38.	253+00	254+25
N	Notes		Project Beg, 227+00	Sheet flow 227+00 to 231+00	Sheet flow 227+00 to 233+41	At high-side gutter	Flip to Rt, w/ high-side gutter	End of high-side gutter	Flip	Ruby Hill	OSD	Sheet flow 235+10 to 243+95		End high-side gutter	Sheet Flow 223+10 to 243+90				Flip				Flanking
	Unpaved watershed area (acres):	>>				0.09		**0.03**			0.00	0.11	0.16	0.00		0.01	0.00	0.00	0.00	0.00	0.07	0.07	0.05
	Paved watershed area (acres):	>>				0.21		0.01			0.49	0.88	0.00	0.05		0.42	0.11	0.16	0.06	0.02	0.31	0.73	0.33	0.29
Ar	**Contributing watershed area (acres):**					**0.29**		**0.04**			**0.49**	**0.99**	**0.17**	**0.05**		**0.44**	**0.11**	**0.16**	**0.06**	**0.02**	**0.31**	**0.80**	**0.40**	**0.34**
C	Composite Runoff Coefficient "C":	>>				0.95		0.82			1.00	1.00	0.72	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
Ic	Precipitation intensity (in/hr):	>>				3.266		3.266			3.266		3.266	3.266		3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266
Qa	Subarea discharge Q (ft^3/s):					0.90		0.10			1.60		0.39	0.16		1.43	0.35	0.52	0.18	0.07	1.00	2.61	1.30	1.11
qq	Previous by-pass flow (ft^3/s):	>						0.00									0.12	0.02	0.01	0.01	0.01	0.12	0.16	0.05
Qadd	Discharge added by operator (ft^3/s):	>																						
Qt	**Total discharge Q (ft^3/s):**					**0.90**		**0.10**			**1.60**		**0.39**	**0.16**		**1.43**	**0.47**	**0.54**	**0.20**	**0.08**	**1.01**	**2.73**	**1.46**	**1.17**
SHOULDER AND GUTTER CONFIGURATION:																								
n	Manning's n:	>>				0.015		0.015			0.015		0.015	0.015		0.015	0.015	0.015	0.015		0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>				0.019		0.011			0.028		0.012	0.029		0.019	0.017	0.012	0.009		0.036	0.023	0.008	0.002
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>				1		1			2		1	1		1	1	1	1		1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>				1		1			1		1	1		1	1	1	1		1	1	1	1
ID	Inlet description:	>				G2		G2			OSD		G2	G2		G2	G2	GDOM	GDOM		G2	G2	G2	G2
	Standard Gutter Depression (1=SGD, 2=no SGD)	>				2		2					2	2		2	2	2	2		2	2	2	2
Gw	Grate width (in):	>				24.0		24.0					24.0	24.0		24.0	24.0	48.0	48.0		24.0	24.0	24.0	24.0
Gl	Grate length (in):	>				40.0		40.0					40.0	40.0		40.0	40.0	40.0	40.0		40.0	40.0	40.0	40.0
	3 or 4 sided weir?	>				3		3			3		3	3		3	3	3	3		3	3	3	3
Lco	Curb opening length provided (ft):	>									13.00													
Ls	Slotted drain length provided: (ft)	>																						
Sx	Shoulder cross-slope Sx (ft/ft):	>>				0.1667		0.1667			0.1667		0.1667	0.1667		0.0600	0.0397	0.0200	0.0103		0.0360	0.1000	0.1000	0.1000
W	Width of gutter from flowline (in):	>				36.0		36.0			0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
a(t)	Gutter depression from horizontal (in):	>				0.0		0.0			0.0		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)					0.167		0.167			0.167		0.167	0.167		0.060	0.040	0.020	0.010		0.036	0.100	0.100	0.100
	Available Flooded Width (ft)	>				11.00		10.00			10.00		12.00	12.00		14.70	15.00	9.50	8.00		10.00	10.00	10.00	12.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**					**1.60**		**0.78**			**1.83**		**1.27**	**0.76**		**3.59**	**3.15**	**5.42**	**5.87**		**3.84**	**3.22**	**3.13**	**3.89**
Du/s	Depth at flowline before inlet (ft):					0.27		0.13			0.31		0.21	0.13		0.22	0.13	0.11	0.06		0.14	0.32	0.31	0.39
Au/s	Water cross-area before inlet (ft^2):					0.21		0.05			0.28		0.14	0.05		0.39	0.20	0.29	0.18		0.27	0.52	0.49	0.76
Vu/s	Velocity for total discharge before inlet (ft/s):					4.24		2.02			5.69		2.92	3.21		3.69	2.40	1.85	1.11		3.78	5.27	2.98	1.54
Eod	Ratio of gutter depression flow to total Q (Eod):					100%		100%			-----		0%	-----		-----	-----	-----	-----		-----	-----	-----	-----
Se	Equivalent cross-slope (ft/ft):					0.167		0.167			0.167		0.167	0.167		0.060	0.040	0.020	0.010		0.036	0.100	0.100	0.100
GRATE INLETS ON-GRADE:																								
Eog	Ratio of grate frontal flow to total flow:					100%		100%			-----		100%	100%		89%	93%	97%	95%		86%	92%	93%	85%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression					0.90		0.10			0.39		0.16			1.26	0.44	0.53	0.19		0.87	2.53	1.36	1.00
Vo	Vo for effective length (P-50, Chart 5) (ft/s):					9.20		9.20			-----		9.20	9.20		9.20	9.20	9.20	9.20		9.20	9.20	9.20	9.20
Rf	Fraction of frontal flow intercepted (Rf):					1.00		1.00			-----		1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):					0.00		0.00			-----		0.00	0.00		0.16	0.03	0.02	0.01		0.14	0.21	0.10	0.17
Gle	Effective grate length w/ 25% clogging (in):					30		30			-----		30	30		30	30	30	30		30	30	30	30
Rs	Fraction of side flow interception (Rs):					0%		0%			-----		0%	0%		24%	31%	27%	32%		15%	22%	43%	72%
E	Grate Efficiency (E):					100%		100%			-----		100%	100%		91%	95%	98%	97%		88%	94%	96%	96%
Qi	**Total flow intercepted (ft^3/s):**					**0.90**		**0.10**			-----		**0.39**	**0.16**		**1.30**	**0.45**	**0.53**	**0.19**		**0.89**	**2.57**	**1.40**	**1.12**
Qb	**Grate flow-by (ft^3/s):**					**0.00**		**0.00**			-----		**0.00**	**0.00**		**0.12**	**0.02**	**0.01**	**0.01**		**0.12**	**0.16**	**0.05**	**0.05**
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)																								
Lt	Length required for total interception (ft):					-----		-----			9.11		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):					-----		-----			1.6		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
El	Efficiency for providged length L:					-----		-----			100%		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**					-----		-----			**0.0**		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:																								
	Grate Inlets																							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
	Slotted drains																							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
	Curb opening inlets																							
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>																						
g1	approach grade #1 (%):	>																						
g2	approach grade #2 (%):	>																						
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----
Df	Flanking inlets distance (ft):					-----		-----			-----		-----	-----		-----	-----	-----	-----		-----	-----	-----	-----

"A1" Lt	"A1" Lt	"A1" Lt
4q	4s	
254+47.50	254+75	258+93.88
Sag	**Flanking**	**HP**
0.02	0.27	
0.18	0.80	
0.20	**1.08**	
1.00	0.96	
3.266	3.266	
0.64	3.37	
0.49		
1.13	**3.37**	
0.015	0.015	
0.000	0.002	
1	1	
2	1	
G2	G2	
2	2	
24.0	24.0	
40.0	40.0	
3	3	
0.1000	0.1000	
0.0	0.0	
0.0	0.0	
0.100	0.100	
12.00	12.00	
-----	**5.54**	
-----	0.55	
-----	1.54	
-----	2.20	
-----	-----	
0.100	0.100	
-----	70%	
-----	2.35	
-----	9.20	
-----	1.00	
-----	1.02	
-----	30	
-----	57%	
-----	87%	
-----	**2.94**	
-----	**0.44**	
-----	-----	
-----	-----	
-----	-----	
-----	-----	
0.18	-----	
0.22	-----	
1.80	-----	
2.19	-----	
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State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: AO, SN ☑ **Date:** 3/1/2010

	Layout Line:		"R"	"R"	"R"	"R"	"R"	"A1"
In#	**Offset:**		Rt	Rt	Rt	Lt	Lt	Lt
		(Input Data Required)						
HYDROLOGY COMPUTATION:								
			1k	1i	1g	1r	1t	1q
	Flow direction:		→		←	→		←
St	Structure location station:	>>	8+59	9+03.10	9+23.97	8+59	9+03.42	234+96
N	Notes			Sag			Sag	
	Unpaved watershed area (acres):	>>	1.16	0.12	0.06	0.17	0.10	0.00
	Paved watershed area (acres):	>>	0.30	0.07	0.01	0.29	0.08	0.00
Ar	**Contributing watershed area (acres):**		**1.47**	**0.19**	**0.07**	**0.46**	**0.18**	**0.01**
C	Composite Runoff Coefficient "C":	>>	0.78	0.83	0.77	0.93	0.86	0.90
Ic	Precipitation intensity (in/hr):	>>	3.266	3.266	3.266	3.266	3.266	3.266
Qa	Subarea discharge Q (ft^3/s):		3.76	0.51	0.17	1.39	0.51	0.02
qq	Previous by-pass flow (ft^3/s):	>		1.14			0.02	
Qadd	Discharge added by operator (ft^3/s):	>						
Qt	**Total discharge Q (ft^3/s):**		**3.76**	**1.65**	**0.17**	**1.39**	**0.53**	**0.02**
SHOULDER AND GUTTER CONFIGURATION:								
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.042	0.000	0.030	0.057	0.000	0.006
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	2	1	1	2	1
ID	Inlet description:	>	G2	GO	G2	G2	GO	G2
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	24.0
Gl	Grate length (in):	>	40.0	40.0	40.0	40.0	40.0	40.0
	3 or 4 sided weir?	>	3	3	3	3	3	3
Lco	Curb opening length provided (ft):	>						
Ls	Slotted drain length provided: (ft)	>						
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0108	0.0170	0.0100	0.0277	0.0270	0.0170
W	Width of gutter from flowline (in):	>	24.0	24.0	24.0	24.0	24.0	24.0
a(t)	Gutter depression from horizontal (in):	>	0.0	0.0	0.0	0.0	0.0	0.0
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.083	0.083	0.083	0.083	0.083	0.083
	Available Flooded Width (ft)	>	7.00	7.00	9.00	13.00	17.00	20.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**10.88**	**-----**	**1.22**	**3.03**	**-----**	**0.78**
Du/s	Depth at flowline before inlet (ft):		0.26	-----	0.10	0.20	-----	0.06
Au/s	Water cross-area before inlet (ft^2):		0.78	-----	0.06	0.24	-----	0.03
Vu/s	Velocity for total discharge before inlet (ft/s):		4.80	-----	2.81	5.84	-----	0.93
Eod	Ratio of gutter depression flow to total Q (Eod):		64%	-----	100%	98%	-----	100%
Se	Equivalent cross-slope (ft/ft):		0.057	-----	0.083	0.082	-----	0.083
GRATE INLETS ON-GRADE:								
Eog	Ratio of grate frontal flow to total flow:		64%	-----	100%	98%	-----	100%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		2.40	-----	0.17	1.37	-----	0.02
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		9.20	-----	9.20	9.20	-----	9.20
Rf	Fraction of frontal flow intercepted (Rf):		1.00	-----	1.00	1.00	-----	1.00
Qs	Side flow in ft^3/s (Qs):		1.35	-----	0.00	0.02	-----	0.00
Gle	Effective grate length w/ 25% clogging (in):		30	-----	30	30	-----	30
Rs	Fraction of side flow interception (Rs):		16%	-----	0%	16%	-----	0%
E	Grate Efficiency (E):		70%	-----	100%	99%	-----	100%
Qi	**Total flow intercepted (ft^3/s):**		**2.61**	**-----**	**0.17**	**1.37**	**-----**	**0.02**
Qb	**Grate flow-by (ft^3/s):**		**1.14**	**-----**	**0.00**	**0.02**	**-----**	**0.00**
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)								
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----
El	Efficiency for providged length L:		-----	-----	-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:								
	Grate Inlets							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	0.23	-----	-----	0.11	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	0.28	-----	-----	0.13	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	15.66	-----	-----	6.05	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	18.61	-----	-----	6.92	-----
	Slotted drains							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
	Curb opening inlets							
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>						
g1	approach grade #1 (%):	>						
g2	approach grade #2 (%):	>						
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: SN ☑ **Date:** 3/1/2010

In#	Layout Line:		"VEX"	"VEX"	"VEX"	"VEX"
	Offset:		Rt	Rt	Rt	Rt
		(Input Data Required)				
HYDROLOGY COMPUTATION:						
				6i	6k	6m
	Flow direction:			←	←	←
St	Structure location station:	>>	48+00	50+90	51+20	53+00
N	Notes		Flip			
	Unpaved watershed area (acres):	>>		0.00	0.00	0.00
	Paved watershed area (acres):	>>	0.01	0.01	0.08	0.02
Ar	**Contributing watershed area (acres):**		**0.01**	**0.01**	**0.08**	**0.02**
C	Composite Runoff Coefficient "C":	>>	1.00	1.00	1.00	1.00
Ic	Precipitation intensity (in/hr):	>>	3.266	3.266	3.266	3.266
Qa	Subarea discharge Q (ft^3/s):		0.02	0.05	0.26	0.07
qq	Previous by-pass flow (ft^3/s):	>	0.01	0.03		
Qadd	Discharge added by operator (ft^3/s):	>				
Qt	**Total discharge Q (ft^3/s):**		**0.02**	**0.08**	**0.26**	**0.07**
SHOULDER AND GUTTER CONFIGURATION:						
n	Manning's n:	>>		0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>		0.013	0.013	0.029
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>		1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>		1	1	1
ID	Inlet description:	>		G2	G2	G2
	Standard Gutter Depression (1=SGD, 2=no SGD)	>		2	2	2
Gw	Grate width (in):	>		24.0	24.0	24.0
Gl	Grate length (in):	>		40.0	40.0	40.0
	3 or 4 sided weir?	>		3	3	3
Lco	Curb opening length provided (ft):	>				
Ls	Slotted drain length provided: (ft)	>				
Sx	Shoulder cross-slope Sx (ft/ft):	>>		0.0096	0.0200	0.0200
W	Width of gutter from flowline (in):	>		0.0	0.0	0.0
a(t)	Gutter depression from horizontal (in):	>		0.0	0.0	0.0
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)			0.010	0.020	0.020
	Available Flooded Width (ft)	>		8.00	8.00	8.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**			**4.05**	**4.06**	**2.08**
Du/s	Depth at flowline before inlet (ft):			0.04	0.08	0.00
Au/s	Water cross-area before inlet (ft^2):			0.08	0.17	0.00
Vu/s	Velocity for total discharge before inlet (ft/s):			0.96	1.58	0.00
Eod	Ratio of gutter depression flow to total Q (Eod):			-----	-----	-----
Se	Equivalent cross-slope (ft/ft):			0.010	0.020	0.020
GRATE INLETS ON-GRADE:						
Eog	Ratio of grate frontal flow to total flow:			84%	84%	100%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression			0.06	0.22	0.07
Vo	Vo for effective length (P-50, Chart 5) (ft/s):			9.20	9.20	9.20
Rf	Fraction of frontal flow intercepted (Rf):			1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):			0.01	0.04	0.00
Gle	Effective grate length w/ 25% clogging (in):			30	30	30
Rs	Fraction of side flow interception (Rs):			36%	32%	0%
E	Grate Efficiency (E):			90%	89%	100%
Qi	**Total flow intercepted (ft^3/s):**			**0.07**	**0.23**	**0.07**
Qb	**Grate flow-by (ft^3/s):**			**0.01**	**0.03**	**0.00**
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)						
Lt	Length required for total interception (ft):			-----	-----	-----
Ci	Interception for provided length L (ft^3/s):			-----	-----	-----
El	Efficiency for providged length L:			-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**			**-----**	**-----**	**-----**
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:						
	Grate Inlets					
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----
	Slotted drains					
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----
	Curb opening inlets					
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):			-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):			-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----
Lc	Length of the vertical curve (ft):	>				
g1	approach grade #1 (%):	>				
g2	approach grade #2 (%):	>				
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):			-----	-----	-----
Df	Flanking inlets distance (ft):			-----	-----	-----

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: SN ☑ **Date:** 3/1/2010

	Layout Line:		"V"	"A1"	"V"	"V"	"V"	"V"	"V"	"V"	"V"
In#	**Offset:**		Lt	Rt	Lt	Lt	Lt	Lt		Rt	Rt
		(Input Data Required)									
HYDROLOGY COMPUTATION:											
				9a	4x				13f	13h	
	Flow direction						→	→	→		←
St	Structure location station:	>>		255+32	102+33.74	103+10		109+00	113+16	113+54.00	115+64.62
N	Notes		Flip, Sheet Flow U/S of this	OSD	Sag	HP	Sheet flow, 103+10 to 109+00	Flip to Rt	Curb Inlet	Sag, Curb Opening	Project ends
	Unpaved watershed area (acres):	>>									
	Paved watershed area (acres):	>>		0.16	0.15				0.49	0.24	
Ar	**Contributing watershed area (acres):**			**0.16**	**0.15**				**0.49**	**0.24**	
C	Composite Runoff Coefficient "C":	>>		1.00	1.00				1	1.00	
Ic	Precipitation intensity (in/hr):	>>		3.266	3.266				3.266	3.266	
Qa	Subarea discharge Q (ft^3/s):			0.53	0.50				1.61	0.77	
qq	Previous by-pass flow (ft^3/s):	>			0.00					0.42	
Qadd	Discharge added by operator (ft^3/s):	>									
Qt	**Total discharge Q (ft^3/s):**			**0.53**	**0.50**				**1.61**	**1.20**	
SHOULDER AND GUTTER CONFIGURATION:											
n	Manning's n:	>>		0.015	0.015				0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>		0.017	0.028				0.007	0.000	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>		2	1				2	2	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>		1	2				1	2	
ID	Inlet description:	>		OSD	G2				COL	COL	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>			2				2	2	
Gw	Grate width (in):	>			24.0				24.0	24.0	
Gl	Grate length (in):	>			40.0				40.0	40.0	
	3 or 4 sided weir?	>		3	3				3	3	
Lco	Curb opening length provided (ft):	>		13.00					4.00	4.00	
Ls	Slotted drain length provided: (ft)	>									
Sx	Shoulder cross-slope Sx (ft/ft):	>>		0.0091	0.1250				0.1100	0.1100	
W	Width of gutter from flowline (in):	>		0.0	0.0				0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>		0.0	0.0				0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)			0.009	0.125				0.110	0.110	
	Available Flooded Width (ft)	>		12.00	8.00				8.00	8.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**			**8.20**	**-----**				**3.11**	**-----**	
Du/s	Depth at flowline before inlet (ft):			0.07	-----				0.34	-----	
Au/s	Water cross-area before inlet (ft^2):			0.31	-----				0.53	-----	
Vu/s	Velocity for total discharge before inlet (ft/s):			1.72	-----				3.01	-----	
Eod	Ratio of gutter depression flow to total Q (Eod):			-----	-----				-----	-----	
Se	Equivalent cross-slope (ft/ft):			0.009	0.125				0.110	0.110	
GRATE INLETS ON-GRADE:											
Eog	Ratio of grate frontal flow to total flow:			-----	-----				-----	-----	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression			-----	-----				-----	-----	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):			-----	-----				-----	-----	
Rf	Fraction of frontal flow intercepted (Rf):			-----	-----				-----	-----	
Qs	Side flow in ft^3/s (Qs):			-----	-----				-----	-----	
Gle	Effective grate length w/ 25% clogging (in):			-----	-----				-----	-----	
Rs	Fraction of side flow interception (Rs):			-----	-----				-----	-----	
E	Grate Efficiency (E):			-----	-----				-----	-----	
Qi	**Total flow intercepted (ft^3/s):**			**-----**	**-----**				**-----**	**-----**	
Qb	**Grate flow-by (ft^3/s):**			**-----**	**-----**				**-----**	**-----**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)											
Lt	Length required for total interception (ft):			28.04	-----				7.65	-----	
Ci	Interception for provided length L (ft^3/s):			0.4	-----				1.2	-----	
El	Efficiency for providged length L:			67%	-----				74%	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**			**0.2**	**-----**				**0.4**	**-----**	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:											
	Grate Inlets										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	0.11				-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	0.13				-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	0.84				-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	1.02				-----	-----	
	Slotted drains										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----				-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----				-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----				-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----				-----	-----	
	Curb opening inlets										
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):			-----	-----				-----	0.34	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):			-----	-----				-----	0.41	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----				-----	3.05	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----				-----	3.71	
Lc	Length of the vertical curve (ft):	>									
g1	approach grade #1 (%):	>									
g2	approach grade #2 (%):	>									
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):			-----	-----				-----	-----	
Df	Flanking inlets distance (ft):			-----	-----				-----	-----	

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: AO ☑ **Date:** 3/1/2010

In#									
	Layout Line:		"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"
	Offset:		Med	Med	Med	Med	Med	Med	Lt
		(Input Data Required)							
HYDROLOGY COMPUTATION:									
			22a	22c	22e	26a	29a	29c	
	Flow direction		→	→	→	→	→	→	
St	Structure location station:	>>	291+00	293+50	296+00	301+00	306+50	306+73	306+75
N	Notes								End concrete barrier
	Unpaved watershed area (acres):	>>	0.03	0.02	0.01	0.04	0.04	0.00	
	Paved watershed area (acres):	>>	0.59	0.27	0.27	0.52	0.59	0.02	
Ar	**Contributing watershed area (acres):**		**0.62**	**0.28**	**0.27**	**0.56**	**0.63**	**0.03**	
C	Composite Runoff Coefficient "C":	>>	1.00	1.00	1.00	1.00	1.00	1.00	
Ic	Precipitation intensity (in/hr):	>>	3.266	3.266	3.266	3.266	3.266	3.266	
Qa	Subarea discharge Q (ft^3/s):		2.02	0.92	0.90	1.83	2.06	0.08	
qq	Previous by-pass flow (ft^3/s):	>		0.64	0.42	0.33	0.72	1.04	
Qadd	Discharge added by operator (ft^3/s):	>							
Qt	**Total discharge Q (ft^3/s):**		**2.02**	**1.56**	**1.31**	**2.16**	**2.79**	**1.13**	
SHOULDER AND GUTTER CONFIGURATION:									
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>	0.015	0.015	0.012	0.005	0.006	0.006	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1	1	1	1	
ID	Inlet description:	>	G2	G2	G2	G2	G2	G2	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2	
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	48.0	
Gl	Grate length (in):	>	40.0	40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>	3	3	3	3	3	3	
Lco	Curb opening length provided (ft):	>							
Ls	Slotted drain length provided: (ft)	>							
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0300	0.0307	0.0300	0.0300	0.0300	0.0300	
W	Width of gutter from flowline (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.030	0.031	0.030	0.030	0.030	0.030	
	Available Flooded Width (ft)	>	10.00	10.00	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**6.62**	**5.91**	**5.87**	**8.21**	**8.94**	**6.37**	
Du/s	Depth at flowline before inlet (ft):		0.20	0.18	0.18	0.25	0.27	0.19	
Au/s	Water cross-area before inlet (ft^2):		0.66	0.54	0.52	1.01	1.20	0.61	
Vu/s	Velocity for total discharge before inlet (ft/s):		3.08	2.92	2.54	2.14	2.32	1.85	
Eod	Ratio of gutter depression flow to total Q (Eod):		-----	-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):		0.030	0.031	0.030	0.030	0.030	0.030	
GRATE INLETS ON-GRADE:									
Eog	Ratio of grate frontal flow to total flow:		62%	67%	67%	52%	49%	93%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		1.25	1.04	0.88	1.13	1.37	1.05	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		9.20	9.20	9.20	9.20	9.20	9.20	
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00	1.00	1.00	1.00	
Qs	Side flow in ft^3/s (Qs):		0.78	0.52	0.43	1.03	1.42	0.08	
Gle	Effective grate length w/ 25% clogging (in):		30	30	30	30	30	30	
Rs	Fraction of side flow interception (Rs):		18%	20%	24%	30%	27%	35%	
E	Grate Efficiency (E):		69%	73%	75%	67%	63%	95%	
Qi	**Total flow intercepted (ft^3/s):**		**1.39**	**1.15**	**0.98**	**1.44**	**1.74**	**1.07**	
Qb	**Grate flow-by (ft^3/s):**		**0.64**	**0.42**	**0.33**	**0.72**	**1.04**	**0.05**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)									
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----	
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----	
El	Efficiency for providged length L:		-----	-----	-----	-----	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:									
	Grate Inlets								
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	
	Slotted drains								
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	
	Curb opening inlets								
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>							
g1	approach grade #1 (%):	>							
g2	approach grade #2 (%):	>							
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑
Checked by: SN ☑

In#																							
	Layout Line:		"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"		"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"
	Offset:		Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt		Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt
		(Input Data Required)																					
HYDROLOGY COMPUTATION:																							
	Flow direction			33t →	33v →	33q	33y ←		33aa →	→	36s →	36u	36y →	36aa	36ac ←	36ae ←		36ai →	36am →	36ao →	36aq	36au ←	36ay ←
St	Structure location station:	>>		315+75	316+30	316+55.	316+80	318+15	319+00		322+78	323+47.05	324+70	325+00.	325+30	328+30.	329+97.41	334+00	338+85	341+07	341+36.67	341+67	344+72
N	Notes		Vineyard Ave		Flanking DI	Sag	Flanking DI	HP		Arroyo Del Valle Bridge		Sag/Turnout	Flanking DI	Sag	Flanking DI		HP			Flanking DI	Sag	Flanking DI		Drains to Access Road
	Unpaved watershed area (acres):	>>		0.01	0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	
	Paved watershed area (acres):	>>		0.09	0.19	0.07	0.10		0.17		0.40	0.11	0.11	0.06	0.32	0.18		0.42	0.53	0.27	0.08	0.37	0.01	
Ar	**Contributing watershed area (acres):**			**0.10**	**0.20**	**0.07**	**0.10**		**0.17**		**0.40**	**0.11**	**0.11**	**0.06**	**0.32**	**0.18**		**0.42**	**0.53**	**0.27**	**0.08**	**0.37**	**0.01**	
C	Composite Runoff Coefficient "C":	>>		1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	
Ic	Precipitation intensity (in/hr):	>>		3.266	3.266	3.266	3.266		3.266		3.266	3.266	3.266	3.266	3.266	3.266		3.266	3.266	3.266	3.266	3.266	3.266	
Qa	Subarea discharge Q (ft^3/s):			0.31	0.65	0.22	0.32		0.57		1.30	0.36	0.36	0.20	1.04	0.58		1.39	1.73	0.89	0.27	1.22	0.02	
qq	Previous by-pass flow (ft^3/s):	>			0.08	0.17					0.13	0.23		0.13	0.04				0.21	0.38	0.35				0.05
Qadd	Discharge added by operator (ft^3/s):	>																						
Qt	**Total discharge Q (ft^3/s):**			**0.31**	**0.72**	**0.39**	**0.32**		**0.57**		**1.43**	**0.59**	**0.36**	**0.34**	**1.07**	**0.58**		**1.39**	**1.94**	**1.27**	**0.63**	**1.22**	**0.02**	**0.05**
SHOULDER AND GUTTER CONFIGURATION:																								
n	Manning's n:	>>		0.015	0.015	0.015	0.015		0.015		0.015	0.015	0.015	0.015	0.015	0.015		0.015	0.015	0.015	0.015	0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>		0.002	0.001	0.000	0.001		0.004		0.003	0.000	0.001	0.000	0.009	0.003		0.007	0.007	0.003	0.000	0.003	0.011	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>		1	1	1	1		1		1	1	1	1	1	1		1	1	1	1	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>		1	1	2	1		1		1	2	1	2	1	1		1	1	1	2	1	1	
ID	Inlet description:	>		G2	G2	GO	G2		G2		G2	G2	G2	G2	G2	G2		G2	G2	G2	G2	G2	G2	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>		2	2	2	2		2		2	2	2	2	2	2		2	2	2	2	2	2	
Gw	Grate width (in):	>		24.0	24.0	24.0	24.0		24.0		24.0	24.0	24.0	24.0	24.0	24.0		24.0	24.0	24.0	24.0	24.0	24.0	
Gl	Grate length (in):	>		40.0	40.0	40.0	40.0		40.0		40.0	40.0	40.0	40.0	40.0	40.0		40.0	40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>		3	3	3	3		3		3	3	3	3	3	3		3	3	3	3	3	3	
Lco	Curb opening length provided (ft):	>																						
Ls	Slotted drain length provided: (ft)	>																						
Sx	Shoulder cross-slope Sx (ft/ft):	>>		0.0103	0.0200	0.0200	0.0200		0.0200		0.0500	0.0500	0.0500	0.0500	0.0500	0.0500		0.0500	0.0500	0.0500	0.0500	0.0500	0.0198	
W	Width of gutter from flowline (in):	>		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)			0.010	0.020	0.020	0.020		0.020		0.050	0.050	0.050	0.050	0.050	0.050		0.050	0.050	0.050	0.050	0.050	0.020	
	Available Flooded Width (ft)	>		10.00	10.00	10.00	10.00		10.00		10.00	21.00	10.00	10.00	10.00	10.00		10.00	10.00	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**			**9.63**	**10.27**	**-----**	**7.11**		**6.68**		**5.59**	**-----**	**4.34**	**-----**	**4.16**	**4.06**		**4.87**	**5.44**	**5.45**	**-----**	**5.42**	**1.57**	
Du/s	Depth at flowline before inlet (ft):			0.10	0.21	-----	0.14		0.13		0.28	-----	0.22	-----	0.21	0.20		0.24	0.27	0.27	-----	0.27	0.03	
Au/s	Water cross-area before inlet (ft^2):			0.48	1.05	-----	0.50		0.45		0.78	-----	0.47	-----	0.43	0.41		0.59	0.74	0.74	-----	0.74	0.02	
Vu/s	Velocity for total discharge before inlet (ft/s):			0.66	0.69	-----	0.64		1.28		1.83	-----	0.76	-----	2.48	1.41		2.34	2.62	1.72	-----	1.65	0.77	
Eod	Ratio of gutter depression flow to total Q (Eod):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):			0.010	0.020	0.020	0.020		0.020		0.050	0.050	0.050	0.050	0.050	0.050		0.050	0.050	0.050	0.050	0.050	0.020	
GRATE INLETS ON-GRADE:																								
Eog	Ratio of grate frontal flow to total flow:			46%	44%	-----	58%		61%		69%	-----	81%	-----	83%	84%		76%	71%	70%	-----	71%	100%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression			0.14	0.32	-----	0.19		0.35		0.99	-----	0.29	-----	0.89	0.48		1.05	1.37	0.90	-----	0.86	0.02	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):			9.20	9.20	-----	9.20		9.20		9.20	-----	9.20	-----	9.20	9.20		9.20	9.20	9.20	-----	9.20	9.20	
Rf	Fraction of frontal flow intercepted (Rf):			1.00	1.00	-----	1.00		1.00		1.00	-----	1.00	-----	1.00	1.00		1.00	1.00	1.00	-----	1.00	1.00	
Qs	Side flow in ft^3/s (Qs):			0.17	0.41	-----	0.13		0.22		0.44	-----	0.07	-----	0.19	0.09		0.34	0.57	0.38	-----	0.36	0.00	
Gle	Effective grate length w/ 25% clogging (in):			30	30	-----	30		30		30	-----	30	-----	30	30		30	30	30	-----	30	30	
Rs	Fraction of side flow interception (Rs):			54%	68%	-----	71%		41%		48%	-----	82%	-----	35%	60%		37%	33%	51%	-----	53%	0%	
E	Grate Efficiency (E):			75%	82%	-----	88%		77%		84%	-----	96%	-----	89%	93%		85%	80%	85%	-----	86%	100%	
Qi	**Total flow intercepted (ft^3/s):**			**0.24**	**0.60**	**-----**	**0.28**		**0.44**		**1.20**	**-----**	**0.35**	**-----**	**0.95**	**0.54**		**1.17**	**1.55**	**1.09**	**-----**	**1.05**	**0.02**	
Qb	**Grate flow-by (ft^3/s):**			**0.08**	**0.13**	**-----**	**0.04**		**0.13**		**0.23**	**-----**	**0.01**	**-----**	**0.12**	**0.04**		**0.21**	**0.38**	**0.18**	**-----**	**0.17**	**0.00**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)																								
Lt	Length required for total interception (ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
Ci	Interception for provided length L (ft^3/s):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
El	Efficiency for providged length L:			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**			**-----**	**-----**	**-----**	**-----**		**-----**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:																								
	Grate Inlets																							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	0.09	-----		-----		-----	0.12	-----	0.08	-----	-----		-----	-----	-----	0.12	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	0.11	-----		-----		-----	0.14	-----	0.10	-----	-----		-----	-----	-----	0.15	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	4.45	-----		-----		-----	2.34	-----	1.62	-----	-----		-----	-----	-----	2.44	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	5.41	-----		-----		-----	2.85	-----	1.97	-----	-----		-----	-----	-----	2.96	-----	-----	
	Slotted drains																							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
	Curb opening inlets																							
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>																						
g1	approach grade #1 (%):	>																						
g2	approach grade #2 (%):	>																						
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):			-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	

	Date:	2/26/2010
	Date:	3/1/2010
	"A2"	"A2"
	Lt	Lt
	36bc	
	346+20	348+10.
		HP
	0.01	
	0.20	
	0.22	
	1.00	
	3.266	
	0.71	
	0.71	
	0.015	
	0.008	
	1	
	1	
	G2	
	2	
	24.0	
	40.0	
	3	
	0.0500	
	0.0	
	0.0	
	0.050	
	10.00	
	3.60	
	0.18	
	0.32	
	2.18	

	0.050	
	88%	
	0.62	
	9.20	
	1.00	
	0.08	
	30	
	40%	
	93%	
	0.66	
	0.05	

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: SN ☑ **Date:** 003/01/10

In#	Layout Line: / Offset:	(Input Data Required)	"A2" Lt	"A2" Lt	"A2" Lt	"A2" Lt	"A2" Lt	"A2" Lt	"A2" Lt
	HYDROLOGY COMPUTATION:								
	Flow direction			36be →	36bg →	36bi →	36bk	36bm ←	
St	Structure location station:	>>	348+10.	349+50.	352+06	355+10	355+41.15	355+70	356+91.58
N	Notes					Flanking	Sag	Flanking	Flip towards median
	Unpaved watershed area (acres):	>>		0.00	0.00	0.00	0.00	0.00	
	Paved watershed area (acres):	>>		0.15	0.27	0.32	0.06	0.09	0.01
Ar	**Contributing watershed area (acres):**			**0.15**	**0.27**	**0.32**	**0.06**	**0.09**	**0.01**
C	Composite Runoff Coefficient "C":	>>		1.00	1.00	1.00	1.00	1.00	1.00
Ic	Precipitation intensity (in/hr):	>>		3.266	3.266	3.266	3.266	3.266	3.266
Qa	Subarea discharge Q (ft^3/s):			0.50	0.89	1.05	0.20	0.30	0.03
qq	Previous by-pass flow (ft^3/s):	>			0.02	0.00	0.32		
Qadd	Discharge added by operator (ft^3/s):	>							
Qt	**Total discharge Q (ft^3/s):**			**0.50**	**0.92**	**1.05**	**0.53**	**0.30**	**0.03**
	SHOULDER AND GUTTER CONFIGURATION:								
n	Manning's n:	>>		0.015	0.015	0.015	0.002	0.015	
S	Longitudinal slope S (ft/ft):	>>		0.005	0.005	0.003	0.000	0.002	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>		1	1	1	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>		1	1	1	2	1	
ID	Inlet description:	>		G2	GDOM	G2	GDOM	G2	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>		2	2	2	2	2	
Gw	Grate width (in):	>		24.0	48.0	24.0	48.0	24.0	
Gl	Grate length (in):	>		40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>		3	3	3	3	3	
Lco	Curb opening length provided (ft):	>							
Ls	Slotted drain length provided: (ft)	>							
Sx	Shoulder cross-slope Sx (ft/ft):	>>		0.0500	0.0500	0.0242	0.0202	0.0162	
W	Width of gutter from flowline (in):	>		0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>		0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)			0.050	0.050	0.024	0.020	0.016	
	Available Flooded Width (ft)	>		10.00	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**			**3.45**	**4.39**	**7.96**	**-----**	**7.12**	
Du/s	Depth at flowline before inlet (ft):			0.17	0.22	0.19	-----	0.12	
Au/s	Water cross-area before inlet (ft^2):			0.30	0.48	0.77	-----	0.41	
Vu/s	Velocity for total discharge before inlet (ft/s):			1.67	1.90	1.36	-----	0.73	
Eod	Ratio of gutter depression flow to total Q (Eod):			-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):			0.050	0.050	0.024	0.020	0.016	
	GRATE INLETS ON-GRADE:								
Eog	Ratio of grate frontal flow to total flow:			90%	100%	54%	-----	58%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression			0.45	0.91	0.56	-----	0.17	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):			9.20	9.20	9.20	-----	9.20	
Rf	Fraction of frontal flow intercepted (Rf):			1.00	1.00	1.00	-----	1.00	
Qs	Side flow in ft^3/s (Qs):			0.05	0.00	0.48	-----	0.12	
Gle	Effective grate length w/ 25% clogging (in):			30	30	30	-----	30	
Rs	Fraction of side flow interception (Rs):			52%	46%	43%	-----	61%	
E	Grate Efficiency (E):			95%	100%	74%	-----	84%	
Qi	**Total flow intercepted (ft^3/s):**			**0.47**	**0.91**	**0.77**	**-----**	**0.25**	
Qb	**Grate flow-by (ft^3/s):**			**0.02**	**0.00**	**0.28**	**-----**	**0.05**	
	SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)								
Lt	Length required for total interception (ft):			-----	-----	-----	-----	-----	
Ci	Interception for provided length L (ft^3/s):			-----	-----	-----	-----	-----	
El	Efficiency for providged length L:			-----	-----	-----	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**			**-----**	**-----**	**-----**	**-----**	**-----**	
	INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:								
	Grate Inlets								
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	0.08	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	0.10	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	4.03	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	4.89	-----	
	Slotted drains								
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	
	Curb opening inlets								
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):			-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>							
g1	approach grade #1 (%):	>							
g2	approach grade #2 (%):	>							
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):			-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):			-----	-----	-----	-----	-----	

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: SN ☑ **Date:** 3/1/2010

In#												
	Layout Line:		"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"
	Offset:		Med	Med	Med	Med	Med	Med	Med	Med	Med	Med
		(Input Data Required)										
HYDROLOGY COMPUTATION:												
	Flow direction		45a	45c	45i	45m	45n	45o	45p	45q	45q	
St	Structure location station:	>>	357+00	360+00	362+85	364+10	365+80	366+20	366+50	366+70	366+80	367+05.28
N	Notes											Flip
	Unpaved watershed area (acres):	>>			0.00	0.00	0.02	0.00	0.00	0.00	0.00	
	Paved watershed area (acres):	>>	0.08	0.36	0.30	0.12	0.18	0.04	0.02	0.01	0.01	0.01
Ar	**Contributing watershed area (acres):**		**0.08**	**0.36**	**0.30**	**0.12**	**0.19**	**0.04**	**0.02**	**0.01**	**0.01**	**0.01**
C	Composite Runoff Coefficient "C":	>>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ic	Precipitation intensity (in/hr):	>>	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524
Qa	Subarea discharge Q (ft^3/s):		0.29	1.27	1.06	0.44	0.68	0.13	0.08	0.05	0.05	0.05
qq	Previous by-pass flow (ft^3/s):	>		0.04	0.19	0.17	0.14	0.14	0.08	0.05	0.02	0.03
Qadd	Discharge added by operator (ft^3/s):	>										
Qt	**Total discharge Q (ft^3/s):**		**0.29**	**1.31**	**1.25**	**0.61**	**0.82**	**0.27**	**0.16**	**0.11**	**0.07**	**0.08**
SHOULDER AND GUTTER CONFIGURATION:												
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>	0.005	0.004	0.004	0.004	0.006	0.006	0.006	0.007	0.007	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1	1	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1	1	1	1	1	1	1	
ID	Inlet description:	>	G2	GDOM	GDOM	G2	GDOM	G2	G2	GDOM	G2	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	1	1	1	1	
Gw	Grate width (in):	>	24.0	48.0	48.0	24.0	48.0	24.0	24.0	48.0	24.0	
Gl	Grate length (in):	>	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>	3	3	3	3	3	3	3	3	3	
Lco	Curb opening length provided (ft):	>										
Ls	Slotted drain length provided: (ft)	>										
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0200	0.0200	0.0200	0.0200	0.0131	0.0089	0.0058	0.0037	0.0027	
W	Width of gutter from flowline (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.020	0.020	0.020	0.020	0.013	0.009	0.006	0.004	0.003	
	Available Flooded Width (ft)	>	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**5.10**	**9.09**	**9.04**	**7.02**	**9.47**	**7.92**	**8.48**	**9.47**	**9.85**	
Du/s	Depth at flowline before inlet (ft):		0.10	0.18	0.18	0.14	0.12	0.07	0.05	0.03	0.03	
Au/s	Water cross-area before inlet (ft^2):		0.26	0.83	0.82	0.49	0.59	0.28	0.21	0.17	0.13	
Vu/s	Velocity for total discharge before inlet (ft/s):		1.10	1.59	1.53	1.24	1.40	0.97	0.79	0.64	0.52	
Eod	Ratio of gutter depression flow to total Q (Eod):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):		0.020	0.020	0.020	0.020	0.013	0.009	0.006	0.004	0.003	
GRATE INLETS ON-GRADE:												
Eog	Ratio of grate frontal flow to total flow:		73%	79%	79%	59%	77%	54%	51%	77%	45%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		0.21	1.03	0.98	0.36	0.63	0.15	0.08	0.08	0.03	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Qs	Side flow in ft^3/s (Qs):		0.08	0.28	0.26	0.25	0.19	0.13	0.08	0.02	0.04	
Gle	Effective grate length w/ 25% clogging (in):		30	30	30	30	30	30	30	30	30	
Rs	Fraction of side flow interception (Rs):		48%	32%	34%	43%	28%	34%	33%	31%	32%	
E	Grate Efficiency (E):		86%	86%	86%	76%	83%	70%	67%	84%	62%	
Qi	**Total flow intercepted (ft^3/s):**		**0.25**	**1.12**	**1.07**	**0.47**	**0.69**	**0.19**	**0.11**	**0.09**	**0.04**	
Qb	**Grate flow-by (ft^3/s):**		**0.04**	**0.19**	**0.17**	**0.14**	**0.14**	**0.08**	**0.05**	**0.02**	**0.03**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)												
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
El	Efficiency for providged length L:		-----	-----	-----	-----	-----	-----	-----	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:												
	Grate Inlets											
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
	Slotted drains											
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
	Curb opening inlets											
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>										
g1	approach grade #1 (%):	>										
g2	approach grade #2 (%):	>										
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: SN ☑ **Date:** 3/1/2010

In#	Layout Line:		"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"
	Offset:		Rt	Rt	Med	Med	Med	Med	Med	Med	Med	Med	Med
		(Input Data Required)											
HYDROLOGY COMPUTATION:													
	Flow direction		→	14d →	14a →	18a →	19a →	20a →	20c →	20e →	20g →	20i →	→
St	Structure location station:	>>	257+05	267+41	267+41	272+00	277+00	282+00	283+50	284+50	284+90	285+10	285+37.66
N	Notes		HP	End of High-side gutter									Flip, bypass calcs only. Sheet flow Beg
	Unpaved watershed area (acres):	>>		0.58	0.00	0.03	0.03	0.03	0.01	0.01	0.00	0.00	0.00
	Paved watershed area (acres):	>>		0.10	0.71	0.47	0.52	0.51	0.15	0.10	0.04	0.02	0.03
Ar	**Contributing watershed area (acres):**			**0.68**	**0.71**	**0.50**	**0.56**	**0.55**	**0.16**	**0.10**	**0.04**	**0.02**	**0.03**
C	Composite Runoff Coefficient "C":	>>		0.76	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ic	Precipitation intensity (in/hr):	>>		3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266
Qa	Subarea discharge Q (ft^3/s):			1.70	2.33	1.65	1.82	1.79	0.53	0.33	0.14	0.07	0.08
qq	Previous by-pass flow (ft^3/s):	>				0.49	0.44	0.15	0.07	0.02	0.05	0.02	0.01
Qadd	Discharge added by operator (ft^3/s):	>											
Qt	**Total discharge Q (ft^3/s):**			**1.70**	**2.33**	**2.14**	**1.10**	**1.94**	**0.60**	**0.35**	**0.19**	**0.10**	**0.10**
SHOULDER AND GUTTER CONFIGURATION:													
n	Manning's n:	>>		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>		0.040	0.042	0.036	0.021	0.017	0.015	0.015	0.016	0.016	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>		1	1	1	1	1	1	1	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>		1	1	1	1	1	1	1	1	1	
ID	Inlet description:	>		G2	G2	G2	G2	GDOM	GDOM	GDOM	GDOM	GDOM	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>		2	2	2	2	2	2	2	2	2	
Gw	Grate width (in):	>		24.0	24.0	24.0	24.0	48.0	48.0	48.0	48.0	48.0	
Gl	Grate length (in):	>		40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>		3	3	3	3	3	3	3	3	3	
Lco	Curb opening length provided (ft):	>											
Ls	Slotted drain length provided: (ft)	>											
Sx	Shoulder cross-slope Sx (ft/ft):	>>		0.1667	0.0400	0.0400	0.0400	0.0344	0.0182	0.0074	0.0051	0.0033	
W	Width of gutter from flowline (in):	>		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)			0.167	0.040	0.050	0.040	0.034	0.018	0.007	0.005	0.003	
	Available Flooded Width (ft)	>		3.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**			**1.76**	**4.78**	**4.78**	**4.13**	**5.80**	**5.70**	**8.16**	**8.02**	**8.27**	
Du/s	Depth at flowline before inlet (ft):			0.29	0.19	0.19	0.17	0.20	0.10	0.06	0.04	0.03	
Au/s	Water cross-area before inlet (ft^2):			0.26	0.46	0.46	0.34	0.58	0.30	0.25	0.17	0.11	
Vu/s	Velocity for total discharge before inlet (ft/s):			6.60	5.10	4.68	3.22	3.34	2.02	1.43	1.12	0.85	
Eod	Ratio of gutter depression flow to total Q (Eod):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):			0.167	0.040	0.040	0.040	0.034	0.018	0.007	0.005	0.003	
GRATE INLETS ON-GRADE:													
Eog	Ratio of grate frontal flow to total flow:			100%	76%	76%	83%	96%	96%	83%	84%	83%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression			1.70	1.78	1.63	0.91	1.85	0.57	0.29	0.16	0.08	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):			9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	
Rf	Fraction of frontal flow intercepted (Rf):			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Qs	Side flow in ft^3/s (Qs):			0.00	0.55	0.50	0.19	0.09	0.02	0.06	0.03	0.02	
Gle	Effective grate length w/ 25% clogging (in):			30	30	30	30	30	30	30	30	30	
Rs	Fraction of side flow interception (Rs):			0%	10%	12%	21%	18%	22%	18%	19%	20%	
E	Grate Efficiency (E):			100%	79%	79%	86%	96%	97%	86%	87%	86%	
Qi	**Total flow intercepted (ft^3/s):**			**1.70**	**1.84**	**1.69**	**0.95**	**1.87**	**0.58**	**0.30**	**0.16**	**0.08**	
Qb	**Grate flow-by (ft^3/s):**			**0.00**	**0.49**	**0.44**	**0.15**	**0.07**	**0.02**	**0.05**	**0.02**	**0.01**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)													
Lt	Length required for total interception (ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
Ci	Interception for provided length L (ft^3/s):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
El	Efficiency for providged length L:			-----	-----	-----	-----	-----	-----	-----	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**			-----	-----	-----	-----	-----	-----	-----	-----	-----	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:													
	Grate Inlets												
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
	Slotted drains												
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
	Curb opening inlets												
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>											
g1	approach grade #1 (%):	>											
g2	approach grade #2 (%):	>											
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):			-----	-----	-----	-----	-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☑ **Date:** 2/26/2010
Checked by: SN ☑ **Date:** 3/1/2010

	Layout Line:		"VIN"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"		"A1"		"A1"	"A1"	"A1"	"A1"	"A1"	"A1"
In#	Offset:		Rt	Rt	Rt	Rt	Rt	Rt	Rt		Rt		Rt	Rt	Rt	Rt	Rt	Rt
		(Input Data Required)																
HYDROLOGY COMPUTATION:																		
			30m	30n	33c	33e	33g	33i	33k		33m		39b	39e	39g	39i	39k	
	Flow direction					→	→		←		→	→	→	→		←	←	
St	Structure location station:	>>	21+52	312+41	313+75	314+40	316+30	316+55.	316+80	318+00	319+00		322+80	324+70	325+00.	325+30	328+30.	329+97.41
N	Notes			Sag			Flanking DI	Sag	Flanking DI	HP		Arroyo Del Valle Bridge		Flanking DI	Sag	Flanking DI		HP
	Unpaved watershed area (acres):	>>	**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.03	0.01	
	Paved watershed area (acres):	>>	0.08	0.35	0.26	0.06	0.23	0.05	0.08		0.15		0.39	0.20	0.06	0.32	0.17	
Ar	**Contributing watershed area (acres):**		**0.08**	**0.35**	**0.26**	**0.06**	**0.23**	**0.05**	**0.08**		**0.15**		**0.39**	**0.20**	**0.06**	**0.34**	**0.18**	
C	Composite Runoff Coefficient "C":	>>	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	
Ic	Precipitation intensity (in/hr):	>>	3.266	3.266	3.266	3.266	3.266	3.266	3.266		3.266		3.266	3.266	3.266	3.266	3.266	
Qa	Subarea discharge Q (ft^3/s):		0.27	1.13	0.84	0.19	0.75	0.16	0.25		0.49		1.29	0.67	0.20	1.12	0.60	
qq	Previous by-pass flow (ft^3/s):	>					0.00	0.06					0.10	0.22	0.21	0.04		
Qadd	Discharge added by operator (ft^3/s):	>																
Qt	**Total discharge Q (ft^3/s):**		**0.27**	**1.13**	**0.84**	**0.19**	**0.75**	**0.23**	**0.25**		**0.49**		**1.39**	**0.88**	**0.41**	**1.16**	**0.60**	
SHOULDER AND GUTTER CONFIGURATION:																		
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	0.015		0.015		0.015	0.015	0.015	0.015	0.015	
S	Longitudinal slope S (ft/ft):	>>	0.020	0.019	0.003	0.008	0.001	0.000	0.001		0.004		0.003	0.001	0.000	0.001	0.003	
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1	1		1		1	1	1	1	1	
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	2	2	1	1	2	1		1		1	1	2	1	1	
ID	Inlet description:	>	G2	G2	G2	G2	G2	G2	G2		G2		G2	G2	GDOM	G2	G2	
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2	2		2		2	2	2	2	2	
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	24.0	24.0		24.0		24.0	24.0	48.0	24.0	24.0	
Gl	Grate length (in):	>	40.0	40.0	40.0	40.0	40.0	40.0	40.0		40.0		40.0	40.0	40.0	40.0	40.0	
	3 or 4 sided weir?	>	3	3	3	3	3	3	3		3		3	3	3	3	3	
Lco	Curb opening length provided (ft):	>																
Ls	Slotted drain length provided: (ft)	>																
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500		0.0200		0.0500	0.0500	0.0500	0.0500	0.0500	
W	Width of gutter from flowline (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	
a(t)	Gutter depression from horizontal (in):	>	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.050	0.050	0.050	0.050	0.050	0.050	0.050		0.020		0.050	0.050	0.050	0.050	0.050	
	Available Flooded Width (ft)	>	10.00	10.00	10.00	10.00	10.00	10.00	10.00		10.00		10.00	10.00	10.00	10.00	10.00	
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**2.15**	**-----**	**-----**	**2.22**	**5.48**	**-----**	**3.71**		**6.31**		**5.56**	**6.09**	**-----**	**6.59**	**4.10**	
Du/s	Depth at flowline before inlet (ft):		0.11	-----	-----	0.11	0.27	-----	0.19		0.13		0.28	0.30	-----	0.33	0.20	
Au/s	Water cross-area before inlet (ft^2):		0.12	-----	-----	0.12	0.75	-----	0.34		0.40		0.77	0.93	-----	1.09	0.42	
Vu/s	Velocity for total discharge before inlet (ft/s):		2.38	-----	-----	1.57	1.00	-----	0.74		1.23		1.80	0.95	-----	1.07	1.42	
Eod	Ratio of gutter depression flow to total Q (Eod):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
Se	Equivalent cross-slope (ft/ft):		0.050	0.050	0.050	0.050	0.050	0.050	0.050		0.020		0.050	0.050	0.050	0.050	0.050	
GRATE INLETS ON-GRADE:																		
Eog	Ratio of grate frontal flow to total flow:		100%	-----	-----	100%	70%	-----	87%		64%		70%	65%	-----	62%	83%	
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		0.27	-----	-----	0.19	0.52	-----	0.22		0.31		0.97	0.58	-----	0.72	0.50	
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		9.20	-----	-----	9.20	9.20	-----	9.20		9.20		9.20	9.20	-----	9.20	9.20	
Rf	Fraction of frontal flow intercepted (Rf):		1.00	-----	-----	1.00	1.00	-----	1.00		1.00		1.00	1.00	-----	1.00	1.00	
Qs	Side flow in ft^3/s (Qs):		0.00	-----	-----	0.00	0.22	-----	0.03		0.18		0.42	0.31	-----	0.44	0.10	
Gle	Effective grate length w/ 25% clogging (in):		30	-----	-----	30	30	-----	30		30		30	30	-----	30	30	
Rs	Fraction of side flow interception (Rs):		37%	-----	-----	55%	73%	-----	83%		43%		49%	75%	-----	71%	59%	
E	Grate Efficiency (E):		100%	-----	-----	100%	92%	-----	98%		79%		84%	91%	-----	89%	93%	
Qi	**Total flow intercepted (ft^3/s):**		**0.27**	**-----**	**-----**	**0.19**	**0.69**	**-----**	**0.25**		**0.39**		**1.17**	**0.81**	**-----**	**1.03**	**0.56**	
Qb	**Grate flow-by (ft^3/s):**		**0.00**	**-----**	**-----**	**0.00**	**0.06**	**-----**	**0.01**		**0.10**		**0.22**	**0.08**	**-----**	**0.13**	**0.04**	
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)																		
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
El	Efficiency for providged length L:		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**		**-----**		**-----**	**-----**	**-----**	**-----**	**-----**	
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:																		
	Grate Inlets																	
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	0.18	0.15	-----	-----	0.06	-----		-----		-----	-----	0.07	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	0.22	0.18	-----	-----	0.08	-----		-----		-----	-----	0.08	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	3.60	2.97	-----	-----	1.24	-----		-----		-----	-----	1.37	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	4.38	3.61	-----	-----	1.50	-----		-----		-----	-----	1.66	-----	-----	
	Slotted drains																	
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
	Curb opening inlets																	
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
Lc	Length of the vertical curve (ft):	>																
g1	approach grade #1 (%):	>																
g2	approach grade #2 (%):	>																
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	-----		-----		-----	-----	-----	-----	-----	

State Route 84 Isabel Widening

Caltrans Highway Drainage Inlet Calculations

Designed by: KC, IL ☐ **Date:** 2/26/2010
Checked by: SN ☐ **Date:** 3/1/2010

In#	Layout Line:		"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"A1"	"CON"	"CON"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"	"A2"
	Offset:		Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Lt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt
		(Input Data Required)																					
HYDROLOGY COMPUTATION:																							
	Flow direction			39m →	39o →	39s →	39u →	39w	39y ←	39aa ←	39ae	39ag	39ai ←		39ak →	41a →	41c →	41e →	41g →	42a →	42b	43b ←		44b →
St	Structure location station:	>>	329+97.41	334+00	336+92	338+85	340+95	341+25.	341+55	343+00	31+09	30+86	346+30	348+10.	352+06	357+10.	359+50.	362+00.	363+57.49	364+50.	365+14.25	365+30.	365+50.	365+80.49
N	Notes		HP				Flanking DI	Sag	Flanking DI		South Side Concannon, Sag	North Side Concannon, Sag		HP					(E) DI	Flanking	Sag	Flanking	HP	
	Unpaved watershed area (acres):	>>		0.08	0.00	0.06				0.18	0.15	0.12				0.14	0.10	0.12	0.07	0.04	0.04	0.01		0.02
	Paved watershed area (acres):	>>		0.42	0.31	0.21	0.28	0.09	0.23	0.28	0.39	0.54	0.28		0.65	0.62	0.26	0.26	0.16	0.10	0.08	0.02		0.03
Ar	**Contributing watershed area (acres):**			**0.50**	**0.31**	**0.26**	**0.28**	**0.09**	**0.23**	**0.46**	**0.54**	**0.66**	**0.28**		**0.65**	**0.76**	**0.36**	**0.37**	**0.24**	**0.14**	**0.12**	**0.03**		**0.05**
C	Composite Runoff Coefficient "C":	>>		0.99	1.00	0.97	1.00	1.00	1.00	0.92	1.00	1.00	1.00		1.00	0.98	0.95	0.94	0.94	0.94	0.95	0.94		0.93
Ic	Precipitation intensity (in/hr):	>>		3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266	3.266		3.266	3.524	3.524	3.524	3.524	3.524	3.524	3.524		3.524
Qa	Subarea discharge Q (ft^3/s):			1.61	1.00	0.84	0.90	0.30	0.76	1.36	1.78	2.17	0.93		2.12	2.65	1.22	1.24	0.78	0.46	0.39	0.11		0.15
qq	Previous by-pass flow (ft^3/s):	>			0.28	0.18	0.00	0.21	0.21	0.10		0.10				0.45	0.83	0.43	0.30	0.20	0.04			
Qadd	Discharge added by operator (ft^3/s):	>																						
Qt	**Total discharge Q (ft^3/s):**			**1.61**	**1.28**	**1.02**	**0.90**	**0.51**	**0.97**	**1.46**	**1.78**	**2.27**	**0.93**		**2.12**	**3.10**	**2.06**	**1.67**	**1.08**	**0.66**	**0.43**	**0.11**		**0.15**
SHOULDER AND GUTTER CONFIGURATION:																								
n	Manning's n:	>>		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015		0.015
S	Longitudinal slope S (ft/ft):	>>		0.007	0.007	0.008	0.003	0.000	0.003	0.013	0.024	0.012	0.005		0.005	0.004	0.004	0.004	0.003	0.003	0.000	0.001		0.001
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>		1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1		1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>		1	1	1	1	2	1	1	2	2	1		1	1	1	1	1	1	2	1		1
ID	Inlet description:	>		G2	G2	G2	G2	G2	G2	G2	G2	G2	G2		G2	G2	G2	G2	G2	GDO	G2	G2		G2
	Standard Gutter Depression (1=SGD, 2=no SGD)	>		2	2	2	2	2	2	2	2	2	2		2	2	2	2	2	2	2	2		2
Gw	Grate width (in):	>		24.0	24.0	48.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0		24.0	24.0	24.0	24.0	24.0	48.0	24.0	24.0		24.0
Gl	Grate length (in):	>		40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0		40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0		40.0
	3 or 4 sided weir?	>		3	3	3	3	3	3	3	3	3	3		3	3	3	3	3	3	3	3		3
Lco	Curb opening length provided (ft):	>																						
Ls	Slotted drain length provided: (ft)	>																						
Sx	Shoulder cross-slope Sx (ft/ft):	>>		0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0254	0.0142	0.0500		0.0500	0.0500	0.0500	0.0500	0.0372	0.0246	0.0204	0.0168		0.0131
W	Width of gutter from flowline (in):	>		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
a(t)	Gutter depression from horizontal (in):	>		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)			0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.025	0.014	0.050		0.050	0.050	0.050	0.050	0.037	0.025	0.020	0.017		0.013
	Available Flooded Width (ft)	>		10.00	10.00	10.00	10.00	10.00	10.00	10.00	13.00	17.00	10.00		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00		10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**			**5.15**	**4.72**	**4.19**	**4.78**	**-----**	**5.02**	**4.36**	**-----**	**-----**	**4.38**		**6.06**	**7.14**	**6.12**	**5.64**	**6.06**	**6.71**	**-----**	**6.10**		**7.87**
Du/s	Depth at flowline before inlet (ft):			0.26	0.24	0.21	0.24	-----	0.25	0.22	-----	-----	0.22		0.30	0.36	0.31	0.28	0.23	0.17	-----	0.10		0.10
Au/s	Water cross-area before inlet (ft^2):			0.66	0.56	0.44	0.57	-----	0.63	0.47	-----	-----	0.48		0.92	1.27	0.94	0.80	0.68	0.55	-----	0.31		0.41
Vu/s	Velocity for total discharge before inlet (ft/s):			2.43	2.30	2.32	1.57	-----	1.54	3.08	-----	-----	1.94		2.31	2.43	2.20	2.10	1.59	1.19	-----	0.36		0.36
Eod	Ratio of gutter depression flow to total Q (Eod):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
Se	Equivalent cross-slope (ft/ft):		0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.025	0.014	0.050		0.050	0.050	0.050	0.050	0.037	0.025	0.020	0.017		0.013
GRATE INLETS ON-GRADE:																								
Eog	Ratio of grate frontal flow to total flow:			73%	77%	100%	76%	-----	74%	81%	-----	-----	80%		66%	58%	65%	69%	66%	91%	-----	65%		54%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression			1.18	0.98	1.02	0.69	-----	0.72	1.18	-----	-----	0.75		1.39	1.81	1.34	1.15	0.71	0.60	-----	0.07		0.08
Vo	Vo for effective length (P-50, Chart 5) (ft/s):			9.20	9.20	9.20	9.20	-----	9.20	9.20	-----	-----	9.20		9.20	9.20	9.20	9.20	9.20	9.20	-----	9.20		9.20
Rf	Fraction of frontal flow intercepted (Rf):			1.00	1.00	1.00	1.00	-----	1.00	1.00	-----	-----	1.00		1.00	1.00	1.00	1.00	1.00	1.00	-----	1.00		1.00
Qs	Side flow in ft^3/s (Qs):			0.43	0.29	0.00	0.21	-----	0.25	0.28	-----	-----	0.18		0.73	1.29	0.72	0.52	0.37	0.06	-----	0.04		0.07
Gle	Effective grate length w/ 25% clogging (in):			30	30	30	30	-----	30	30	-----	-----	30		30	30	30	30	30	30	-----	30		30
Rs	Fraction of side flow interception (Rs):			36%	38%	38%	55%	-----	56%	27%	-----	-----	45%		38%	36%	40%	42%	47%	50%	-----	85%		82%
E	Grate Efficiency (E):			83%	86%	100%	89%	-----	89%	86%	-----	-----	89%		79%	73%	79%	82%	82%	96%	-----	95%		92%
Qi	**Total flow intercepted (ft^3/s):**			**1.33**	**1.09**	**1.02**	**0.80**	**-----**	**0.86**	**1.25**	**-----**	**-----**	**0.83**		**1.66**	**2.27**	**1.63**	**1.37**	**0.89**	**0.63**	**-----**	**0.11**		**0.14**
Qb	**Grate flow-by (ft^3/s):**			**0.28**	**0.18**	**0.00**	**0.10**	**-----**	**0.11**	**0.21**	**-----**	**-----**	**0.10**		**0.45**	**0.83**	**0.43**	**0.30**	**0.20**	**0.03**	**-----**	**0.01**		**0.01**
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)																								
Lt	Length required for total interception (ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
Ci	Interception for provided length L (ft^3/s):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
El	Efficiency for providged length L:			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**			**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**		**-----**
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:																								
	Grate Inlets																							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	0.11	-----	-----	0.24	0.29	-----		-----	-----	-----	-----	-----	-----	0.09	-----		-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	0.13	-----	-----	0.30	0.35	-----		-----	-----	-----	-----	-----	-----	0.12	-----		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	2.12	-----	-----	9.61	20.22	-----		-----	-----	-----	-----	-----	-----	4.63	-----		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	2.57	-----	-----	11.68	24.58	-----		-----	-----	-----	-----	-----	-----	5.63	-----		-----
	Slotted drains																							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
	Curb opening inlets																							
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
Lc	Length of the vertical curve (ft):	>																						
g1	approach grade #1 (%):	>																						
g2	approach grade #2 (%):	>																						
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----
Df	Flanking inlets distance (ft):			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----	-----	-----	-----	-----	-----		-----

☐ ☐ **Designed by:** KC, IL **Checked by:** AO ☑ ☑

"A2" Rt	"A2" Rt	"A2" Med	"A2" Med			"A2" Med	"A2" Med	"A2" Med	"A2" Med
46a →		47a →	47c →	47e →	47h →	47k	47m ←	47o ←	47q ←
366+80.	367+05.28	369+00.	370+35.	370+75.	371+09.62	371+20.83	371+50.83	372+00.	373+70.
	Flip				Flanking DI	Sag	Flanking DI		
0.05	0.01	0.09	0.07	0.02	0.02	0.02	0.02	0.08	0.10
0.09	0.02	0.24	0.15	0.04	0.04	0.04	0.05	0.18	0.21
0.14	**0.03**	**0.34**	**0.21**	**0.06**	**0.06**	**0.06**	**0.07**	**0.26**	**0.30**
0.93	0.90	0.95	0.94	0.94	0.93	0.93	0.94	0.94	0.94
3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524
0.45	0.09	1.13	0.70	0.20	0.19	0.20	0.24	0.88	1.00
0.01	0.00		0.38	0.32	0.09	0.10	0.27	0.10	
0.46	**0.09**	**1.13**	**1.08**	**0.52**	**0.28**	**0.30**	**0.51**	**0.98**	**1.00**
0.015		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
0.002		0.006	0.002	0.001	0.000	0.000	0.001	0.002	0.006
3		1	1	1	1	1	1	1	1
1		1	1	1	1	2	1	1	1
G2		G2	G2	G2	G2	GDOM	G2	G2	GDOM
2		2	2	2	1	2	2	2	2
24.0		24.0	24.0	24.0	24.0	48.0	24.0	24.0	48.0
40.0		40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
3		3	3	3	3	3	3	3	3
100.00									
0.0031		0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200
0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.003		0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
10.00		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
-----		**8.16**	**9.54**	**8.11**	**8.27**	**-----**	**8.65**	**9.35**	**7.73**
-----		0.16	0.19	0.16	0.17	-----	0.17	0.19	0.15
-----		0.67	0.91	0.66	0.68	-----	0.75	0.88	0.60
-----		1.70	1.19	0.78	0.41	-----	0.69	1.12	1.67
0.003		0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
-----		53%	47%	53%	52%	-----	50%	47%	86%
-----		0.60	0.50	0.27	0.15	-----	0.26	0.46	0.86
-----		9.20	9.20	9.20	9.20	-----	9.20	9.20	9.20
-----		1.00	1.00	1.00	1.00	-----	1.00	1.00	1.00
-----		0.53	0.58	0.24	0.14	-----	0.26	0.51	0.14
-----		30	30	30	30	-----	30	30	30
-----		30%	45%	63%	84%	-----	68%	47%	30%
-----		67%	70%	83%	92%	-----	84%	72%	90%
-----		**0.75**	**0.76**	**0.43**	**0.26**	**-----**	**0.43**	**0.71**	**0.90**
-----		**0.38**	**0.32**	**0.09**	**0.02**	**-----**	**0.08**	**0.27**	**0.10**
27.09		-----	-----	-----	-----	-----	-----	-----	-----
0.5		-----	-----	-----	-----	-----	-----	-----	-----
100%		-----	-----	-----	-----	-----	-----	-----	-----
0.0		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**
-----		-----	-----	-----	-----	0.06	-----	-----	-----
-----		-----	-----	-----	-----	0.07	-----	-----	-----
-----		-----	-----	-----	-----	2.81	-----	-----	-----
-----		-----	-----	-----	-----	3.42	-----	-----	-----
-----		-----	-----	-----	-----	-----	-----	-----	-----
-----		-----	-----	-----	-----	-----	-----	-----	-----
-----		-----	-----	-----	-----	-----	-----	-----	-----
-----		-----	-----	-----	-----	-----	-----	-----	-----
-----		-----	-----	-----	-----	-----	-----	-----	-----
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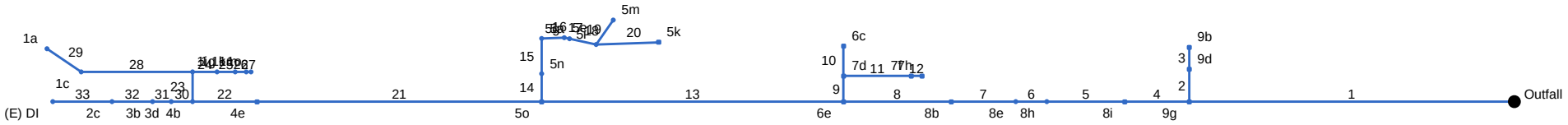
-----		-----	-----	-----	-----	-----	-----	-----	-----

Appendix G On-site System Capacity Analysis

(Storm Sewers 2008 Model Reports)

Segment A
(PM 25.5 to PM 27.1)

DS_1-9



Project File: DS_1-9.stm	Number of lines: 33	Date: 01-14-2011

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	489	0.83	11.75	0.90	0.75	8.97	5.0	22.1	1.8	15.79	25.23	4.28	36	0.14	401.80	402.50	403.07	404.60	416.67	414.97	exist Lt 381-386
2	1	49	0.00	0.64	0.00	0.00	0.61	0.0	5.2	3.6	2.18	16.16	3.44	24	0.51	407.35	407.60	407.85	408.13	414.97	415.20	(E) 24 in. PP
3	2	33	0.64	0.64	0.95	0.61	0.61	5.0	5.0	3.7	2.22	19.69	2.92	24	0.76	407.65	407.90	408.30	408.43	415.20	414.97	(E) 24 in. PP
4	1	97	0.19	10.28	0.94	0.18	7.62	5.0	21.4	1.8	13.62	21.41	2.32	36	0.10	402.50	402.60	404.85	404.89	414.97	414.56	(E) 36 in. PP
5	4	117	0.18	10.09	0.94	0.17	7.44	5.0	20.5	1.8	13.56	19.50	2.33	36	0.09	402.60	402.70	404.93	404.98	414.56	414.17	(E) 36 in. PP
6	5	47	0.08	9.91	0.94	0.08	7.27	5.0	20.2	1.8	13.36	36.40	2.35	36	0.30	402.70	402.84	405.02	405.03	414.17	414.12	(E) 36 in. PP
7	6	97	0.13	9.83	0.94	0.12	7.20	5.0	19.5	1.9	13.45	16.59	2.39	36	0.06	402.84	402.90	405.08	405.12	414.12	414.11	(E) 36 in. PP
8	7	162	0.00	9.70	0.90	0.00	7.07	5.0	18.4	1.9	13.61	23.43	2.45	36	0.12	402.90	403.10	405.17	405.24	414.11	414.07	(E) 36 in. PP
9	8	39	0.00	1.04	0.90	0.00	0.98	5.0	6.3	3.3	3.19	14.03	3.62	24	0.38	404.80	404.95	405.45	405.60	414.07	413.17	(E) 24 in. PP
10	9	45	0.95	0.95	0.94	0.89	0.89	5.0	5.0	3.7	3.27	16.86	3.31	24	0.56	405.02	405.27	405.81	405.91	413.17	411.97	7a (E) 24 in PP
11	9	102	0.07	0.09	0.97	0.07	0.09	5.0	5.3	3.5	0.31	5.66	1.71	18	0.99	409.14	410.15	409.38	410.39	413.17	414.11	7e
12	11	16	0.02	0.02	1.00	0.02	0.02	5.0	5.0	3.7	0.07	5.51	0.78	18	0.94	410.25	410.40	410.46	410.52	414.11	414.11	7g
13	8	454	0.00	8.66	0.90	0.00	6.09	5.0	15.8	2.1	12.63	14.91	2.94	30	0.13	403.20	403.80	405.34	405.76	414.07	412.07	(E) 30 in. PP
14	13	42	0.00	6.31	0.90	0.00	4.09	5.0	10.8	2.5	10.26	17.10	3.74	24	0.57	404.16	404.40	405.90	405.94	412.07	411.14	(E) 24 in. PP
15	14	53	1.38	6.31	0.95	1.31	4.09	5.0	10.6	2.5	10.35	20.37	4.58	24	0.81	404.40	404.83	406.05	406.00	411.14	410.04	(E) 24 in. PP
16	15	34	0.13	4.93	0.95	0.12	2.78	5.0	10.5	2.5	7.08	9.36	4.01	18	0.79	404.93	405.20	406.61	406.76	410.04	410.01	5d
17	16	8	0.18	4.80	0.94	0.17	2.66	5.0	10.4	2.5	6.78	8.30	3.83	18	0.63	405.30	405.35	406.91	406.94	410.01	410.01	5f
18	17	41	0.33	4.62	0.93	0.31	2.49	5.0	10.2	2.6	6.40	9.28	3.64	18	0.78	405.45	405.77	407.08	407.22	410.01	410.05	5h
19	18	45	3.41	3.41	0.40	1.36	1.36	10.0	10.0	2.6	3.55	15.75	3.19	18	7.67	406.34	409.79	407.66	410.51	410.05	413.50	5l
20	18	94	0.88	0.88	0.93	0.82	0.82	5.0	5.0	3.7	2.99	9.75	1.97	18	0.86	405.87	406.68	407.68	407.74	410.05	410.39	5j
21	13	428	0.21	2.35	0.96	0.20	2.00	5.0	12.8	2.3	4.61	13.70	2.34	24	0.37	403.93	405.50	406.01	406.43	412.07	413.24	(E) 24 in. PP
22	21	97	0.00	2.14	0.90	0.00	1.80	5.0	12.2	2.4	4.23	14.52	2.90	24	0.41	405.50	405.90	406.64	406.72	413.24	413.34	(E) 24 in. PP
23	22	45	0.00	0.65	0.00	0.00	0.39	0.0	11.4	2.4	0.96	14.30	0.85	24	0.40	405.93	406.11	406.81	406.81	413.34	413.92	(E) 24 in. PP

DS_1-9 | Number of lines: 33 | Run Date: 01-14-2011

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50; Return period = 50 Yrs. ; c = cir e = ellip b = box

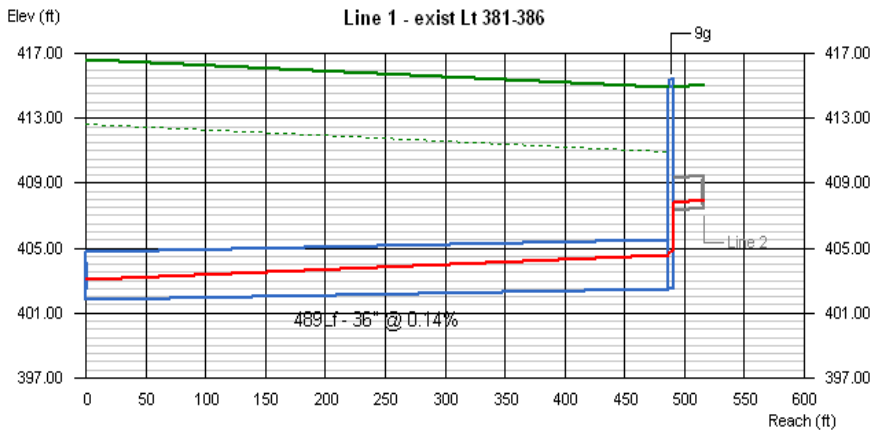
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
24	23	37	0.00	0.01	0.00	0.00	0.01	0.0	5.8	3.4	0.03	7.32	1.02	18	0.49	407.70	407.88	407.77	407.95	413.92	413.72	1h
25	24	27	0.00	0.01	0.00	0.00	0.01	0.0	5.4	3.5	0.03	7.56	1.05	18	0.52	407.98	408.12	408.05	408.19	413.72	413.55	1j
26	25	17	0.00	0.01	0.00	0.00	0.01	0.0	5.1	3.6	0.03	7.64	1.08	18	0.53	408.22	408.31	408.29	408.38	413.55	413.43	1l
27	26	7	0.01	0.01	0.90	0.01	0.01	5.0	5.0	3.7	0.03	6.87	0.99	18	0.43	408.41	408.44	408.49	408.52	413.43	413.36	1n
28	23	167	0.00	0.64	0.00	0.00	0.38	0.0	10.4	2.6	0.98	7.44	2.86	18	0.50	406.50	407.34	406.87	407.72	413.92	414.49	1d
29	28	62	0.64	0.64	0.60	0.38	0.38	10.0	10.0	2.6	1.00	11.56	2.70	18	4.13	407.44	410.00	407.85	410.38	414.49	415.12	1b
30	22	32	0.08	1.49	0.96	0.08	1.41	5.0	6.2	3.3	4.63	14.96	3.67	24	0.44	405.90	406.04	406.81	406.83	413.34	413.33	(E) 24 in. PP
31	30	28	0.24	1.41	0.97	0.23	1.33	5.0	6.0	3.3	4.43	14.81	2.88	24	0.43	406.04	406.16	407.08	407.09	413.33	413.30	(E) 24 in. PP
32	31	61	0.26	1.17	0.96	0.25	1.10	5.0	5.6	3.5	3.79	14.77	2.44	24	0.43	406.16	406.42	407.29	407.31	413.30	413.32	(E) 24 in. PP
33	32	89	0.91	0.91	0.93	0.85	0.85	5.0	5.0	3.7	3.09	14.78	2.43	24	0.43	406.42	406.80	407.48	407.52	413.32	413.18	(E) 24 in. PP

DS_1-9 | Number of lines: 33 | Run Date: 01-14-2011

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50; Return period = 50 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - exist Lt 381-386

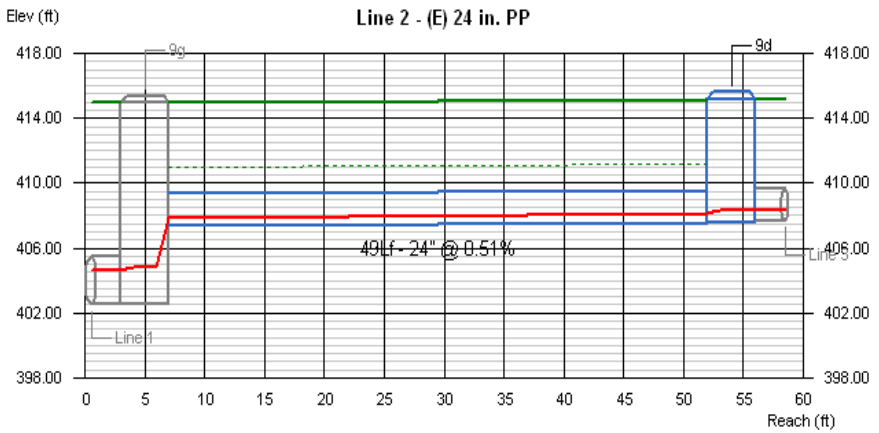


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
1	15.79	401.80	402.50	1.27	2.10	2.30	403.07	404.60	404.80	5.57	2.99	11.87	9.47

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - (E) 24 in. PP

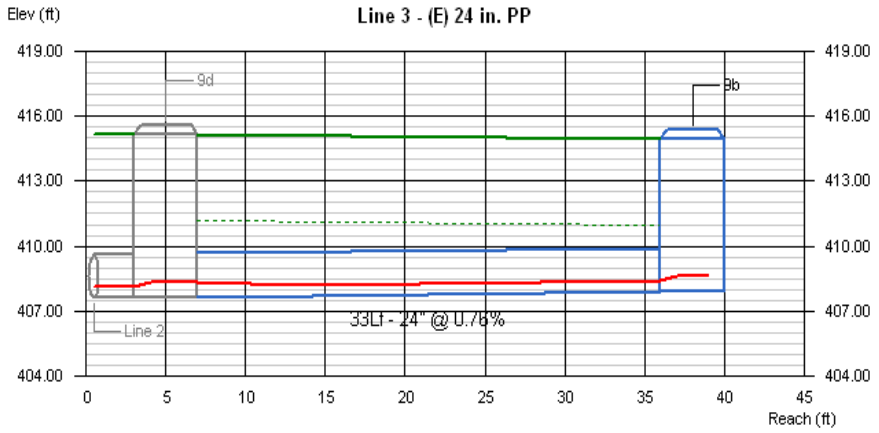


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
2	2.18	407.35	407.60	0.50	0.53	0.70	407.85	408.13	408.30 i	3.59	3.29	5.62	5.60

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - (E) 24 in. PP

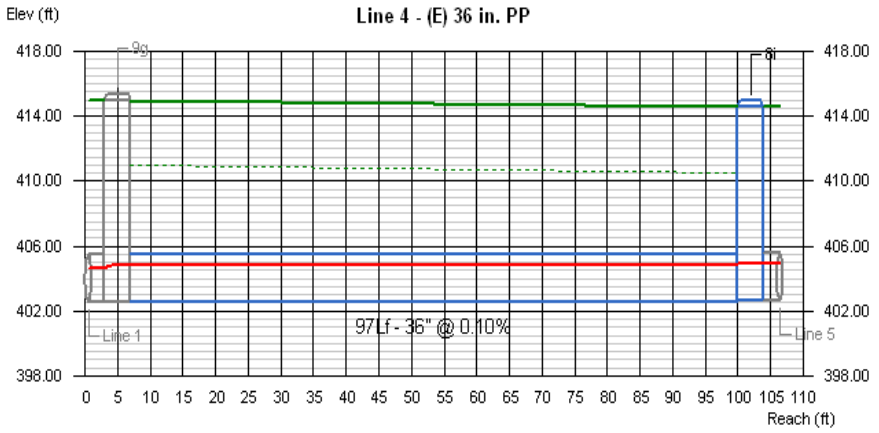


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
3	2.22	407.65	407.90	0.65	0.53	0.72	408.30	408.43 j	408.62 i	2.50	3.35	5.55	5.07

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 4) - (E) 36 in. PP

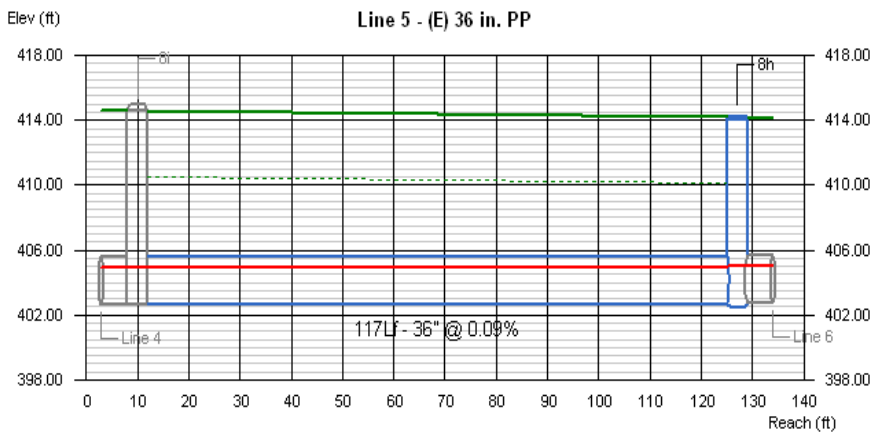


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
4	13.62	402.50	402.60	2.35	2.29	2.33	404.85	404.89	404.93	2.29	2.35	9.47	8.96

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

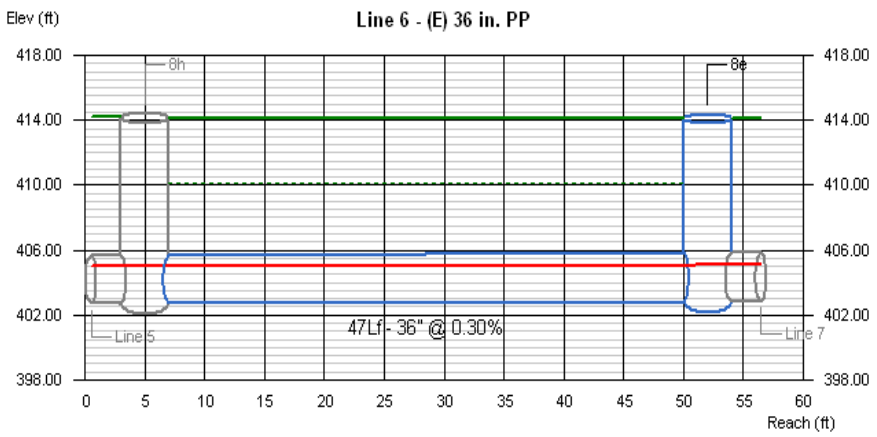
Line Profile (Line 5) - (E) 36 in. PP



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
5	13.56	402.60	402.70	2.33	2.28	2.32	404.93	404.98	405.02	2.30	2.35	8.96	8.47

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

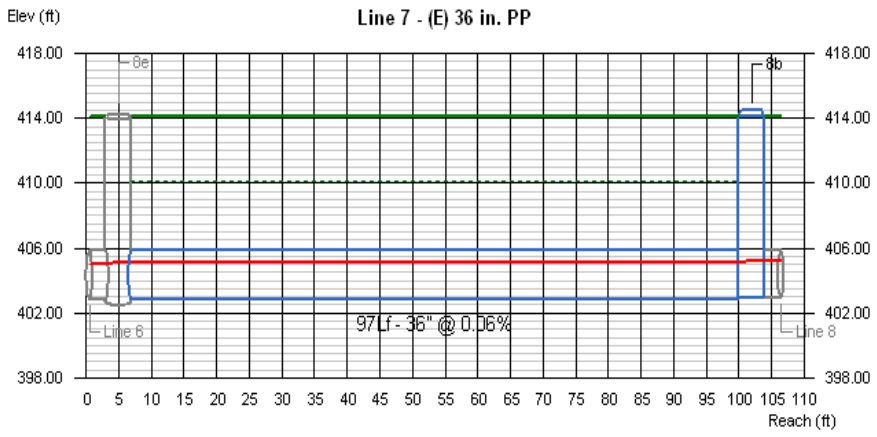
Line Profile (Line 6) - (E) 36 in. PP



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
6	13.36	402.70	402.84	2.32	2.19	2.24	405.02	405.03	405.08	2.28	2.41	8.47	8.28

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

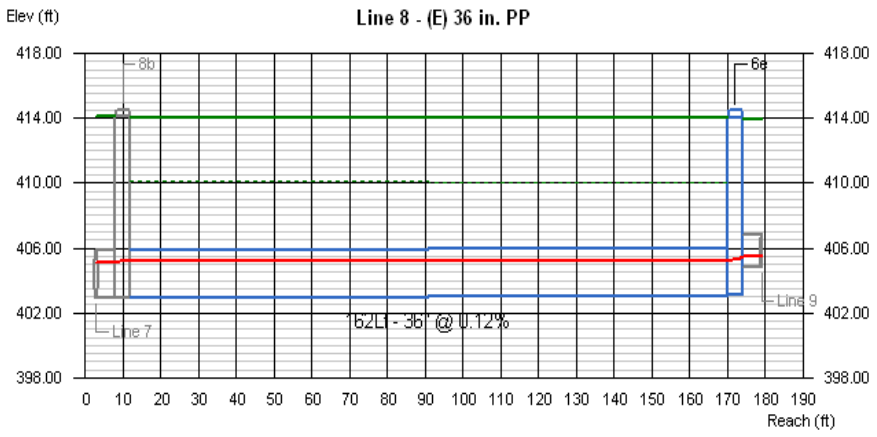
Line Profile (Line 7) - (E) 36 in. PP



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
7	13.45	402.84	402.90	2.24	2.22	2.27	405.08	405.12	405.17	2.38	2.40	8.28	8.21

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

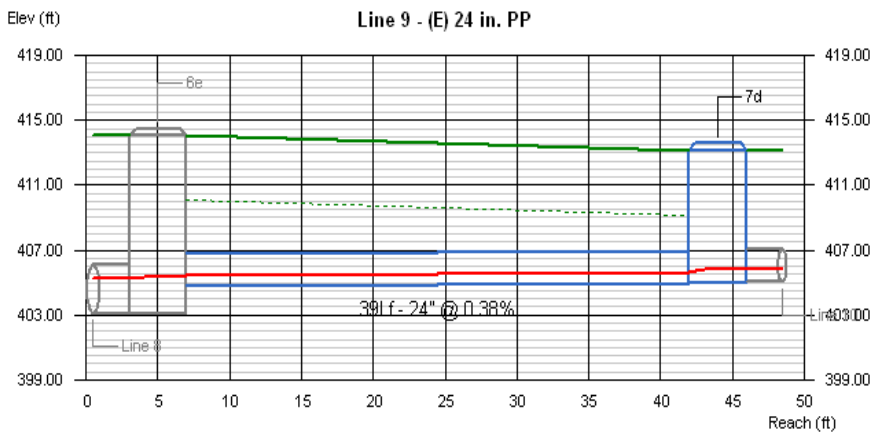
Line Profile (Line 8) - (E) 36 in. PP



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
8	13.61	402.90	403.10	2.27	2.14	2.24	405.17	405.24	405.34	2.37	2.52	8.21	7.97

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

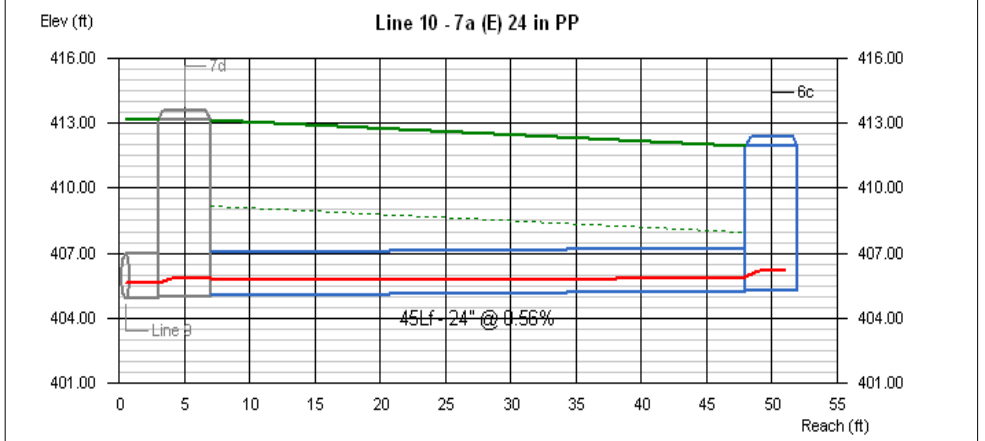
Line Profile (Line 9) - (E) 24 in. PP



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
9	3.19	404.80	404.95	0.65	0.65	0.86	405.45	405.60	405.81 i	3.61	3.63	7.27	6.22

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

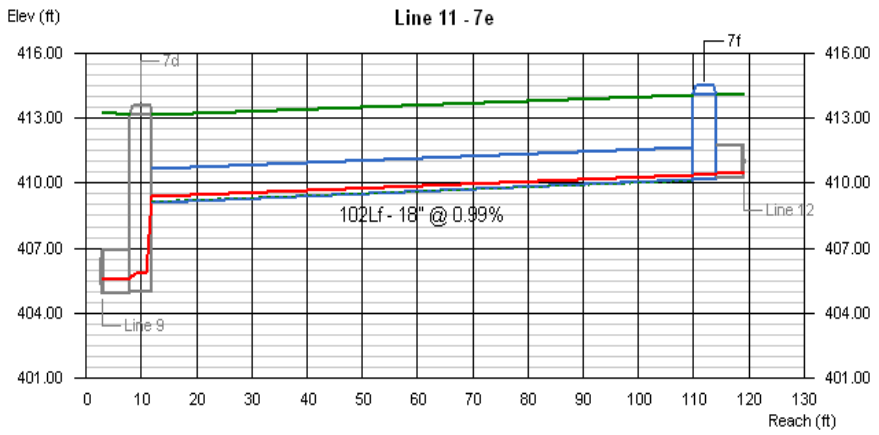
Line Profile (Line 10) - 7a (E) 24 in PP



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
10	3.27	405.02	405.27	0.79	0.64	0.89	405.81	405.91 j	406.16 i	2.85	3.77	6.15	4.70

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

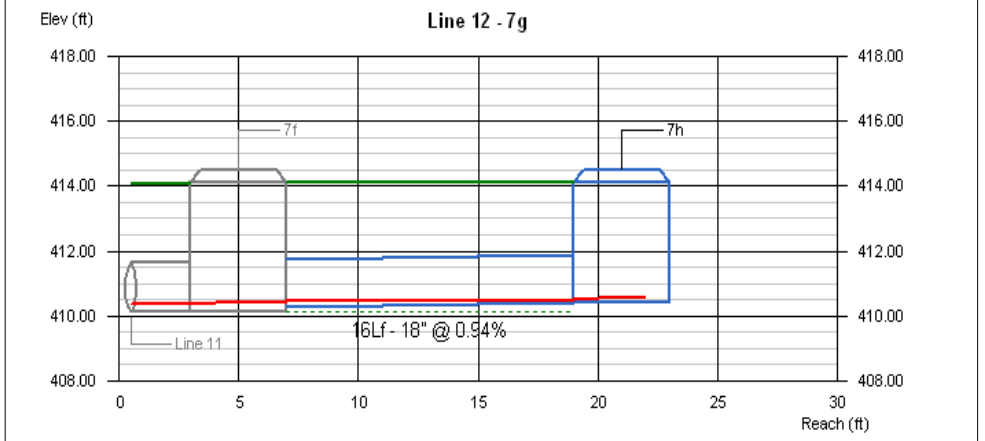
Line Profile (Line 11) - 7e



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
11	0.31	409.14	410.15	0.24	0.24	0.26	409.38	410.39	410.41	1.72	1.71	2.53	2.46

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

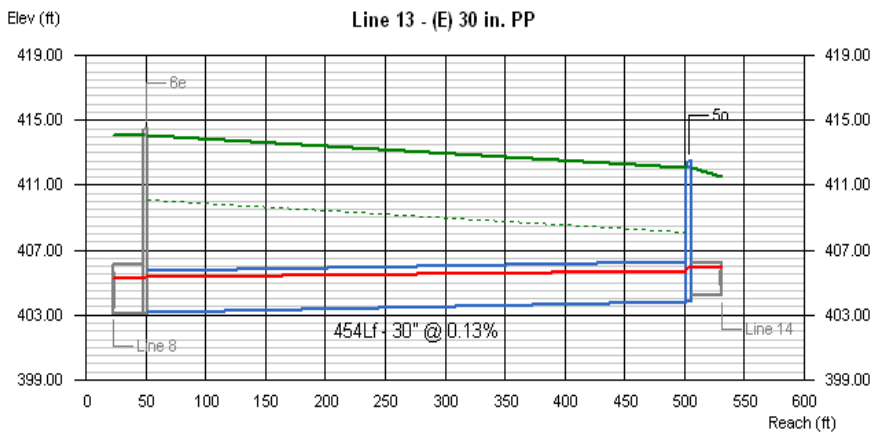
Line Profile (Line 12) - 7g



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
12	0.07	410.25	410.40	0.21	0.12	0.14	410.46	410.52	410.54	0.49	1.06	2.36	2.21

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

Line Profile (Line 13) - (E) 30 in. PP

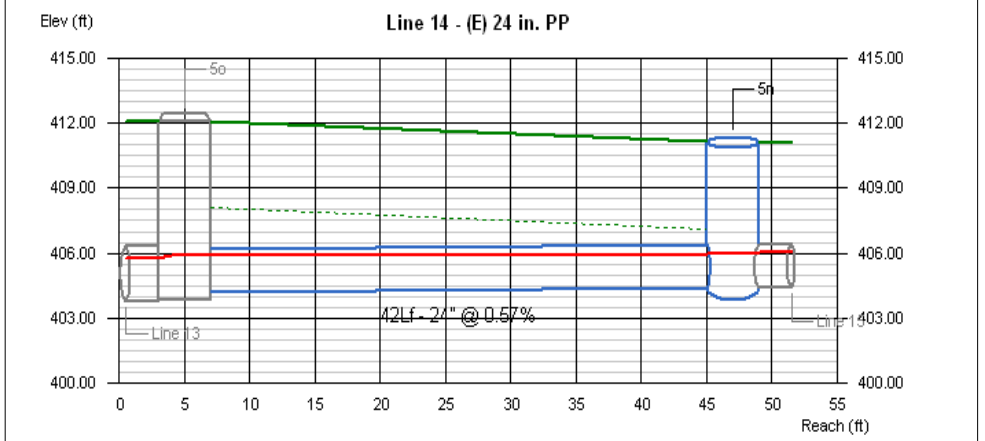


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
13	12.63	403.20	403.80	2.14	1.96	2.10	405.34	405.76	405.90	2.82	3.07	8.37	5.77

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 14) - (E) 24 in. PP

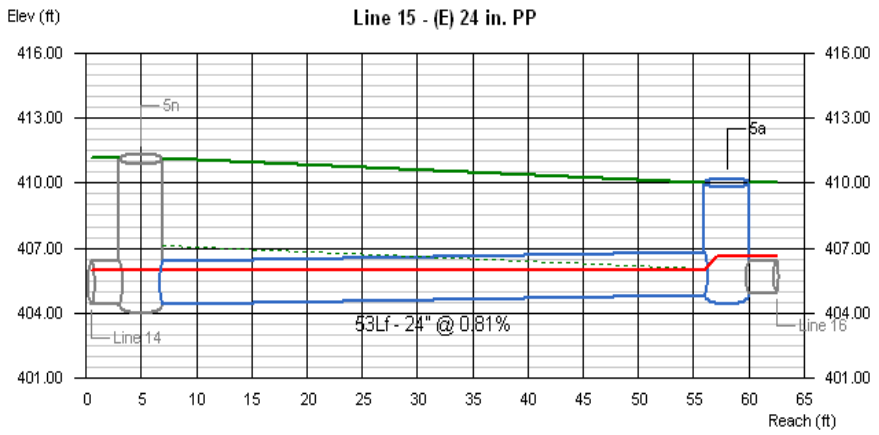


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
14	10.26	404.16	404.40	1.74	1.54	1.58	405.90	405.94	405.98	3.53	3.94	5.91	4.74

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 15) - (E) 24 in. PP

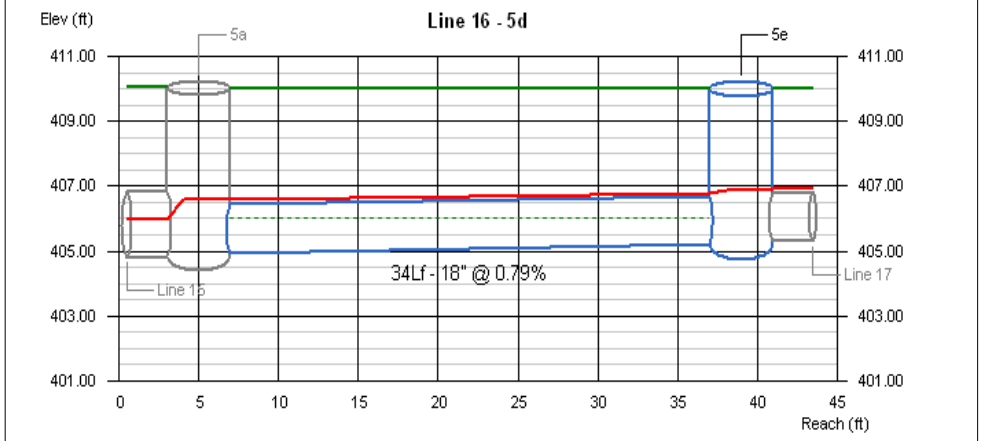


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
15	10.35	404.40	404.83	1.65	1.17	1.77	406.05	406.00	406.61 i	3.73	5.43	4.74	3.21

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 16) - 5d

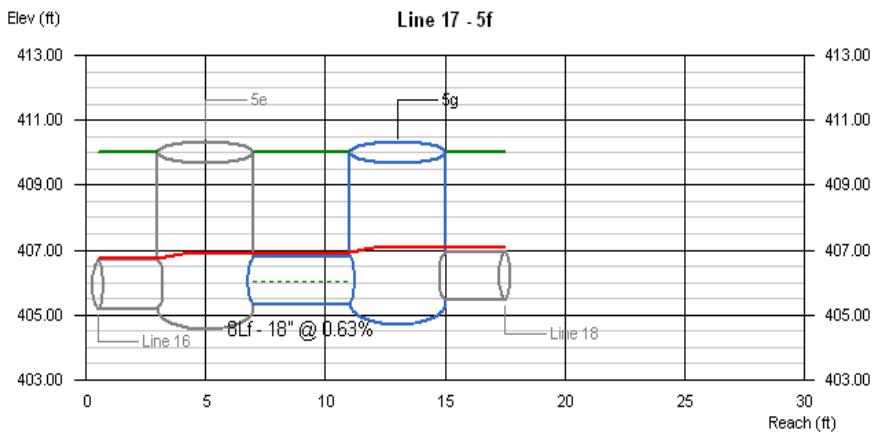


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
16	7.08	404.93	405.20	1.50	1.50	1.68	406.61	406.76	406.88	4.01	4.01	3.61	3.31

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

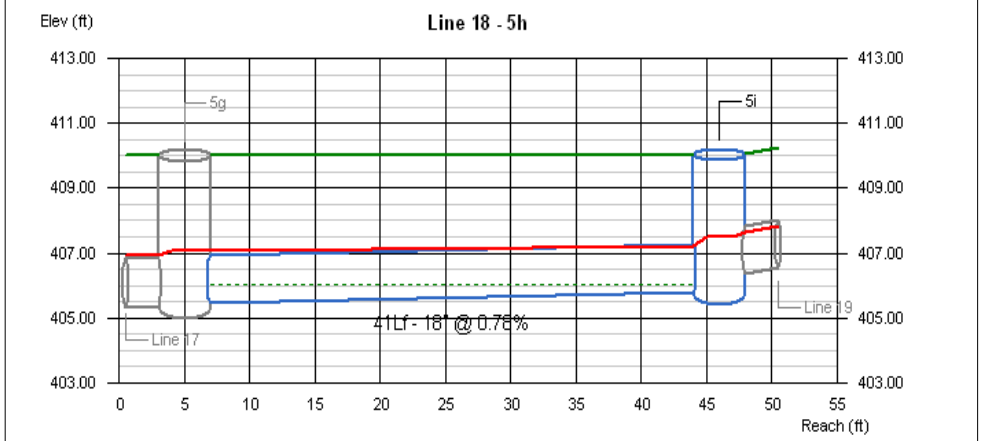
Line Profile (Line 17) - 5f



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
17	6.78	405.30	405.35	1.50	1.50	1.70	406.91	406.94	407.05	3.83	3.83	3.21	3.16

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

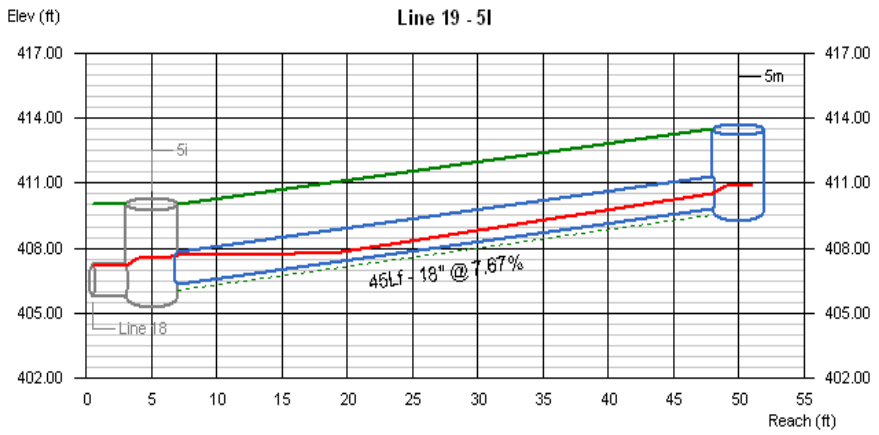
Line Profile (Line 18) - 5h



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
18	6.40	405.45	405.77	1.50	1.45	1.75	407.08	407.22	407.52	3.62	3.67	3.06	2.78

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

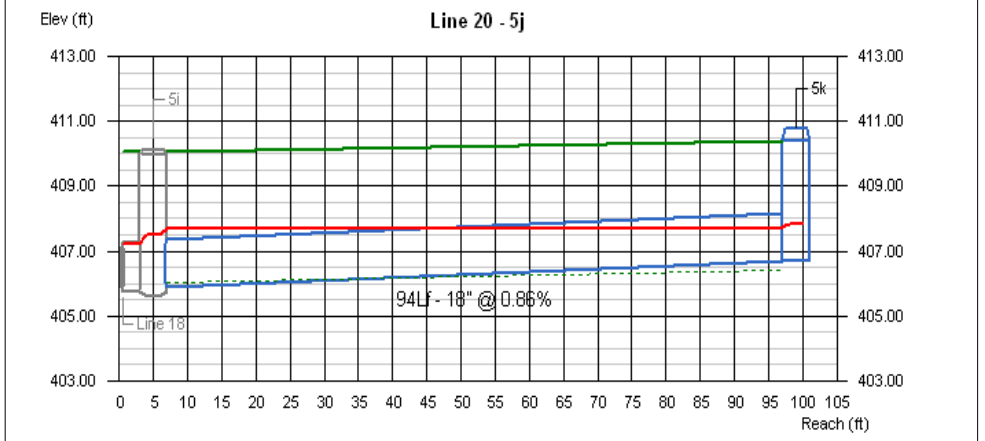
Line Profile (Line 19) - 5l



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
19	3.55	406.34	409.79	1.32	0.72	1.09	407.66	410.51 j	410.88 i	2.15	4.24	2.21	2.21

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

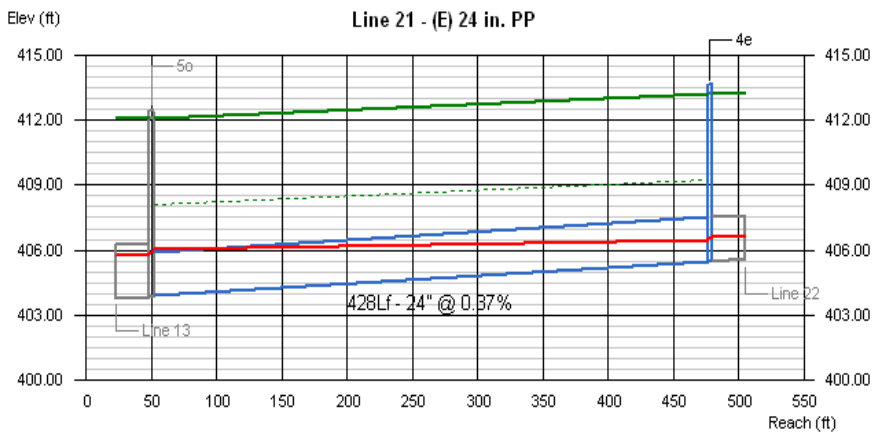
Line Profile (Line 20) - 5j



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
20	2.99	405.87	406.68	1.50	1.06	1.14	407.68	407.74	407.82	1.69	2.24	2.68	2.21

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

Line Profile (Line 21) - (E) 24 in. PP

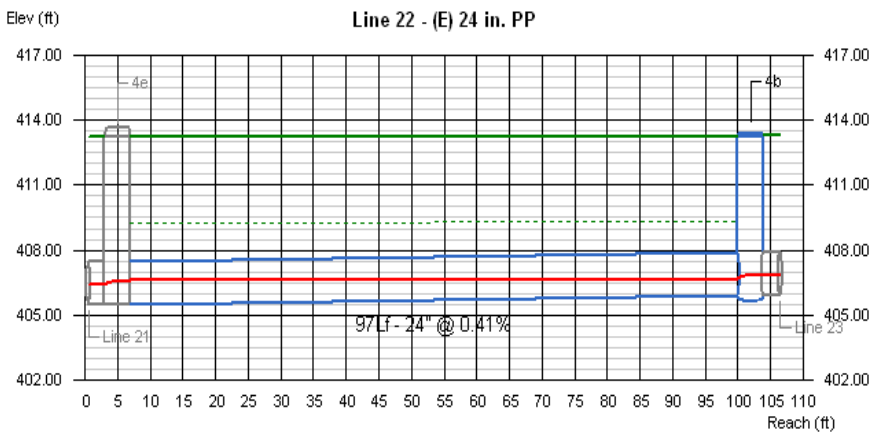


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
21	4.61	403.93	405.50	2.00	0.93	1.01	406.01	406.43	406.51	1.47	3.21	6.14	5.74

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 22) - (E) 24 in. PP

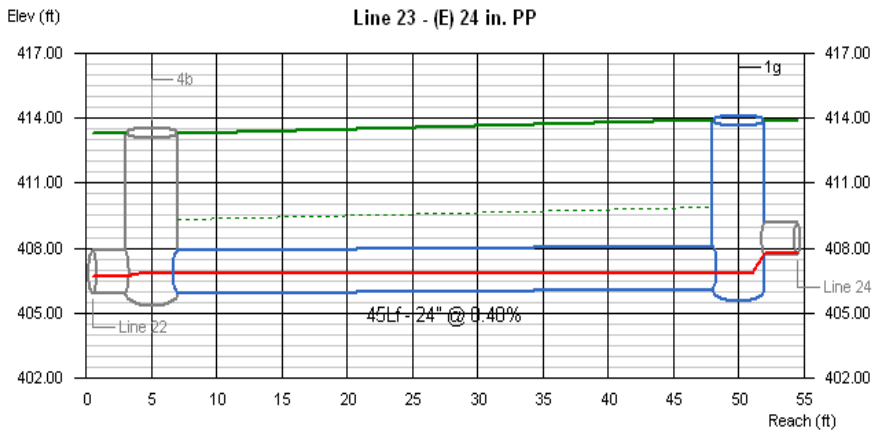


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
22	4.23	405.50	405.90	1.14	0.82	0.91	406.64	406.72	406.81 i	2.28	3.51	5.74	5.44

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 23) - (E) 24 in. PP

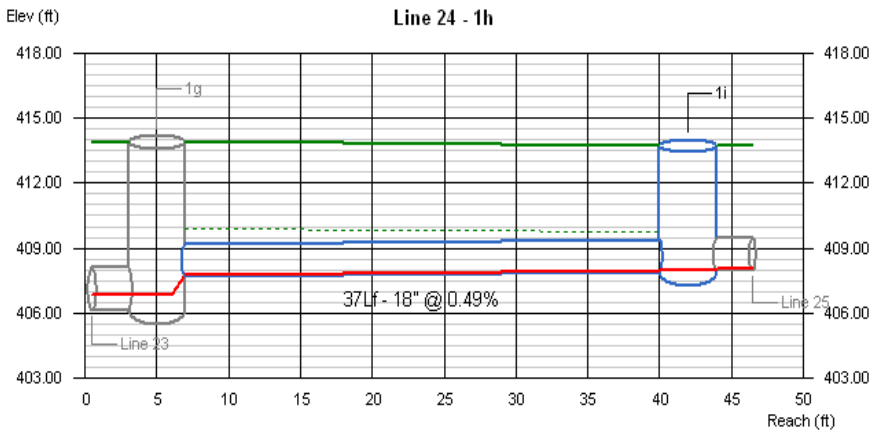


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
23	0.96	405.93	406.11	0.88	0.70	0.71	406.81	406.81	406.82	0.72	0.98	5.41	5.81

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 24) - 1h

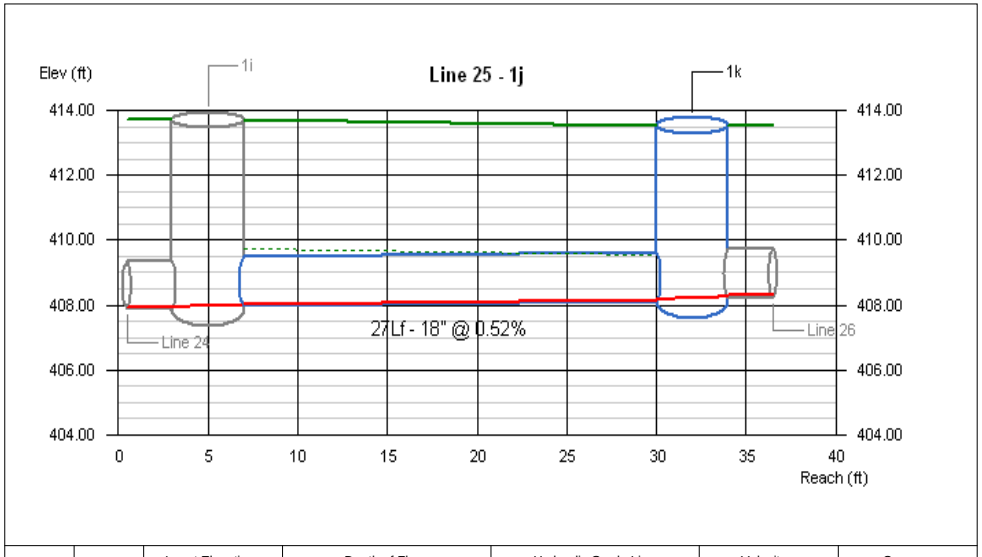


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
24	0.03	407.70	407.88	0.07	0.07	0.08	407.77	407.95	407.96 i	1.02	1.03	4.72	4.34

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

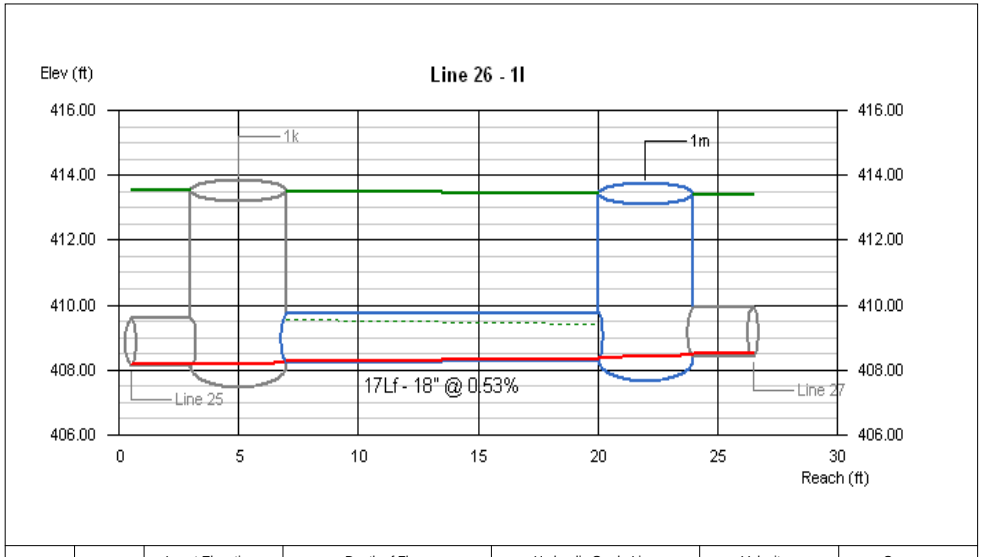
Line Profile (Line 25) - 1j



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
25	0.03	407.98	408.12	0.07	0.07	0.08	408.05	408.19	408.20 i	1.05	1.04	4.24	3.93

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

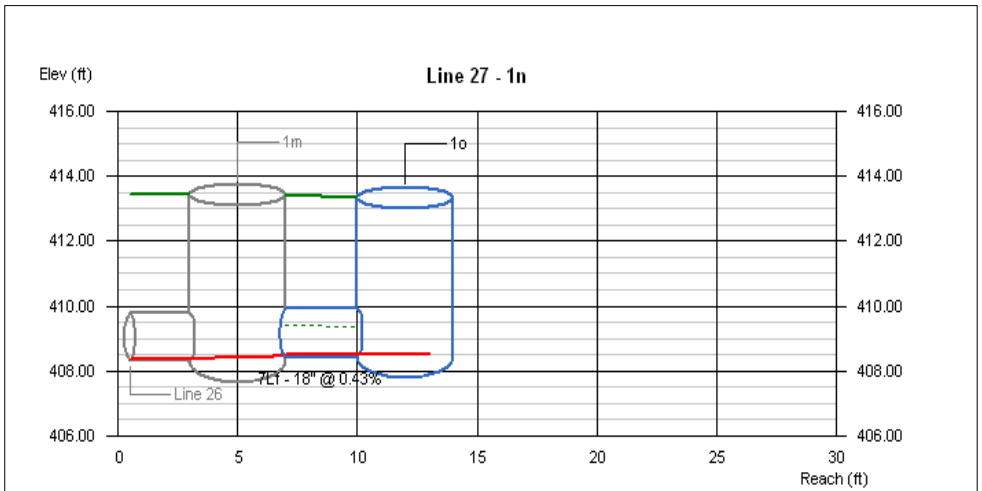
Line Profile (Line 26) - 1l



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
26	0.03	408.22	408.31	0.07	0.07	0.08	408.29	408.38	408.39 i	1.07	1.08	3.83	3.62

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

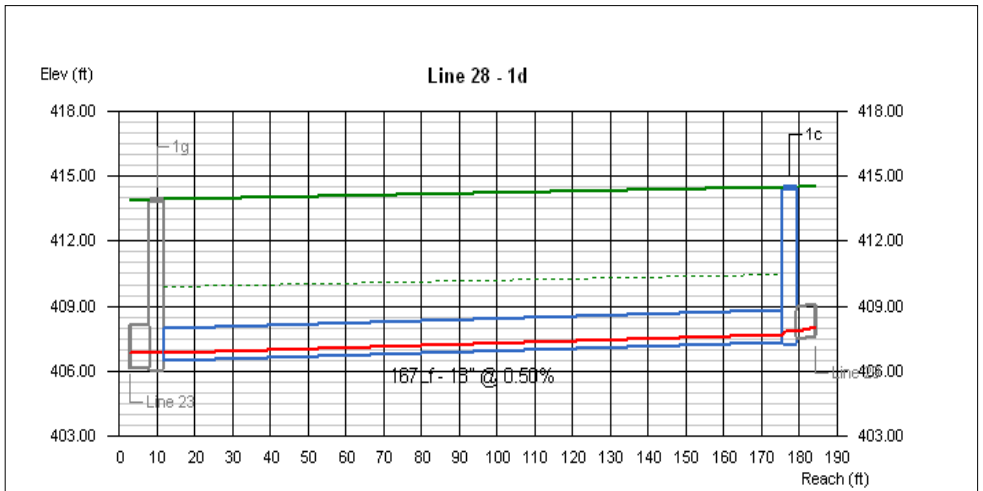
Line Profile (Line 27) - 1n



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
27	0.03	408.41	408.44	0.07	0.08	0.08	408.49	408.52	408.52 i	1.00	0.98	3.52	3.42

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

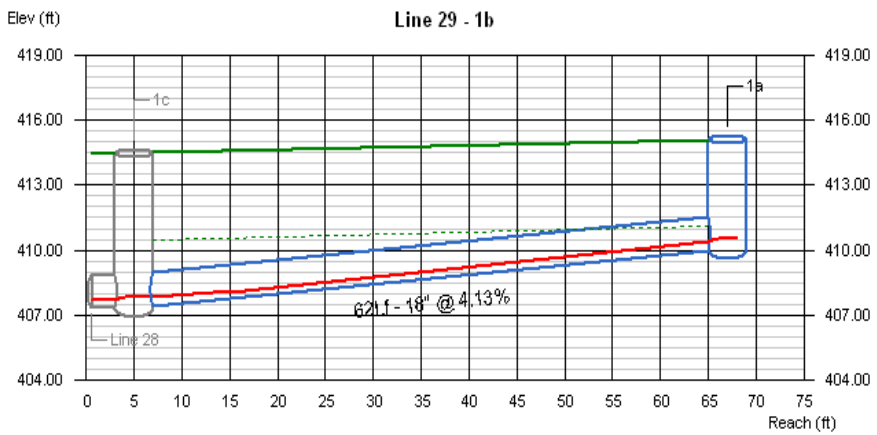
Line Profile (Line 28) - 1d



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
28	0.98	406.50	407.34	0.37	0.38	0.51	406.87	407.72	407.85 i	2.91	2.81	5.92	5.65

DS_1-9	No. Lines: 33	Run Date: 01-14-2011

Line Profile (Line 29) - 1b

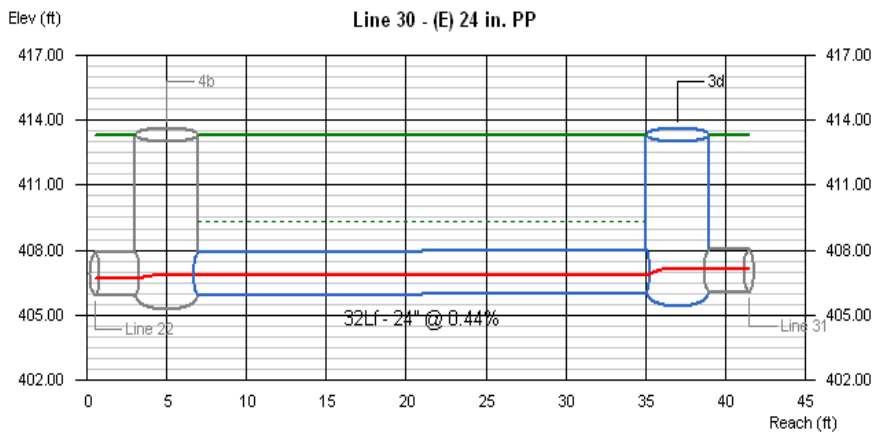


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
29	1.00	407.44	410.00	0.41	0.38	0.51	407.85	410.38 j	410.51 i	2.57	2.82	5.55	3.62

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 30) - (E) 24 in. PP

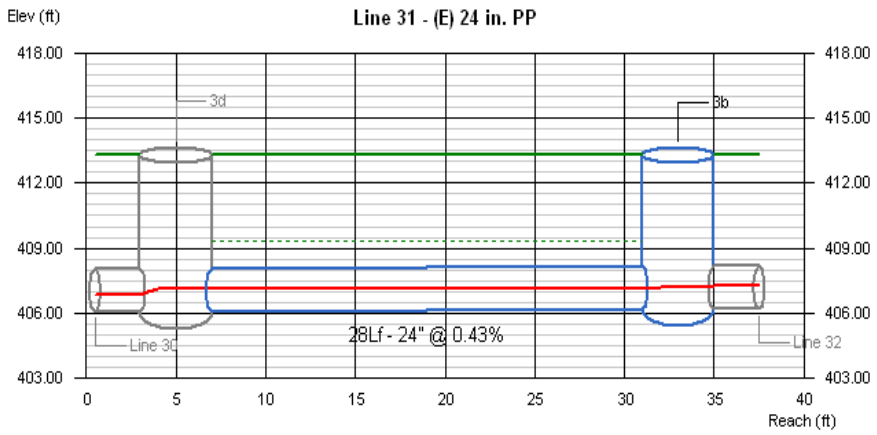


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
30	4.63	405.90	406.04	0.91	0.79	1.04	406.81	406.83	407.08 i	3.34	4.00	5.44	5.29

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 31) - (E) 24 in. PP

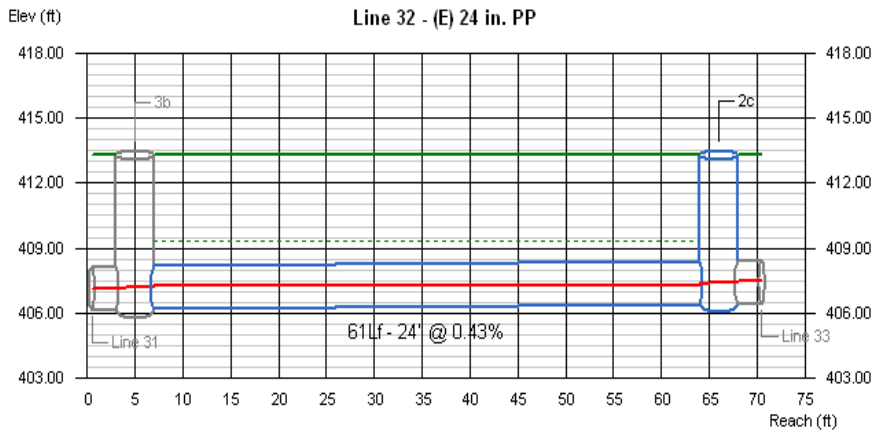


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
31	4.43	406.04	406.16	1.04	0.93	1.01	407.08	407.09	407.17	2.67	3.09	5.29	5.14

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 32) - (E) 24 in. PP

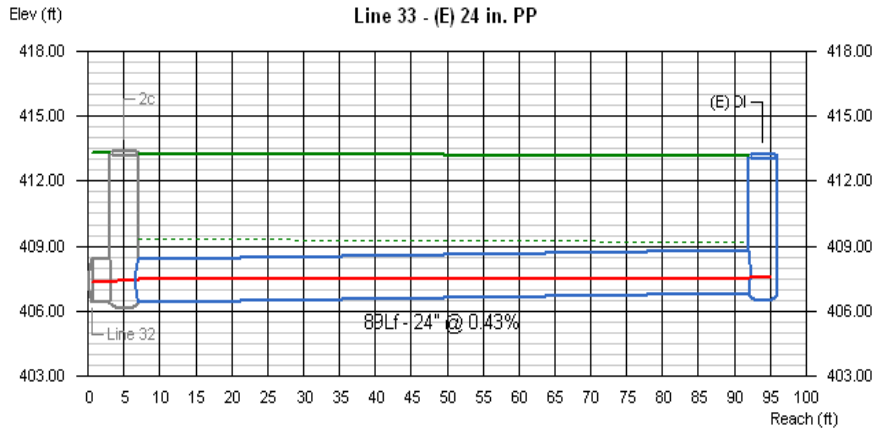


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
32	3.79	406.16	406.42	1.13	0.89	0.95	407.29	407.31	407.37	2.06	2.81	5.14	4.90

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 33) - (E) 24 in. PP

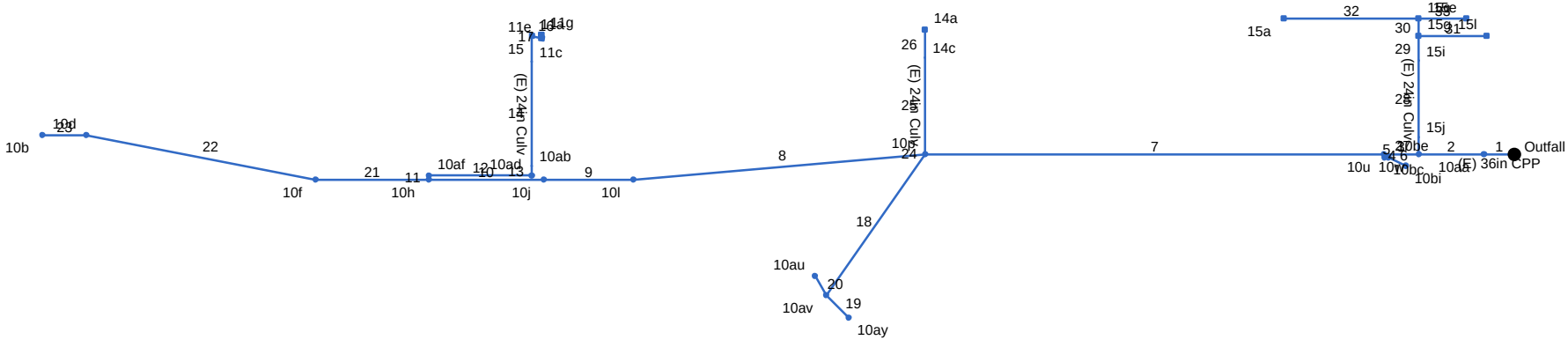


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
33	3.09	406.42	406.80	1.06	0.72	0.73	407.48	407.52	407.53 i	1.83	3.03	4.90	4.38

DS_1-9 | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Hydraflow Storm Sewers Plan



Project File: DS_10,11,14,15.stm	Number of lines: 33	Date: 01-14-2011

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	30	0.10	13.38	1.00	0.10	11.62	5.0	208.5	0.6	7.69	38.51	1.16	36	0.33	387.53	387.63	390.25	390.25	394.63	394.64	(E) 36in CPP
2	1	64	0.06	13.28	1.00	0.06	11.52	5.0	207.9	0.6	7.64	26.33	1.31	36	0.53	387.78	388.12	390.26	390.29	394.64	394.95	
3	2	34	1.45	11.44	0.87	1.26	10.04	5.0	207.5	0.6	6.79	24.78	1.32	36	0.47	388.22	388.38	390.34	390.36	394.95	395.38	
4	3	3	0.08	0.70	0.60	0.05	0.52	5.0	5.1	3.6	1.90	66.66	2.25	18	137.33	388.38	392.50	390.41	393.03	395.38	395.50	
5	4	4	0.01	0.62	0.60	0.01	0.48	5.0	5.1	3.6	1.73	11.26	3.54	12	10.00	392.60	393.00	393.24	393.56	395.50	402.35	
6	5	19	0.61	0.61	0.77	0.47	0.47	5.0	5.0	3.7	1.72	21.59	3.97	12	36.74	393.35	400.33	393.87	400.89	402.35	404.33	
7	3	450	0.34	9.29	0.92	0.31	8.25	5.0	204.9	0.6	5.79	32.13	2.56	36	0.79	388.48	392.04	390.42	392.83	395.38	404.15	
8	7	287	0.59	3.97	0.79	0.47	3.36	5.0	202.8	0.6	2.96	25.59	2.16	36	0.50	392.14	393.58	393.05	394.22	404.15	410.08	
9	8	88	0.63	3.38	0.82	0.52	2.89	5.0	202.2	0.6	2.69	25.54	2.26	36	0.50	393.68	394.12	394.38	394.77	410.08	411.71	
10	9	113	0.46	2.75	0.85	0.39	2.37	5.0	201.4	0.6	2.39	25.66	2.27	36	0.50	403.48	404.05	404.10	404.67	411.71	413.44	
11	10	4	0.00	1.45	0.00	0.00	1.26	0.0	6.5	3.2	5.06	15.99	4.40	24	0.50	404.26	404.28	405.03	405.08	413.44	413.85	
12	11	101	0.00	1.45	0.00	0.00	1.26	0.0	6.1	3.3	5.18	7.39	4.32	18	0.50	404.38	404.88	405.43	405.77	413.85	412.35	
13	12	10	0.00	1.45	0.00	0.00	1.26	0.0	6.0	3.3	5.20	17.52	2.61	24	0.60	404.98	405.04	406.23	406.23	412.35	412.60	
14	13	102	0.00	1.45	0.00	0.00	1.26	0.0	5.4	3.5	4.41	16.76	2.99	24	0.55	405.04	405.60	406.32	406.38	412.60	412.00	(E) 24in Culv
15	14	25	1.01	1.45	0.98	0.99	1.26	5.0	5.3	3.6	4.47	11.97	3.00	24	0.28	405.64	405.71	406.62	406.65	412.00	411.81	
16	15	10	0.04	0.44	0.71	0.03	0.27	5.0	5.1	3.6	0.97	23.25	0.96	18	4.90	405.81	406.30	406.99	406.97	411.81	411.65	
17	16	4	0.40	0.40	0.60	0.24	0.24	5.0	5.0	3.7	0.88	0.00	0.50	18	-1.00	409.86	409.82	411.36	411.36	411.65	417.81	
18	7	169	0.55	4.31	0.82	0.45	3.91	5.0	5.2	3.6	14.05	15.07	5.45	24	0.44	396.04	396.79	397.57	398.32	404.15	402.12	
19	18	31	2.86	2.86	0.94	2.69	2.69	5.0	5.0	3.7	9.83	7.54	5.56	18	0.52	396.89	397.05	398.76	399.03	402.12	402.17	
20	18	22	0.90	0.90	0.86	0.77	0.77	5.0	5.0	3.7	2.83	10.91	1.96	18	3.68	397.00	397.81	398.76	398.79	402.12	402.94	
21	10	111	0.68	0.84	0.86	0.58	0.72	5.0	180.6	0.6	0.45	25.66	0.06	36	0.50	399.54	400.10	404.87	404.87	413.44	414.71	
22	21	229	0.11	0.16	0.87	0.10	0.14	5.0	37.2	1.4	0.19	25.60	0.03	36	0.50	400.20	401.35	404.87	404.87	414.71	416.59	

Project File: DS_10,11,14,15.stm | Number of lines: 33 | Run Date: 01-14-2011

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50; Return period = 50 Yrs. ; c = cir e = ellip b = box

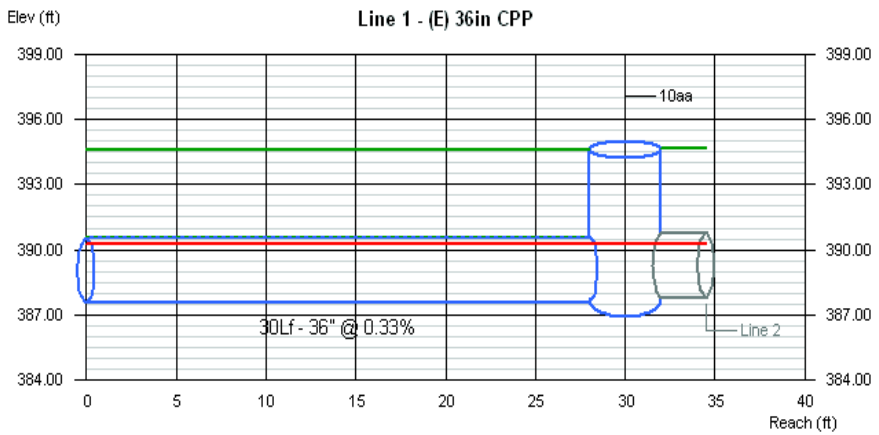
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
23	22	43	0.05	0.05	0.86	0.04	0.04	5.0	5.0	3.7	0.16	27.55	0.02	36	0.58	401.45	401.70	404.87	404.87	416.59	416.67	
24	7	2	0.00	0.67	0.00	0.00	0.67	0.0	5.9	3.4	2.25	16.00	3.46	24	0.50	397.56	397.57	398.07	398.11	404.15	404.10	
25	24	93	0.00	0.67	0.00	0.00	0.67	0.0	5.2	3.6	2.40	7.30	2.08	24	0.35	397.57	397.90	398.36	398.69	404.10	403.50	(E) 24in Culv
26	25	27	0.67	0.67	1.00	0.67	0.67	5.0	5.0	3.7	2.45	10.66	2.20	24	0.22	397.91	397.97	398.70	398.72	403.50	403.88	
27	2	17	0.00	1.78	0.00	0.00	1.42	0.0	11.1	2.5	3.51	10.97	1.23	24	0.24	388.61	388.65	390.34	390.34	394.95	394.95	
28	27	75	0.00	1.78	0.00	0.00	1.42	0.0	10.2	2.6	3.66	8.72	1.44	24	0.51	388.65	389.03	390.34	390.41	394.95	395.00	(E) 24in Culv
29	28	24	0.76	1.78	1.00	0.76	1.42	5.0	9.9	2.6	3.71	11.31	1.63	24	0.25	389.03	389.09	390.42	390.43	395.00	395.08	
30	29	17	0.10	0.92	0.71	0.07	0.56	5.0	6.5	3.2	1.82	32.49	12.30	12	70.94	393.90	405.96	394.06	407.74	395.08	409.87	
31	29	67	0.10	0.10	1.00	0.10	0.10	5.0	5.0	3.7	0.37	5.44	0.24	18	0.27	389.19	389.37	390.53	390.53	395.08	394.83	
32	30	132	0.54	0.54	0.60	0.32	0.32	5.0	5.0	3.7	1.18	2.52	1.51	12	0.50	406.06	406.72	407.91	408.06	409.87	410.22	
33	30	47	0.28	0.28	0.60	0.17	0.17	5.0	5.0	3.7	0.61	2.54	0.78	12	0.51	406.17	406.41	407.94	407.95	409.87	409.91	

Project File: DS_10,11,14,15.stm | Number of lines: 33 | Run Date: 01-14-2011

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50; Return period = 50 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - (E) 36in CPP

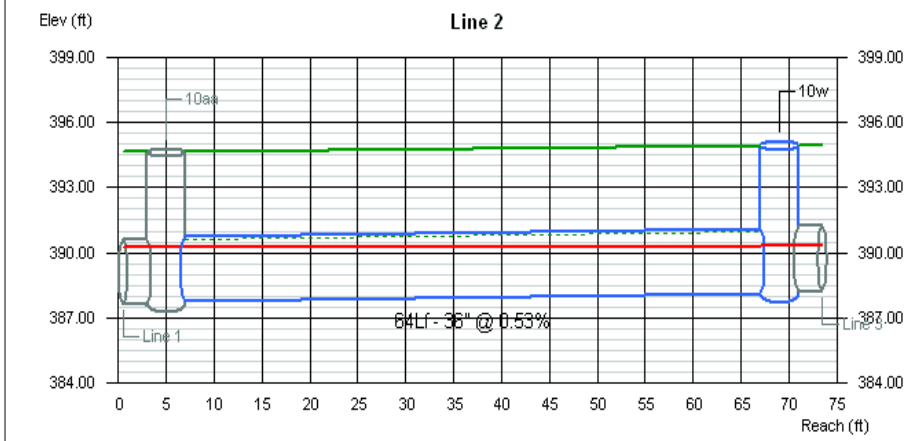


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
1	7.69	387.53	387.63	2.72	2.62	2.63	390.25	390.25	390.26	1.14	1.17	4.10	4.01

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2)

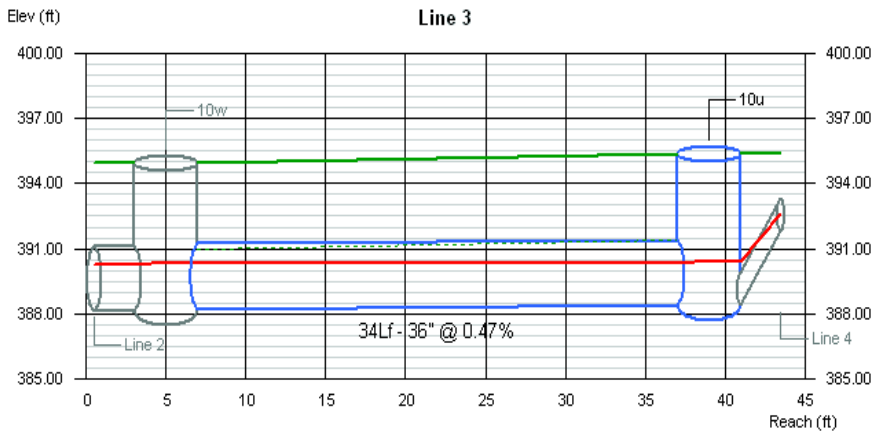


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
2	7.64	387.78	388.12	2.48	2.17	2.22	390.26	390.29	390.34	1.22	1.39	3.86	3.83

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3)

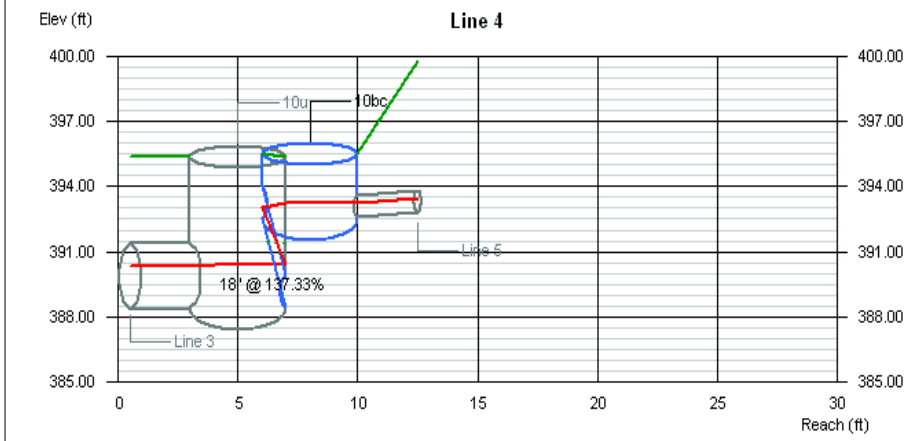


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
3	6.79	388.22	388.38	2.12	1.98	2.02	390.34	390.36	390.40	1.27	1.38	3.73	4.00

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 4)

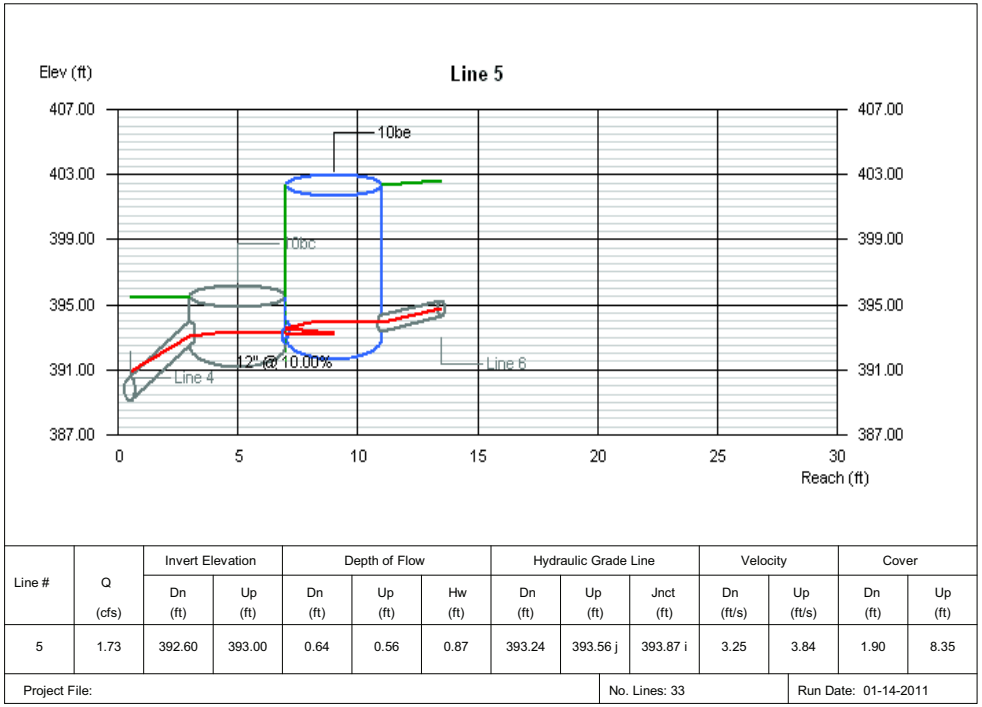


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
4	1.90	388.38	392.50	1.50	0.53	0.74	390.41	393.03	393.24 i	1.07	3.44	5.50	1.50

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 5)

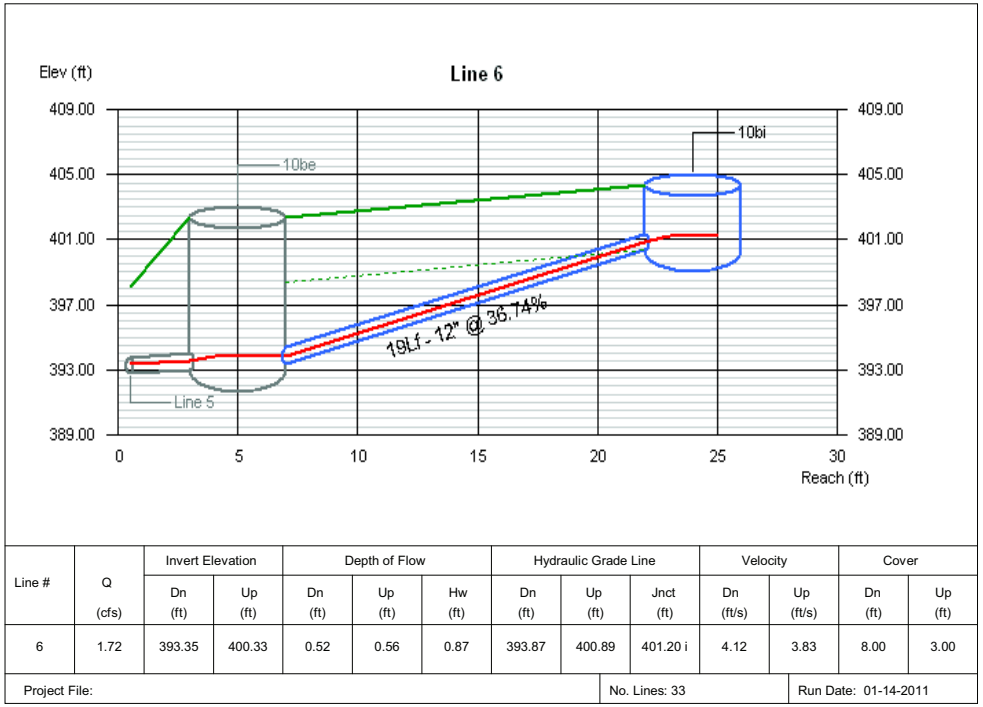


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	1.73	392.60	393.00	0.64	0.56	0.87	393.24	393.56 j	393.87 i	3.25	3.84	1.90	8.35

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 6)

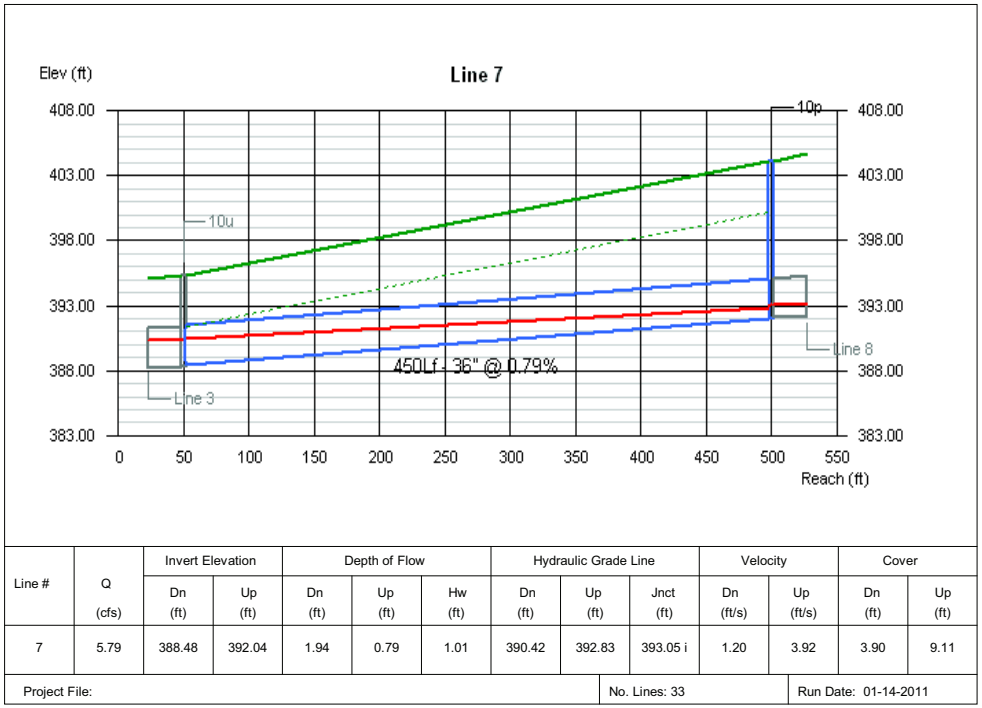


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
6	1.72	393.35	400.33	0.52	0.56	0.87	393.87	400.89	401.20 i	4.12	3.83	8.00	3.00

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 7)

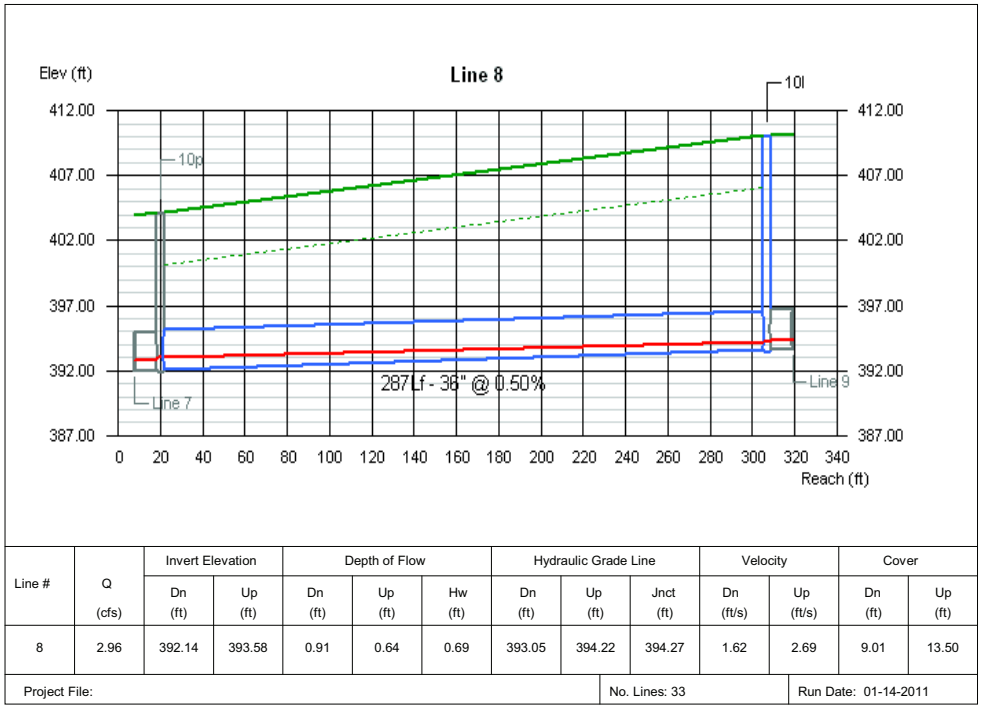


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
7	5.79	388.48	392.04	1.94	0.79	1.01	390.42	392.83	393.05 i	1.20	3.92	3.90	9.11

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 8)

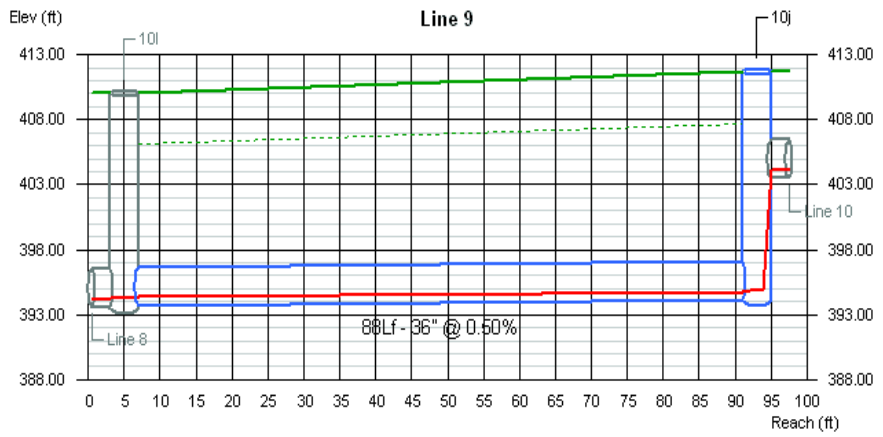


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
8	2.96	392.14	393.58	0.91	0.64	0.69	393.05	394.22	394.27	1.62	2.69	9.01	13.50

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 9)

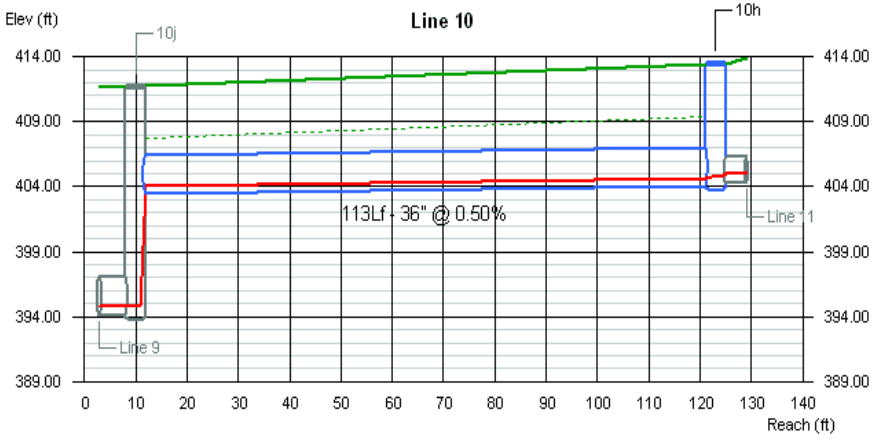


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
9	2.69	393.68	394.12	0.70	0.65	0.69	394.38	394.77	394.81	2.12	2.40	13.40	14.59

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 10)

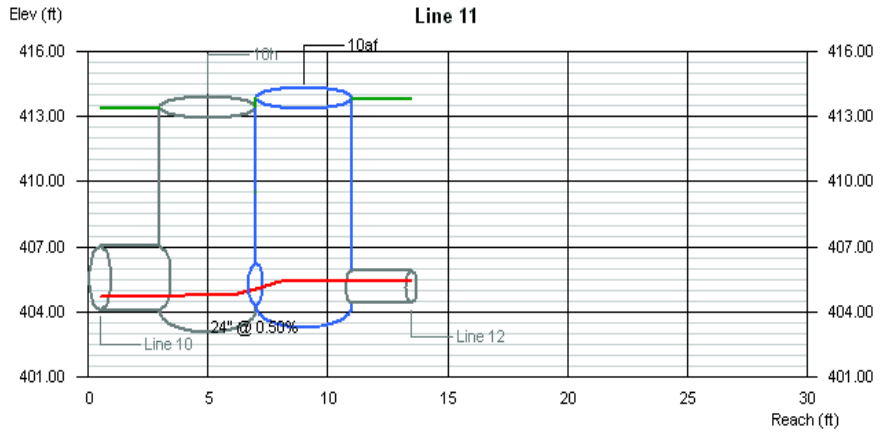


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
10	2.39	403.48	404.05	0.62	0.62	0.74	404.10	404.67	404.79	2.27	2.26	5.23	6.39

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 11)

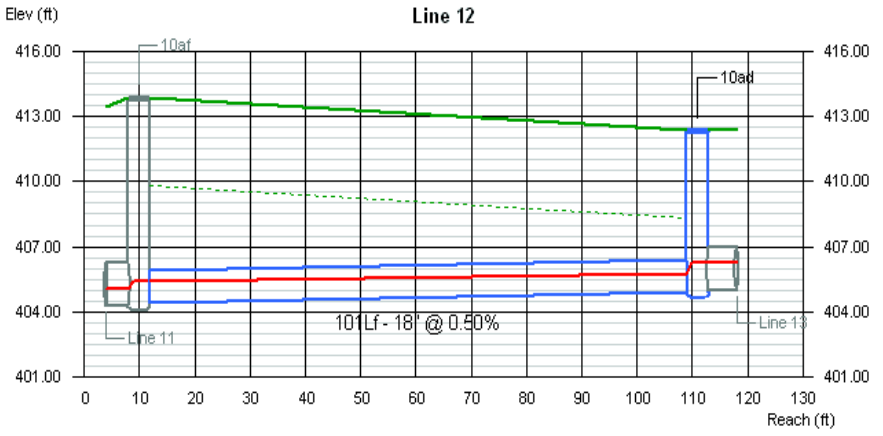


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
11	5.06	404.26	404.28	0.77	0.80	1.15	405.03	405.08	405.43 i	4.51	4.30	7.18	7.57

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 12)

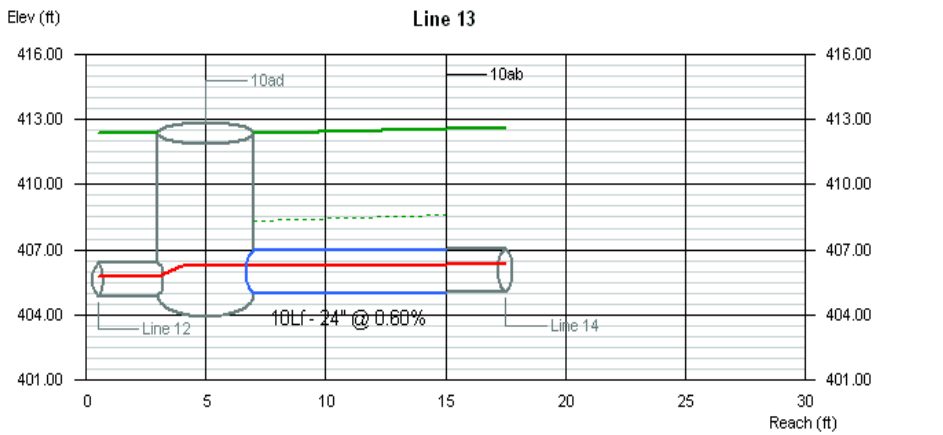


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
12	5.18	404.38	404.88	1.05	0.89	1.35	405.43	405.77	406.23 i	3.93	4.71	7.97	5.97

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 13)

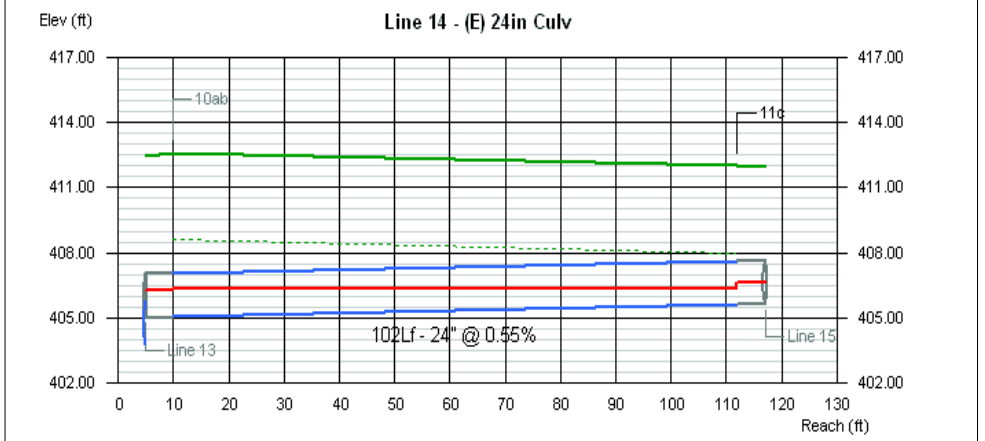


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
13	5.20	404.98	405.04	1.25	1.19	1.20	406.23	406.23	406.24	2.53	2.68	5.37	5.56

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 14) - (E) 24in Culv

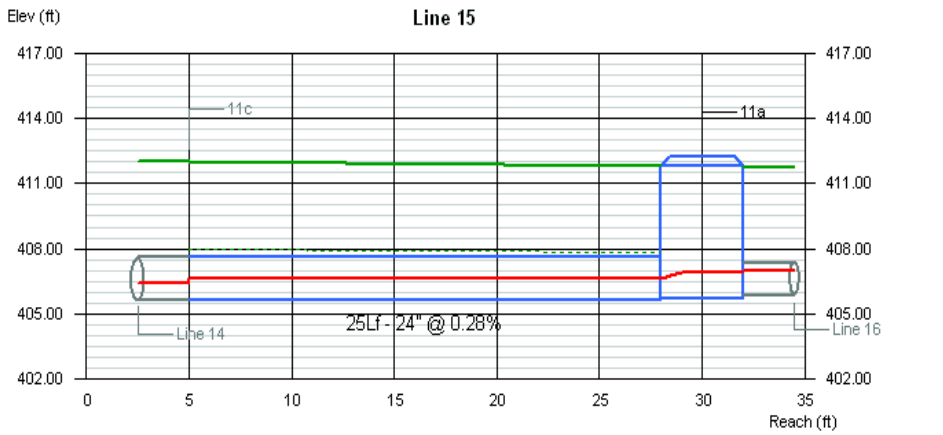


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
14	4.41	405.04	405.60	1.28	0.78	0.81	406.32	406.38	406.41	2.07	3.90	5.56	4.40

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 15)

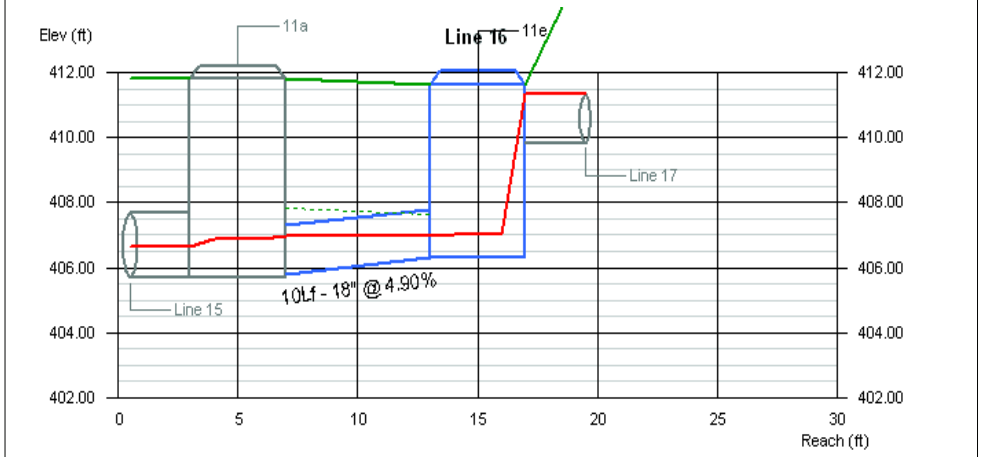


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
15	4.47	405.64	405.71	0.98	0.94	1.16	406.62	406.65	406.87	2.92	3.08	4.36	4.10

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 16)

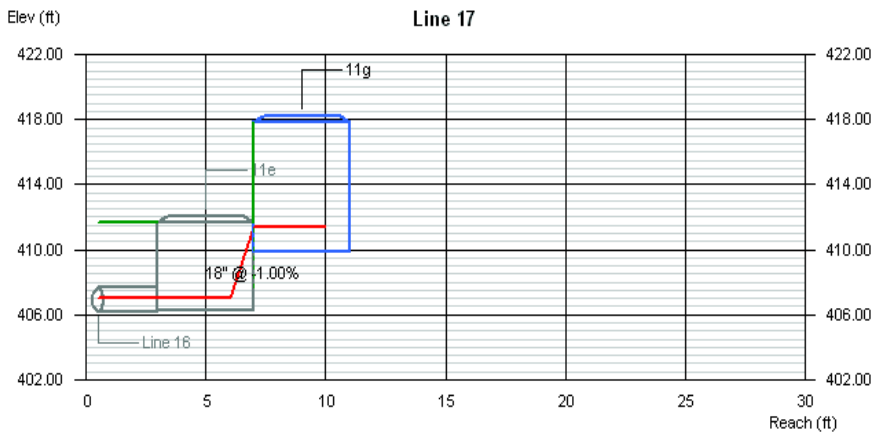


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
16	0.97	405.81	406.30	1.18	0.67	0.71	406.99	406.97	407.01	0.65	1.26	4.50	3.85

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 17)

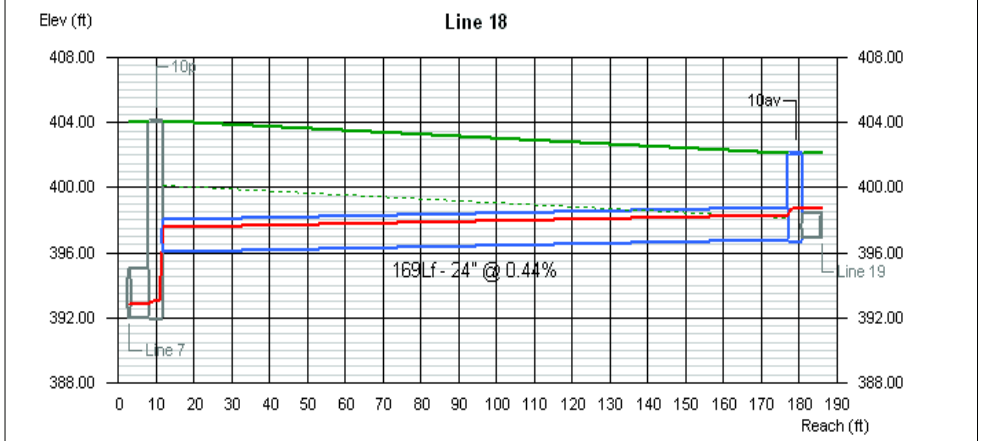


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
17	0.88	409.86	409.82	1.50	1.50	1.54	411.36	411.36	411.36	0.50	0.50	0.29	6.49

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 18)

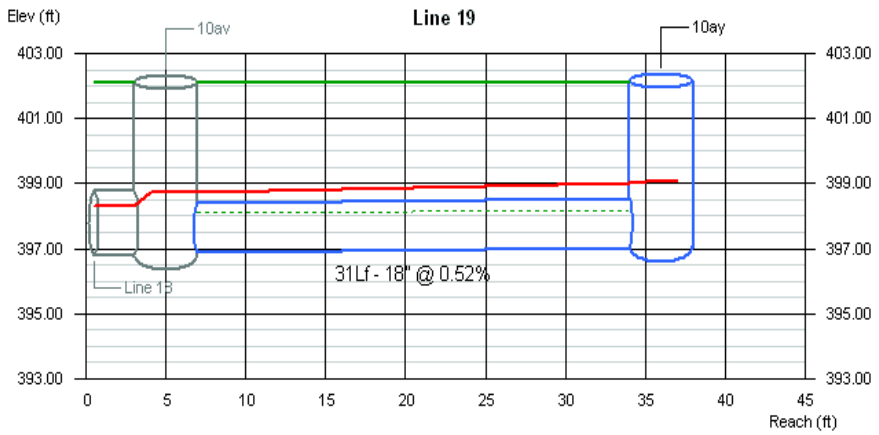


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
18	14.05	396.04	396.79	1.53	1.53	1.97	397.57	398.32	398.76 i	5.45	5.45	6.11	3.33

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 19)

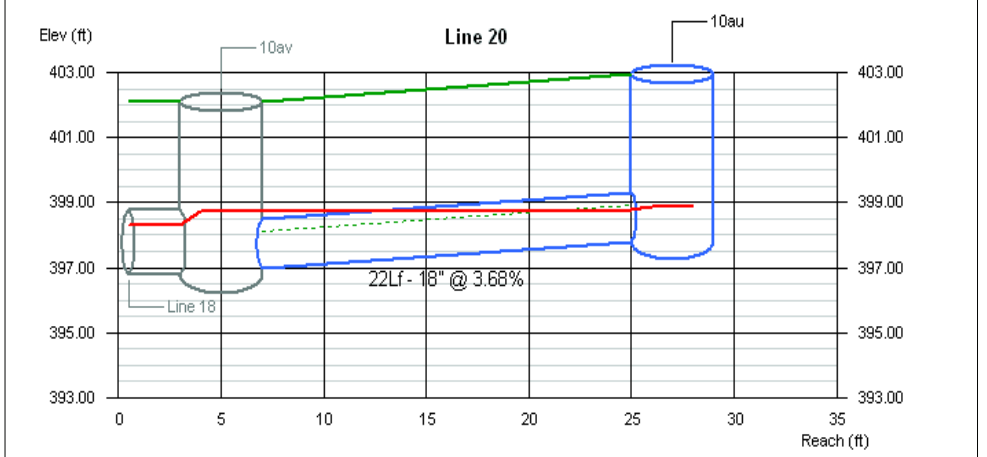


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
19	9.83	396.89	397.05	1.50	1.50	2.00	398.76	399.03	399.05 i	5.56	5.56	3.73	3.62

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 20)

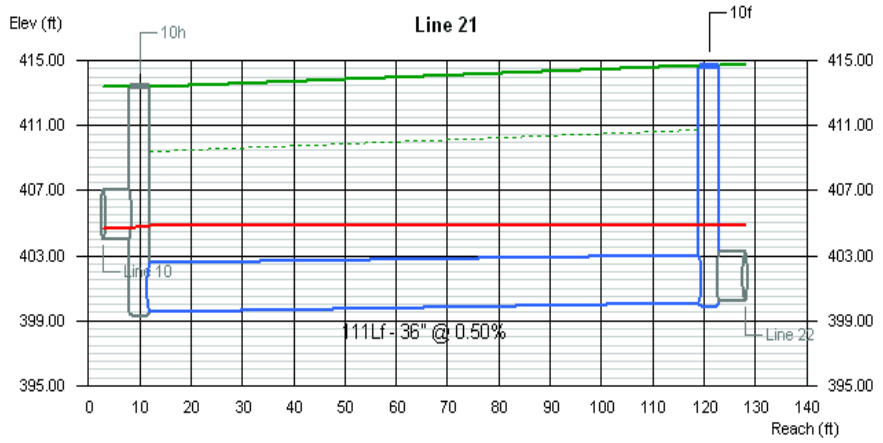


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
20	2.83	397.00	397.81	1.50	0.98	1.06	398.76	398.79	398.87	1.60	2.33	3.62	3.63

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 21)

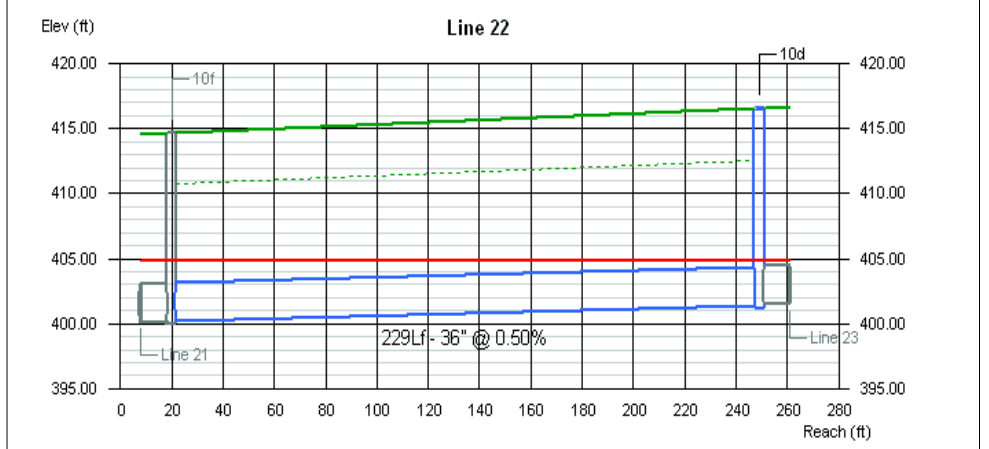


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
21	0.45	399.54	400.10	3.00	3.00	4.77	404.87	404.87	404.87	0.06	0.06	10.90	11.61

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 22)

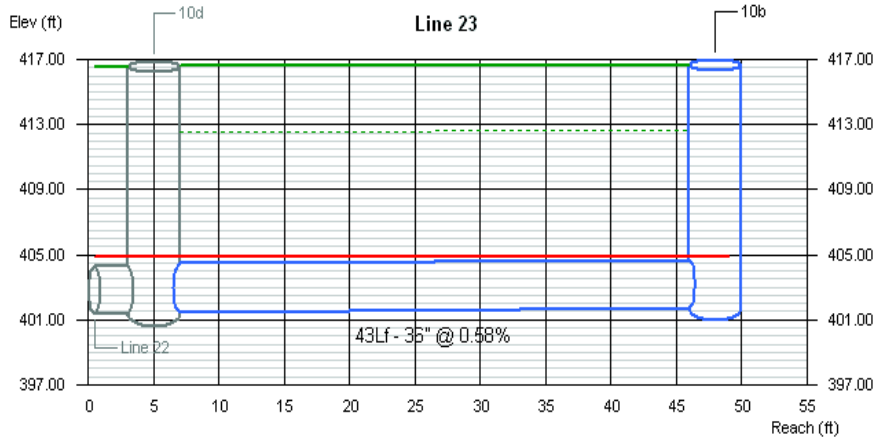


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
22	0.19	400.20	401.35	3.00	3.00	3.52	404.87	404.87	404.87	0.03	0.03	11.51	12.24

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 23)

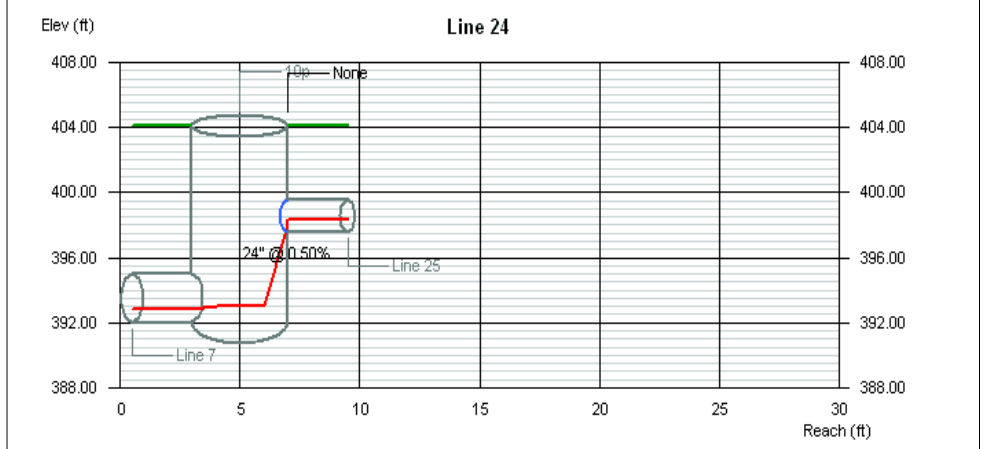


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
23	0.16	401.45	401.70	3.00	3.00	3.17	404.87	404.87	404.87	0.02	0.02	12.14	11.97

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 24)

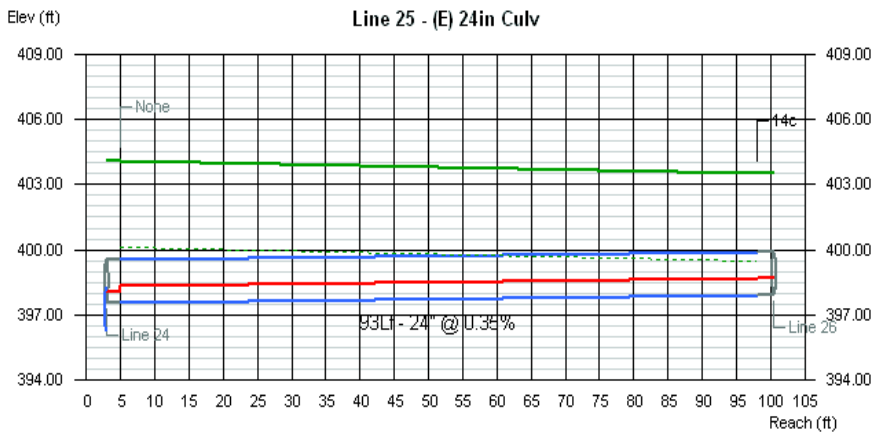


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
24	2.25	397.56	397.57	0.51	0.54	0.56	398.07	398.11	398.13	3.59	3.32	4.59	4.53

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 25) - (E) 24in Culv

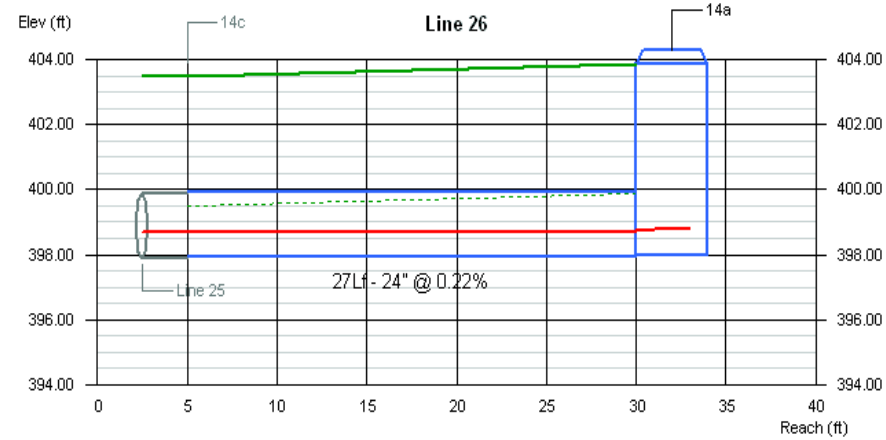


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
25	2.40	397.57	397.90	0.79	0.79	0.80	398.36	398.69	398.70	2.08	2.09	4.53	3.60

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 26)

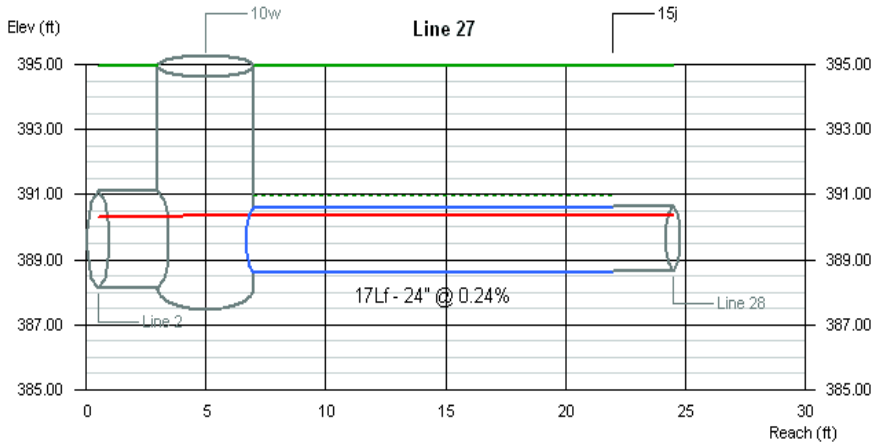


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
26	2.45	397.91	397.97	0.79	0.75	0.83	398.70	398.72	398.80	2.13	2.27	3.59	3.91

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 27)

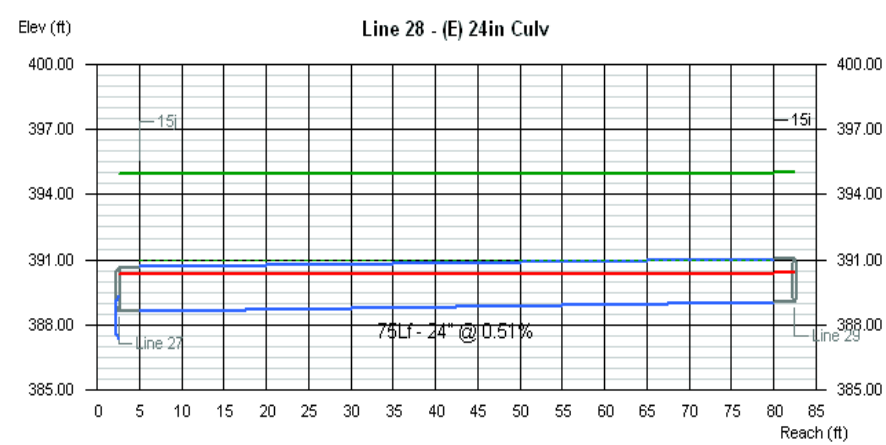


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
27	3.51	388.61	388.65	1.73	1.69	1.69	390.34	390.34	390.34	1.22	1.24	4.34	4.30

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 28) - (E) 24in Culv

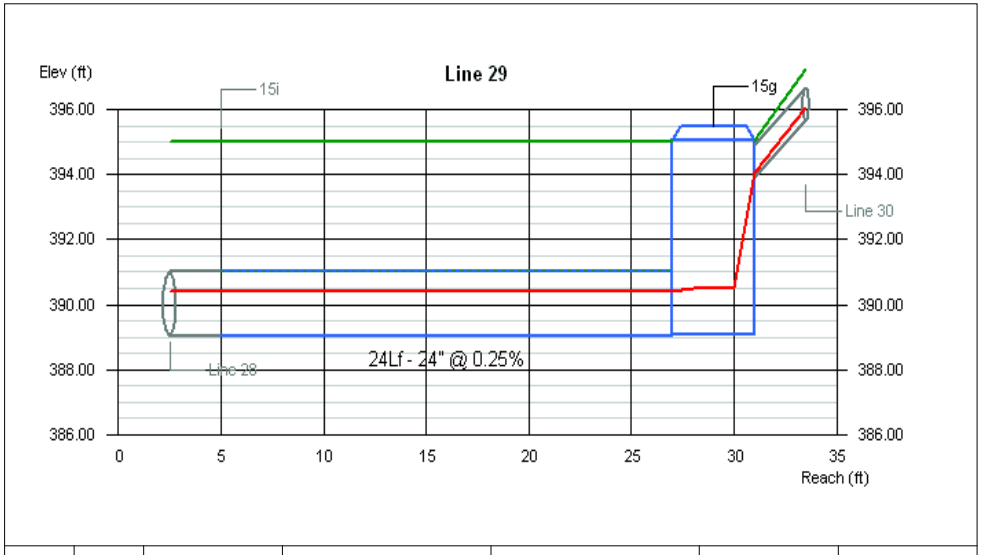


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
28	3.66	388.65	389.03	1.69	1.38	1.39	390.34	390.41	390.42	1.29	1.58	4.30	3.97

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 29)

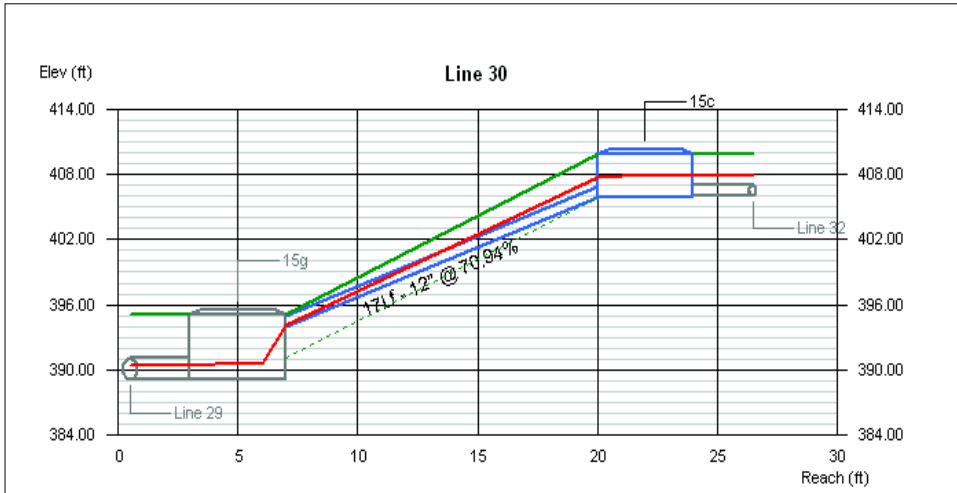


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
29	3.71	389.03	389.09	1.39	1.34	1.40	390.42	390.43	390.49	1.60	1.67	3.97	3.99

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 30)

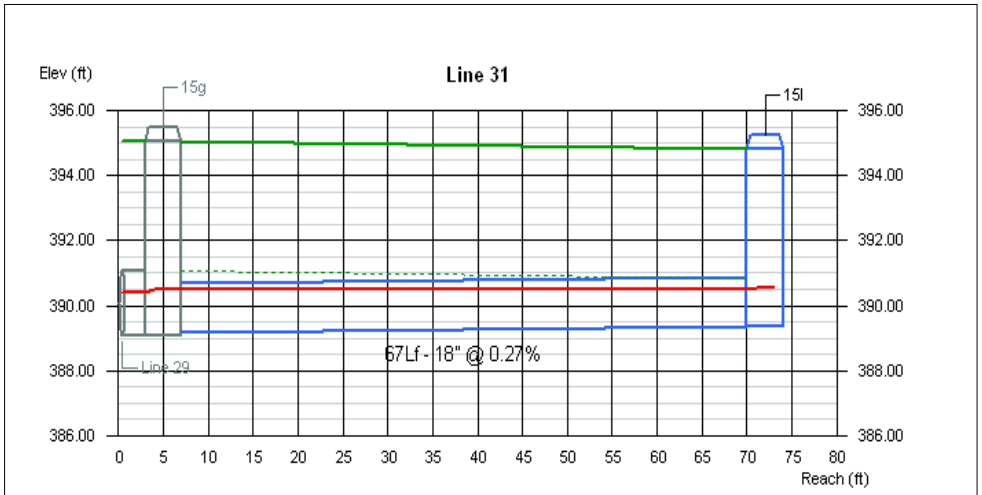


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
30	1.82	393.90	405.96	0.16	1.00	1.90	394.06	407.74	407.86	22.28	2.31	0.18	2.91

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 31)

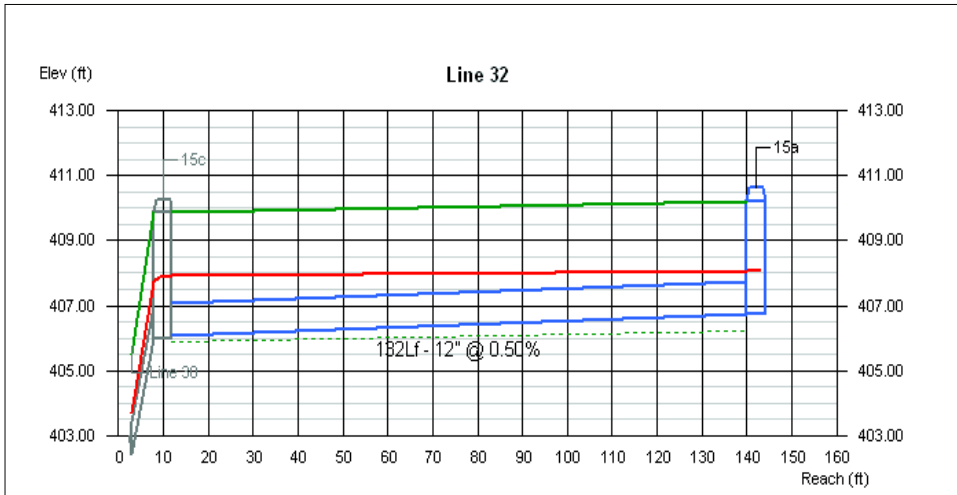


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
31	0.37	389.19	389.37	1.33	1.15	1.16	390.53	390.53	390.53	0.22	0.25	4.39	3.96

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 32)

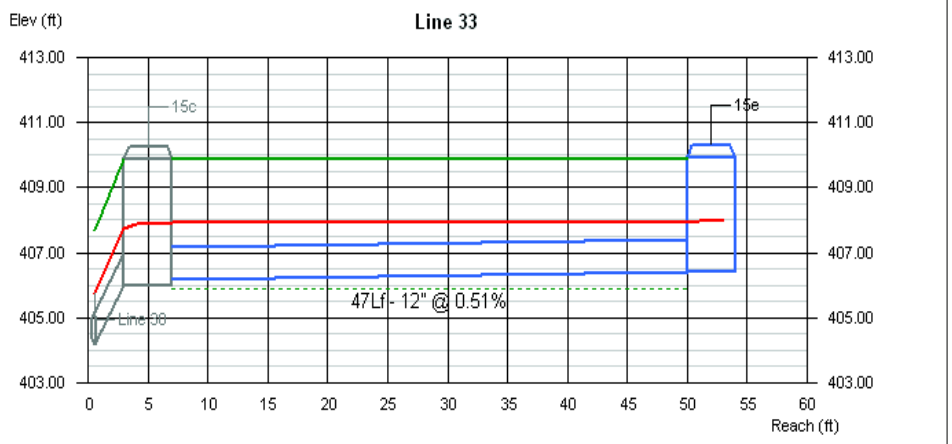


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
32	1.18	406.06	406.72	1.00	1.00	1.37	407.91	408.06	408.09	1.51	1.51	2.81	2.50

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 33)

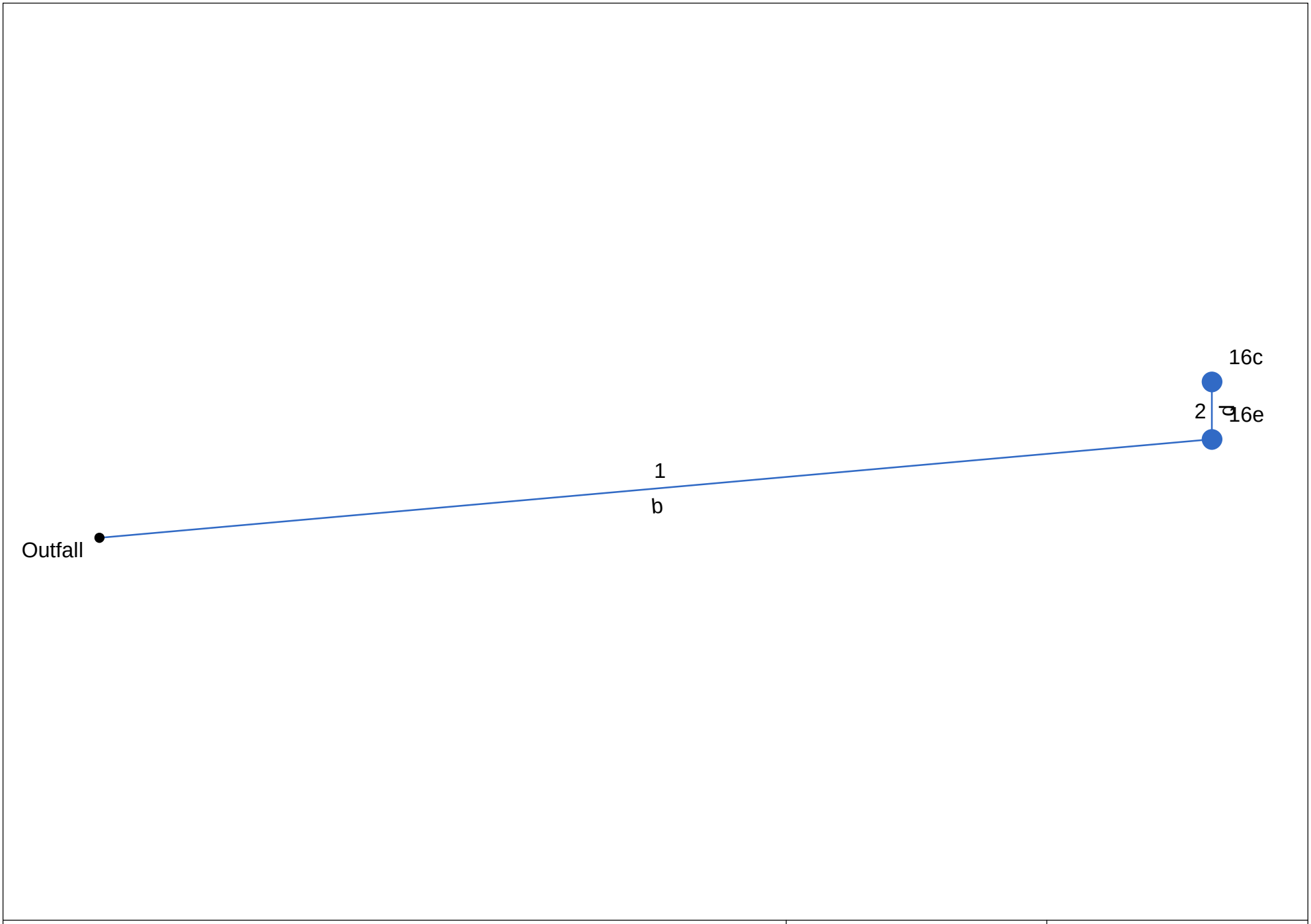


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
33	0.61	406.17	406.41	1.00	1.00	1.55	407.94	407.95	407.96	0.78	0.78	2.70	2.50

Project File: | No. Lines: 33 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

DS_16



Project File: DS_16.stm	Number of lines: 2	Date: 01-14-2011

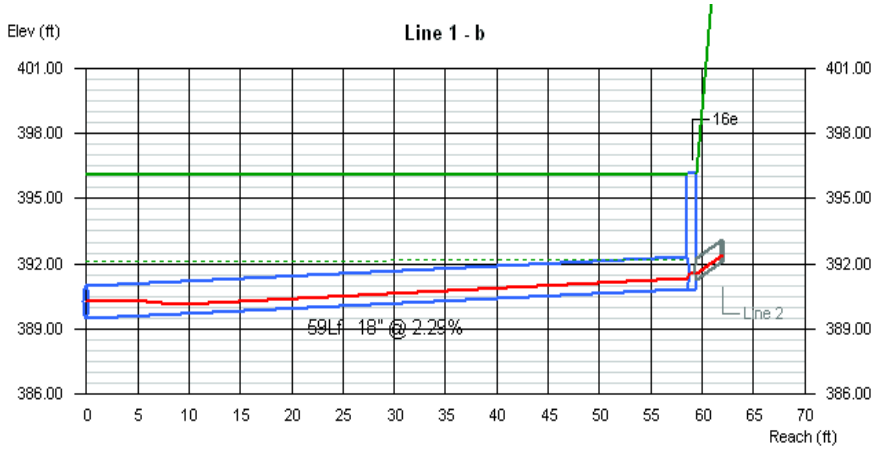
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	59	0.32	0.51	1.00	0.32	0.45	5.0	5.0	3.6	1.63	8.60	2.54	18	2.29	389.49	390.84	390.25	391.33	396.10	396.20	b
2	1	3	0.19	0.19	0.66	0.13	0.13	5.0	5.0	3.7	0.46	20.87	2.46	12	34.33	391.23	392.26	391.52	392.55	396.20	412.97	d

DS_16 | Number of lines: 2 | Run Date: 01-14-2011

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50; Return period = 50 Yrs. ; c = cir e = ellip b = box

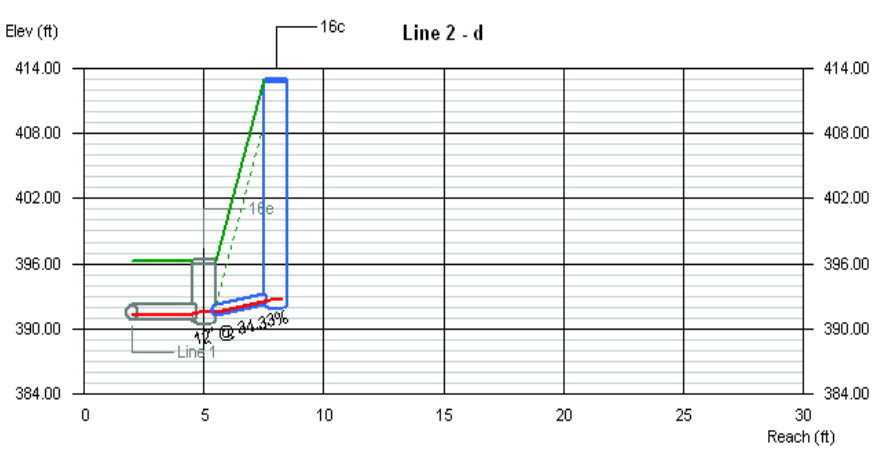
Line Profile (Line 1) - b



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn	Up	Dn	Up	Hw	Dn	Up	Jnct	Dn	Up	Dn	Up
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(ft/s)	(ft)	(ft)
1	1.63	389.49	390.84	0.76	0.49	0.68	390.25	391.33 j	391.52 i	1.81	3.27	5.11	3.86

DS_16 | No. Lines: 2 | Run Date: 01-14-2011

Line Profile (Line 2) - d



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn	Up	Dn	Up	Hw	Dn	Up	Jnct	Dn	Up	Dn	Up
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(ft/s)	(ft)	(ft)
2	0.46	391.23	392.26	0.29	0.29	0.39	391.52	392.55	392.65 i	2.47	2.46	3.97	19.71

DS_16 | No. Lines: 2 | Run Date: 01-14-2011

DS_17

Project File: DS_17.stm	Number of lines: 3	Date: 01-14-2011

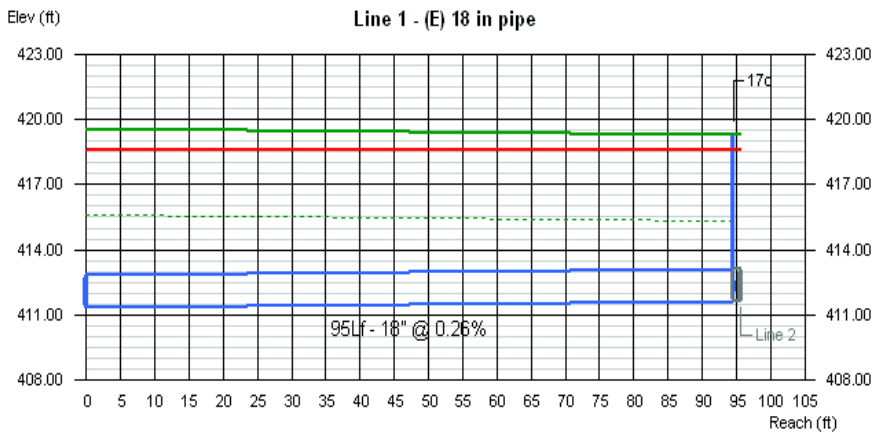
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	95	0.00	0.38	0.90	0.00	0.23	5.0	6.9	2.8	0.63	5.40	0.36	18	0.26	411.35	411.60	418.60	418.60	419.60	419.31	(E) 18 in pipe
2	1	1	0.00	0.38	0.90	0.00	0.23	5.0	6.9	2.8	0.63	10.49	0.36	18	1.00	411.60	411.61	418.60	418.60	419.31	419.31	e
3	2	47	0.38	0.38	0.60	0.23	0.23	5.0	5.0	3.2	0.74	5.09	0.42	18	0.24	411.61	411.72	418.60	418.61	419.31	416.10	

DS_17 | Number of lines: 3 | Run Date: 01-14-2011

NOTES: Intensity = 7.29 / (Inlet time + 0.10) ^ 0.50; Return period = 25 Yrs. ; c = cir e = ellip b = box

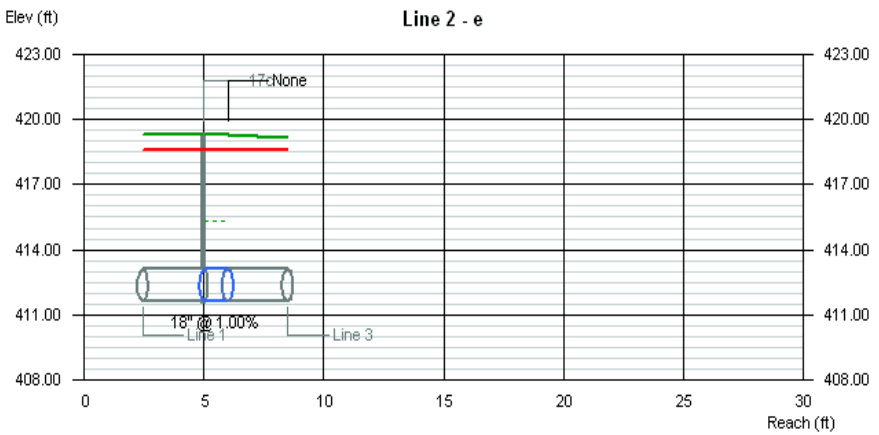
Line Profile (Line 1) - (E) 18 in pipe



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
1	0.63	411.35	411.60	1.50	1.50	7.00	418.60	418.60	418.60	0.36	0.36	6.75	6.21

DS_17	No. Lines: 3	Run Date: 01-14-2011

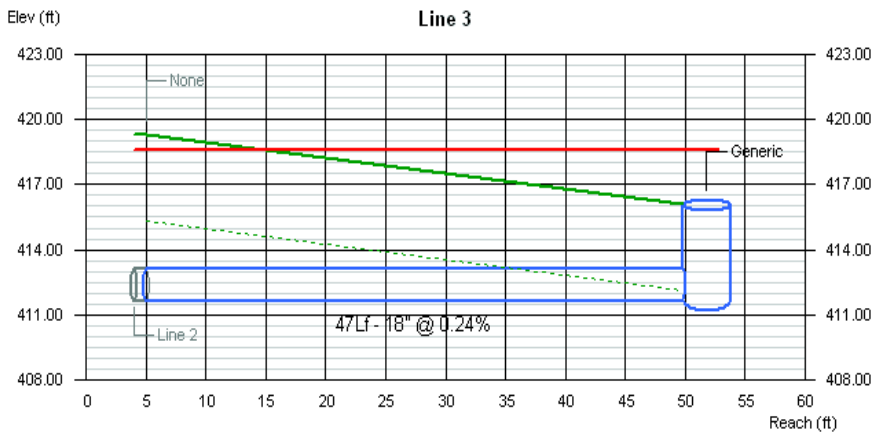
Line Profile (Line 2) - e



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
2	0.63	411.60	411.61	1.50	1.50	6.99	418.60	418.60	418.60	0.36	0.36	6.21	6.20

DS_17	No. Lines: 3	Run Date: 01-14-2011

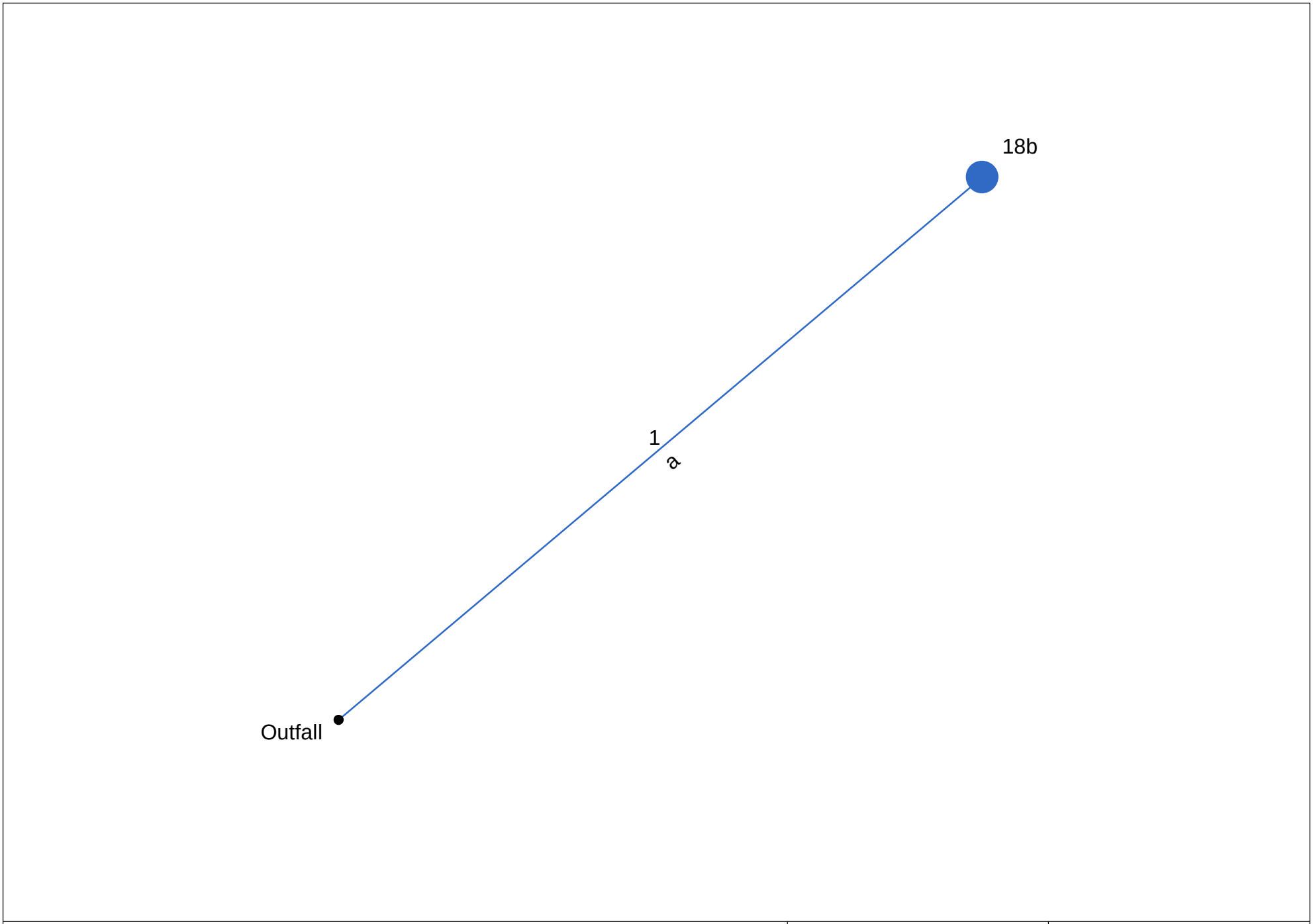
Line Profile (Line 3)



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
3	0.74	411.61	411.72	1.50	1.50	6.89	418.60	418.61	418.61	0.42	0.42	6.20	2.88

DS_17	No. Lines: 3	Run Date: 01-14-2011

DS_18



Project File: DS_18.stm	Number of lines: 1	Date: 01-14-2011

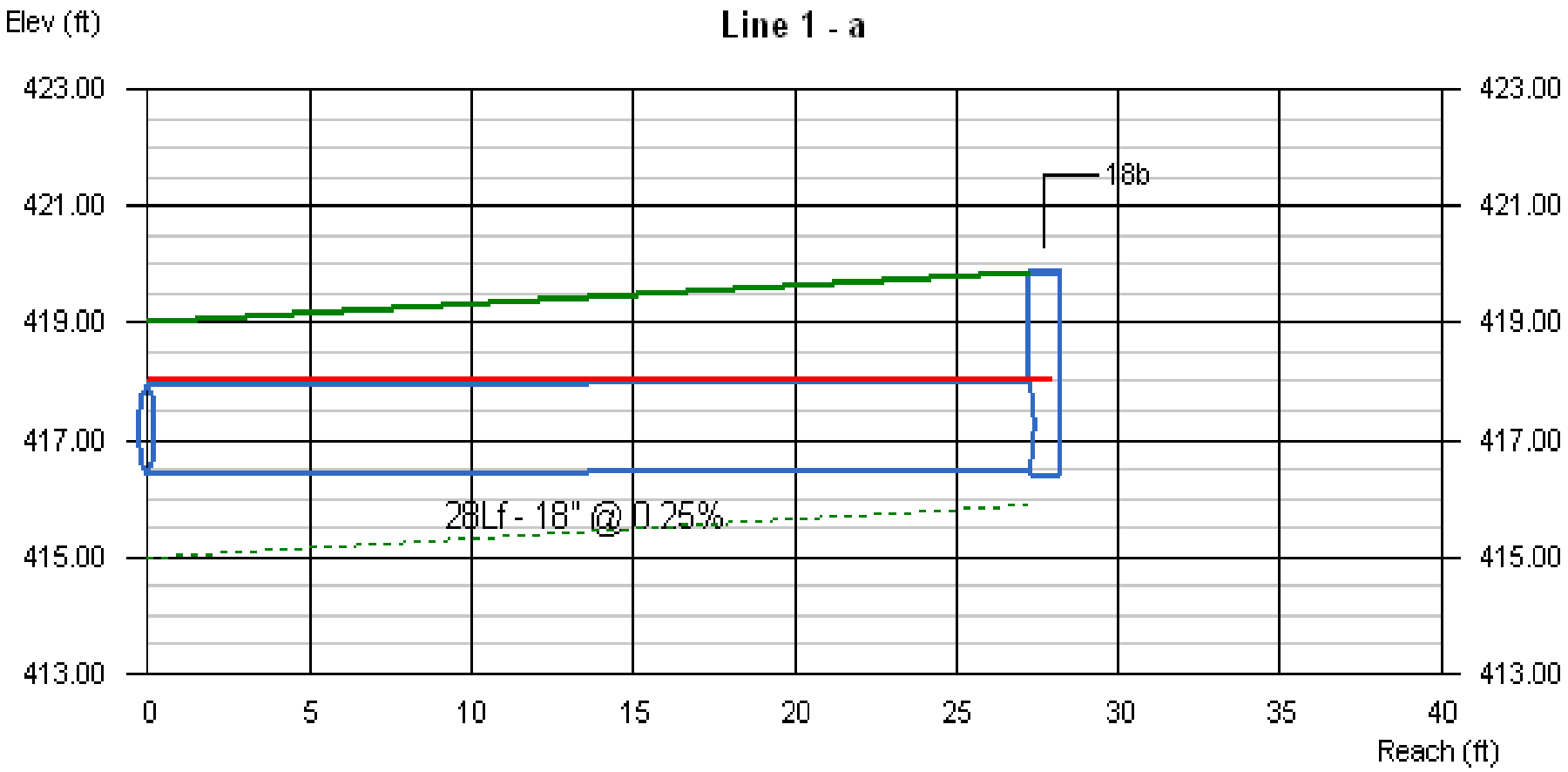
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	28	0.14	0.14	1.00	0.14	0.14	5.0	5.0	3.2	0.45	5.28	0.26	18	0.25	416.43	416.50	418.00	418.00	419.00	419.88	a

DS_18 | Number of lines: 1 | Run Date: 01-14-2011

NOTES: Intensity = 7.29 / (Inlet time + 0.10) ^ 0.50; Return period = 25 Yrs. ; c = cir e = ellip b = box

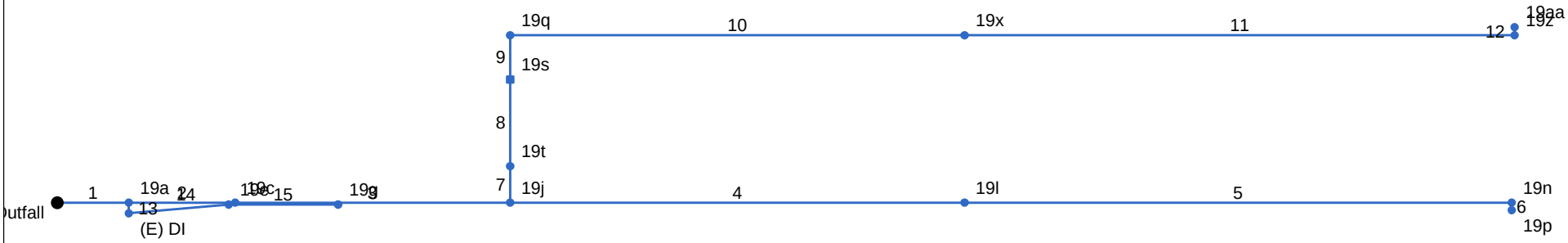
Line Profile (Line 1) - a



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
1	0.45	416.43	416.50	1.50	1.50	1.50	418.00	418.00	418.00	0.26	0.26	1.07	1.88

DS_18 | No. Lines: 1 | Run Date: 01-14-2011

DS_19



Project File: DS_19.stm	Number of lines: 15	Date: 01-14-2011

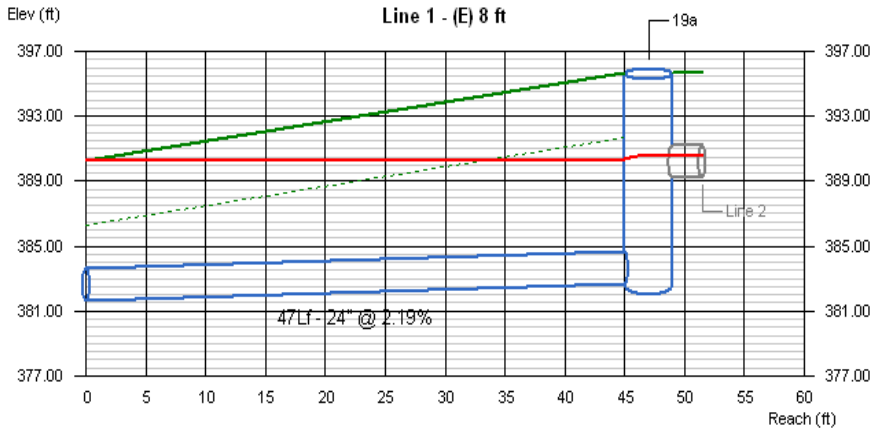
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	47	0.00	3.75	0.00	0.00	3.56	0.0	10.2	2.6	9.16	33.48	2.92	24	2.19	381.61	382.64	390.25	390.33	390.27	395.67	(E) 8 ft
2	1	70	0.25	3.05	1.00	0.25	3.04	5.0	9.9	2.6	7.92	15.29	3.95	24	0.46	389.20	389.52	390.56	390.63	395.67	396.53	19b
3	2	181	0.40	2.80	1.00	0.40	2.79	5.0	9.2	2.7	7.54	13.41	4.24	24	1.20	389.62	391.79	390.87	392.79	396.53	400.24	19h
4	3	299	0.47	0.95	1.00	0.47	0.94	5.0	7.5	3.0	2.84	7.19	2.81	18	0.47	391.89	393.29	393.23	393.93	400.24	408.53	19k
5	4	360	0.46	0.48	1.00	0.46	0.47	5.0	5.1	3.6	1.72	12.54	2.51	18	4.86	393.39	410.90	394.23	411.40	408.53	415.95	19m
6	5	5	0.02	0.02	0.66	0.01	0.01	5.0	5.0	3.7	0.05	3.56	1.44	12	1.00	411.52	411.57	411.60	411.66	415.95	418.46	19o
7	3	24	0.00	1.45	0.00	0.00	1.44	0.0	9.0	2.7	3.96	12.50	3.53	24	1.04	393.68	393.93	394.45	394.70	400.24	400.28	19v and (E) 24 in
8	7	57	0.00	1.45	0.00	0.00	1.44	0.0	8.7	2.8	4.02	12.25	3.32	24	1.00	393.93	394.50	394.82	395.26	400.28	400.28	(E) 24 in
9	8	29	0.42	1.45	1.00	0.42	1.44	5.0	8.6	2.8	4.05	12.04	3.45	24	0.97	394.65	394.93	395.45	395.73	400.28	400.25	19r
10	9	299	0.50	1.03	1.00	0.50	1.02	5.0	7.4	3.0	3.08	9.10	4.34	18	2.56	395.36	403.02	395.96	403.69	400.25	408.52	19w
11	10	362	0.51	0.53	1.00	0.51	0.52	5.0	5.1	3.6	1.90	8.33	2.58	18	2.14	403.12	410.88	404.01	411.41	408.52	415.89	19y
12	11	5	0.02	0.02	0.66	0.01	0.01	5.0	5.0	3.7	0.05	3.45	1.09	12	0.94	411.50	411.55	411.62	411.64	415.89	418.70	19ab
13	1	7	0.44	0.70	0.60	0.26	0.52	0.0	5.6	3.4	1.81	34.55	3.35	12	94.14	389.81	396.40	390.58	396.97	395.67	402.60	(E) 12 in
14	13	66	0.00	0.26	0.00	0.00	0.26	0.0	5.4	3.5	0.91	8.39	5.03	12	5.55	399.38	403.04	399.60	403.45	402.60	406.36	19d
15	14	72	0.26	0.26	1.00	0.26	0.26	5.0	5.0	3.7	0.95	5.57	2.82	12	2.44	403.14	404.90	403.62	405.31	406.36	408.12	19f

DS_19 | Number of lines: 15 | Run Date: 01-14-2011

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50; Return period = 50 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - (E) 8 ft

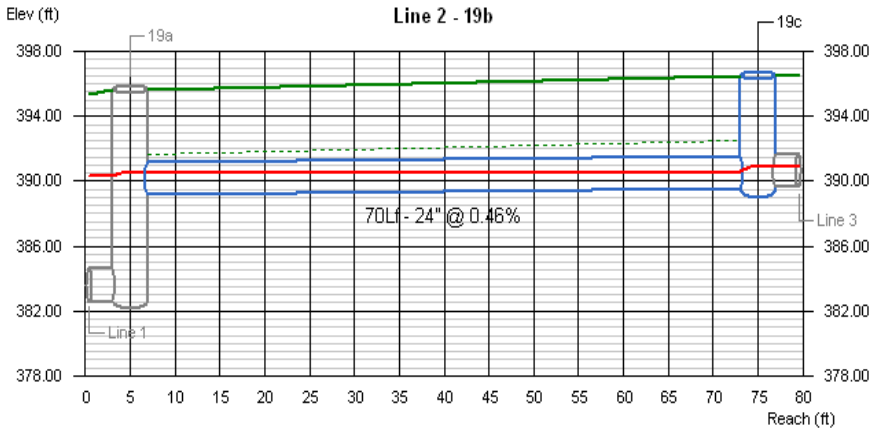


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
1	9.16	381.61	382.64	2.00	2.00	7.89	390.25	390.33	390.53	2.92	2.92	6.66	11.03

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - 19b

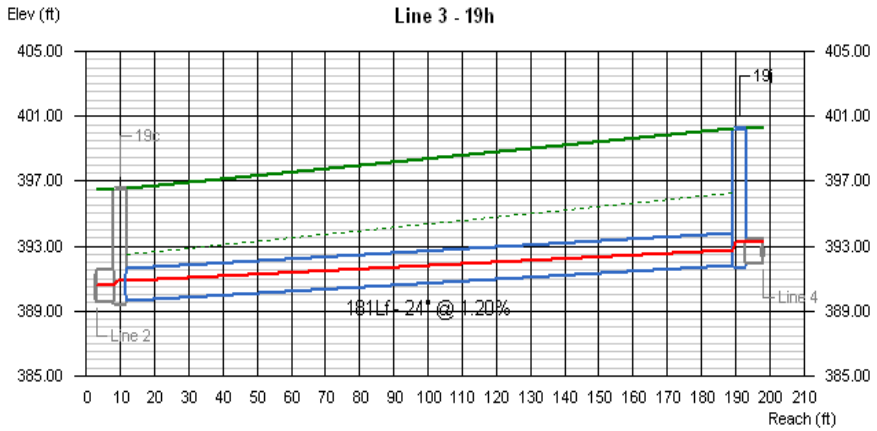


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
2	7.92	389.20	389.52	1.36	1.11	1.35	390.56	390.63	390.87 i	3.49	4.42	4.47	5.01

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - 19h

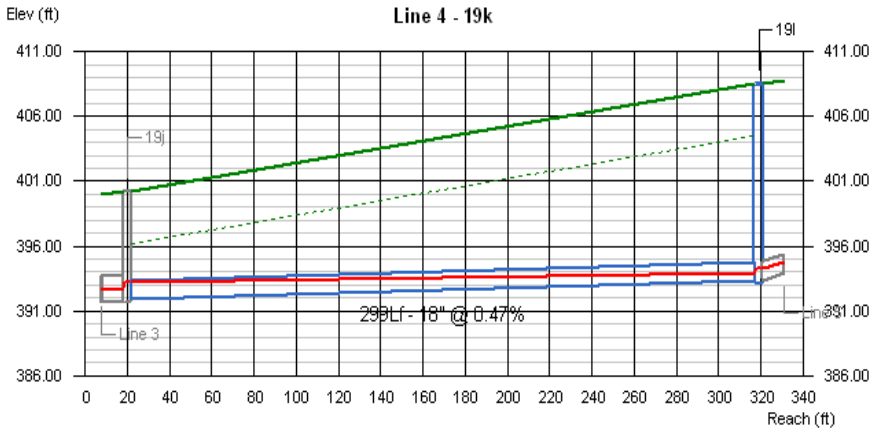


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
3	7.54	389.62	391.79	1.25	1.00	1.44	390.87	392.79	393.23 i	3.67	4.82	4.91	6.45

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 4) - 19k

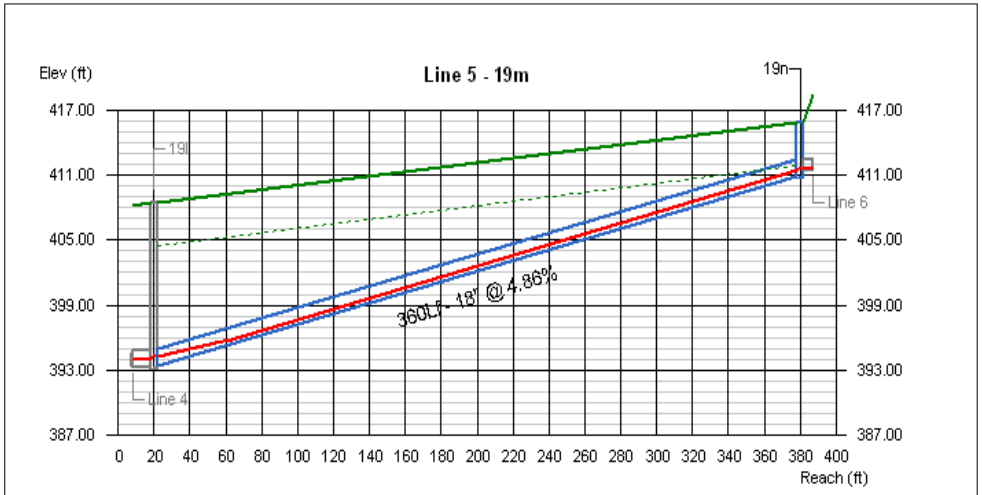


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
4	2.84	391.89	393.29	1.34	0.64	0.94	393.23	393.93	394.23 i	1.71	3.92	6.85	13.74

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 5) - 19m

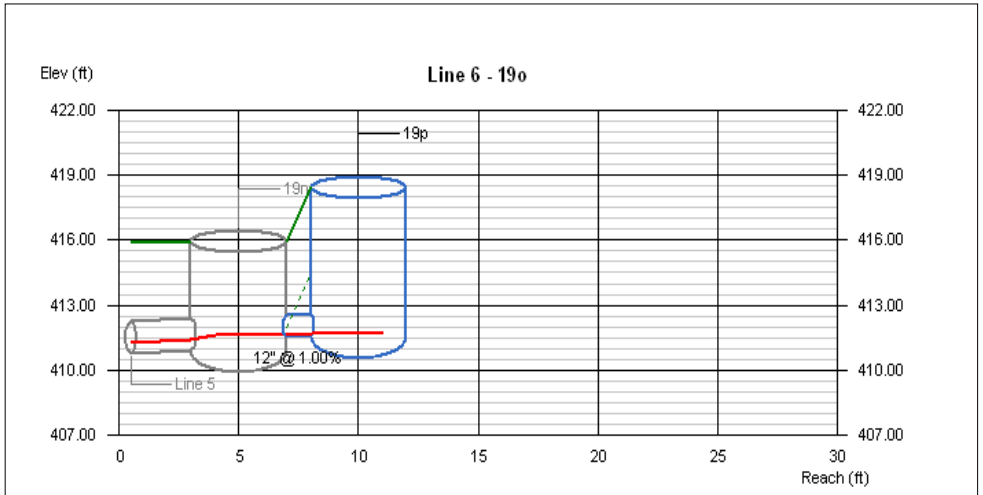


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	1.72	393.39	410.90	0.84	0.50	0.70	394.23	411.40 j	411.60 i	1.68	3.33	13.64	3.55

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 6) - 19o

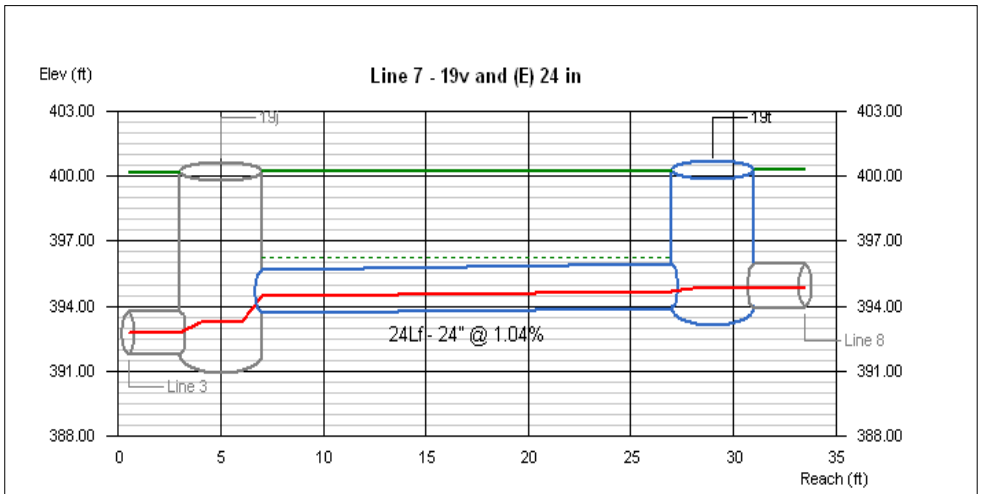


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
6	0.05	411.52	411.57	0.08	0.09	0.11	411.60	411.66	411.68 i	1.60	1.28	3.43	5.89

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 7) - 19v and (E) 24 in

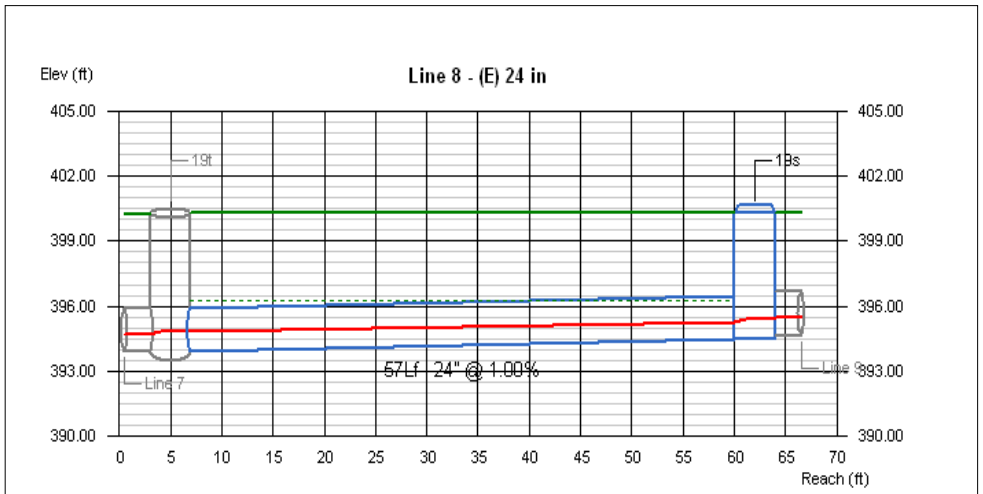


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
7	3.96	393.68	393.93	0.77	0.77	0.89	394.45	394.70	394.82 i	3.53	3.54	4.56	4.35

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 8) - (E) 24 in

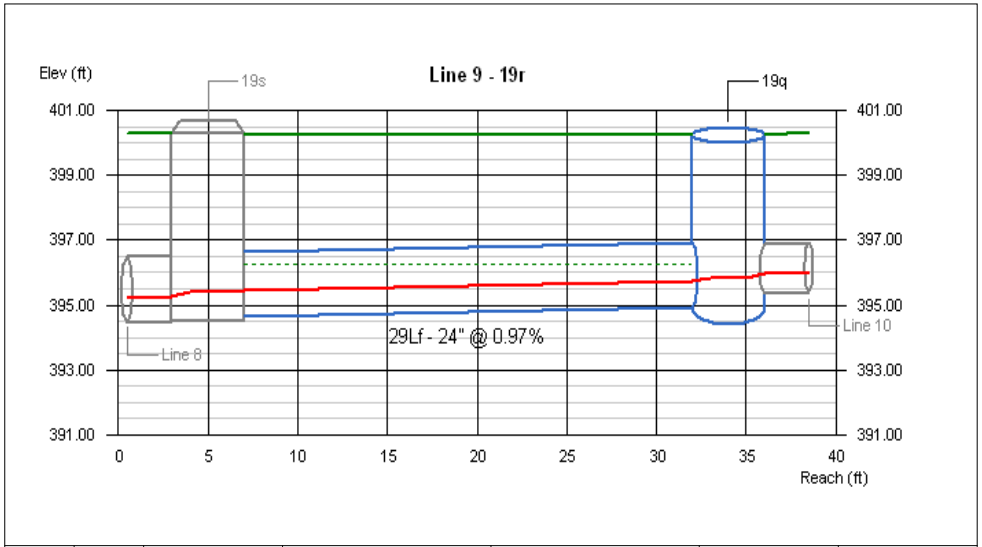


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
8	4.02	393.93	394.50	0.89	0.76	0.93	394.82	395.26	395.43 i	2.97	3.68	4.35	3.78

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 9) - 19r

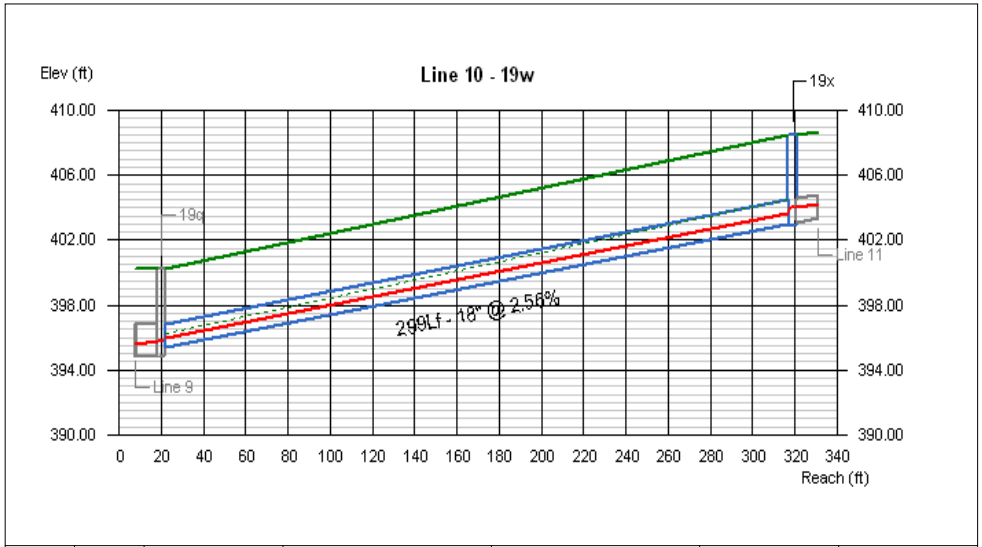


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
9	4.05	394.65	394.93	0.80	0.80	0.88	395.45	395.73	395.81 i	3.46	3.45	3.63	3.32

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 10) - 19w

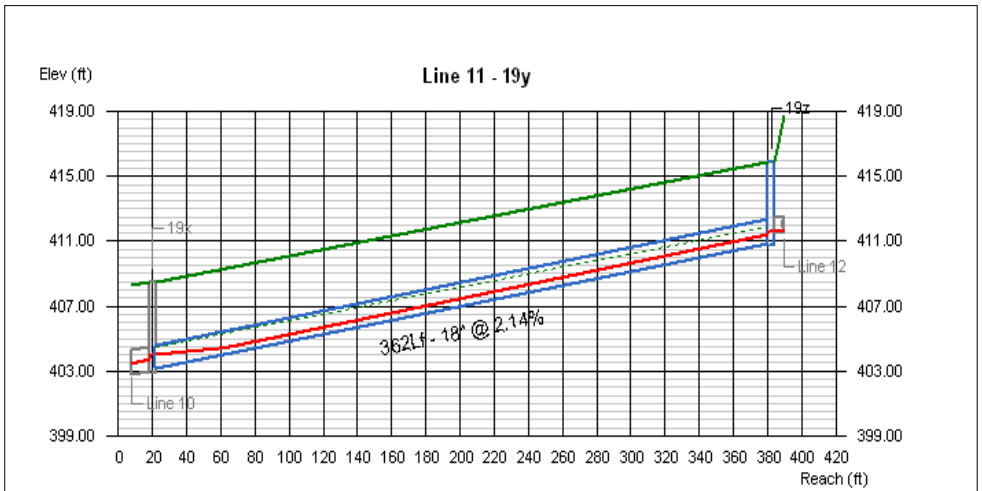


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
10	3.08	395.36	403.02	0.60	0.67	0.99	395.96	403.69	404.01 i	4.65	4.04	3.39	4.00

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 11) - 19y

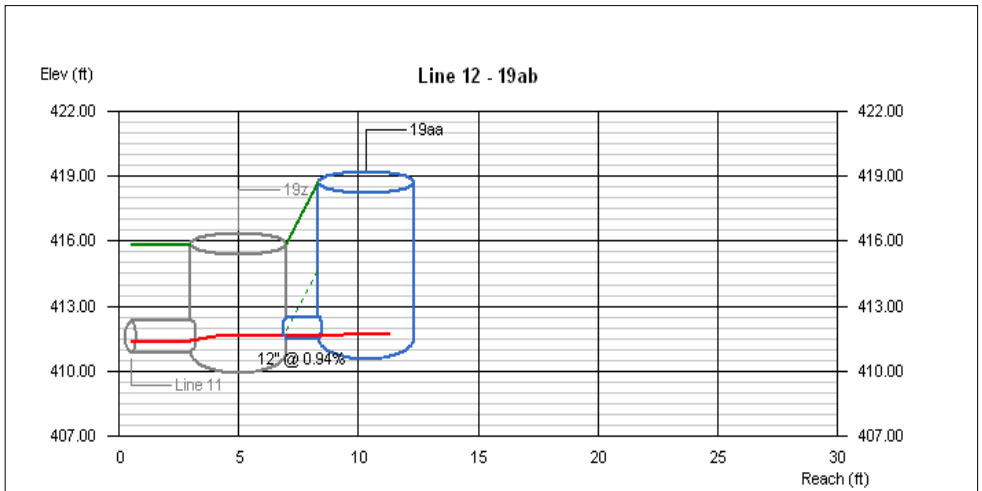


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
11	1.90	403.12	410.88	0.89	0.53	0.74	404.01	411.41 j	411.62 i	1.73	3.44	3.90	3.51

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 12) - 19ab

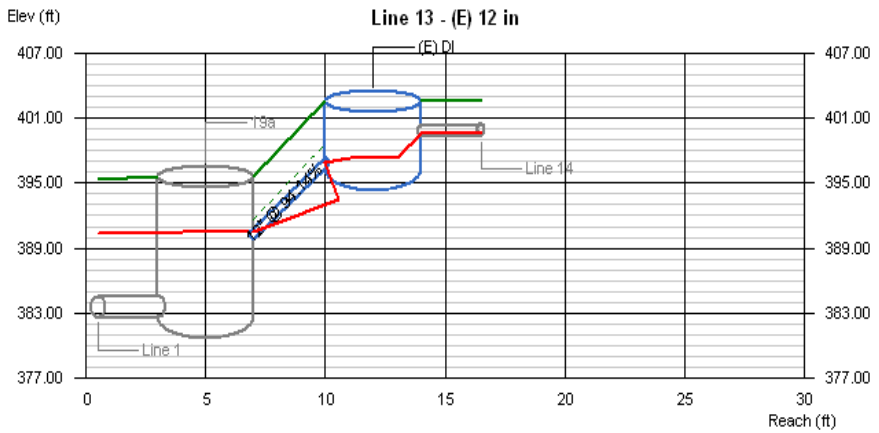


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
12	0.05	411.50	411.55	0.12	0.09	0.11	411.62	411.64 j	411.66 i	0.90	1.28	3.39	6.15

DS_19 | No. Lines: 15 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 13) - (E) 12 in

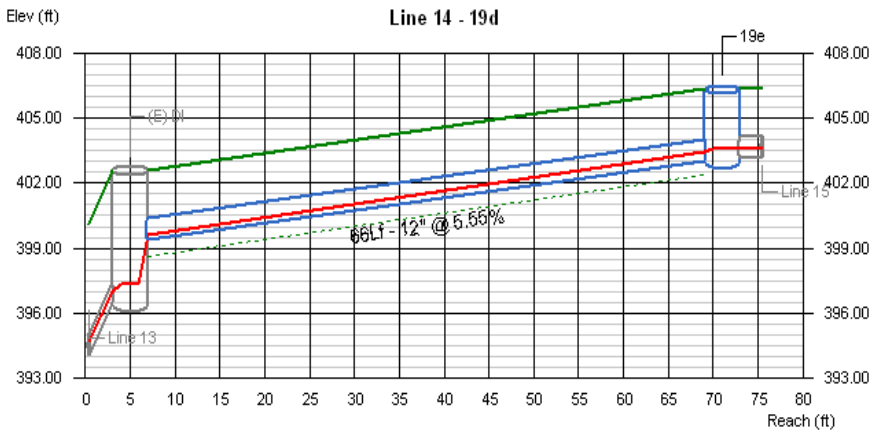


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
13	1.81	389.81	396.40	0.77	0.57	0.90	390.58	396.97 j	397.30 i	2.80	3.91	4.86	5.20

DS_19	No. Lines: 15	Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 14) - 19d

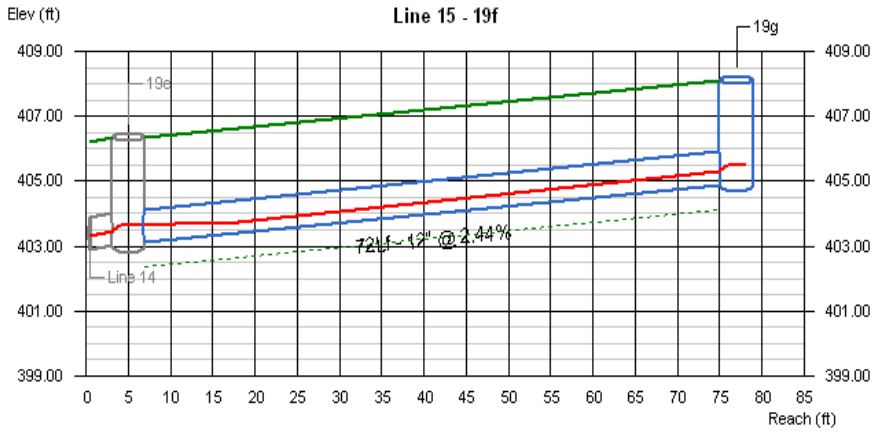


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
14	0.91	399.38	403.04	0.22	0.41	0.58	399.60	403.45	403.62 i	7.00	3.06	2.22	2.32

DS_19	No. Lines: 15	Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 15) - 19f

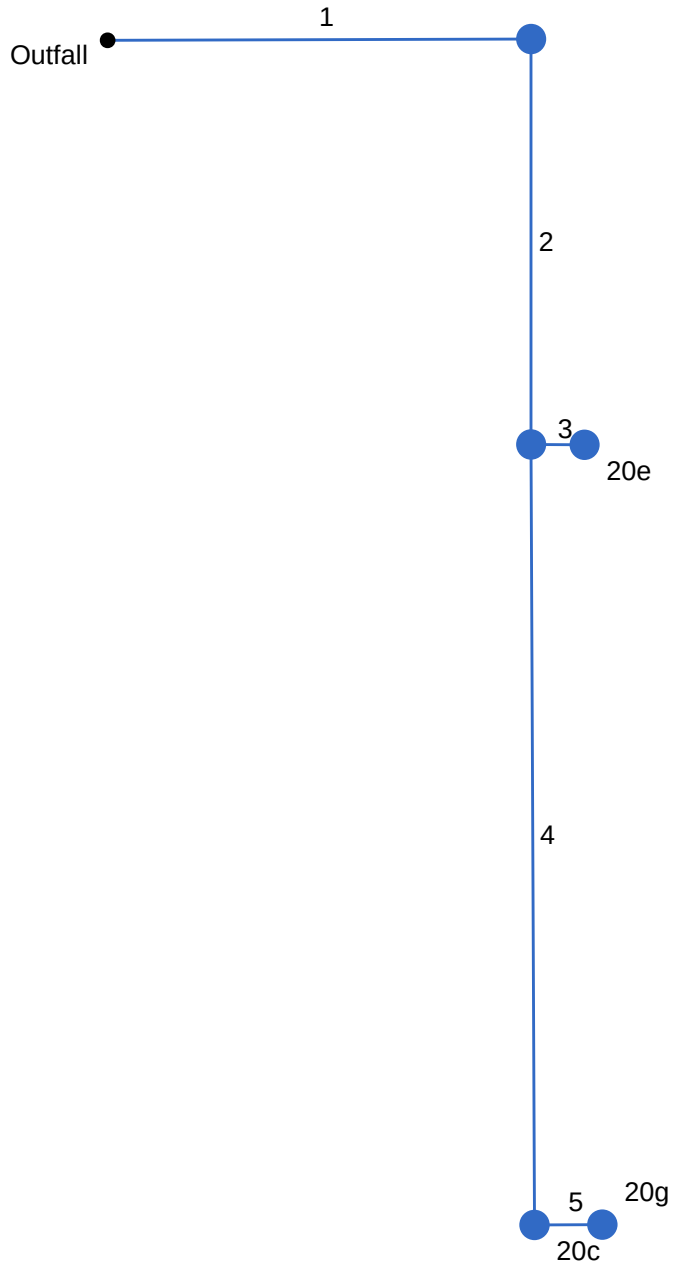


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
15	0.95	403.14	404.90	0.48	0.41	0.60	403.62	405.31 j	405.50 i	2.54	3.10	2.22	2.22

DS_19	No. Lines: 15	Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

DS_20



Project File: DS_20.stm	Number of lines: 5	Date: 01-14-2011

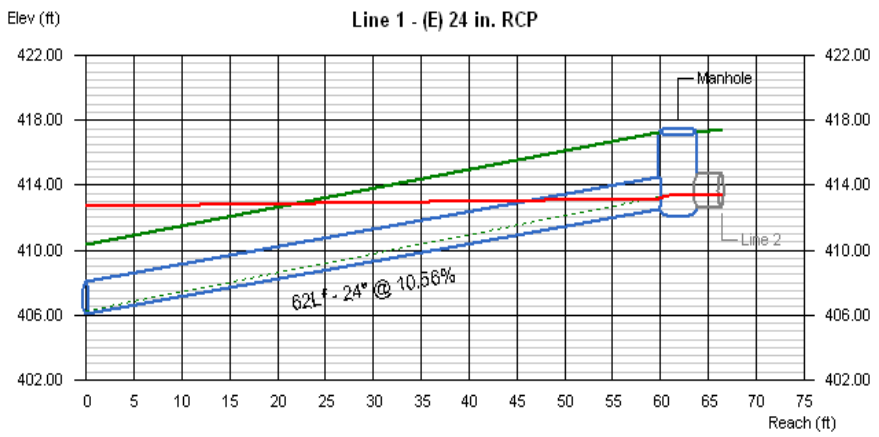
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	62	0.00	1.04	0.00	0.00	0.99	0.0	6.2	2.9	2.86	73.49	2.26	24	10.56	406.03	412.56	412.70	413.16	410.30	417.31	(E) 24 in. RCP
2	1	59	0.02	1.04	1.00	0.02	0.99	5.0	5.9	3.0	2.94	30.97	3.24	24	1.87	412.66	413.77	413.39	414.38	417.31	420.48	(E) 24 in. RCP
3	2	8	0.46	0.46	1.00	0.46	0.46	5.0	5.0	3.2	1.49	5.76	2.74	18	1.03	415.55	415.63	416.07	416.15	420.48	420.55	d
4	2	114	0.02	0.56	1.00	0.02	0.51	5.0	5.1	3.2	1.63	30.92	2.25	24	1.87	413.83	415.96	414.61	416.41	420.48	420.60	ex 24 in
5	4	10	0.54	0.54	0.90	0.49	0.49	5.0	5.0	3.2	1.57	5.72	2.76	18	1.01	416.06	416.16	416.60	416.70	420.60	420.68	f

DS_20 | Number of lines: 5 | Run Date: 01-14-2011

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51; Return period = 25 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - (E) 24 in. RCP

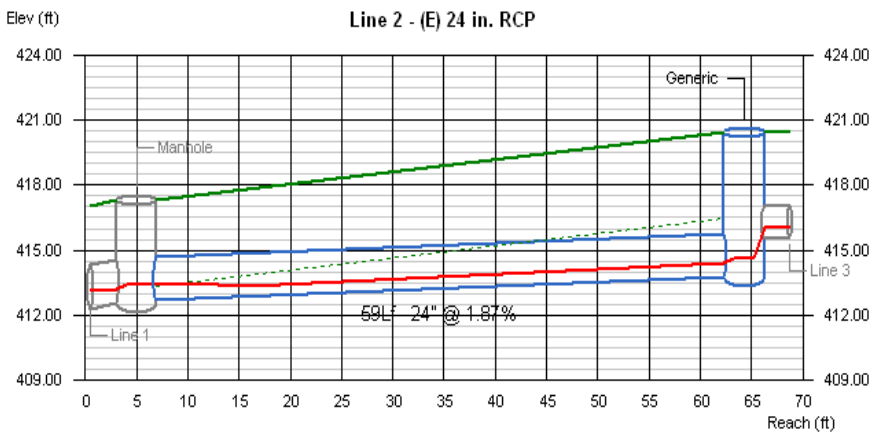


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
1	2.86	406.03	412.56	2.00	0.60	0.83	412.70	413.16	413.39 i	0.91	3.62	2.27	2.75

DS_20 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - (E) 24 in. RCP

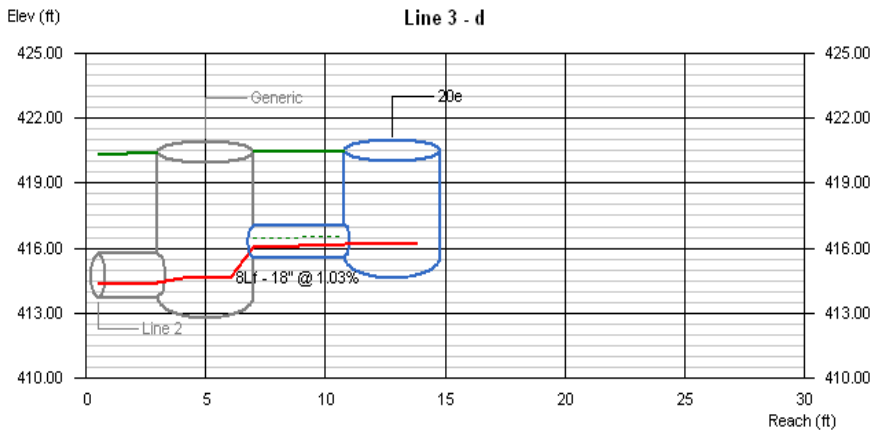


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
2	2.94	412.66	413.77	0.73	0.61	0.84	413.39	414.38 j	414.61 i	2.84	3.65	2.65	4.71

DS_20 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - d

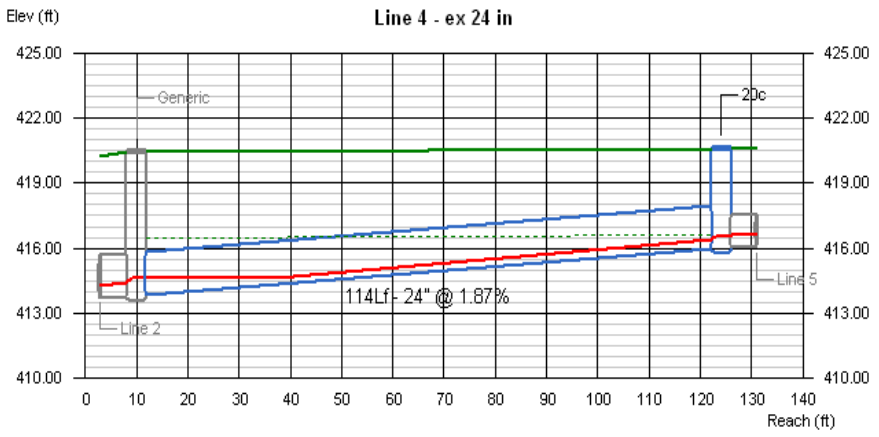


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
3	1.49	415.55	415.63	0.52	0.52	0.56	416.07	416.15	416.19 i	2.73	2.75	3.43	3.42

DS_20 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 4) - ex 24 in

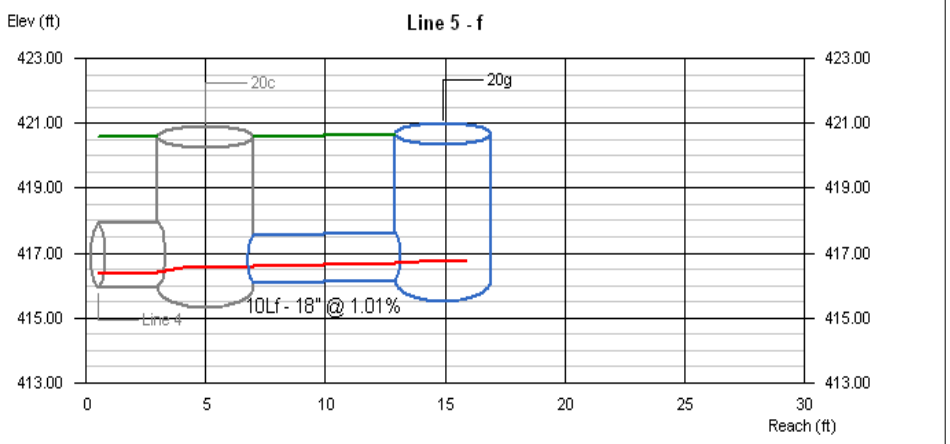


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
4	1.63	413.83	415.96	0.78	0.45	0.60	414.61	416.41 j	416.56 i	1.43	3.06	4.65	2.64

DS_20 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 5) - f

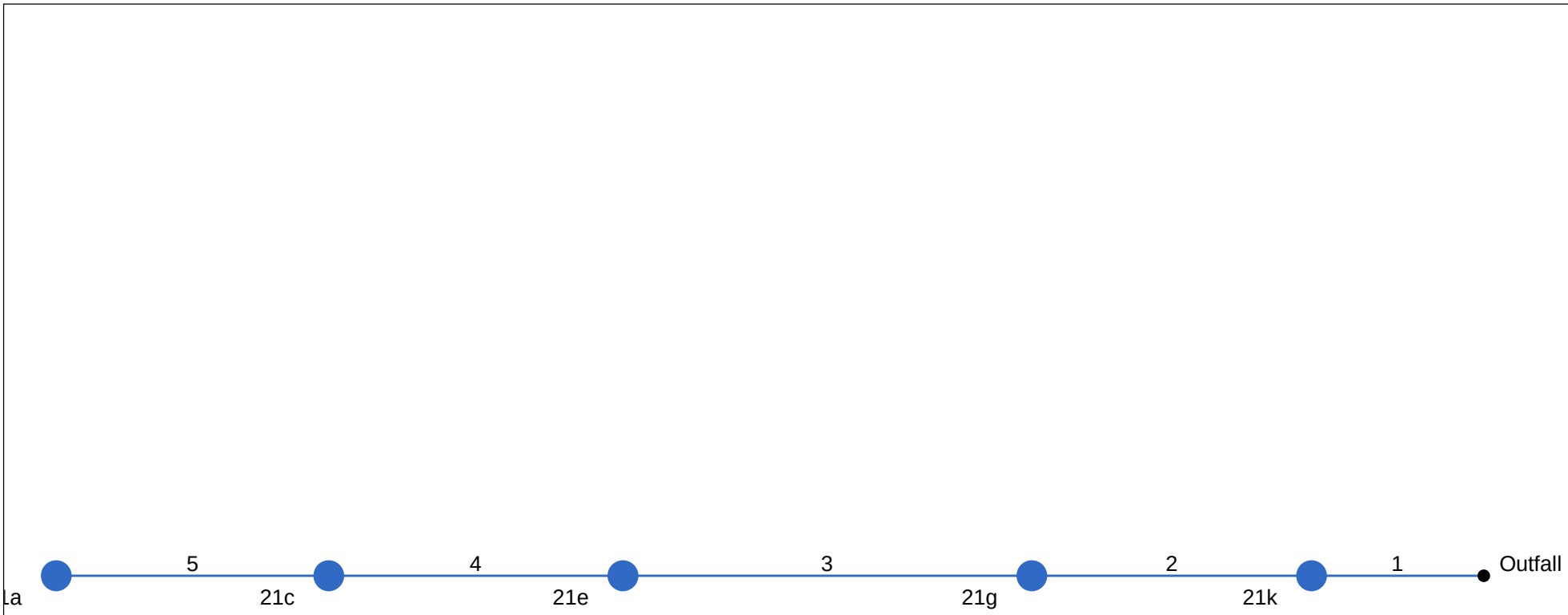


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	1.57	416.06	416.16	0.54	0.54	0.58	416.60	416.70	416.74 i	2.76	2.75	3.04	3.02

DS_20 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

DS_21



Project File: DS_21.stm	Number of lines: 5	Date: 01-14-2011

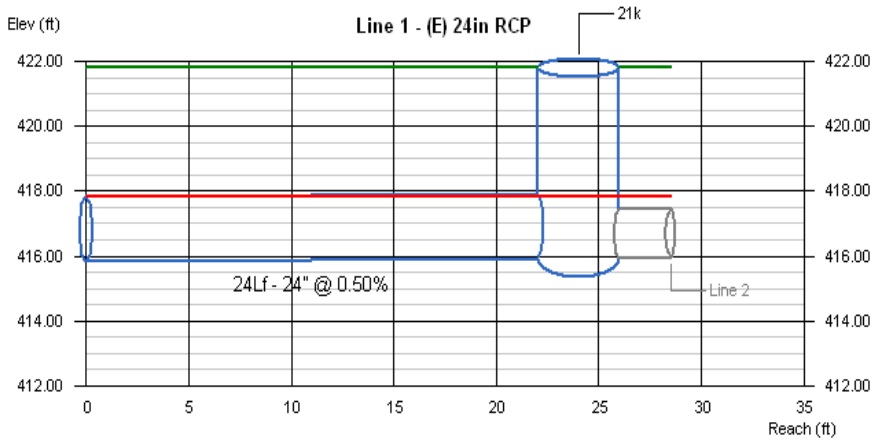
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	24	0.02	0.57	0.77	0.02	0.51	5.0	7.7	2.6	1.33	15.99	0.43	24	0.50	415.82	415.94	417.82	417.82	421.82	421.82	(E) 24in RCP
2	1	39	0.07	0.55	0.89	0.06	0.49	5.0	6.8	2.8	1.36	5.61	0.77	18	0.97	415.94	416.32	417.82	417.84	421.82	421.78	h
3	2	57	0.11	0.48	0.90	0.10	0.43	5.0	5.8	3.0	1.29	5.64	0.95	18	0.98	416.42	416.98	417.85	417.88	421.78	421.66	f
4	3	41	0.15	0.37	0.90	0.14	0.33	5.0	5.4	3.1	1.03	5.62	1.49	18	0.98	417.08	417.48	417.91	417.99	421.66	421.52	d
5	4	38	0.22	0.22	0.89	0.20	0.20	5.0	5.0	3.2	0.63	5.61	1.73	18	0.97	417.58	417.95	418.08	418.28	421.52	421.66	b

DS_21 | Number of lines: 5 | Run Date: 01-14-2011

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51; Return period = 25 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - (E) 24in RCP

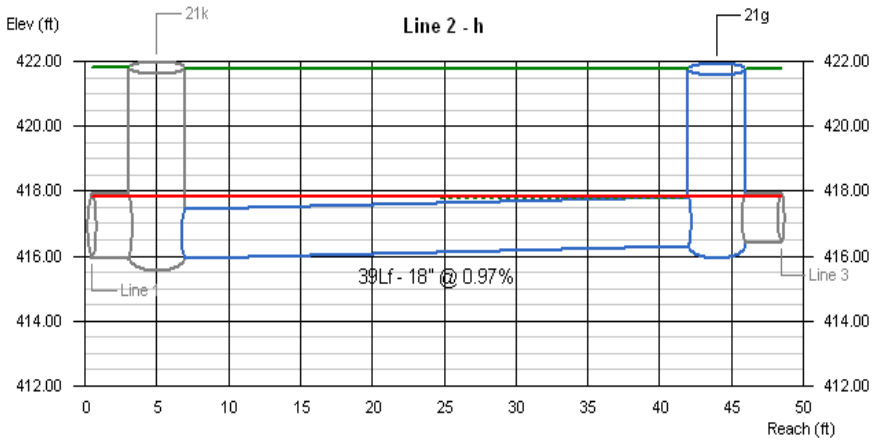


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
1	1.33	415.82	415.94	2.00	1.88	1.88	417.82	417.82	417.82	0.42	0.43	4.00	3.88

DS_21 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - h

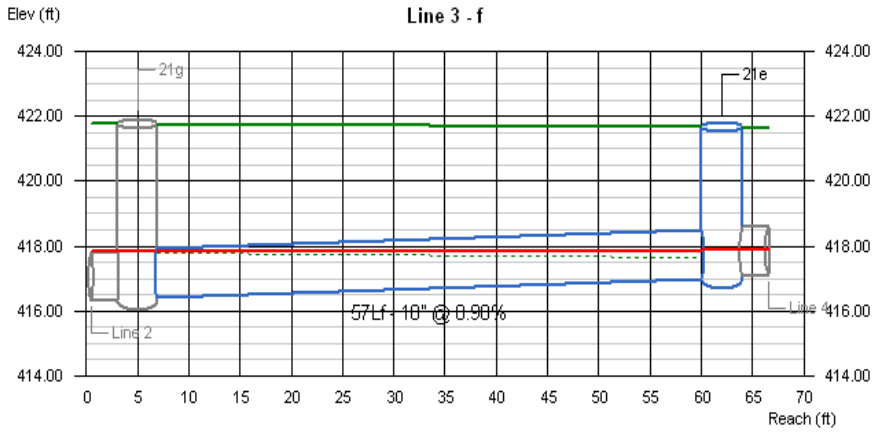


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
2	1.36	415.94	416.32	1.50	1.50	1.53	417.82	417.84	417.85	0.77	0.77	4.38	3.96

DS_21 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - f

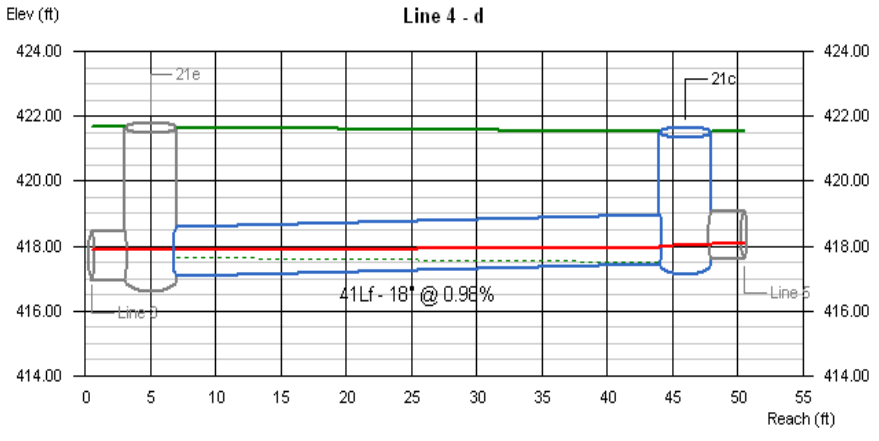


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
3	1.29	416.42	416.98	1.43	0.90	0.91	417.85	417.88	417.89	0.74	1.16	3.86	3.18

DS_21 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 4) - d

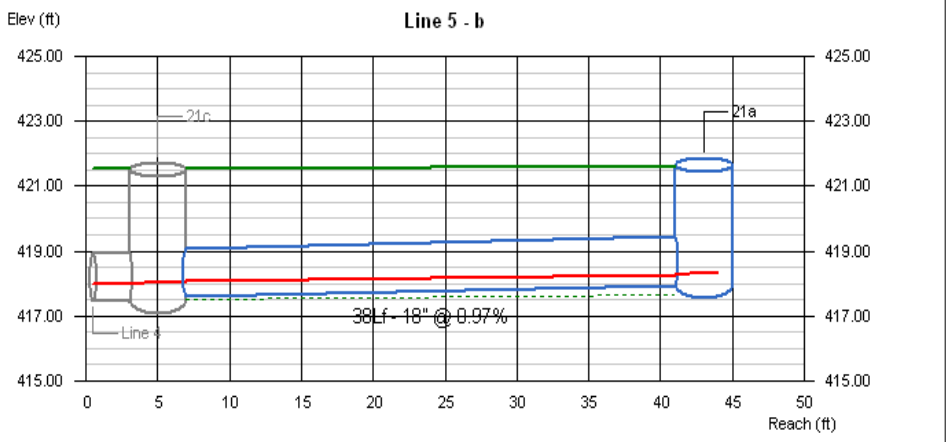


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
4	1.03	417.08	417.48	0.83	0.51	0.54	417.91	417.99	418.02	1.03	1.94	3.08	2.54

DS_21 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 5) - b

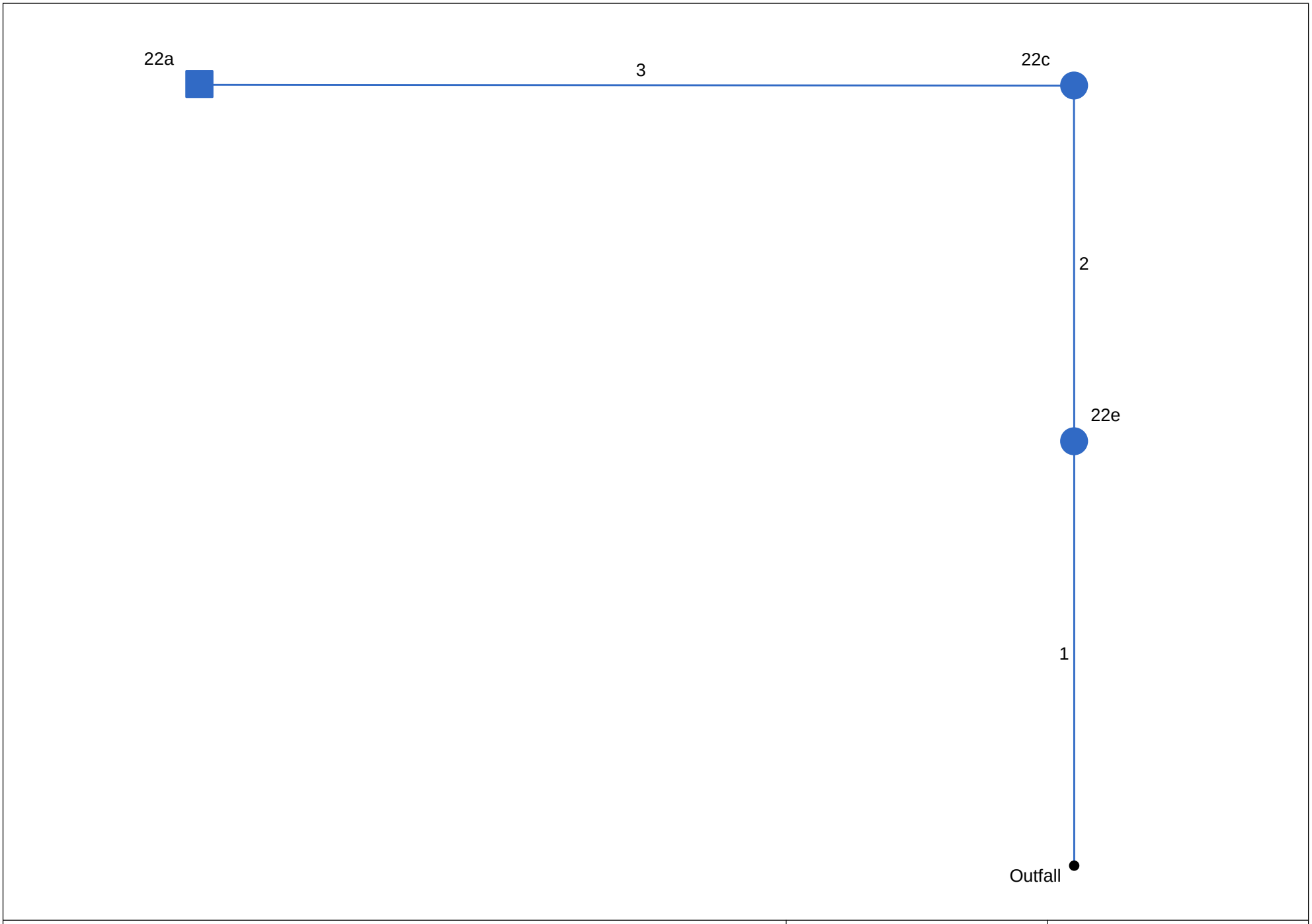


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	0.63	417.58	417.95	0.50	0.33	0.36	418.08	418.28	418.31 i	1.24	2.21	2.44	2.21

DS_21 | No. Lines: 5 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

DS_22



Project File: DS_22.stm	Number of lines: 3	Date: 01-14-2011

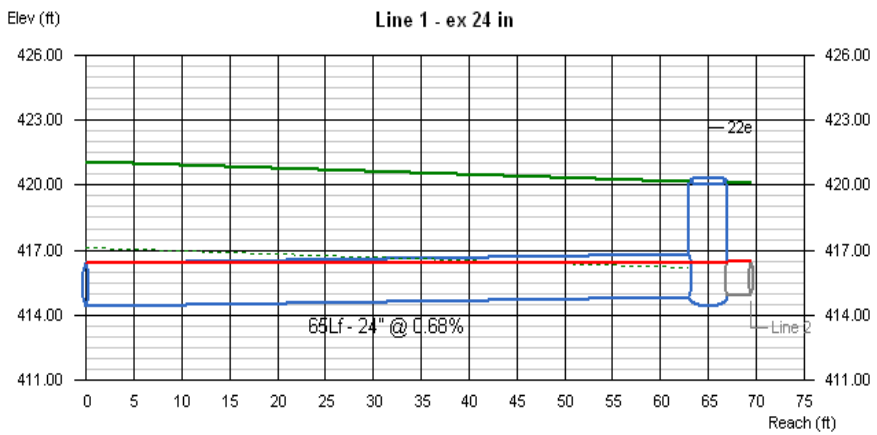
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	65	0.00	1.66	0.00	0.00	1.52	0.0	6.6	2.8	4.27	18.61	1.48	24	0.68	414.40	414.84	416.40	416.41	421.08	420.20	ex 24 in
2	1	55	0.64	1.66	0.95	0.61	1.52	5.0	6.2	2.9	4.39	5.32	2.50	18	0.26	414.94	415.08	416.44	416.53	420.20	418.15	d
3	2	134	1.02	1.02	0.89	0.91	0.91	5.0	5.0	3.2	2.94	5.74	1.80	18	0.30	415.18	415.58	416.69	416.79	418.15	419.29	b

DS_22 | Number of lines: 3 | Run Date: 01-14-2011

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51; Return period = 25 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - ex 24 in

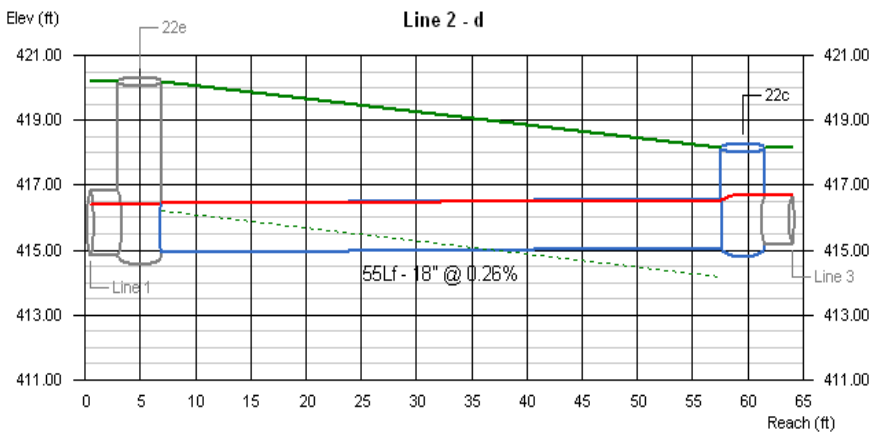


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
1	4.27	414.40	414.84	2.00	1.57	1.58	416.40	416.41	416.42	1.36	1.61	4.68	3.36

DS_22	No. Lines: 3	Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - d

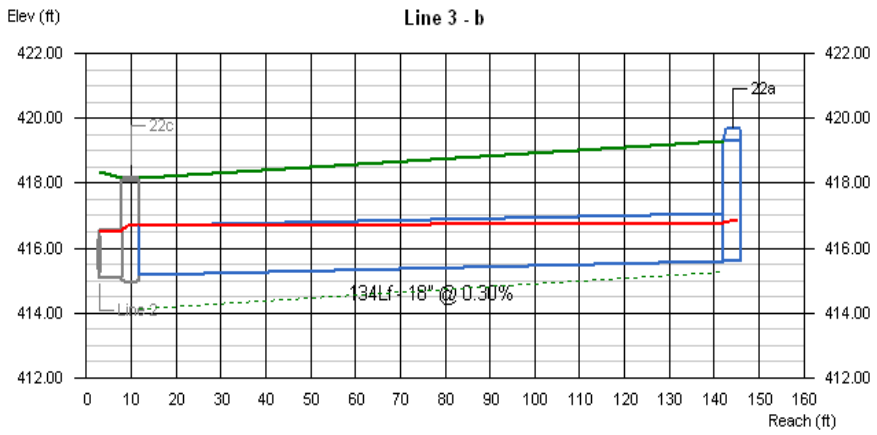


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
2	4.39	414.94	415.08	1.50	1.45	1.59	416.44	416.53	416.67	2.48	2.51	3.76	1.57

DS_22	No. Lines: 3	Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - b

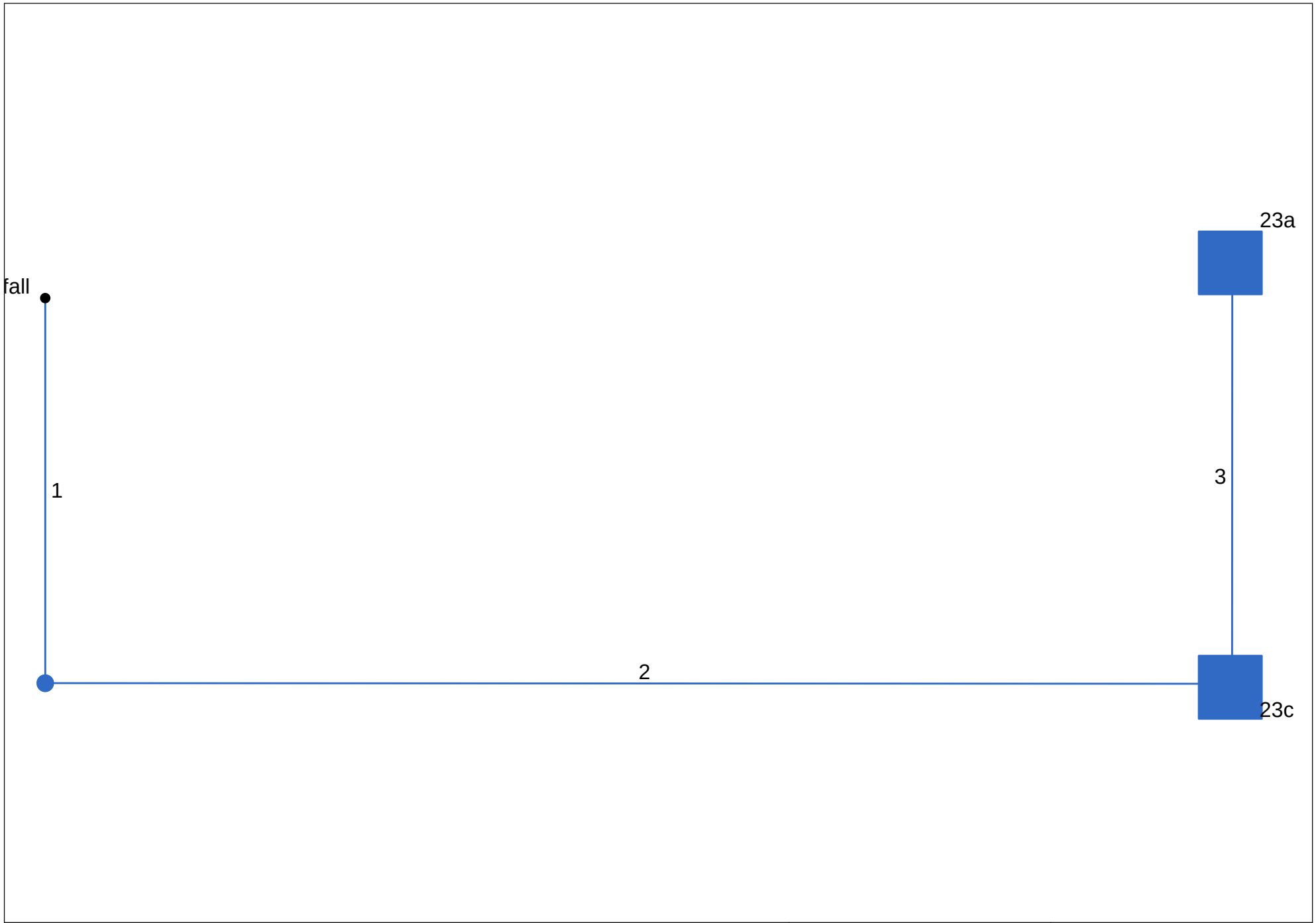


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
3	2.94	415.18	415.58	1.50	1.21	1.26	416.69	416.79	416.84	1.66	1.93	1.47	2.21

DS_22	No. Lines: 3	Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

DS_23



Project File: DS_23.stm	Number of lines: 3	Date: 01-14-2011

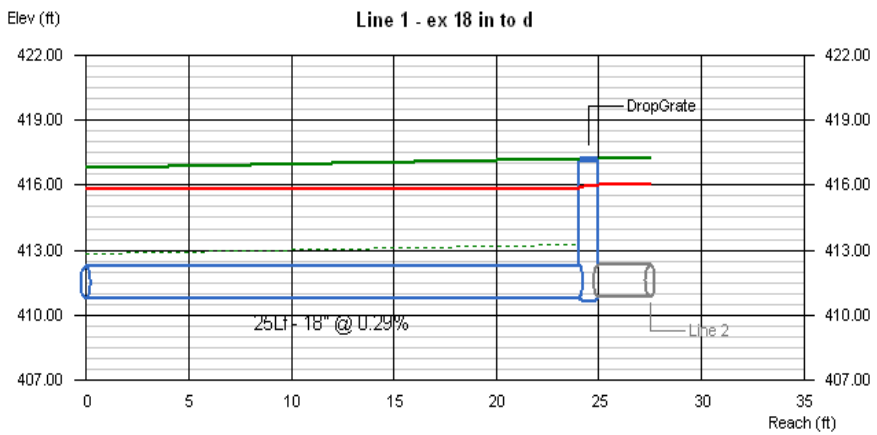
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	25	0.61	1.55	0.95	0.58	1.42	5.0	6.2	2.9	4.14	5.61	2.34	18	0.29	410.76	410.83	415.82	415.86	416.82	417.23	ex 18 in to d
2	1	76	0.24	0.94	0.98	0.24	0.84	5.0	5.4	3.1	2.64	4.98	1.49	18	0.23	410.83	411.00	416.04	416.08	417.23	417.03	ex 18 in
3	2	26	0.70	0.70	0.87	0.61	0.61	5.0	5.0	3.2	1.97	9.14	1.12	18	0.76	411.00	411.20	416.15	416.16	417.03	416.82	b

DS_23 | Number of lines: 3 | Run Date: 01-14-2011

NOTES: Intensity = 7.29 / (Inlet time + 0.10) ^ 0.50; Return period = 25 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - ex 18 in to d

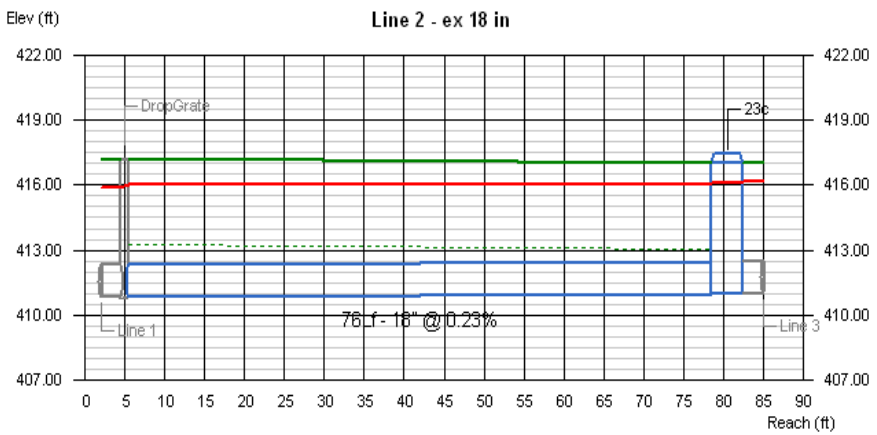


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
1	4.14	410.76	410.83	1.50	1.50	5.16	415.82	415.86	415.99	2.34	2.34	4.56	4.90

DS_23 | No. Lines: 3 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - ex 18 in

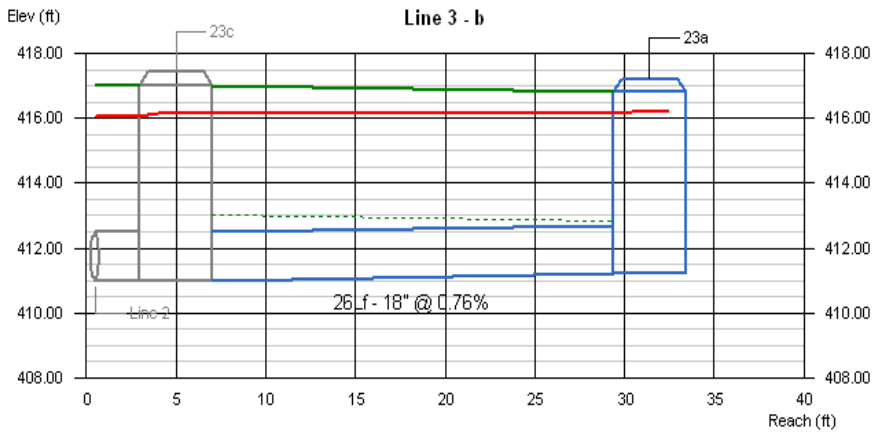


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
2	2.64	410.83	411.00	1.50	1.50	5.14	416.04	416.08	416.14	1.49	1.49	4.90	4.53

DS_23 | No. Lines: 3 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - b

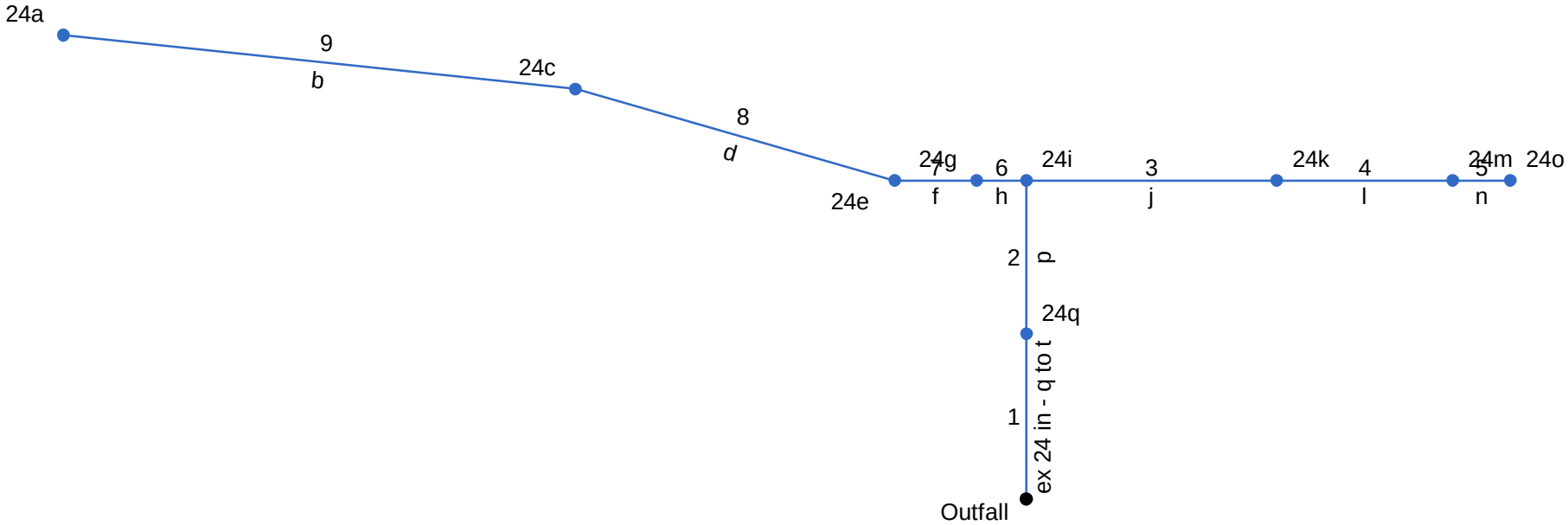


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
3	1.97	411.00	411.20	1.50	1.50	4.98	416.15	416.16	416.18	1.12	1.12	4.53	4.12

DS_23 | No. Lines: 3 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

DS_24



Project File: DS_24.stm	Number of lines: 9	Date: 01-14-2011

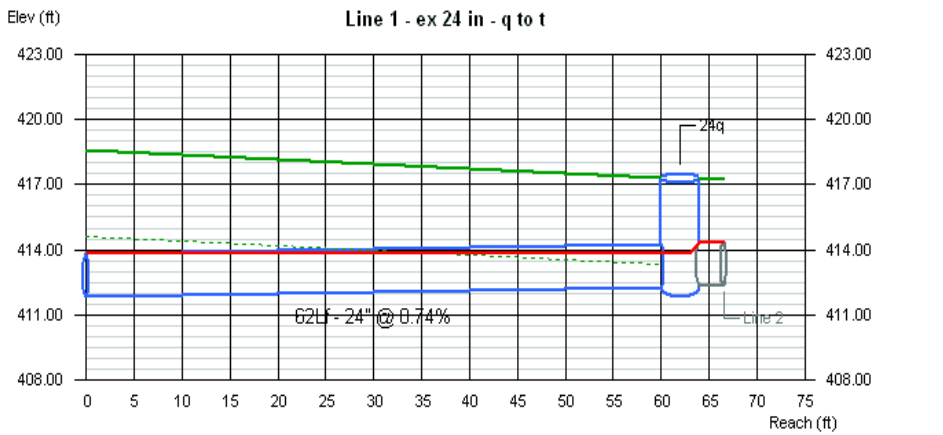
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	62	0.00	2.80	0.00	0.00	2.62	0.0	16.1	1.8	4.69	19.48	1.64	24	0.74	411.80	412.26	413.80	413.81	418.63	417.31	ex 24 in - q to t
2	1	58	0.00	2.80	0.93	0.00	2.62	5.0	15.5	1.8	4.79	10.32	1.54	24	0.21	412.36	412.48	414.36	414.38	417.31	415.81	p
3	2	94	0.29	0.72	0.93	0.27	0.67	5.0	7.2	2.7	1.80	5.30	1.02	18	0.25	412.60	412.84	414.49	414.52	415.81	416.12	j
4	3	66	0.07	0.43	0.93	0.07	0.40	5.0	5.6	3.1	1.21	5.33	0.69	18	0.26	412.94	413.11	414.53	414.54	416.12	416.28	l
5	4	22	0.36	0.36	0.92	0.33	0.33	5.0	5.0	3.2	1.07	5.52	0.61	18	0.28	413.21	413.27	414.71	414.71	416.28	416.29	n
6	2	19	0.27	2.08	0.92	0.25	1.95	5.0	15.3	1.8	3.59	5.44	2.03	18	0.27	412.56	412.61	414.47	414.49	415.81	415.80	h
7	6	31	0.68	1.81	0.93	0.63	1.70	5.0	15.0	1.9	3.16	5.34	1.79	18	0.26	412.71	412.79	414.54	414.56	415.80	415.84	f
8	7	125	0.95	1.13	0.94	0.89	1.07	5.0	13.2	2.0	2.12	5.32	1.21	18	0.26	412.89	413.21	414.62	414.66	415.84	416.16	d
9	8	194	0.18	0.18	0.99	0.18	0.18	5.0	5.0	3.2	0.58	5.34	0.39	18	0.26	413.31	413.81	414.81	414.82	416.16	417.12	b

DS_24 | Number of lines: 9 | Run Date: 01-14-2011

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51; Return period = 25 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - ex 24 in - q to t

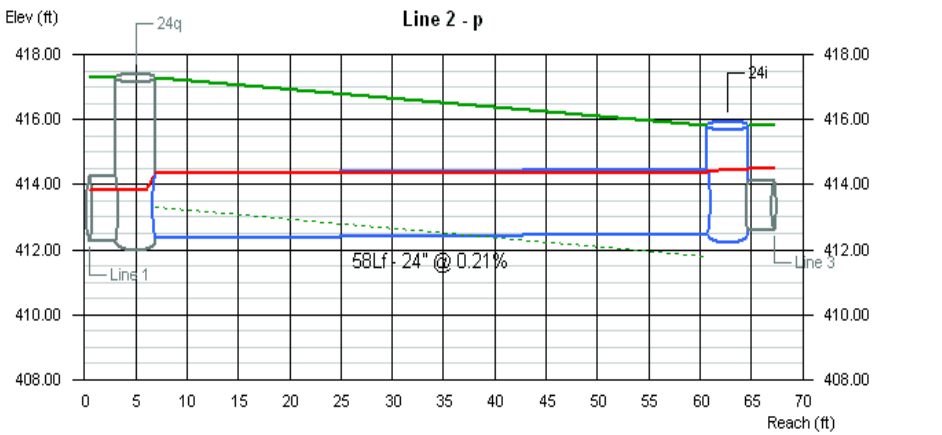


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
1	4.69	411.80	412.26	2.00	1.55	1.56	413.80	413.81	413.82	1.49	1.79	4.83	3.05

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - p

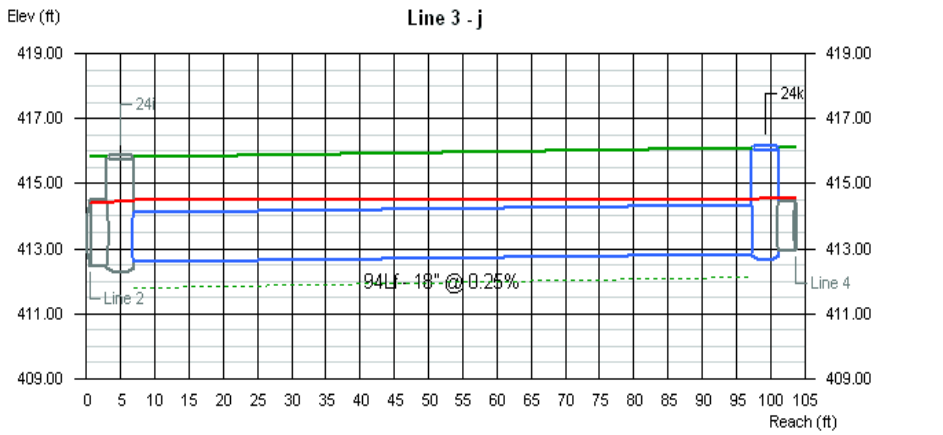


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
2	4.79	412.36	412.48	2.00	1.90	1.99	414.36	414.38	414.47	1.52	1.55	2.95	1.33

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - j

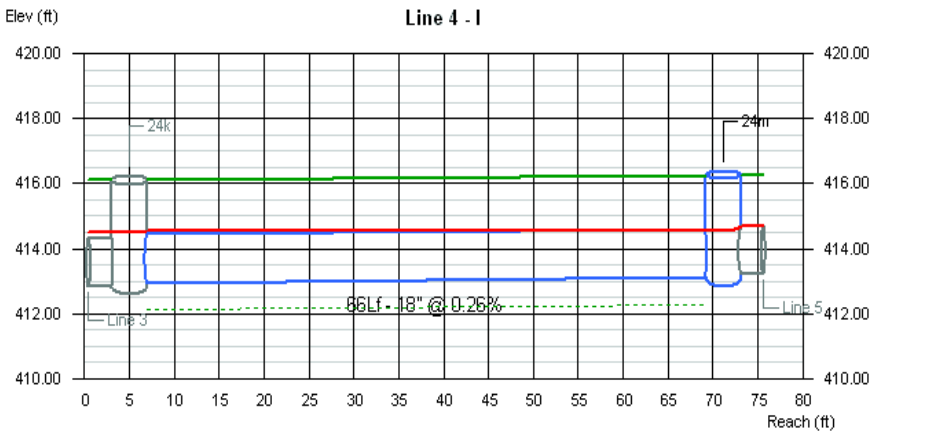


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
3	1.80	412.60	412.84	1.50	1.50	1.68	414.49	414.52	414.52	1.02	1.02	1.71	1.78

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 4) - l

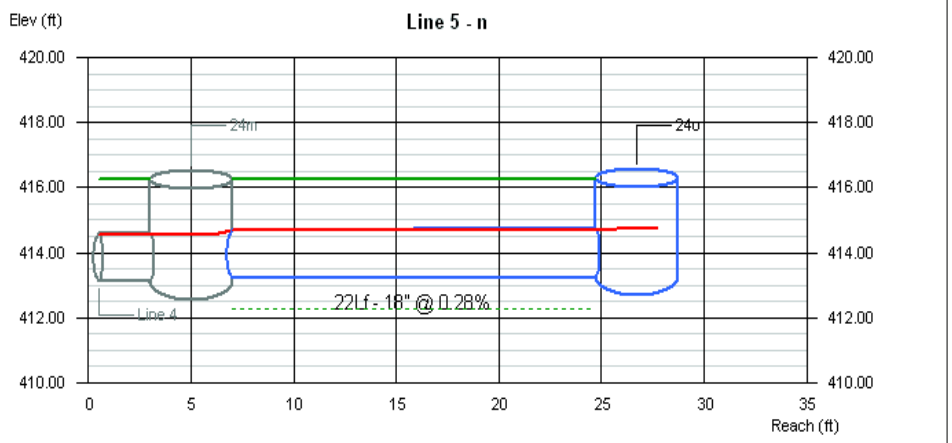


Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
4	1.21	412.94	413.11	1.50	1.43	1.44	414.53	414.54	414.55	0.69	0.70	1.68	1.67

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 5) - n

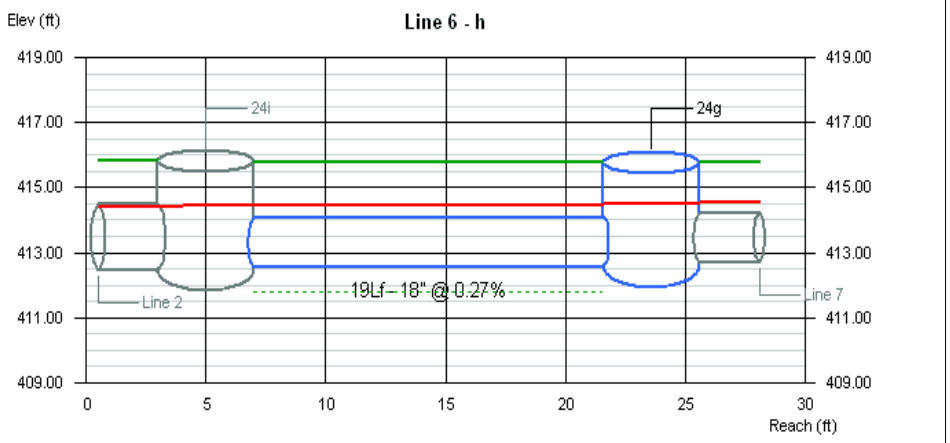


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	1.07	413.21	413.27	1.50	1.44	1.45	414.71	414.71	414.72	0.61	0.61	1.57	1.52

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 6) - h

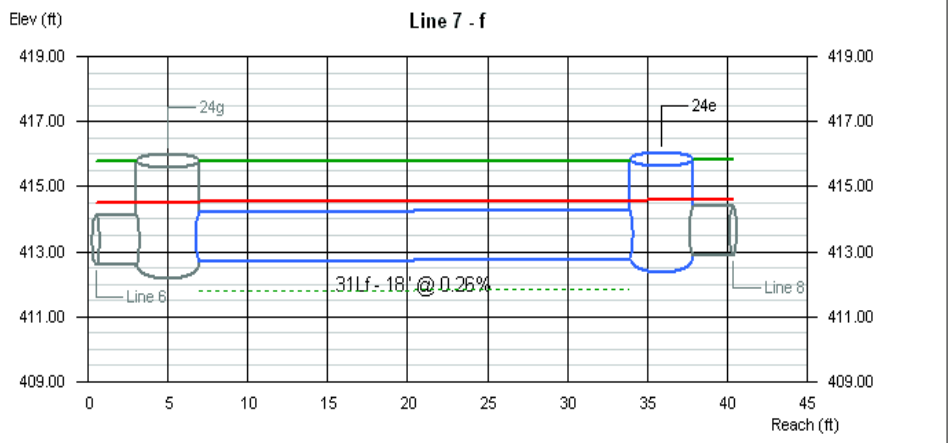


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
6	3.59	412.56	412.61	1.50	1.50	1.91	414.47	414.49	414.52	2.03	2.03	1.75	1.69

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 7) - f

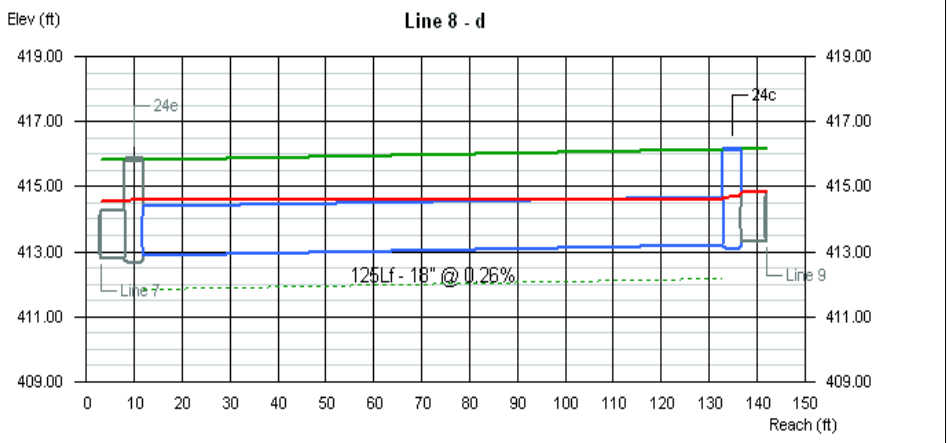


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
7	3.16	412.71	412.79	1.50	1.50	1.80	414.54	414.56	414.59	1.79	1.79	1.59	1.55

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 8) - d

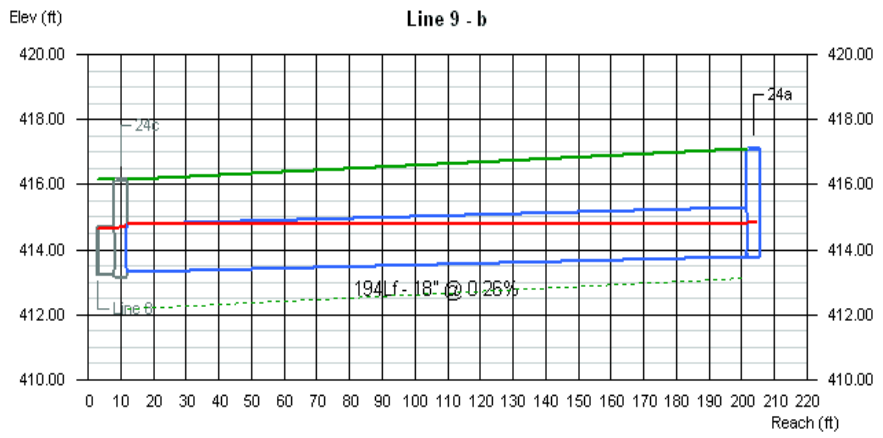


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
8	2.12	412.89	413.21	1.50	1.45	1.47	414.62	414.66	414.68	1.20	1.21	1.45	1.45

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 9) - b

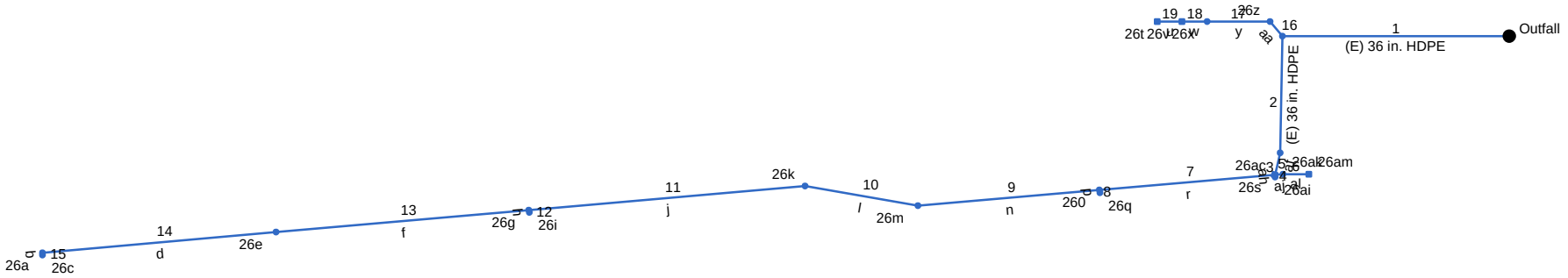


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn	Up	Dn	Up	Hw	Dn	Up	Jnct	Dn	Up	Dn	Up
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(ft/s)	(ft)	(ft)
9	0.58	413.31	413.81	1.50	1.01	1.01	414.81	414.82	414.82	0.33	0.46	1.35	1.81

DS_24 | No. Lines: 9 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

DS_26



Project File: DS_26.stm	Number of lines: 19	Date: 01-14-2011

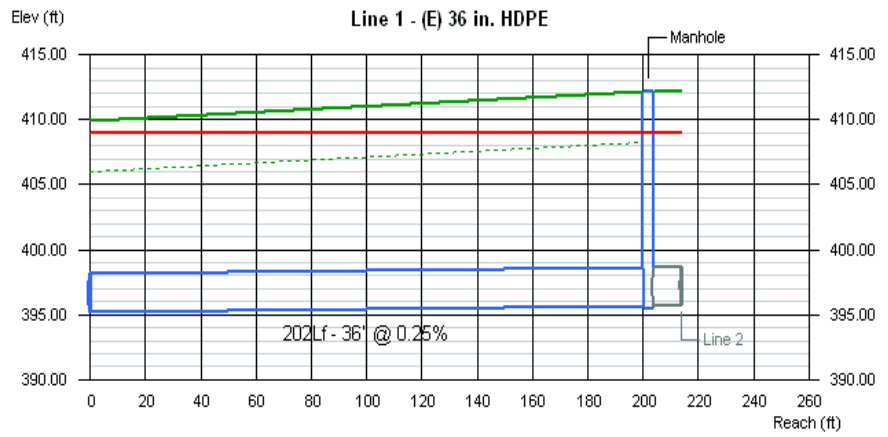
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	202	0.00	4.17	0.00	0.00	4.03	0.0	32.9	1.2	5.02	33.18	0.71	36	0.25	395.16	395.66	408.97	408.98	409.97	412.22	(E) 36 in. HDPE
2	1	104	0.00	3.58	0.00	0.00	3.44	0.0	30.4	1.3	4.46	55.88	0.63	36	0.70	395.66	396.39	408.99	409.00	412.22	411.67	(E) 36 in. HDPE
3	2	20	0.00	3.58	1.00	0.00	3.44	5.0	29.9	1.3	4.50	25.54	0.64	36	0.50	396.39	396.49	409.00	409.00	411.67	410.87	af
4	3	2	0.04	0.04	0.60	0.02	0.02	5.0	5.0	3.2	0.08	3.56	0.10	12	1.00	409.43	409.45	410.43	410.43	410.87	414.71	ah
5	3	7	0.11	0.32	1.00	0.11	0.32	5.0	6.0	3.0	0.95	8.04	0.54	18	2.00	405.03	405.17	409.02	409.02	410.87	410.84	aj
6	5	23	0.21	0.21	1.00	0.21	0.21	5.0	5.0	3.2	0.68	9.49	0.38	18	2.78	405.27	405.91	409.02	409.03	410.84	410.95	al
7	3	157	0.28	3.22	1.00	0.28	3.09	5.0	27.2	1.4	4.25	15.66	0.87	30	0.50	402.47	403.25	409.01	409.07	410.87	411.46	r
8	7	2	0.12	0.12	0.60	0.07	0.07	5.0	5.0	3.2	0.23	3.40	0.30	12	0.91	409.43	409.45	410.43	410.43	411.46	416.43	p
9	7	162	0.31	2.82	1.00	0.31	2.74	5.0	24.1	1.5	4.00	15.71	0.82	30	0.50	403.35	404.16	409.09	409.14	411.46	411.97	n
10	9	102	0.28	2.51	1.00	0.28	2.43	5.0	22.0	1.5	3.72	15.71	0.76	30	0.50	404.26	404.77	409.15	409.18	411.97	412.57	l
11	10	247	0.74	2.23	1.00	0.74	2.15	5.0	16.9	1.8	3.77	15.74	0.77	30	0.50	404.87	406.11	409.18	409.25	412.57	412.45	j
12	11	2	0.07	0.07	0.60	0.04	0.04	5.0	5.0	3.2	0.14	8.35	0.18	12	5.50	410.46	410.57	411.46	411.46	412.45	415.09	h
13	11	226	0.68	1.42	1.00	0.68	1.37	5.0	11.1	2.2	2.96	15.78	0.66	30	0.50	406.21	407.35	409.27	409.31	412.45	414.02	f
14	13	209	0.66	0.74	0.97	0.64	0.69	5.0	5.2	3.2	2.19	15.75	0.58	30	0.50	407.45	408.50	409.95	409.98	414.02	414.60	d
15	14	2	0.08	0.08	0.60	0.05	0.05	5.0	5.0	3.2	0.16	3.56	0.20	12	1.00	412.18	412.20	413.18	413.18	414.60	417.09	b
16	1	17	0.09	0.59	1.00	0.09	0.59	5.0	7.0	2.7	1.61	8.16	0.91	18	2.06	405.32	405.67	408.99	409.00	412.22	411.69	aa
17	16	56	0.01	0.50	1.00	0.01	0.50	5.0	5.9	3.0	1.49	8.08	0.84	18	2.02	405.77	406.90	409.02	409.06	411.69	411.70	y
18	17	22	0.11	0.49	1.00	0.11	0.49	5.0	5.5	3.1	1.52	8.14	0.86	18	2.05	407.00	407.45	409.06	409.08	411.70	411.61	w
19	18	22	0.38	0.38	1.00	0.38	0.38	5.0	5.0	3.2	1.23	8.14	0.79	18	2.05	407.55	408.00	409.09	409.10	411.61	411.71	u

DS_26 | Number of lines: 19 | Run Date: 01-14-2011

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51; Return period = 25 Yrs. ; c = cir e = ellip b = box

Line Profile (Line 1) - (E) 36 in. HDPE

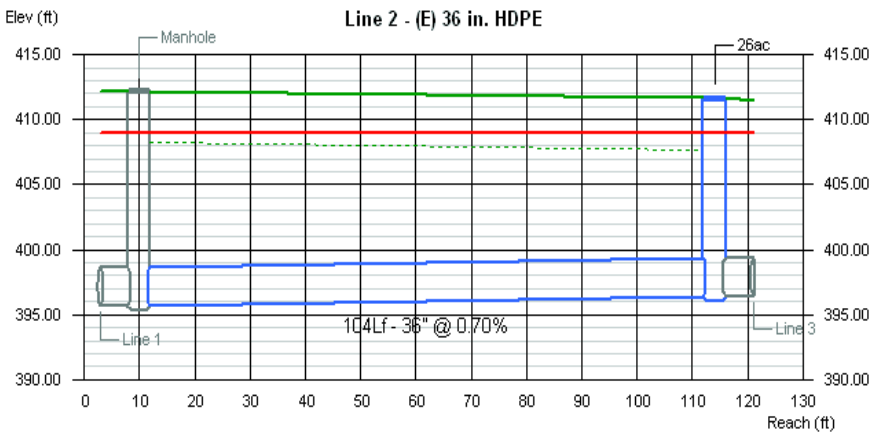


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
1	5.02	395.16	395.66	3.00	3.00	13.33	408.97	408.98	408.99	0.71	0.71	11.81	13.56

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 2) - (E) 36 in. HDPE

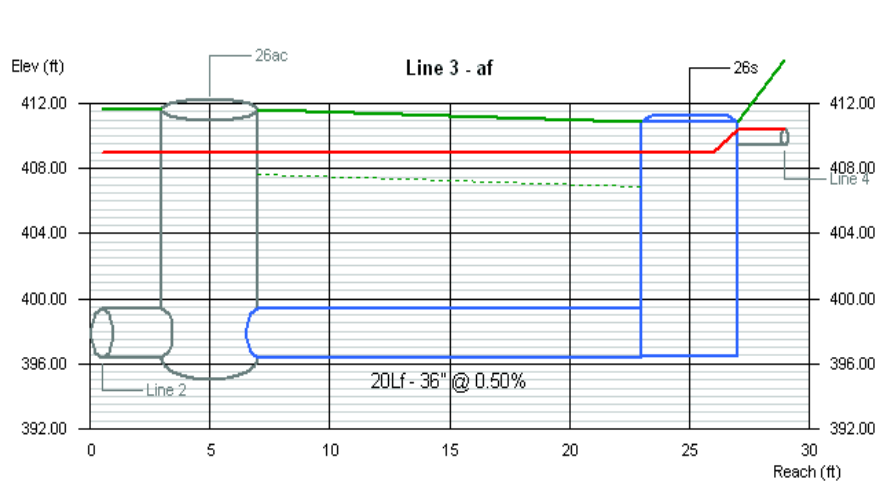


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
2	4.46	395.66	396.39	3.00	3.00	12.61	408.99	409.00	409.00	0.63	0.63	13.56	12.28

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 3) - af

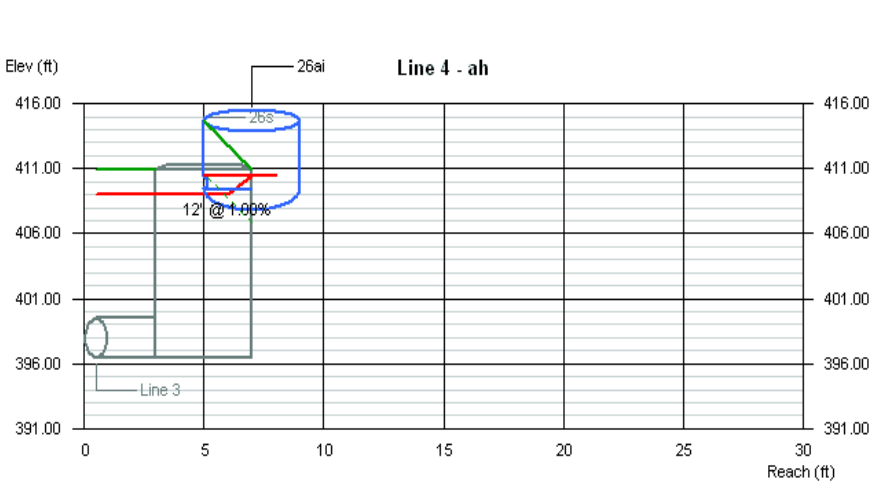


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
3	4.50	396.39	396.49	3.00	3.00	12.52	409.00	409.00	409.01	0.64	0.64	12.28	11.38

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 4) - ah

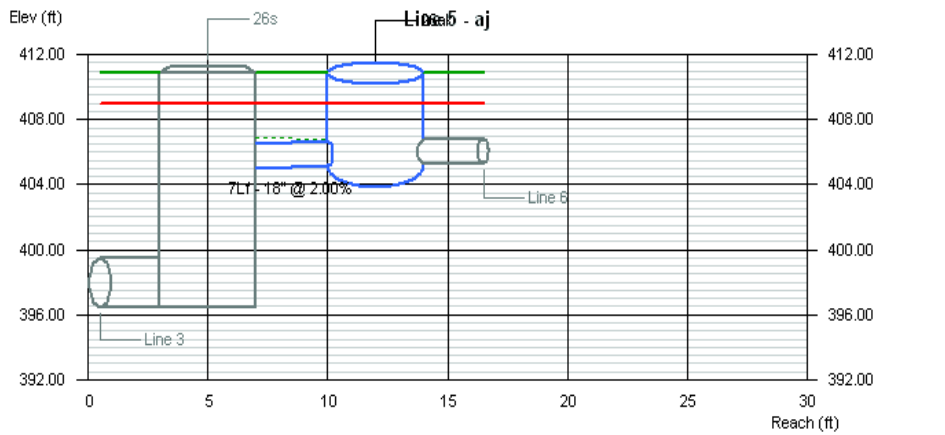


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
4	0.08	409.43	409.45	1.00	0.98	0.98	410.43	410.43	410.43	0.10	0.10	0.44	4.26

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

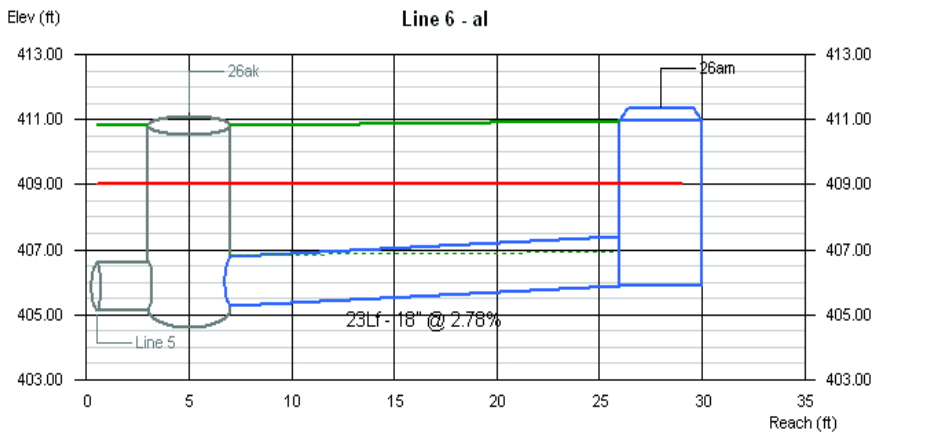
Line Profile (Line 5) - aj



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	0.95	405.03	405.17	1.50	1.50	3.85	409.02	409.02	409.02	0.54	0.54	4.34	4.17

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

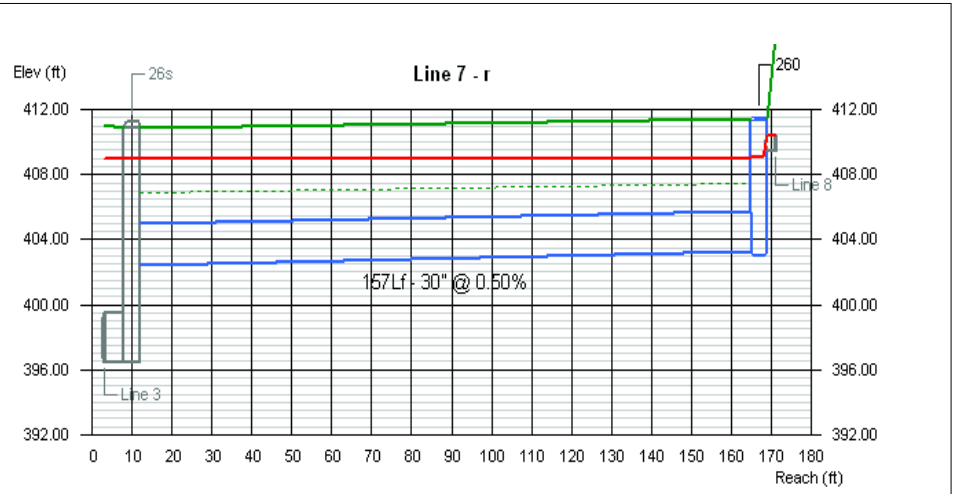
Line Profile (Line 6) - al



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
6	0.68	405.27	405.91	1.50	1.50	3.12	409.02	409.03	409.03	0.38	0.38	4.07	3.54

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

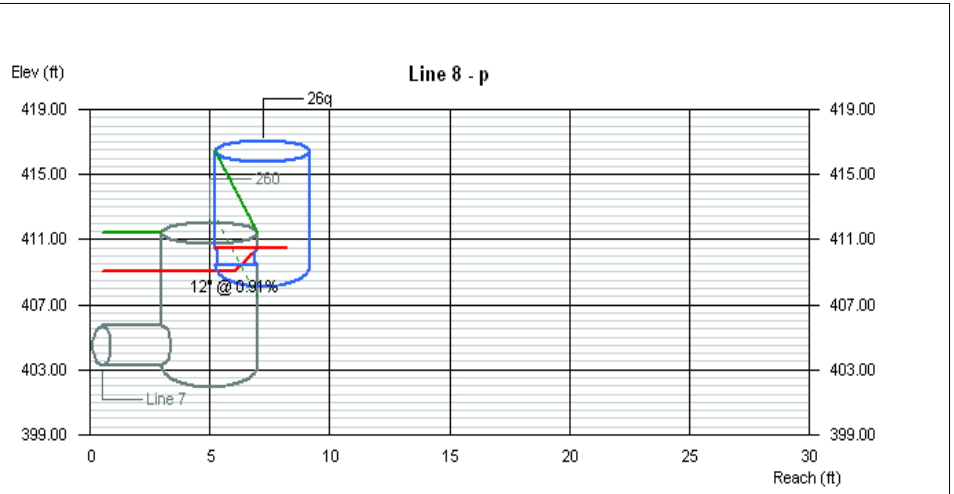
Line Profile (Line 7) - r



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
7	4.25	402.47	403.25	2.50	2.50	5.84	409.01	409.07	409.09	0.87	0.87	5.90	5.71

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

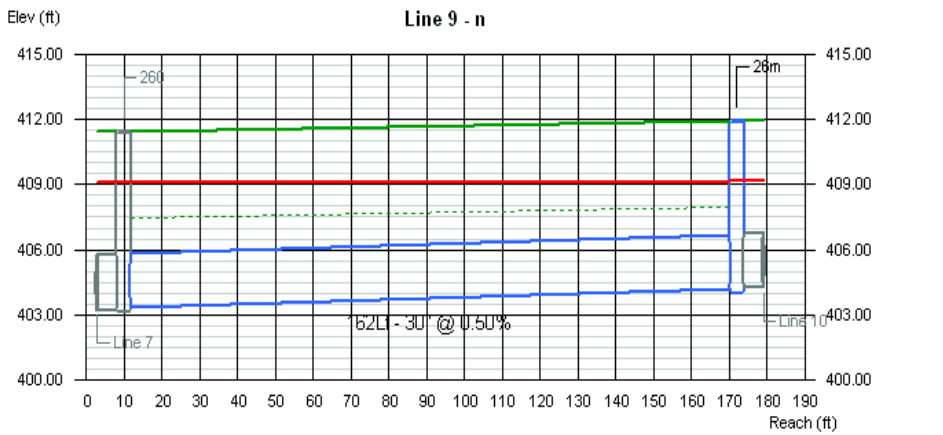
Line Profile (Line 8) - p



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
8	0.23	409.43	409.45	1.00	0.98	0.98	410.43	410.43	410.43	0.30	0.30	1.03	5.98

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Line Profile (Line 9) - n

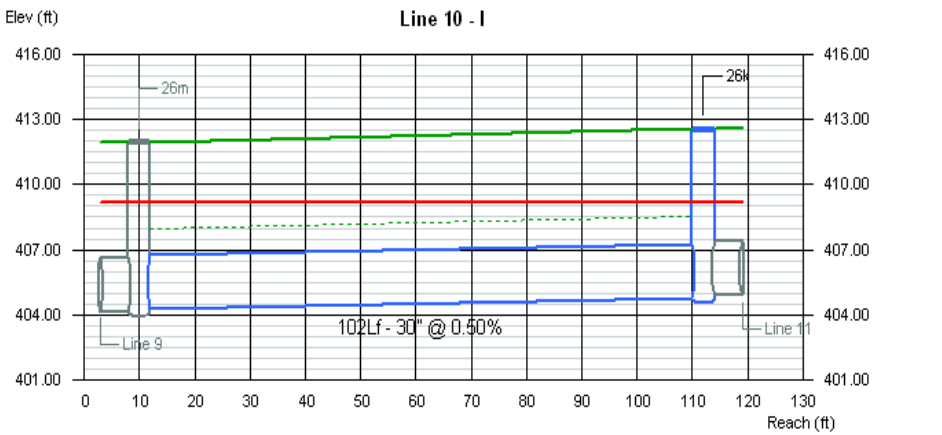


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
9	4.00	403.35	404.16	2.50	2.50	4.99	409.09	409.14	409.15	0.82	0.82	5.61	5.31

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 10) - l

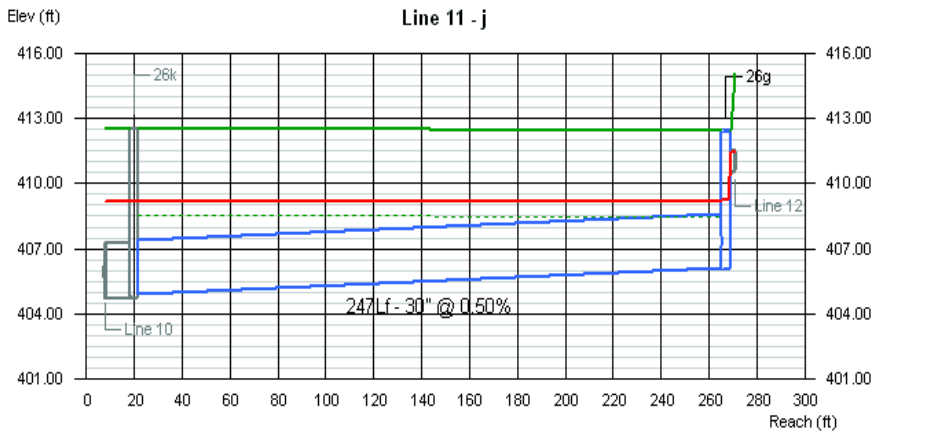


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
10	3.72	404.26	404.77	2.50	2.50	4.41	409.15	409.18	409.18	0.76	0.76	5.21	5.30

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 11) - j

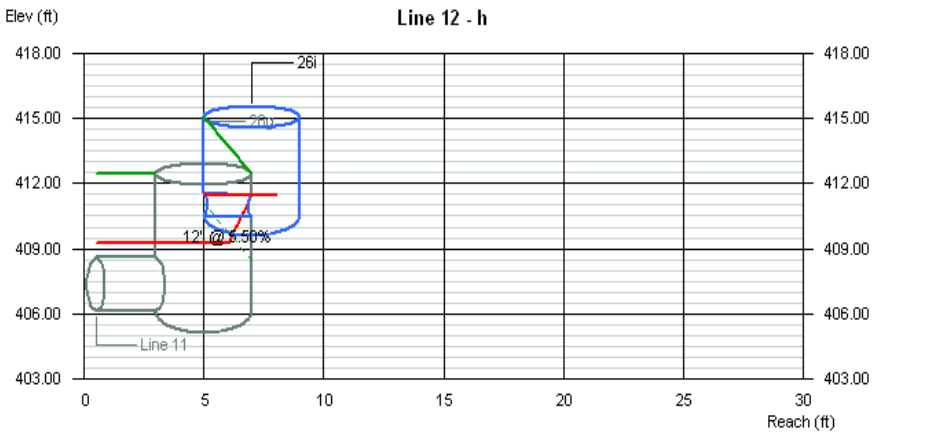


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
11	3.77	404.87	406.11	2.50	2.50	3.16	409.18	409.25	409.27	0.77	0.77	5.20	3.84

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

Line Profile (Line 12) - h

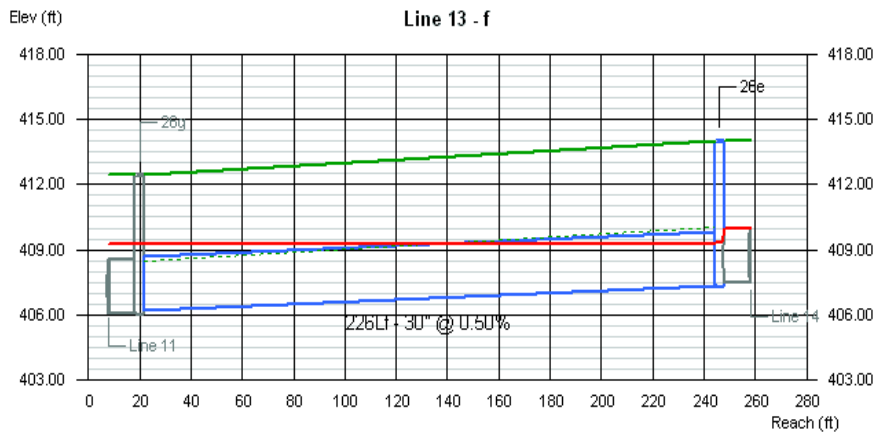


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
12	0.14	410.46	410.57	1.00	0.89	0.89	411.46	411.46	411.46	0.17	0.18	0.99	3.52

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

Hydraflow Storm Sewers 2008

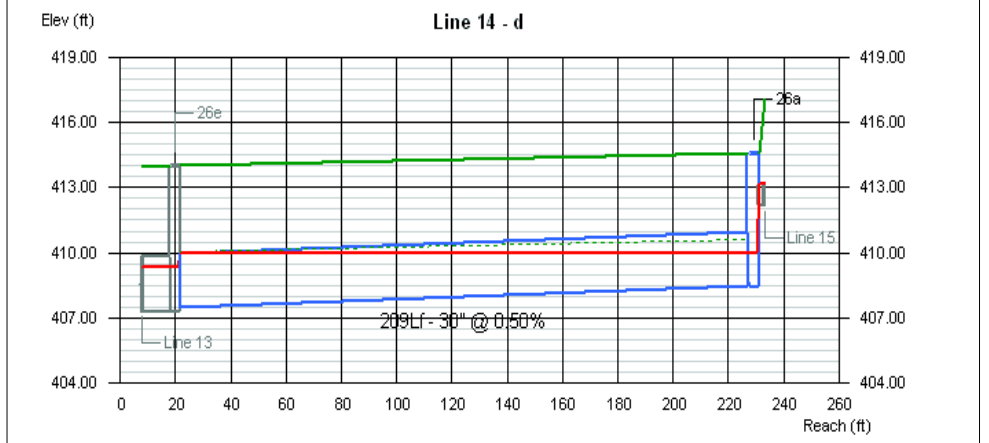
Line Profile (Line 13) - f



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
13	2.96	406.21	407.35	2.50	1.96	1.96	409.27	409.31	409.31	0.60	0.72	3.74	4.17

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

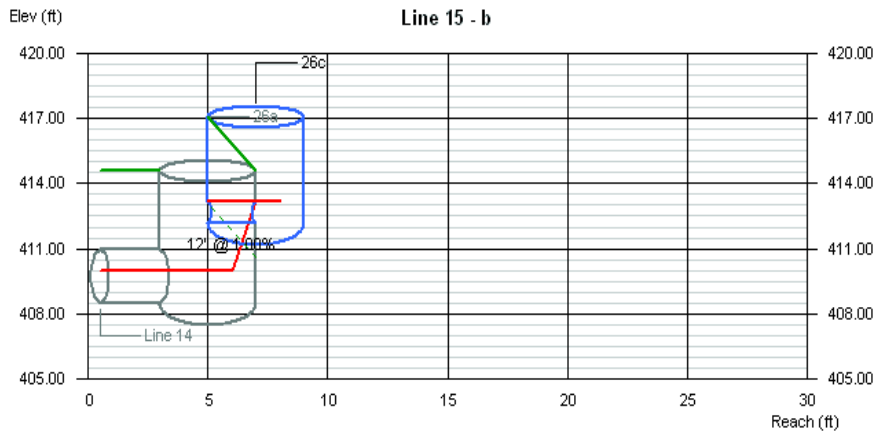
Line Profile (Line 14) - d



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
14	2.19	407.45	408.50	2.50	1.48	1.49	409.95	409.98	409.99	0.45	0.72	4.07	3.60

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

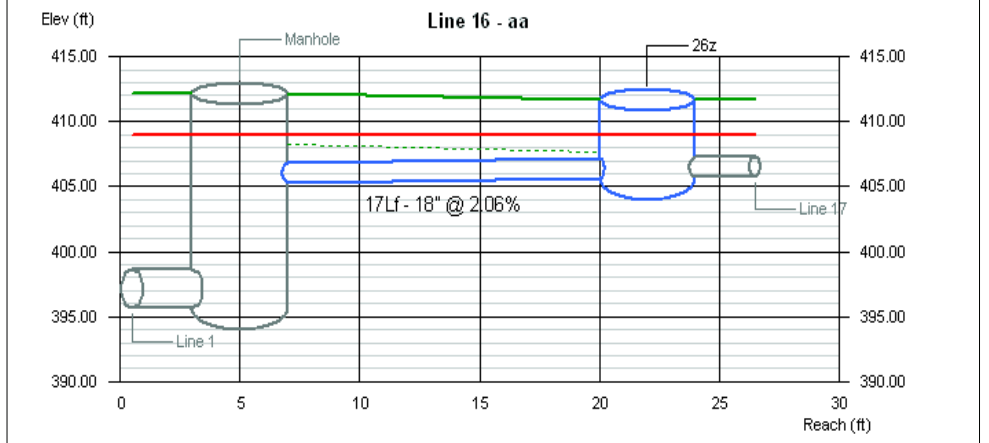
Line Profile (Line 15) - b



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
15	0.16	412.18	412.20	1.00	0.98	0.98	413.18	413.18	413.18	0.20	0.20	1.42	3.89

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

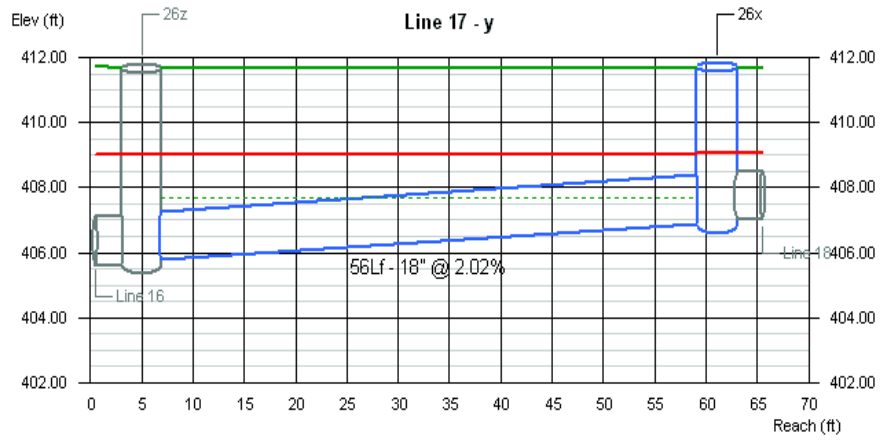
Line Profile (Line 16) - aa



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
16	1.61	405.32	405.67	1.50	1.50	3.35	408.99	409.00	409.02	0.91	0.91	5.40	4.52

DS_26 | No. Lines: 19 | Run Date: 01-14-2011

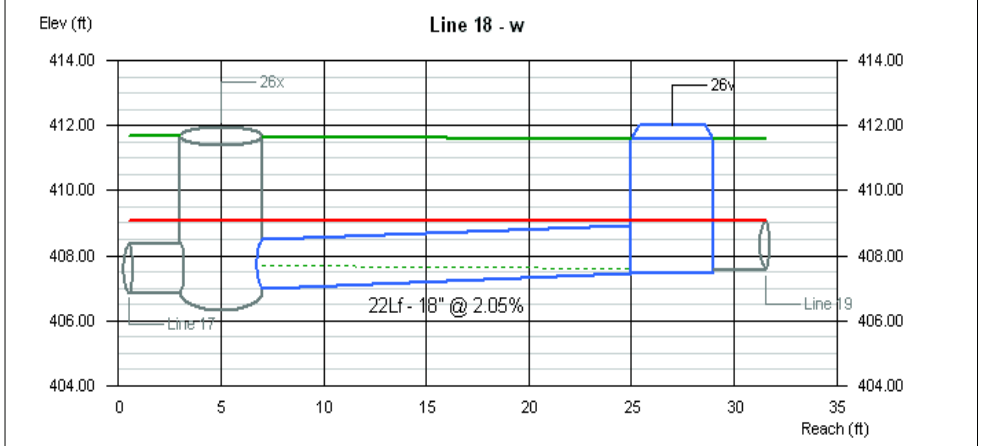
Line Profile (Line 17) - y



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
17	1.49	405.77	406.90	1.50	1.50	2.16	409.02	409.06	409.06	0.84	0.84	4.42	3.30

DS_26	No. Lines: 19	Run Date: 01-14-2011

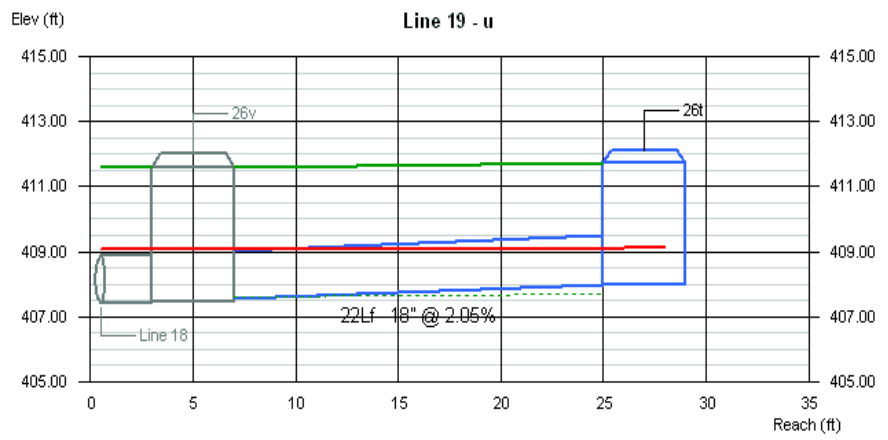
Line Profile (Line 18) - w



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
18	1.52	407.00	407.45	1.50	1.50	1.64	409.06	409.08	409.09	0.86	0.86	3.20	2.66

DS_26	No. Lines: 19	Run Date: 01-14-2011

Line Profile (Line 19) - u

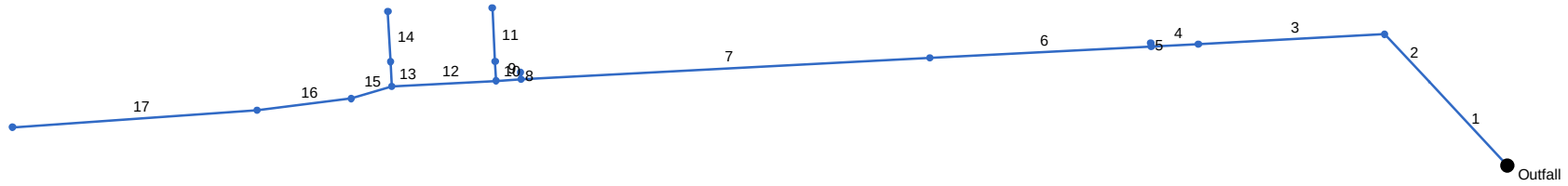


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
19	1.23	407.55	408.00	1.50	1.10	1.11	409.09	409.10	409.11	0.70	0.89	2.56	2.21

DS_26	No. Lines: 19	Run Date: 01-14-2011

Segment B
(PM 22.9 to PM 25.7)

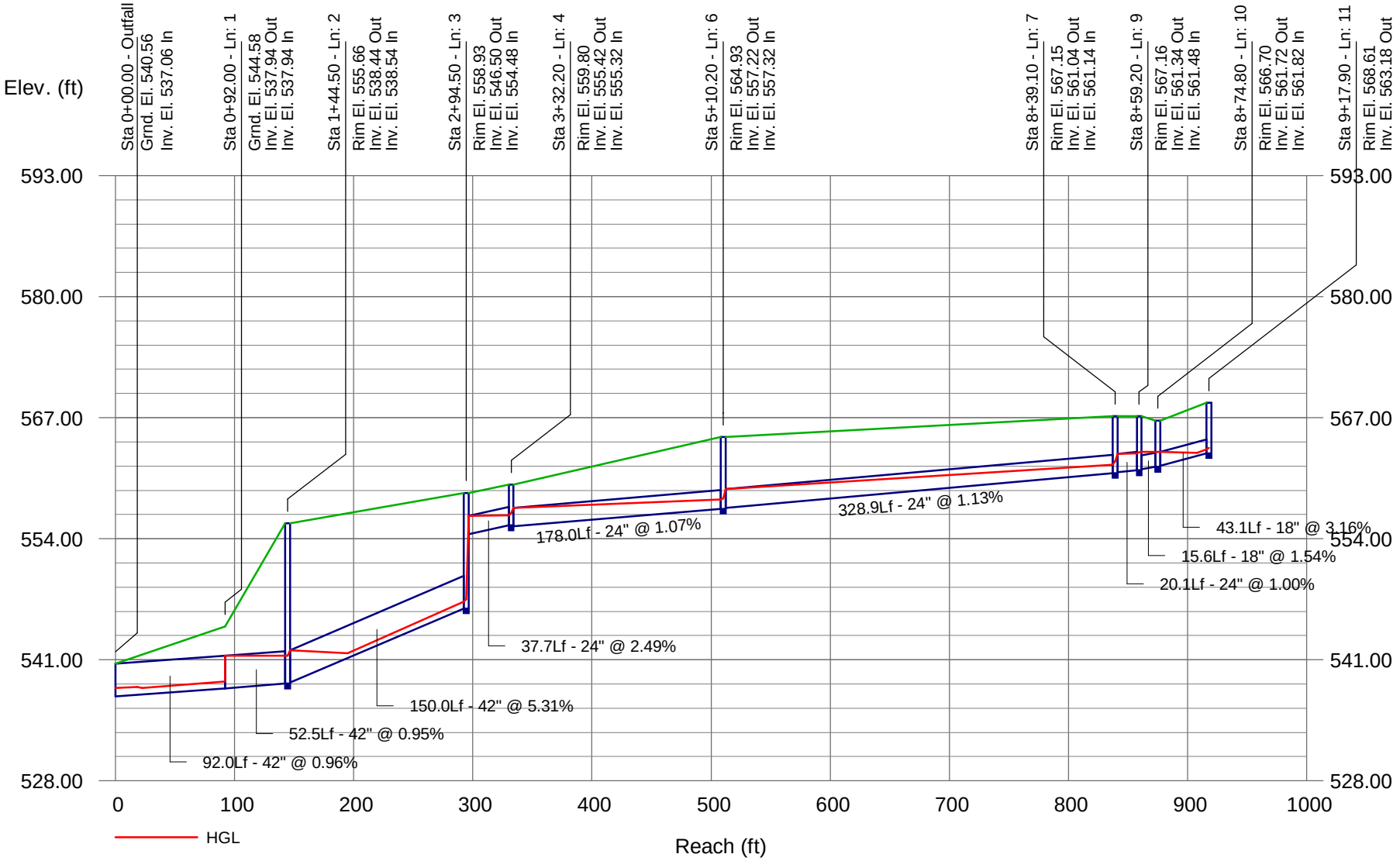
DS_01_100%



Project File: DS_1_100%.stm	Number of lines: 17	Date: 10-20-2010

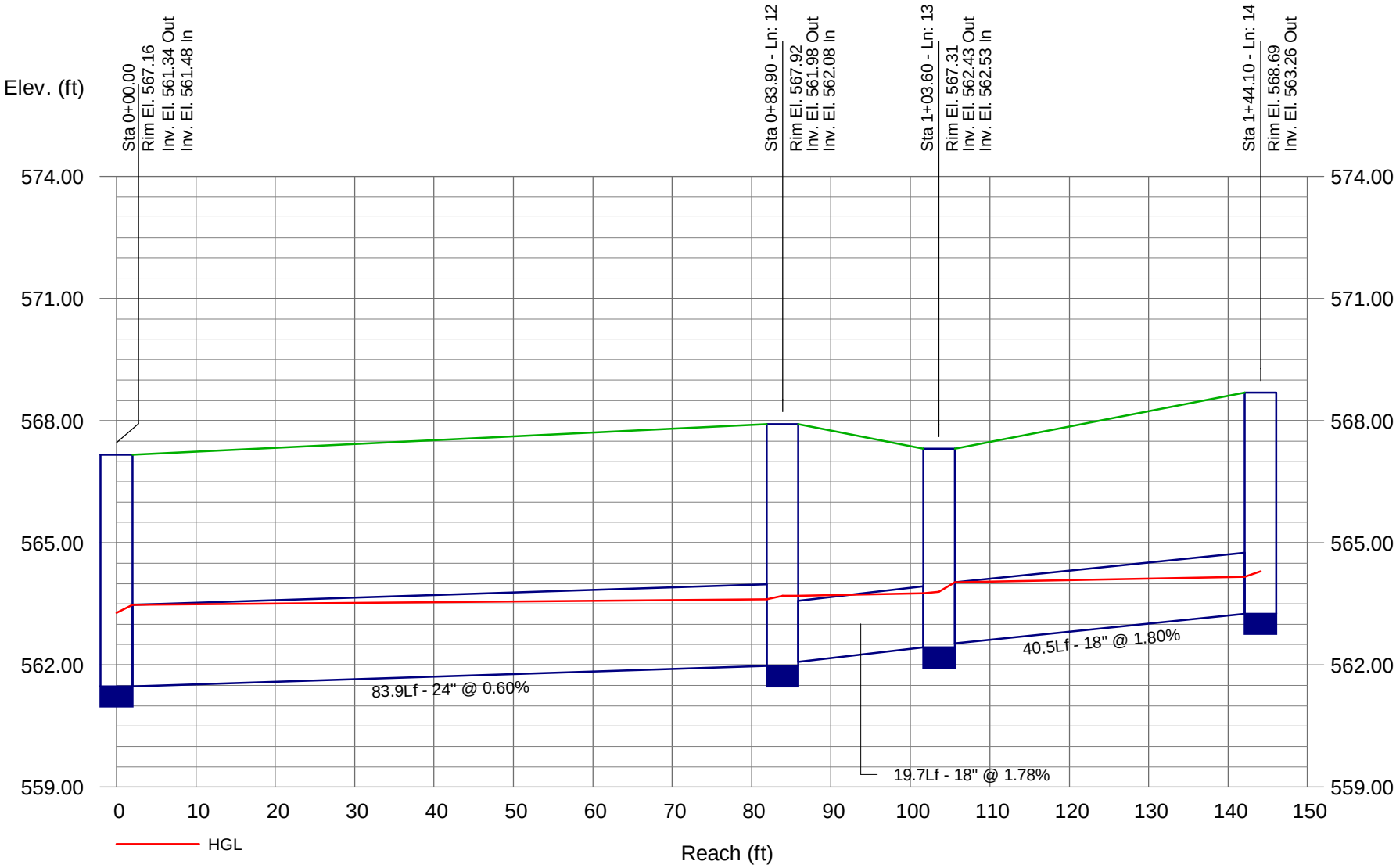
Storm Sewer Profile

Proj. file: DS_1_100%.stm



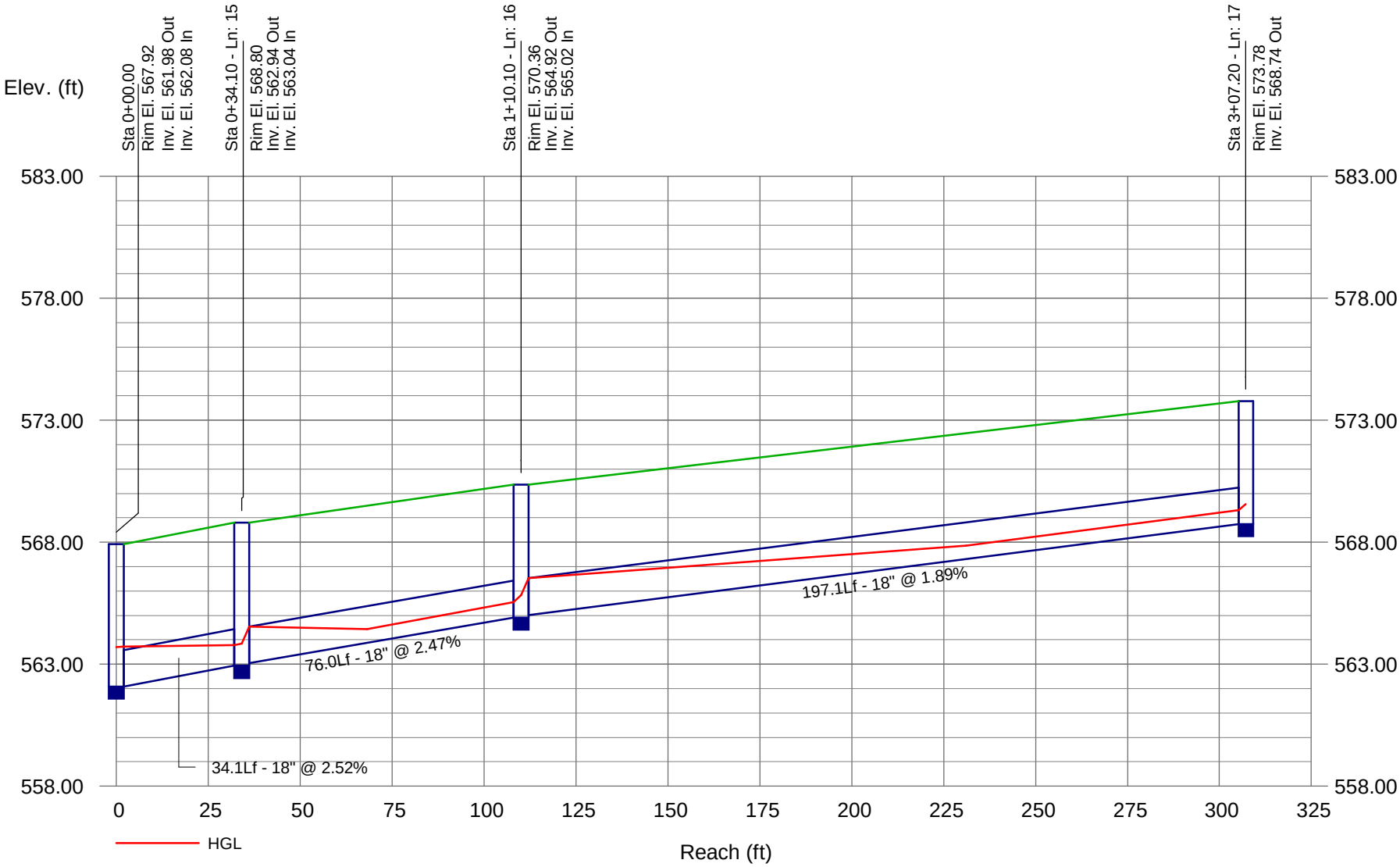
Storm Sewer Profile

Proj. file: DS_1_100%.stm



Storm Sewer Profile

Proj. file: DS_1_100%.stm



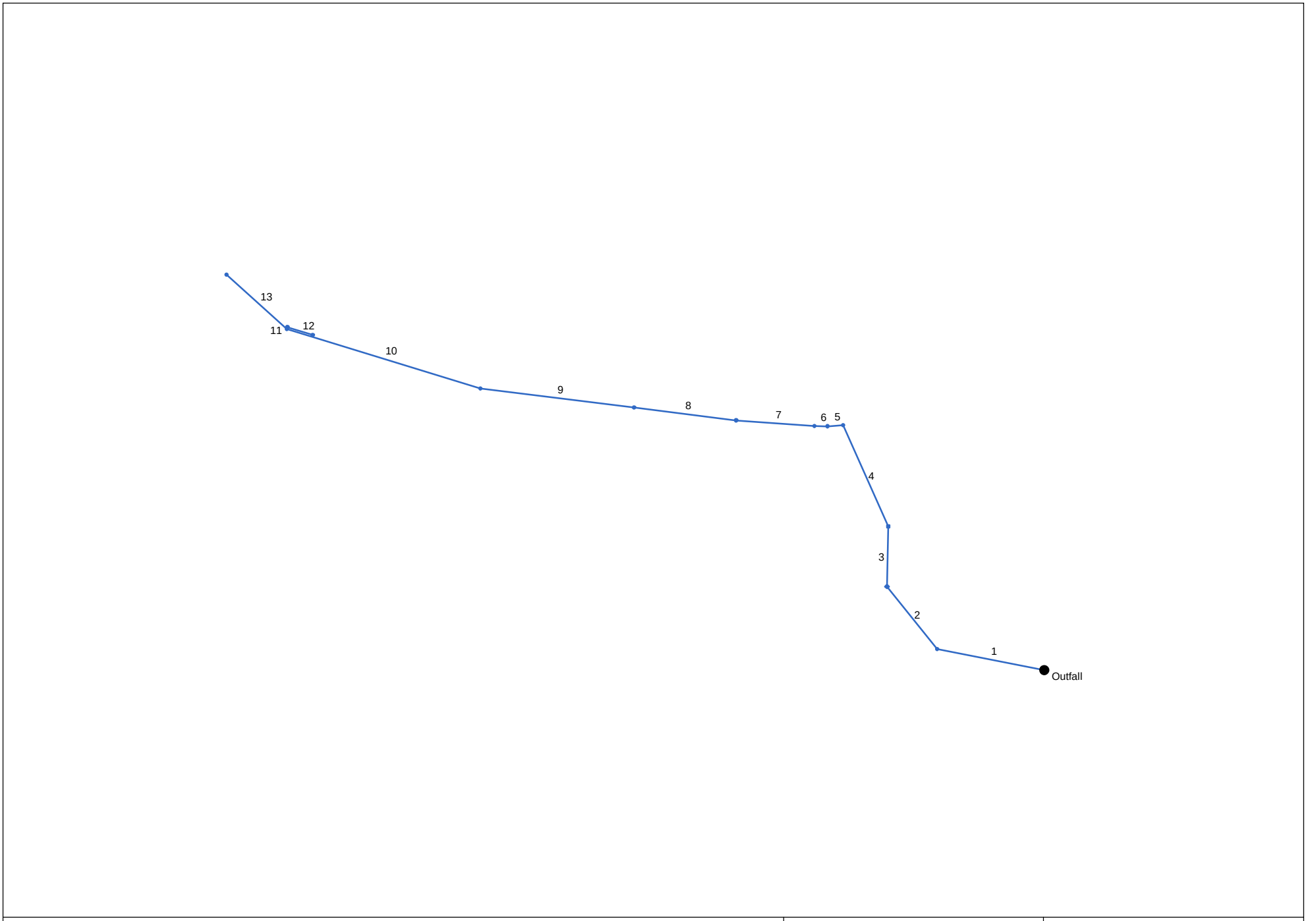
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	92.0	0.00	4.38	1.00	5.0	18.5	1.67	5.66	0.00	5.66	3.31	42	0.96	0.024	537.06	537.94	538.00	538.67 j	540.56	544.58	
2	1	52.5	0.00	4.38	1.00	5.0	17.1	1.74	5.88	0.00	5.88	0.64	42	0.95	0.024	537.94	538.44	541.44	541.45	544.58	555.66	1aj
3	2	150.0	0.00	4.38	1.00	1.0	16.0	1.80	6.08	0.00	6.08	2.31	42	5.31	0.024	538.54	546.50	542.04	547.26 j	555.66	558.93	1ag
4	3	37.7	0.05	4.38	1.00	5.0	15.8	1.81	6.12	0.00	6.12	2.67	24	2.49	0.024	554.48	555.42	556.48	556.54	558.93	559.80	1ac
5	4	2.9	0.26	0.26	0.72	10.0	10.0	2.28	0.43	0.00	0.43	1.10	12	26.90	0.013	555.80	556.58	556.98	556.94	559.80	560.58	1ad
6	4	178.0	0.00	4.07	1.00	5.0	14.7	1.88	5.90	0.00	5.90	2.84	24	1.07	0.024	555.32	557.22	557.32	558.21	559.80	564.93	1aa
7	6	328.9	0.00	4.07	1.00	5.0	13.1	1.99	6.27	0.00	6.27	3.28	24	1.13	0.024	557.32	561.04	559.32	561.94	564.93	567.15	1w
8	7	5.7	0.17	0.17	0.72	5.0	5.0	3.24	0.40	0.00	0.40	1.43	12	110.00	0.013	561.24	567.51	562.33	567.78 j	567.15	570.51	1x
9	7	20.1	0.01	3.90	0.69	5.0	12.9	2.01	6.06	0.00	6.06	1.97	24	1.00	0.024	561.14	561.34	563.14	563.18	567.15	567.16	1q
10	9	15.6	0.19	0.65	0.77	5.0	5.4	3.12	1.69	0.00	1.69	0.96	18	1.54	0.024	561.48	561.72	563.32	563.34	567.16	566.70	1t
11	10	43.1	0.46	0.46	0.86	5.0	5.0	3.24	1.28	0.00	1.28	1.88	18	3.16	0.024	561.82	563.18	563.35	563.61 j	566.70	568.61	1r
12	9	83.9	0.07	3.24	0.69	5.0	12.1	2.07	5.13	0.00	5.13	1.75	24	0.60	0.024	561.48	561.98	563.48	563.61	567.16	567.92	1g
13	12	19.7	0.19	1.66	0.75	5.0	5.3	3.15	3.64	0.00	3.64	2.13	18	1.78	0.024	562.08	562.43	563.69	563.76	567.92	567.31	1i
14	13	40.5	1.47	1.47	0.69	5.0	5.0	3.24	3.28	0.00	3.28	2.40	18	1.80	0.024	562.53	563.26	564.03	564.16	567.31	568.69	1k
15	12	34.1	0.04	1.51	0.73	5.0	11.8	2.10	2.66	0.00	2.66	2.05	18	2.52	0.024	562.08	562.94	563.71	563.78	567.92	568.80	1e
16	15	76.0	0.29	1.47	0.89	5.0	11.3	2.14	2.65	0.00	2.65	2.67	18	2.47	0.024	563.04	564.92	564.54	565.54 j	568.80	570.36	1c
17	16	197.1	1.18	1.18	0.83	10.0	10.0	2.28	2.24	0.00	2.24	2.44	18	1.89	0.024	565.02	568.74	566.52	569.31 j	570.36	573.78	1a

DS_01_100% | Number of lines: 17 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

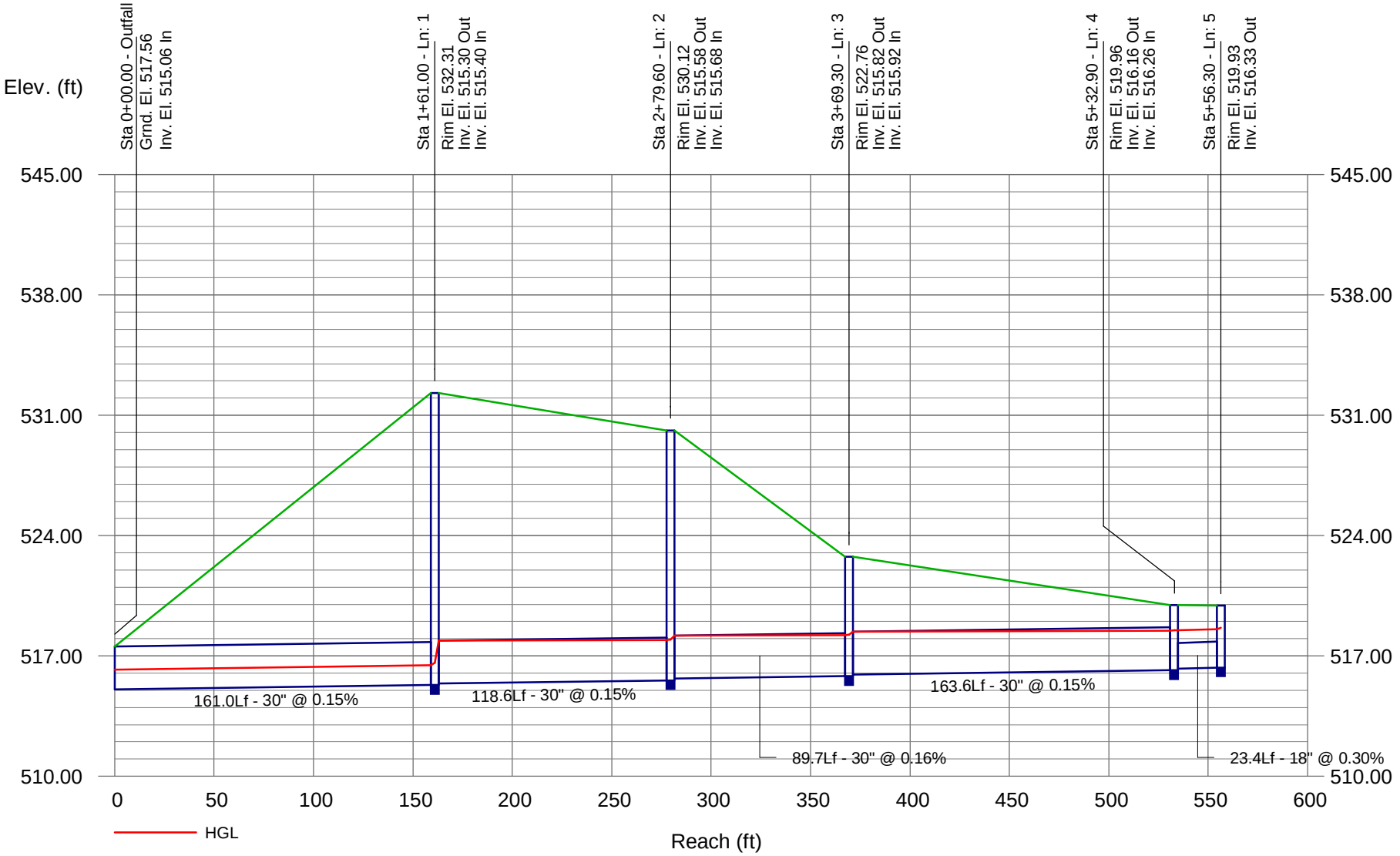
DS_04_100%



Project File: DS_04_100%.stm	Number of lines: 13	Date: 10-20-2010

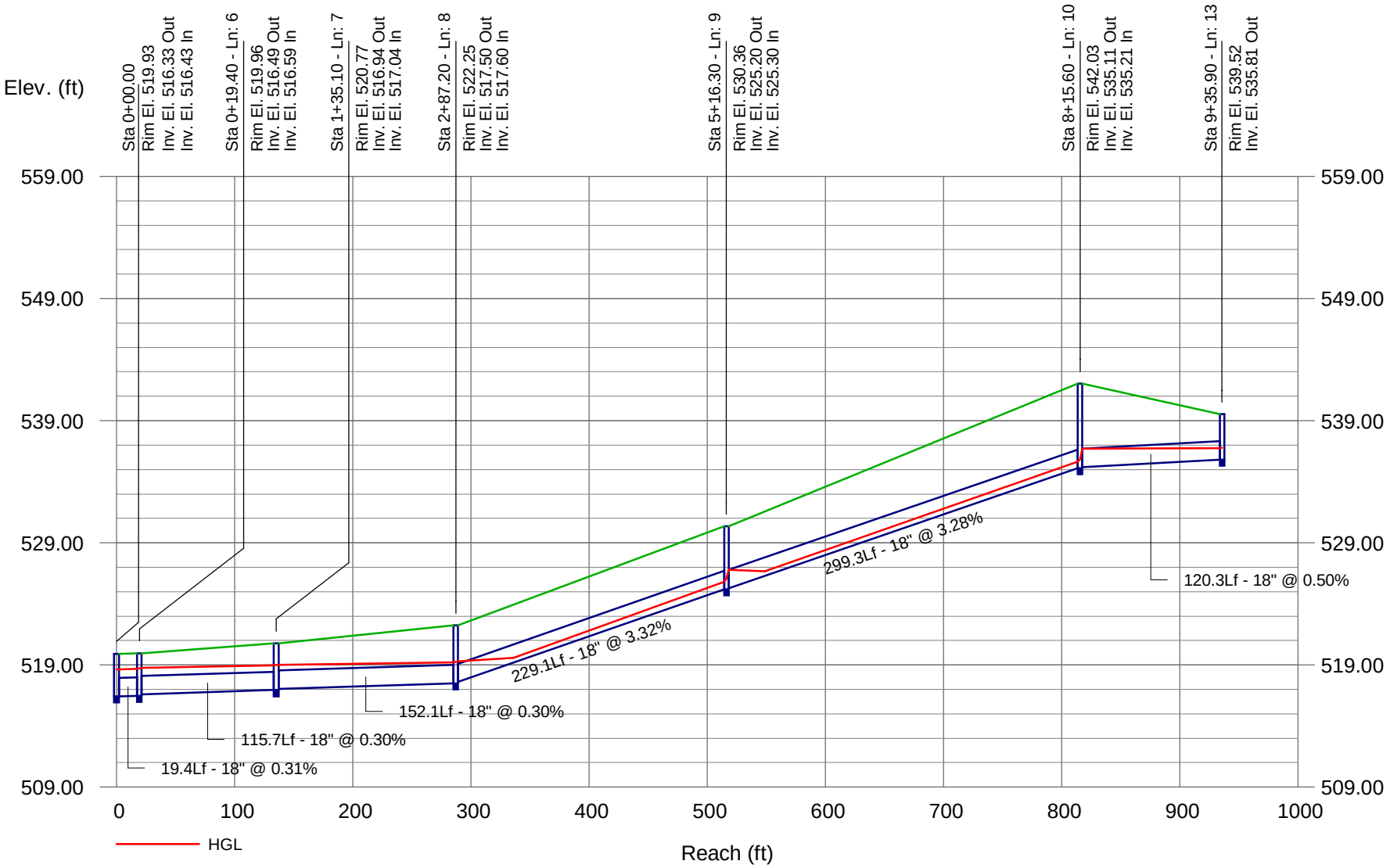
Storm Sewer Profile

Proj. file: DS_04_100%.stm



Storm Sewer Profile

Proj. file: DS_04_100%.stm



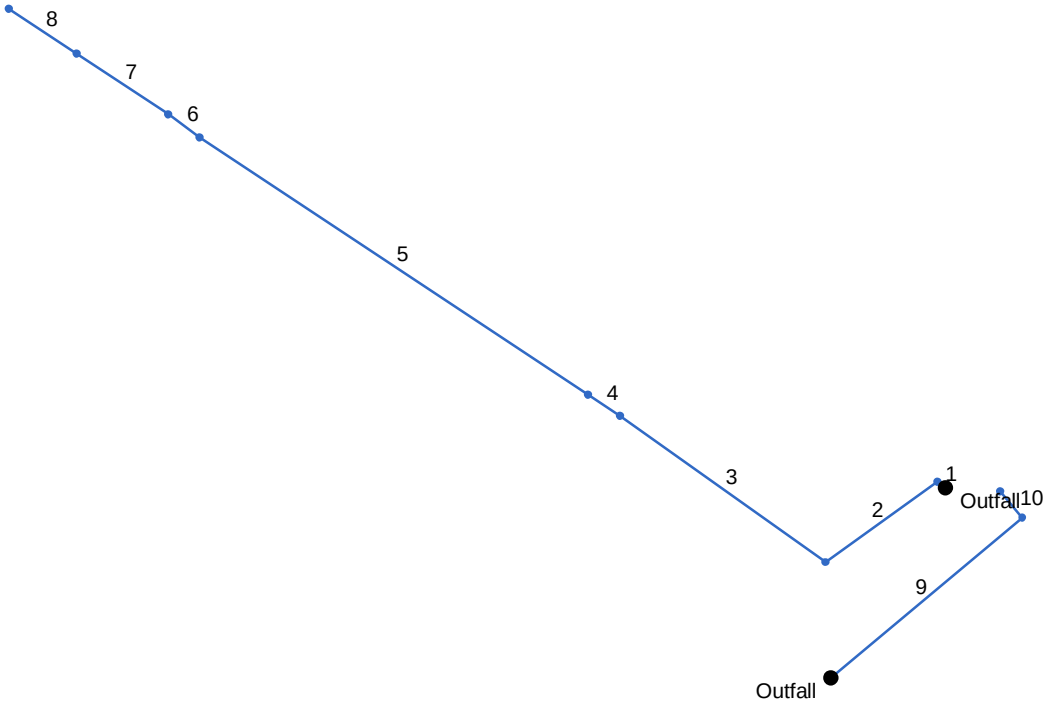
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	161.0	0.00	4.98	0.00	5.0	22.4	1.52	6.83	0.00	6.83	3.10	30	0.15	0.013	515.06	515.30	516.21	516.45	517.56	532.31	4z
2	1	118.6	0.15	4.98	1.00	5.0	21.1	1.56	7.04	0.00	7.04	1.45	30	0.15	0.013	515.40	515.58	517.90	517.93	532.31	530.12	4x
3	2	89.7	0.37	4.83	0.86	5.0	20.1	1.60	6.99	0.00	6.99	1.44	30	0.16	0.013	515.68	515.82	518.18	518.20	530.12	522.76	4v
4	3	163.6	1.08	4.46	0.96	5.0	18.2	1.69	6.81	0.00	6.81	1.41	30	0.15	0.013	515.92	516.16	518.42	518.46	522.76	519.96	4s
5	4	23.4	0.20	3.38	1.00	5.0	18.0	1.69	5.08	0.00	5.08	2.88	18	0.30	0.013	516.26	516.33	518.51	518.56	519.96	519.93	4q
6	5	19.4	0.34	3.18	0.99	5.0	17.9	1.70	4.76	0.00	4.76	2.69	18	0.31	0.013	516.43	516.49	518.64	518.68	519.93	519.96	4o
7	6	115.7	0.40	2.84	0.99	5.0	17.1	1.74	4.28	0.00	4.28	2.42	18	0.30	0.013	516.59	516.94	518.76	518.95	519.96	520.77	4m
8	7	152.1	0.80	2.44	1.00	5.0	15.9	1.80	3.73	0.00	3.73	2.11	18	0.30	0.013	517.04	517.50	519.02	519.21	520.77	522.25	4k
9	8	229.1	0.31	1.64	1.00	5.0	14.4	1.90	2.41	0.00	2.41	2.54	18	3.32	0.013	517.60	525.20	519.29	525.79 j	522.25	530.36	4i
10	9	299.3	0.00	1.33	0.00	0.0	12.2	2.06	1.97	0.00	1.97	2.30	18	3.28	0.013	525.30	535.11	526.80	535.65 j	530.36	542.03	4g
11	10	2.9	0.04	0.18	0.72	5.0	12.1	2.08	0.27	0.00	0.27	0.27	18	30.00	0.013	538.03	538.90	539.53	539.53	542.03	543.42	4c
12	11	39.2	0.14	0.14	0.72	10.0	10.0	2.28	0.23	0.00	0.23	0.32	12	0.51	0.013	539.97	540.17	540.97	540.97	543.42	542.34	4e
13	10	120.3	1.15	1.15	0.72	10.0	10.0	2.28	1.89	0.00	1.89	1.35	18	0.50	0.013	535.21	535.81	536.71	536.75	542.03	539.52	4a

DS_04_100% | Number of lines: 13 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

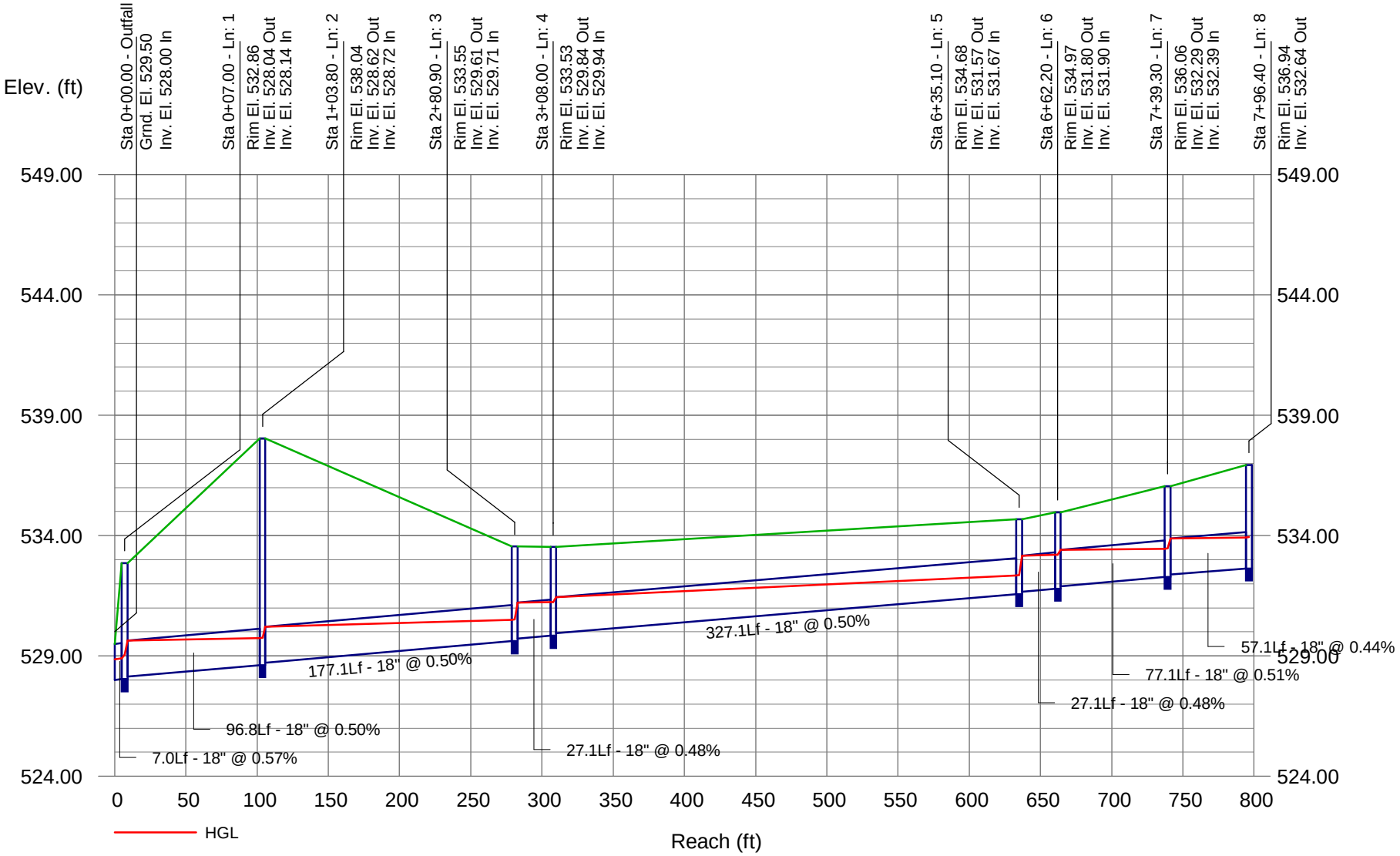
DS_06_100%



Project File: DS_06_100%.stm	Number of lines: 10	Date: 10-20-2010

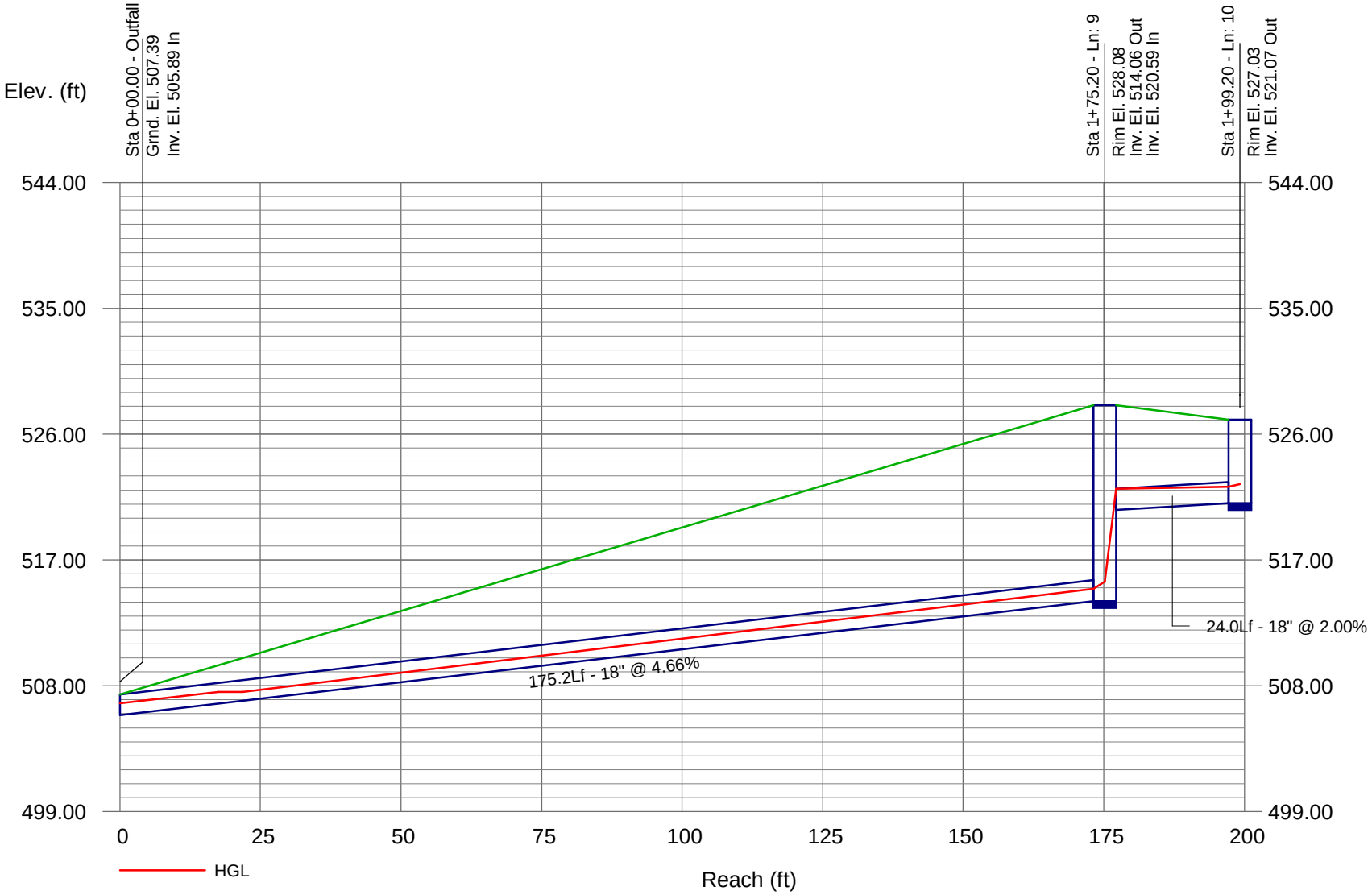
Storm Sewer Profile

Proj. file: DS_06_100%.stm



Storm Sewer Profile

Proj. file: DS_06_100%.stm



Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	7.0	0.81	1.70	0.72	5.0	15.1	1.85	2.73	0.00	2.73	2.60	18	0.57	0.024	528.00	528.04	528.86	528.90	529.50	532.86	6o
2	1	96.8	0.02	0.89	1.00	5.0	13.7	1.95	1.73	0.00	1.73	1.11	18	0.50	0.024	528.14	528.62	529.64	529.73	532.86	538.04	6m
3	2	177.1	0.08	0.87	1.00	5.0	11.5	2.12	1.85	0.00	1.85	1.37	18	0.50	0.024	528.72	529.61	530.22	530.50	538.04	533.55	6k
4	3	27.1	0.02	0.79	1.00	5.0	11.1	2.17	1.71	0.00	1.71	0.98	18	0.48	0.024	529.71	529.84	531.21	531.23	533.55	533.53	6i
5	4	327.1	0.06	0.77	1.00	5.0	7.8	2.58	1.99	0.00	1.99	1.66	18	0.50	0.024	529.94	531.57	531.44	532.33	533.53	534.68	6g
6	5	27.1	0.16	0.71	1.00	5.0	7.4	2.66	1.89	0.00	1.89	1.08	18	0.48	0.024	531.67	531.80	533.17	533.20	534.68	534.97	6e
7	6	77.1	0.11	0.55	1.00	5.0	6.1	2.92	1.61	0.00	1.61	1.00	18	0.51	0.024	531.90	532.29	533.40	533.46	534.97	536.06	6c
8	7	57.1	0.44	0.44	1.00	5.0	5.0	3.24	1.42	0.00	1.42	0.85	18	0.44	0.024	532.39	532.64	533.89	533.92	536.06	536.94	6a
9	Outfall	175.2	0.00	0.68	0.00	0.0	5.1	3.20	1.72	0.00	5.17	4.87	18	4.66	0.024	505.89	514.06	506.76	514.93 j	507.39	528.08	(E) DI
10	9	24.0	0.68	0.68	0.79	5.0	5.0	3.24	1.74	3.45	5.19	3.22	18	2.00	0.024	520.59	521.07	522.09	522.24	528.08	527.03	6t

DS_06_100% | Number of lines: 10 | Date: 10-20-2010

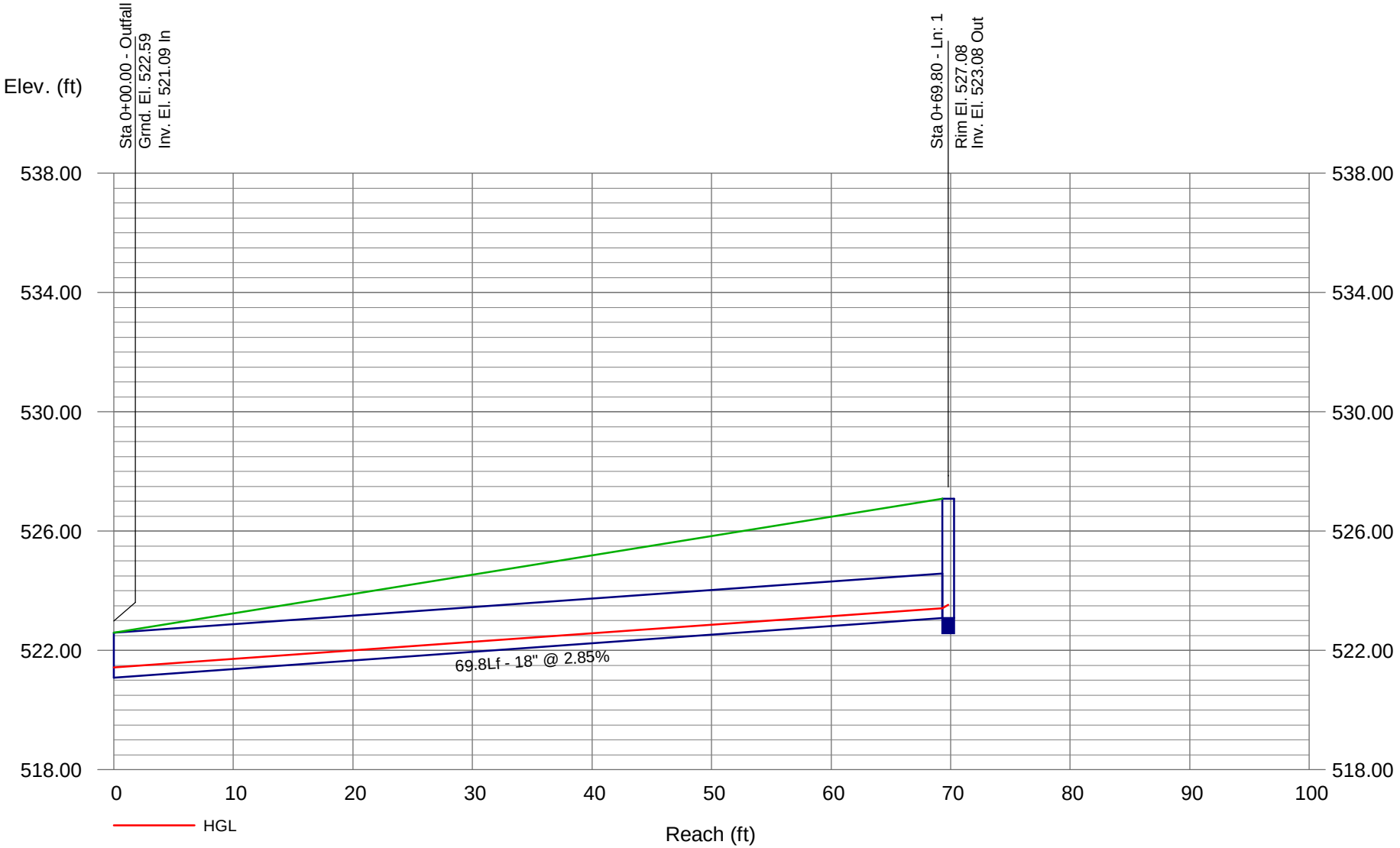
NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

DS_10_95%

Project File: DS_10_100%.stm	Number of lines: 1	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_10_100%.stm



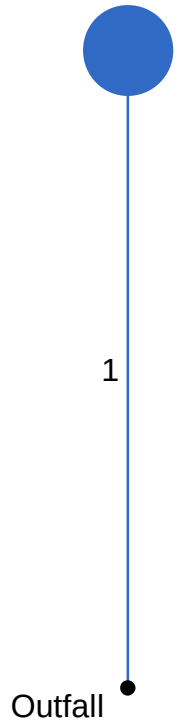
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	69.8	0.41	0.41	0.60	5.0	5.0	3.24	0.80	0.00	0.80	2.64	18	2.85	0.024	521.09	523.08	521.43	523.42	522.59	527.08	10a

DS_10_95% | Number of lines: 1 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

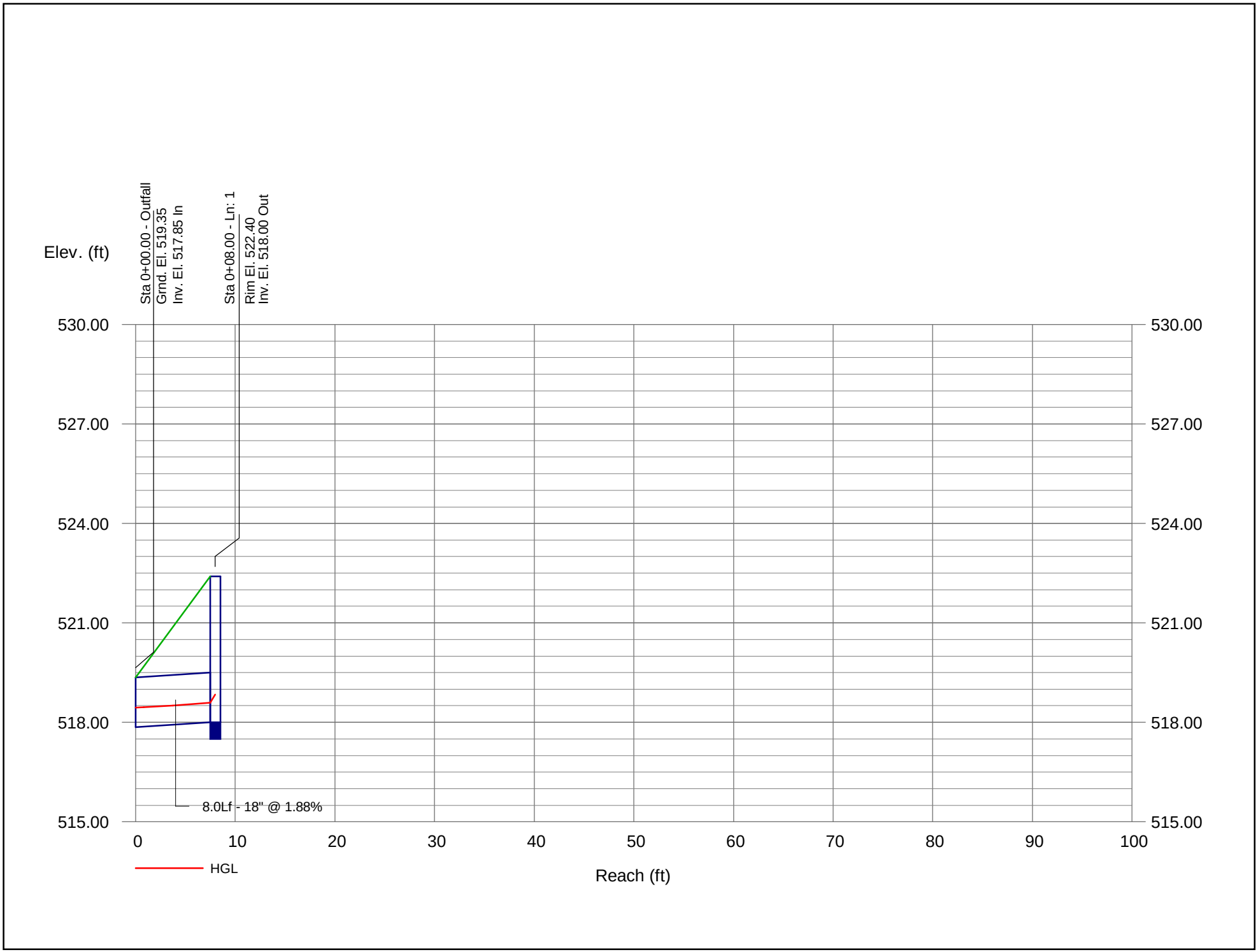
DS_12_100%



Project File: DS_12_100%.stm	Number of lines: 1	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_12_100%.stm



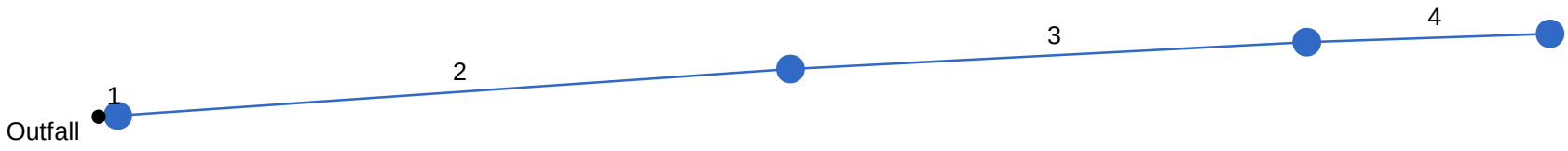
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	8.0	1.72	1.72	0.60	10.0	10.0	2.28	2.36	0.00	2.36	3.65	18	1.88	0.024	517.85	518.00	518.44	518.59 j	519.35	522.40	12b

DS_12_100% | Number of lines: 1 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

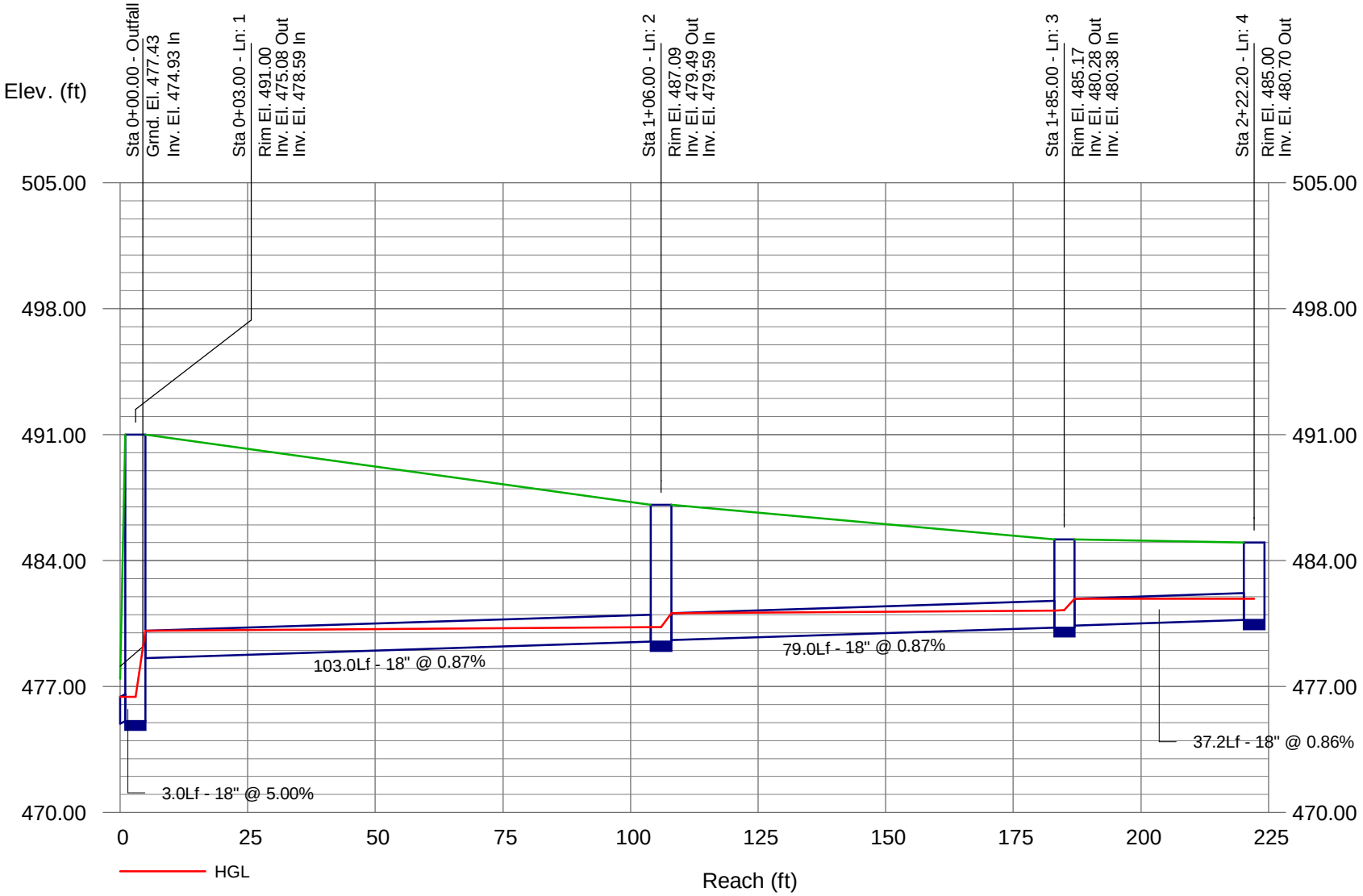
DS_13_100%



Project File: DS_13_100%.stm	Number of lines: 4	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_13_100%.stm



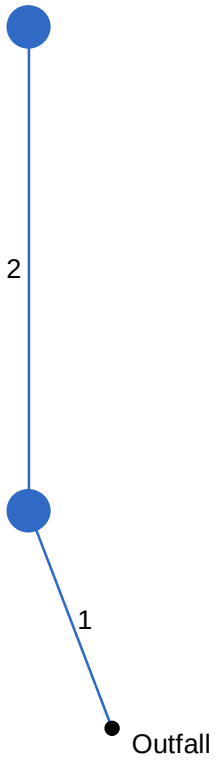
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	3.0	0.00	0.73	0.00	0.0	8.3	2.51	1.84	0.00	1.84	1.07	18	5.00	0.024	474.93	475.08	476.43	476.43	477.43	491.00	13b
2	1	103.0	0.00	0.73	0.00	0.0	7.2	2.70	1.97	0.00	1.97	1.57	18	0.87	0.024	478.59	479.49	480.09	480.30	491.00	487.09	13d
3	2	79.0	0.49	0.73	1.00	5.0	6.3	2.88	2.11	0.00	2.11	1.50	18	0.87	0.024	479.59	480.28	481.09	481.22	487.09	485.17	13f
4	3	37.2	0.24	0.24	1.00	5.0	5.0	3.24	0.78	0.00	0.78	0.48	18	0.86	0.024	480.38	480.70	481.88	481.89	485.17	485.00	13h

DS_13_100% | Number of lines: 4 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

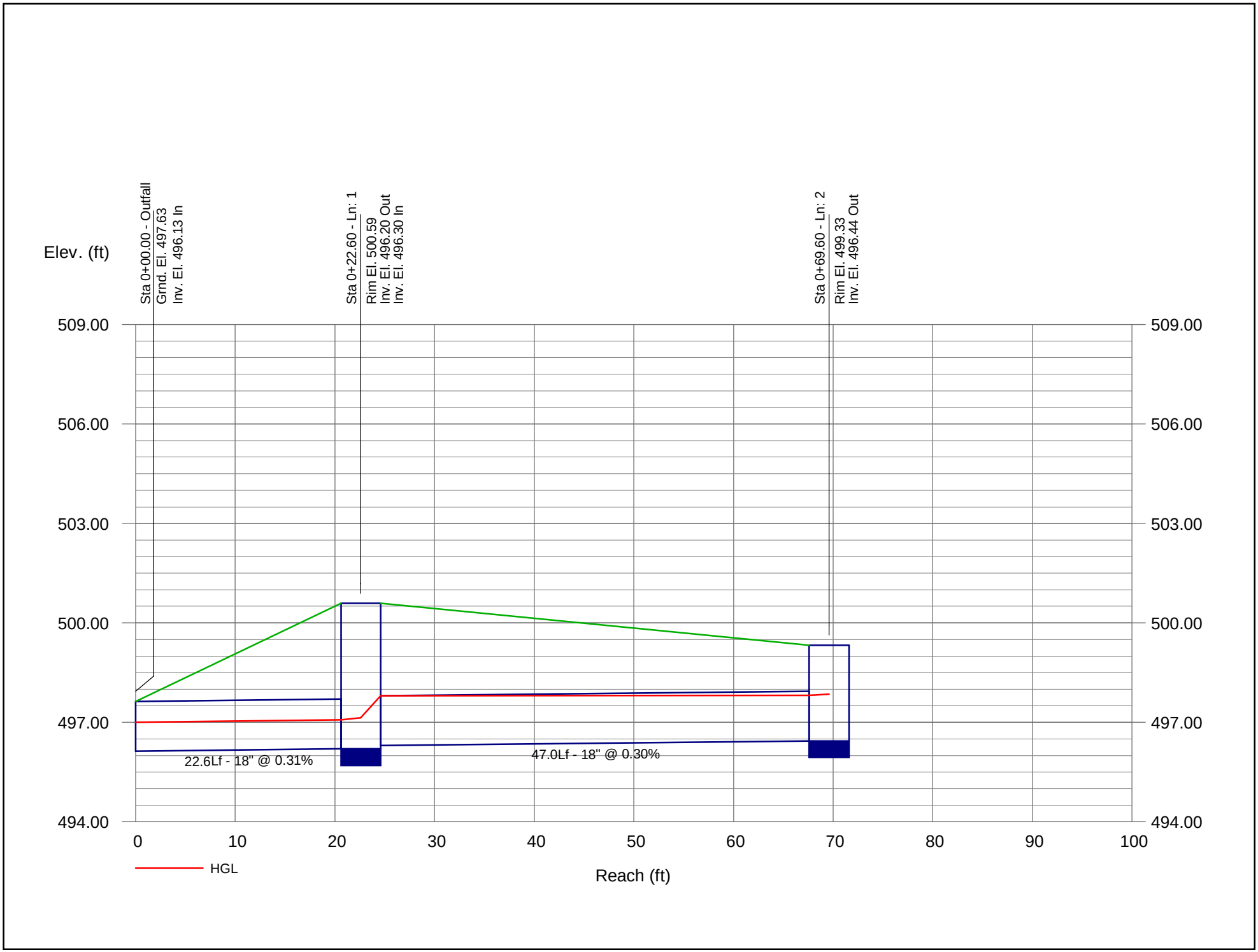
DS_14_100%



Project File: DS_14_100%.stm	Number of lines: 2	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_14_100%.stm



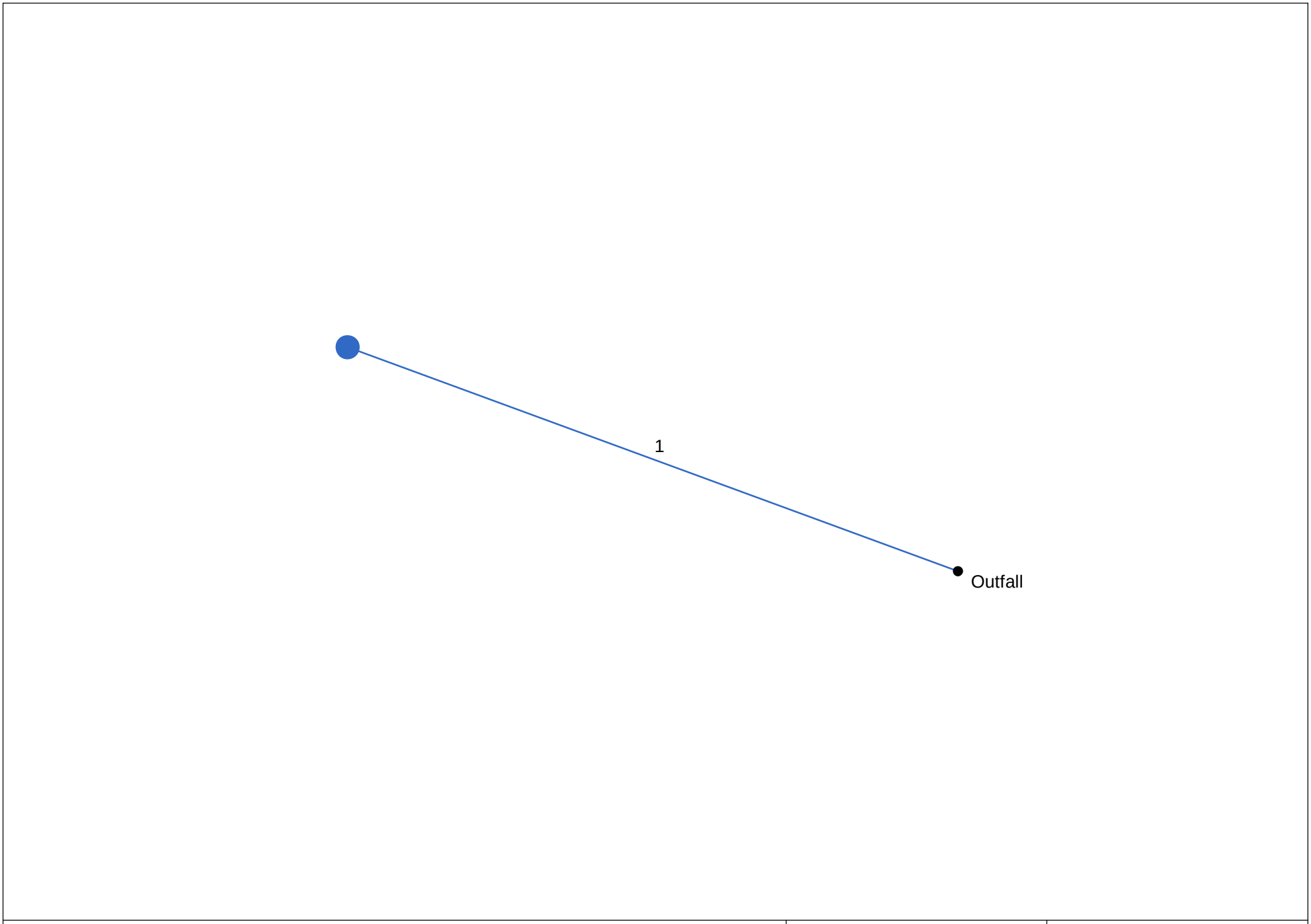
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	22.6	0.68	1.39	0.76	5.0	5.6	3.06	3.76	0.00	3.76	3.53	18	0.31	0.013	496.13	496.20	497.00	497.07	497.63	500.59	14c
2	1	47.0	0.71	0.71	1.00	5.0	5.0	3.24	2.30	0.00	2.30	1.33	18	0.30	0.013	496.30	496.44	497.80	497.82	500.59	499.33	14a

DS_14_100% | Number of lines: 2 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

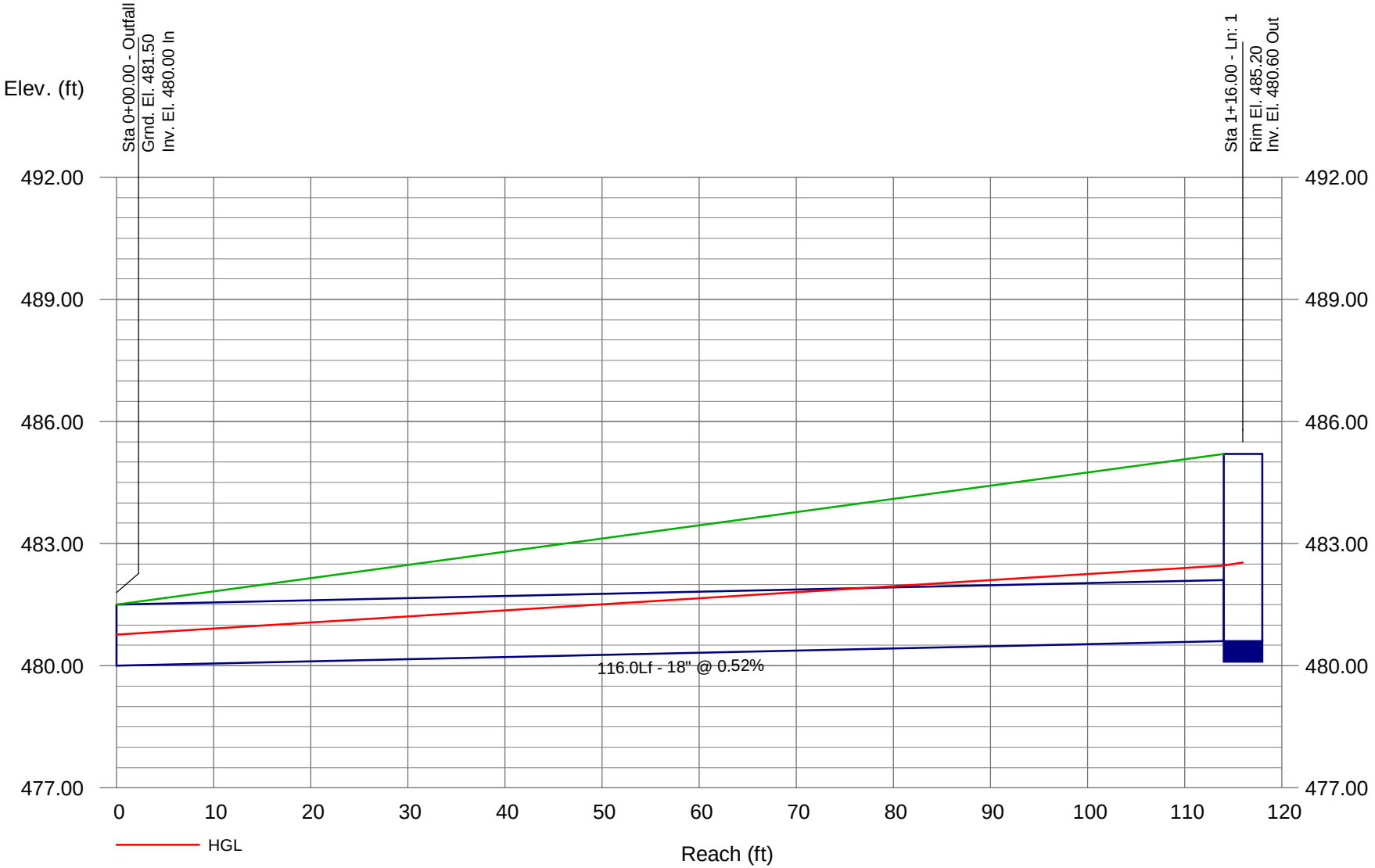
DS_17_100%



Project File: DS_17_100%.stm	Number of lines: 1	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_17_100%.stm



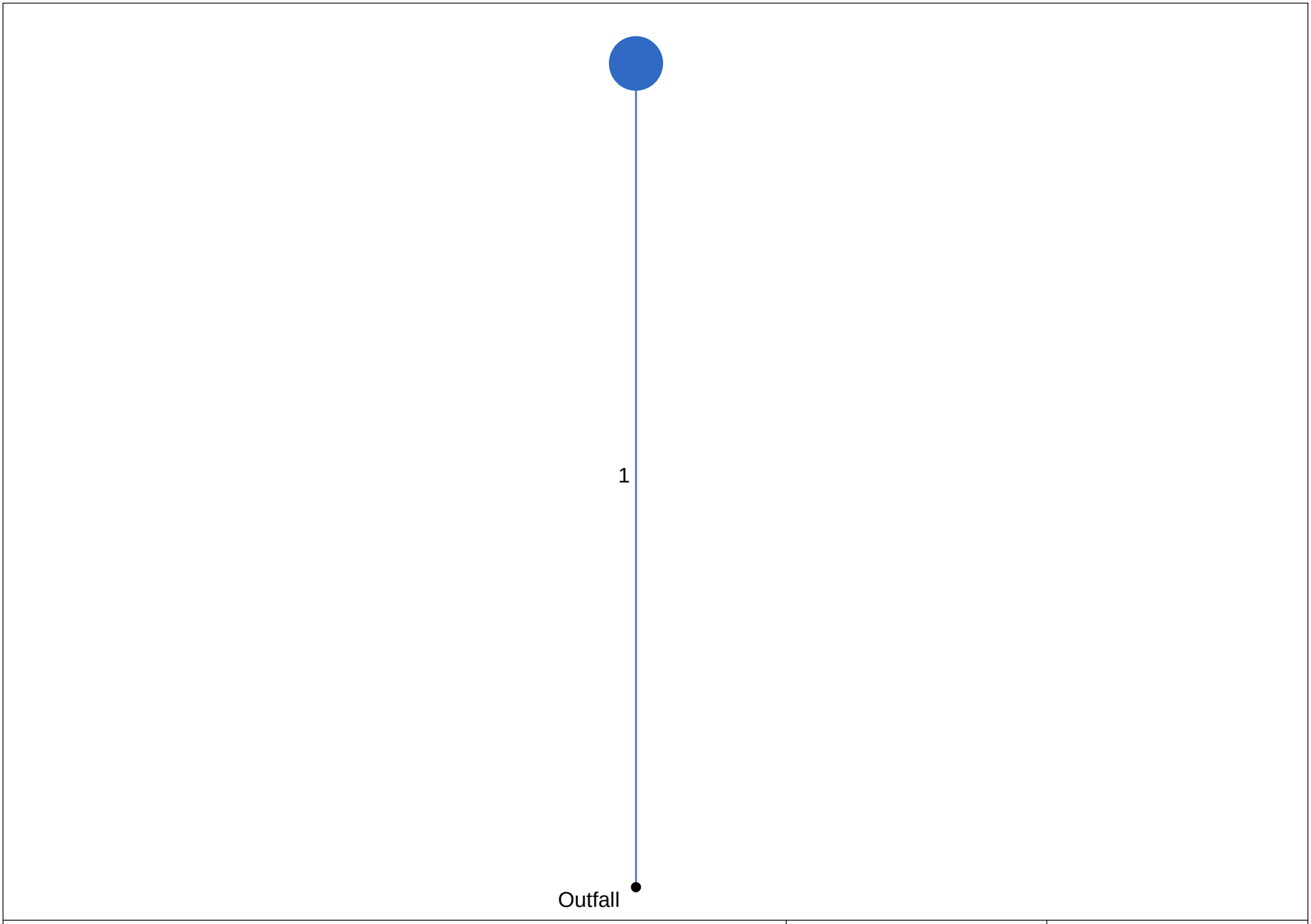
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	116.0	2.78	2.78	0.44	5.0	5.0	3.24	3.96	0.00	3.96	3.32	18	0.52	0.025	480.00	480.60	480.76	482.46	481.50	485.20	(E) MH

DS_17_100% | Number of lines: 1 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

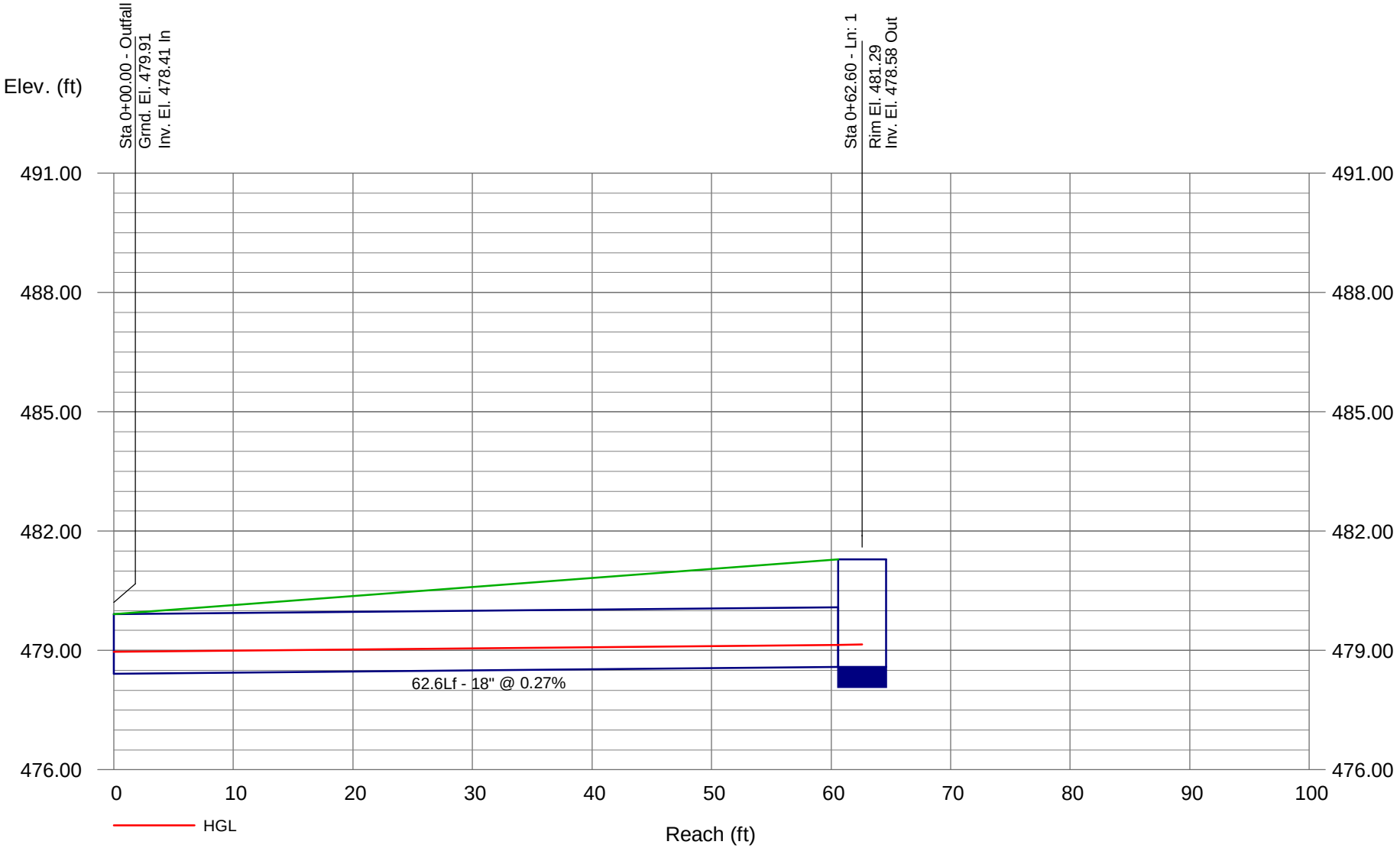
DS_18_100%



Project File: DS_18_100%.stm	Number of lines: 1	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_18_100%.stm



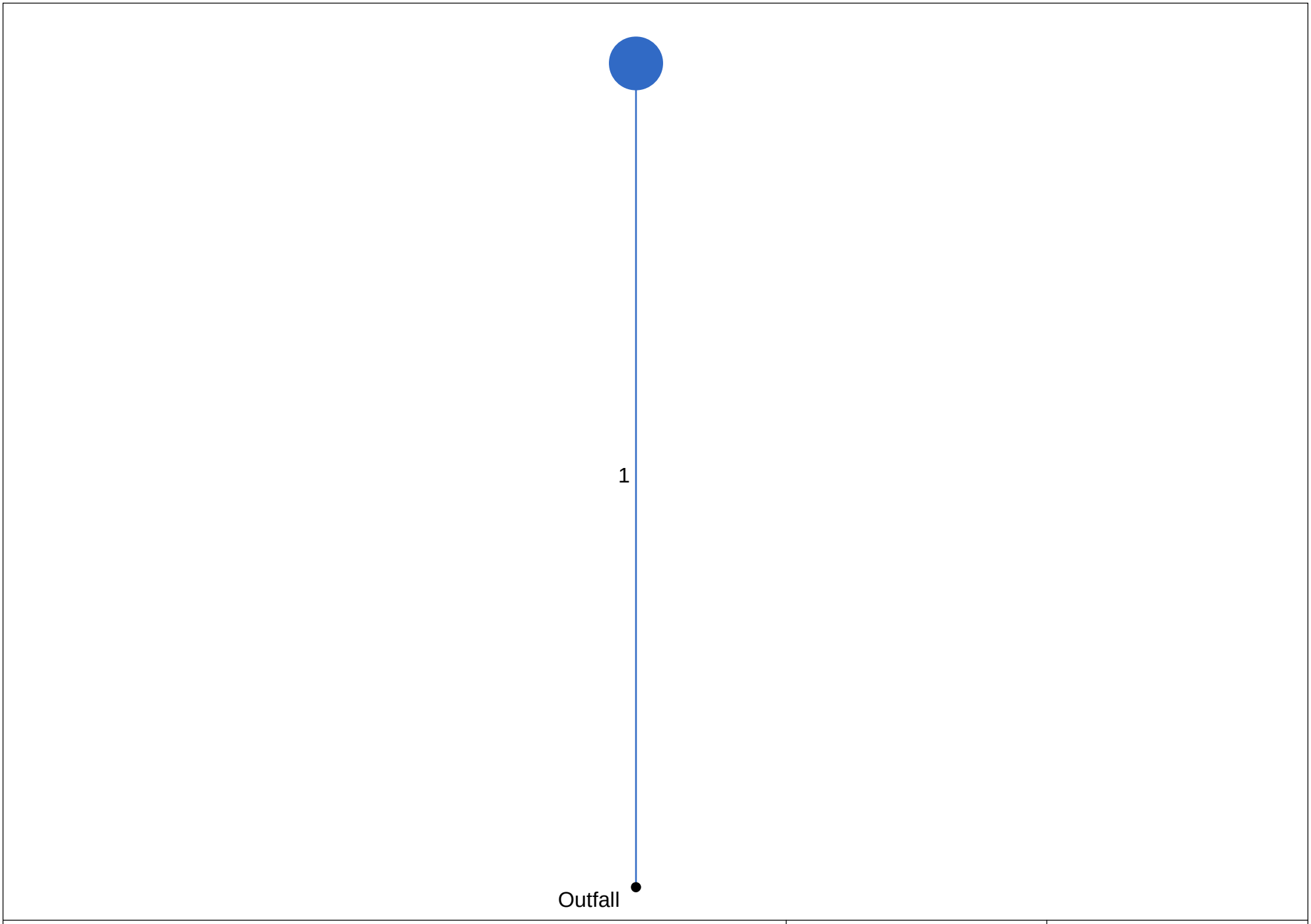
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	62.6	0.50	0.50	1.00	5.0	5.0	3.24	1.62	0.00	1.62	2.69	18	0.27	0.013	478.41	478.58	478.97	479.14	479.91	481.29	18a

DS_18_100% | Number of lines: 1 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

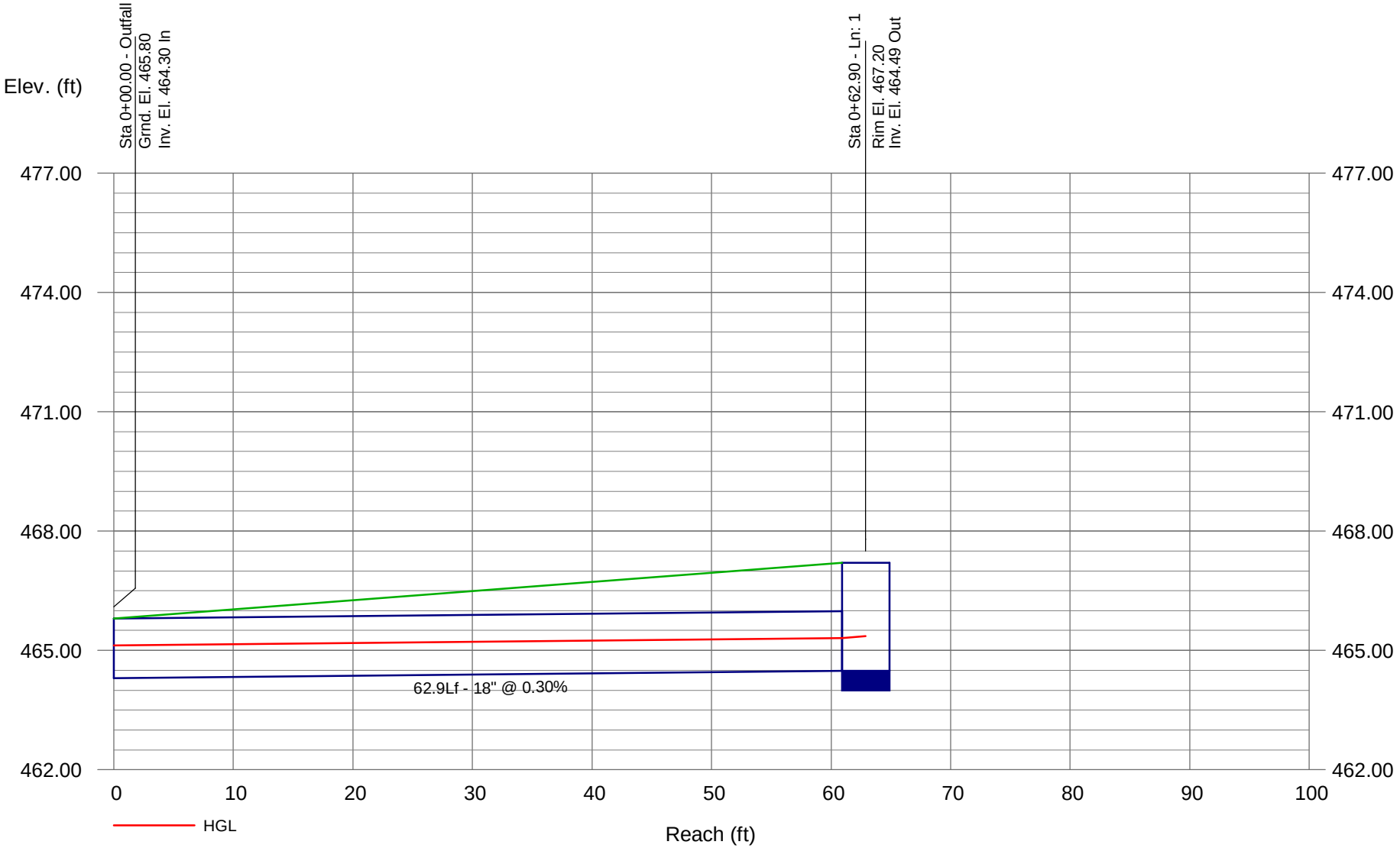
DS_19_100%



Project File: DS_19_100%.stm	Number of lines: 1	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_19_100%.stm



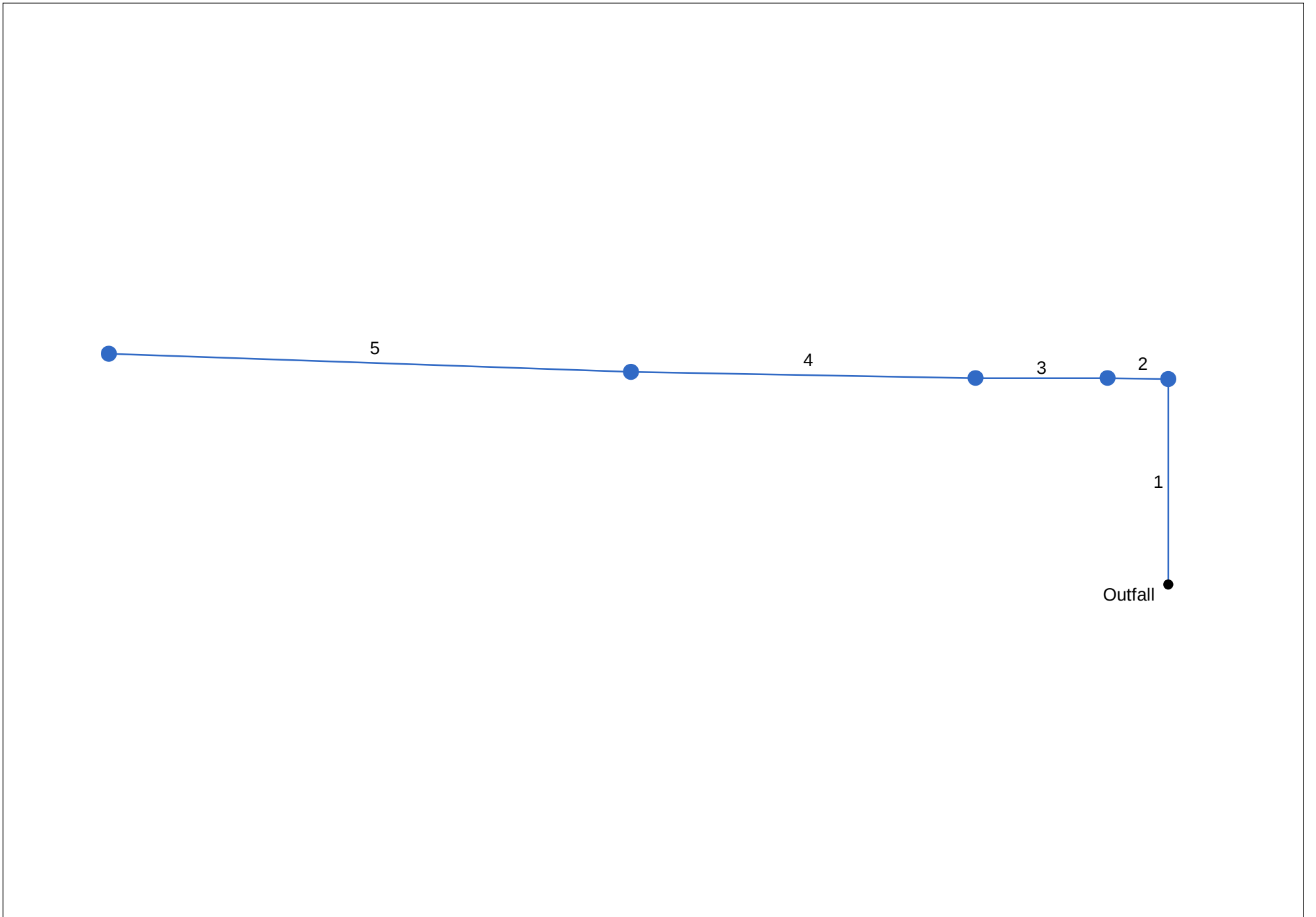
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	62.9	0.56	0.56	1.00	5.0	5.0	3.24	1.81	0.00	1.81	1.83	18	0.30	0.024	464.30	464.49	465.12	465.31	465.80	467.20	19a

DS_19_100% | Number of lines: 1 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

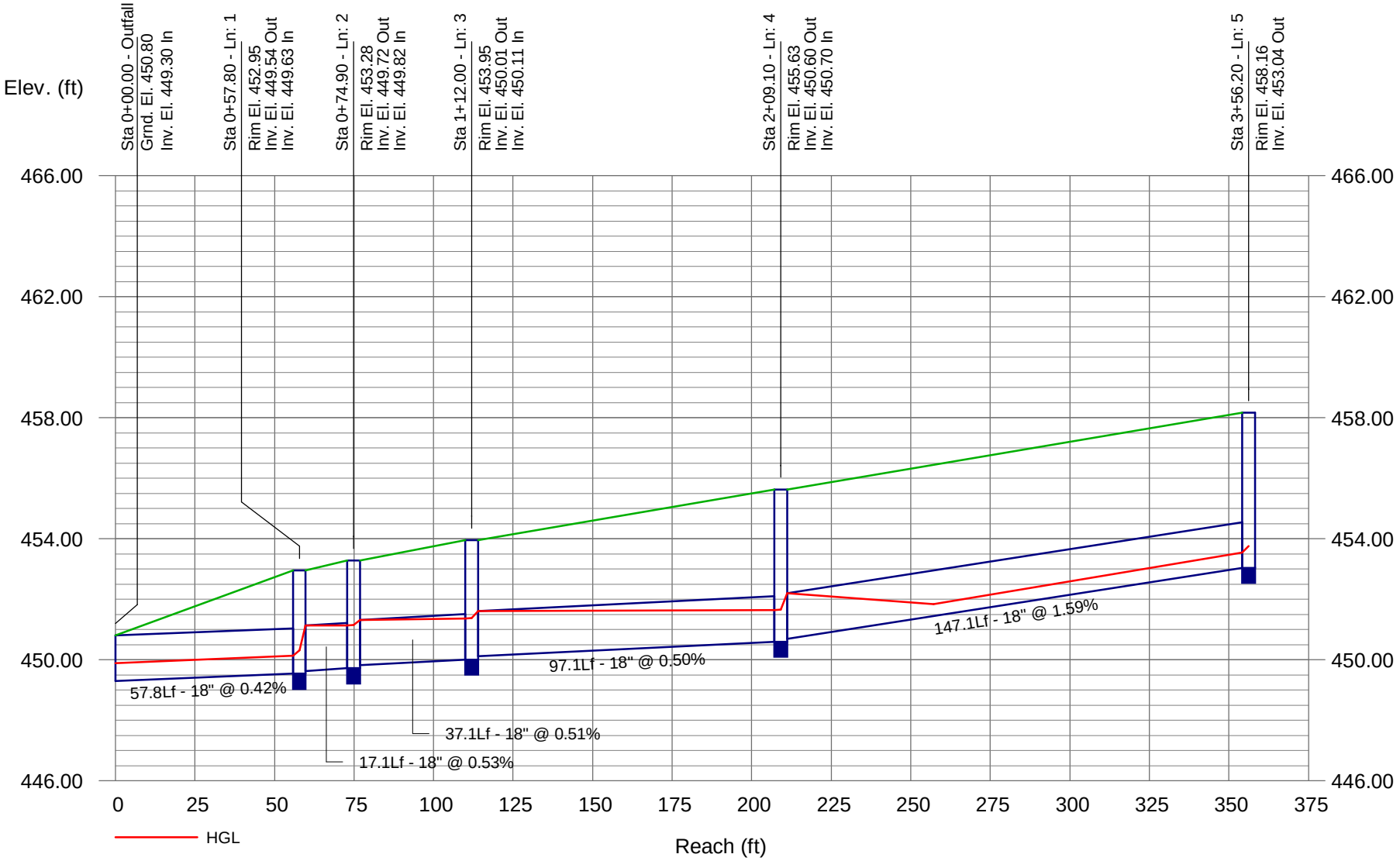
DS_20_100%



Project File: DS_20_100%.stm	Number of lines: 5	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_20_100%.stm



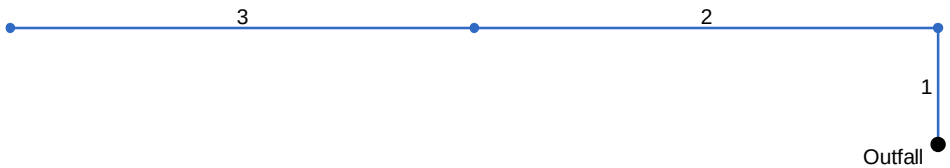
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	57.8	0.02	0.87	1.00	5.0	8.0	2.55	2.22	0.00	2.22	3.44	18	0.42	0.013	449.30	449.54	449.89	450.13	450.80	452.95	20i
2	1	17.1	0.04	0.85	1.00	5.0	7.8	2.59	2.20	0.00	2.20	1.26	18	0.53	0.013	449.63	449.72	451.13	451.14	452.95	453.28	20g
3	2	37.1	0.10	0.81	1.00	5.0	7.3	2.68	2.17	0.00	2.17	1.26	18	0.51	0.024	449.82	450.01	451.32	451.37	453.28	453.95	20e
4	3	97.1	0.16	0.71	1.00	5.0	6.1	2.92	2.08	0.00	2.08	1.38	18	0.50	0.013	450.11	450.60	451.61	451.64	453.95	455.63	20c
5	4	147.1	0.55	0.55	1.00	5.0	5.0	3.24	1.78	0.00	1.78	2.19	18	1.59	0.013	450.70	453.04	452.20	453.55 j	455.63	458.16	20a

DS_20_100% | Number of lines: 5 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

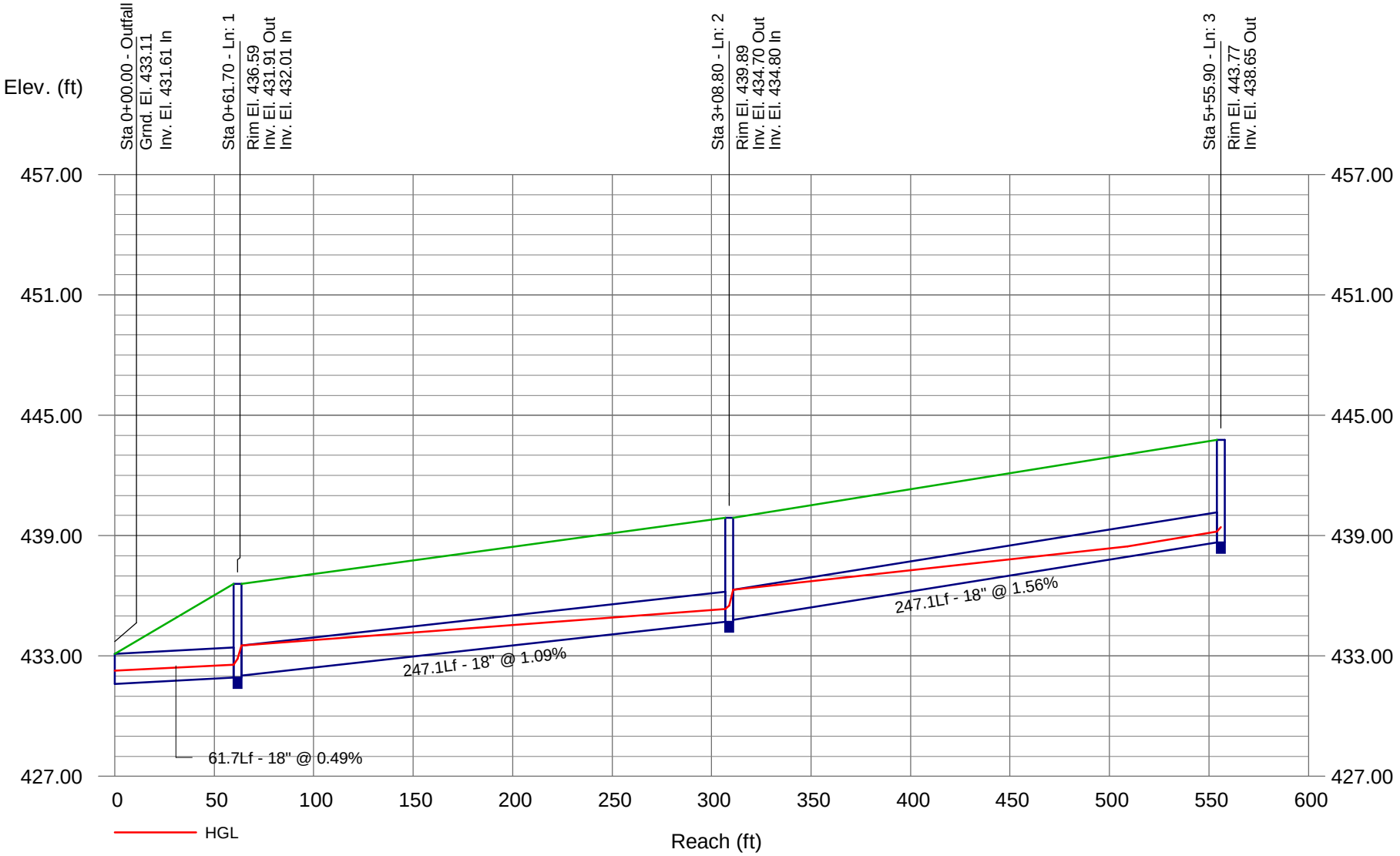
DS_22_100%



Project File: DS_22_100%.stm	Number of lines: 3	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_22_100%.stm



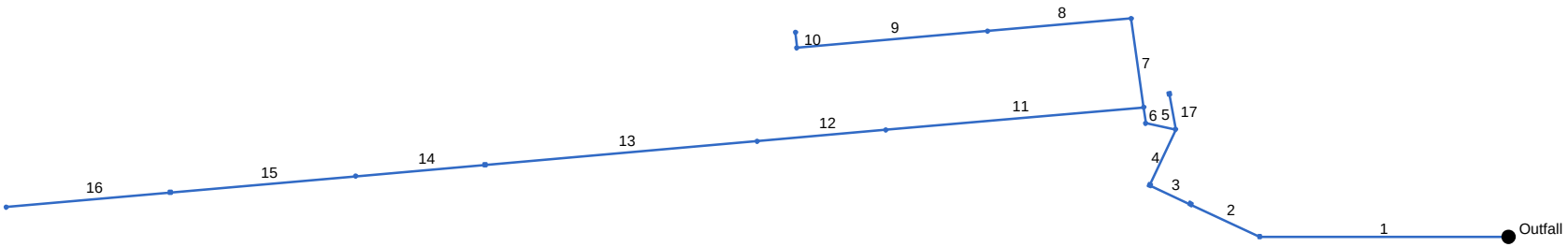
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	61.7	0.27	1.17	1.00	5.0	8.4	2.49	2.91	0.00	2.91	3.91	18	0.49	0.013	431.61	431.91	432.27	432.56	433.11	436.59	22e
2	1	247.1	0.28	0.90	1.00	5.0	6.8	2.78	2.50	0.00	2.50	2.47	18	1.09	0.024	432.01	434.70	433.51	435.33	436.59	439.89	22c
3	2	247.1	0.62	0.62	1.00	5.0	5.0	3.24	2.01	0.00	2.01	2.32	18	1.56	0.024	434.80	438.65	436.30	439.19 j	439.89	443.77	22a

DS_22_100% | Number of lines: 3 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

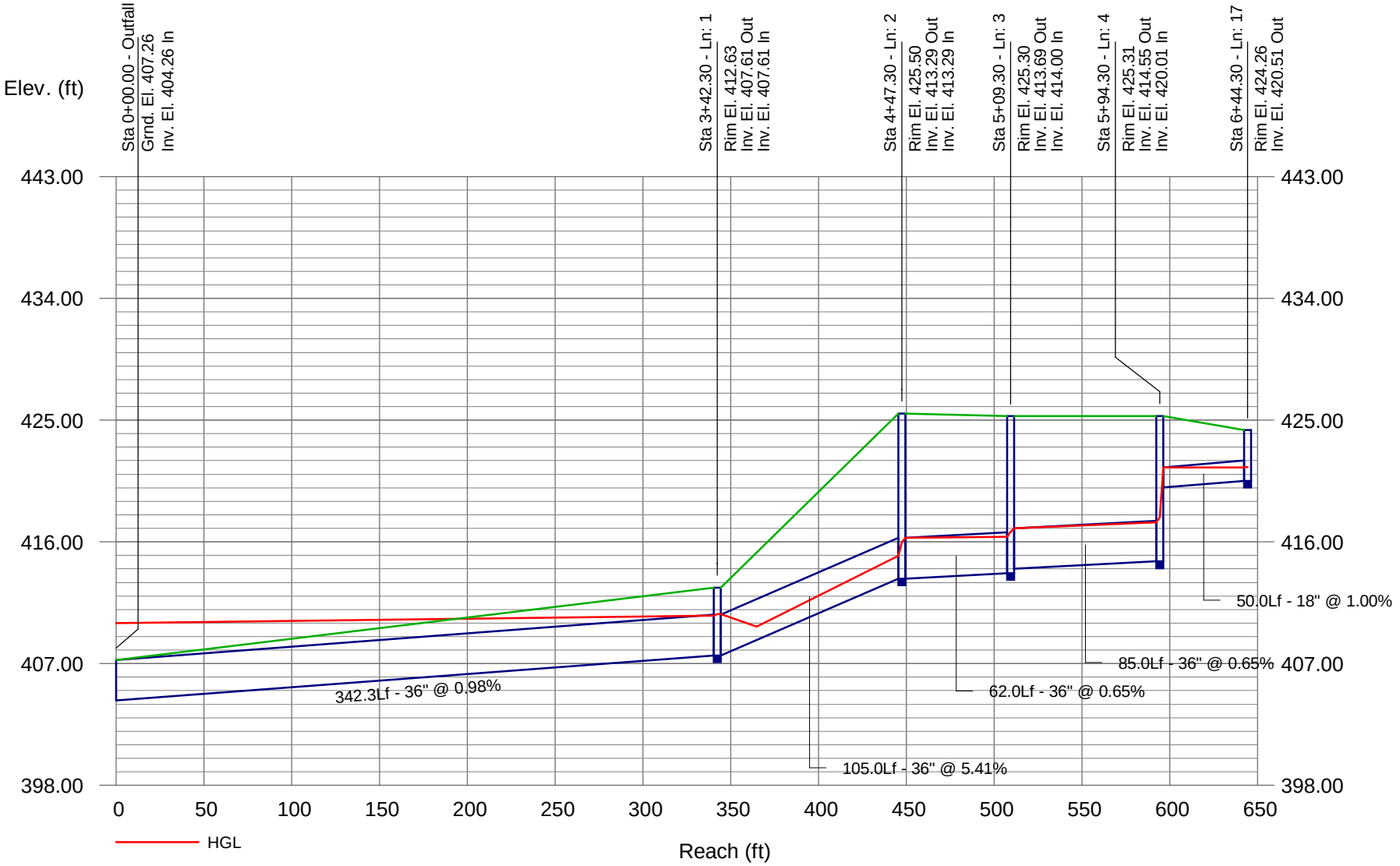
Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2008 Plan



Project File: DS_23_30_100%.stm	Number of lines: 17	Date: 10-20-2010

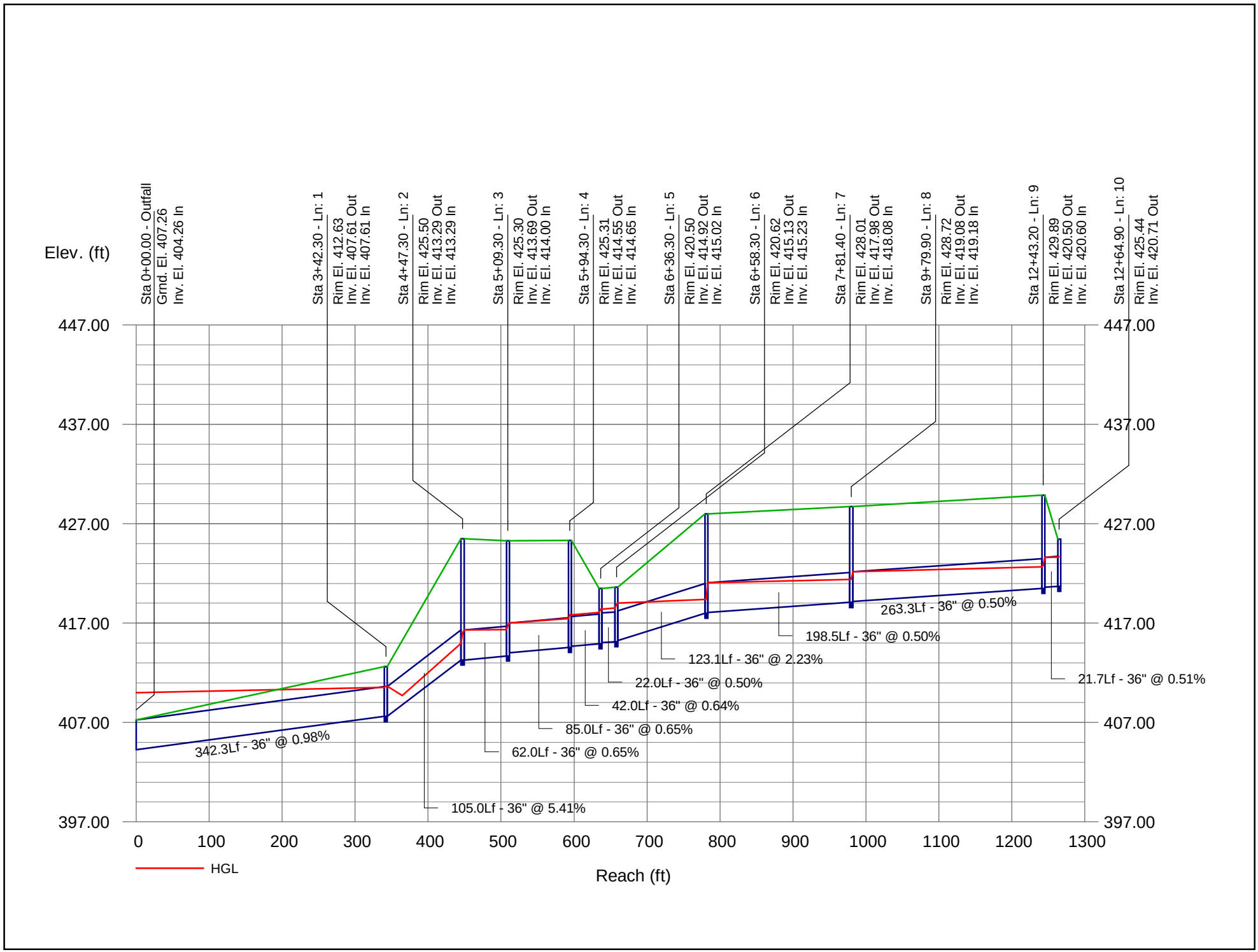
Storm Sewer Profile

Proj. file: DS_23_30_100%.stm



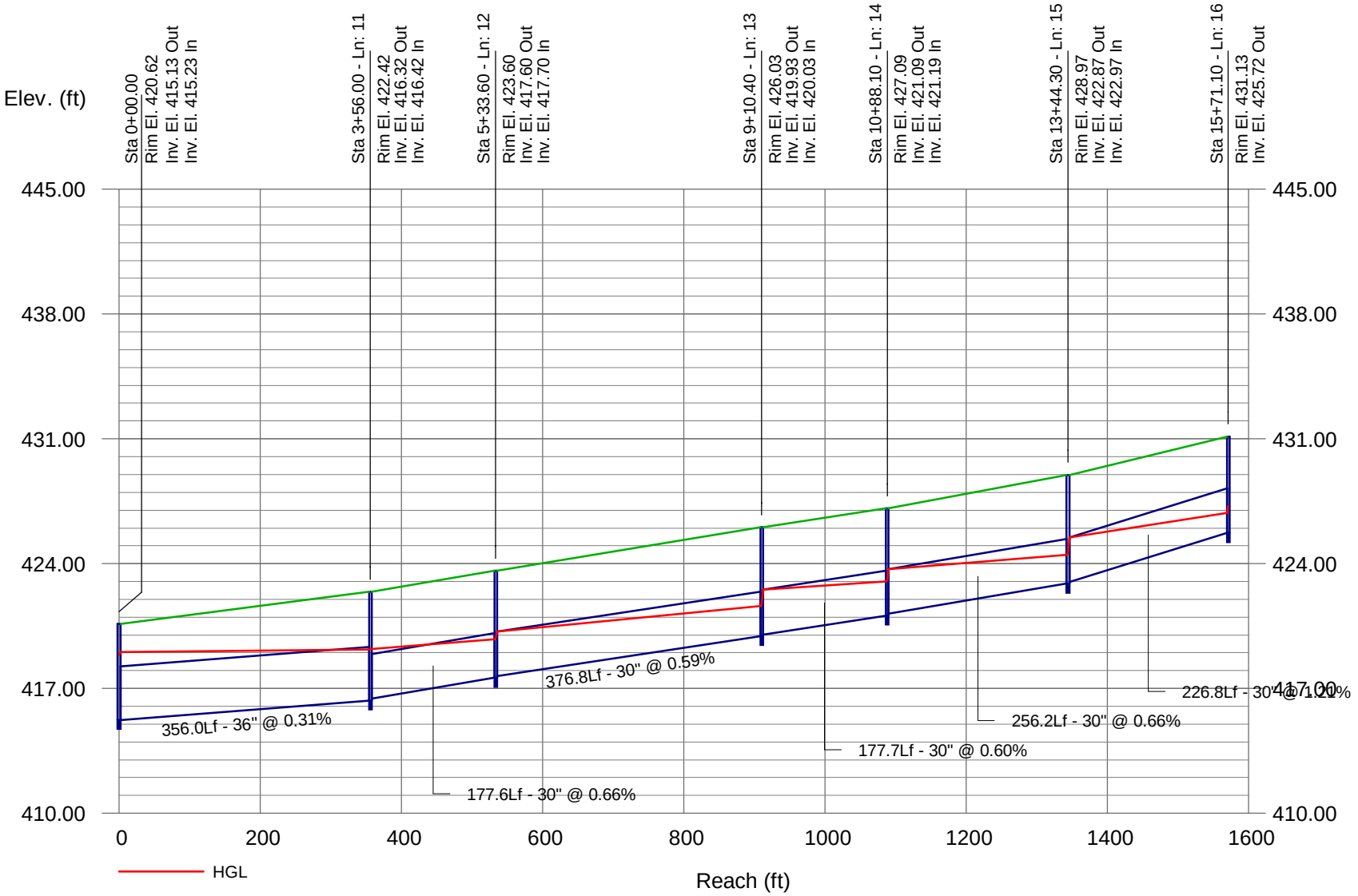
Storm Sewer Profile

Proj. file: DS_23_30_100%.stm



Storm Sewer Profile

Proj. file: DS_23_30_100%.stm



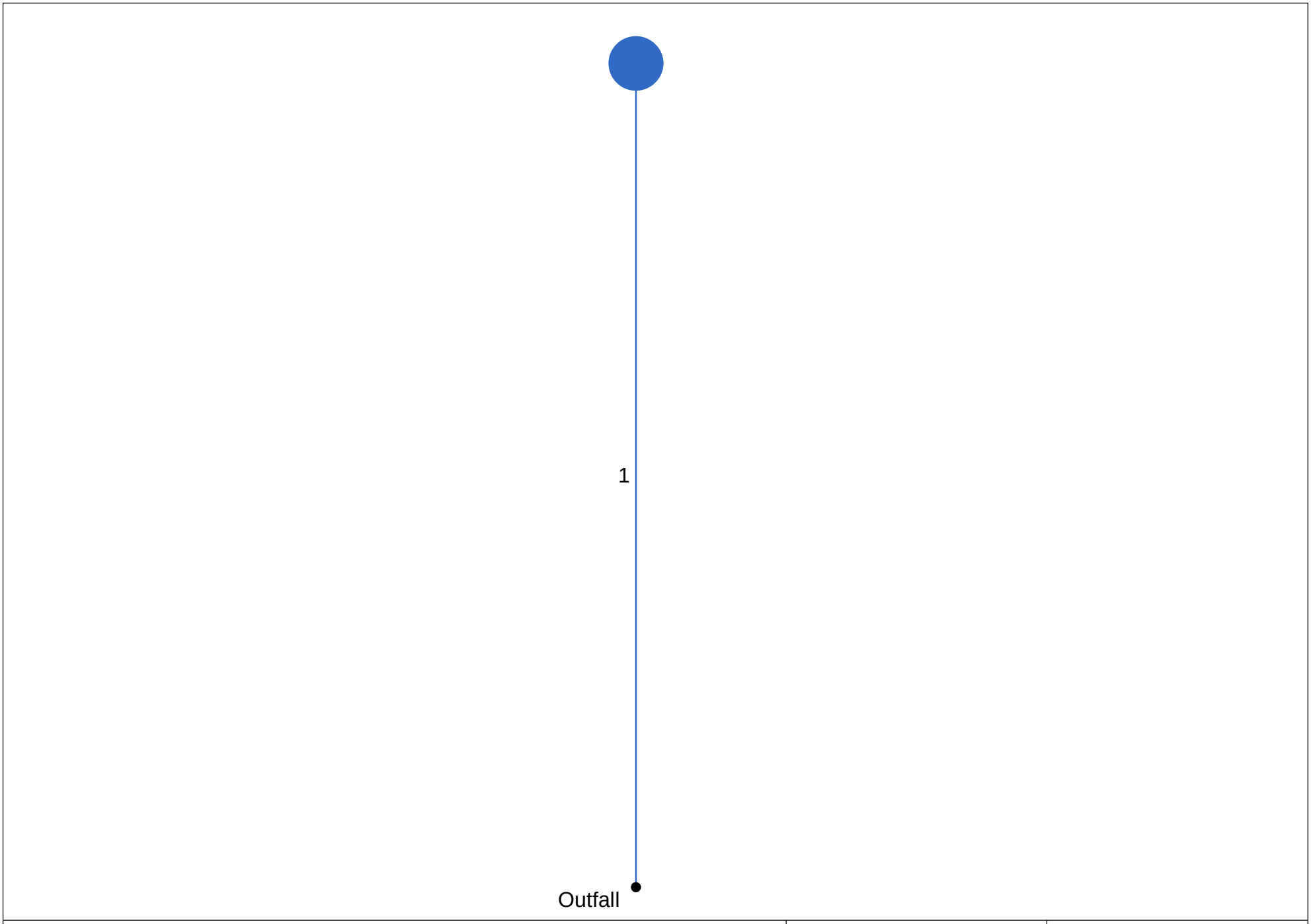
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	342.3	0.00	29.07	0.00	0.0	29.9	1.31	27.19	0.00	27.19	3.86	36	0.98	0.013	404.26	407.61	410.00	410.53	407.26	412.63	(E) DI
2	1	105.0	0.00	29.07	0.00	0.0	29.5	1.32	27.35	0.00	27.35	5.32	36	5.41	0.013	407.61	413.29	410.65	414.96 j	412.63	425.50	(E) DI
3	2	62.0	0.00	29.07	0.00	0.0	29.3	1.32	27.47	0.00	27.47	4.01	36	0.65	0.013	413.29	413.69	416.29	416.36	425.50	425.30	(E) DI
4	3	85.0	0.08	29.07	1.00	5.0	28.9	1.33	27.64	0.00	27.64	3.93	36	0.65	0.024	414.00	414.55	417.00	417.47	425.30	425.31	30n
5	4	42.0	0.46	28.64	0.60	5.0	28.7	1.34	27.16	0.00	27.16	3.84	36	0.64	0.024	414.65	414.92	417.84	418.08	425.31	420.50	30l
6	5	22.0	1.17	28.18	0.98	5.0	28.6	1.34	26.84	0.00	26.84	3.80	36	0.50	0.024	415.02	415.13	418.41	418.53	420.50	420.62	30j
7	6	123.1	0.00	16.97	0.00	5.0	28.0	1.35	13.79	0.00	13.79	3.14	36	2.23	0.024	415.23	417.98	419.03	419.36	420.62	428.01	30g
8	7	198.5	0.00	16.97	0.00	5.0	26.5	1.39	14.18	0.00	14.18	2.22	36	0.50	0.024	418.08	419.08	421.08	421.38	428.01	428.72	30e
9	8	263.3	0.00	16.97	0.00	5.0	24.7	1.44	14.70	0.00	14.70	2.40	36	0.50	0.024	419.18	420.50	422.18	422.64	428.72	429.89	30c
10	9	21.7	16.97	16.97	0.60	24.5	24.5	1.45	14.75	0.00	14.75	2.09	36	0.51	0.024	420.60	420.71	423.60	423.63	429.89	425.44	30a
11	6	356.0	1.04	10.04	1.00	5.0	20.0	1.60	14.01	0.00	14.01	2.00	36	0.31	0.013	415.23	416.32	419.03	419.18	420.62	422.42	23n
12	11	177.6	0.74	9.00	0.83	5.0	19.0	1.65	12.69	0.00	12.69	2.71	30	0.66	0.024	416.42	417.60	419.21	419.74	422.42	423.60	23k
13	12	376.8	0.83	8.26	0.98	5.0	16.9	1.75	12.39	0.00	12.39	3.02	30	0.59	0.024	417.70	419.93	420.20	421.62	423.60	426.03	23i
14	13	177.7	0.53	7.43	0.87	5.0	15.7	1.82	11.36	0.00	11.36	2.58	30	0.60	0.024	420.03	421.09	422.53	422.99	426.03	427.09	23f
15	14	256.2	0.66	6.90	0.94	5.0	14.2	1.91	11.09	0.00	11.09	2.78	30	0.66	0.024	421.19	422.87	423.69	424.48	427.09	428.97	23d
16	15	226.8	6.24	6.24	0.83	13.1	13.1	1.99	10.31	0.00	10.31	3.46	30	1.21	0.024	422.97	425.72	425.47	426.84	428.97	431.13	23a
17	4	50.0	0.35	0.35	0.99	5.0	5.0	3.24	1.12	0.00	1.12	0.77	18	1.00	0.013	420.01	420.51	421.51	421.51	425.31	424.26	30o

Project File: DS_23_30_100%.stm | Number of lines: 17 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

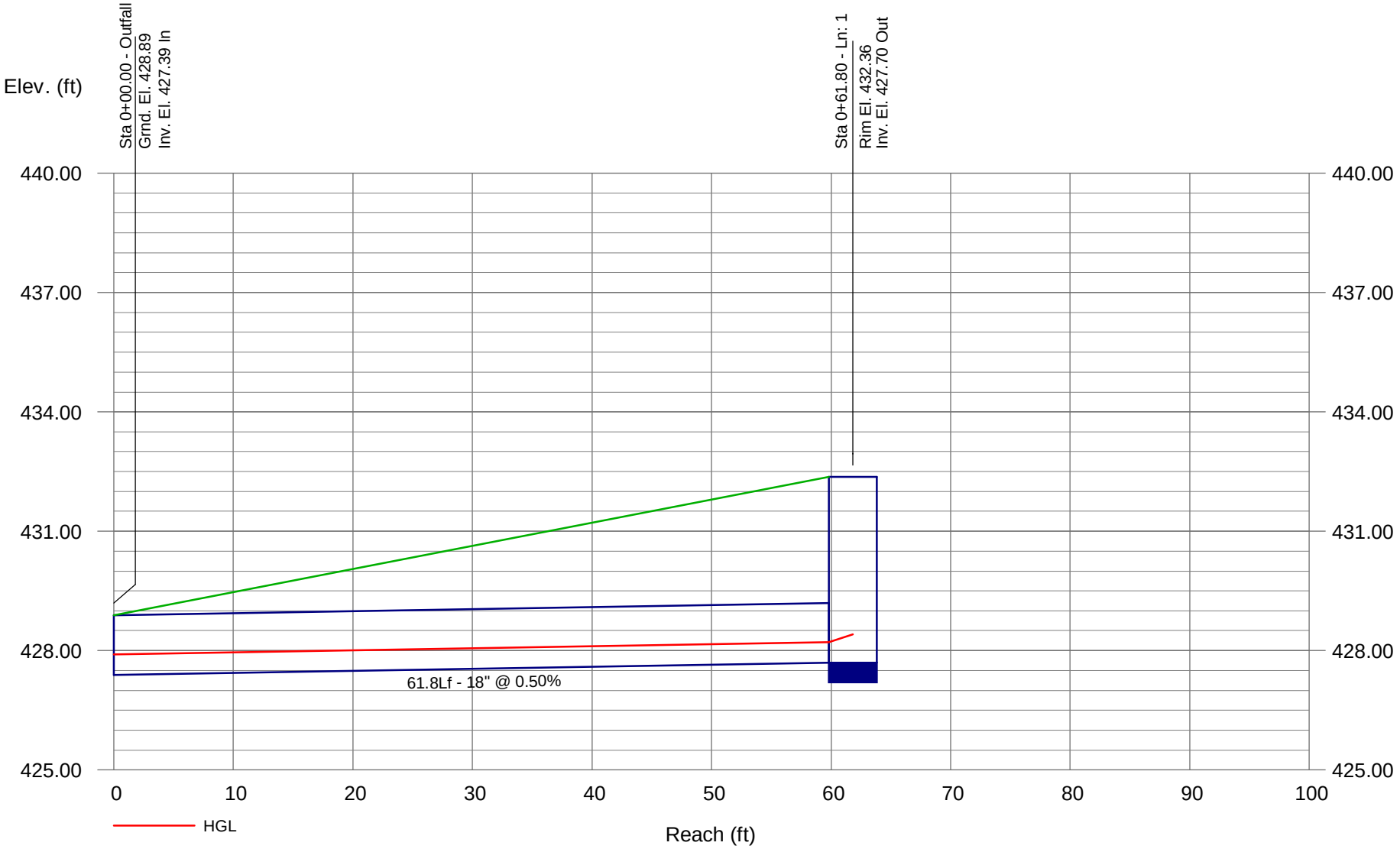
DS_26_100%



Project File: DS_26_100%.stm	Number of lines: 1	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_26_100%.stm



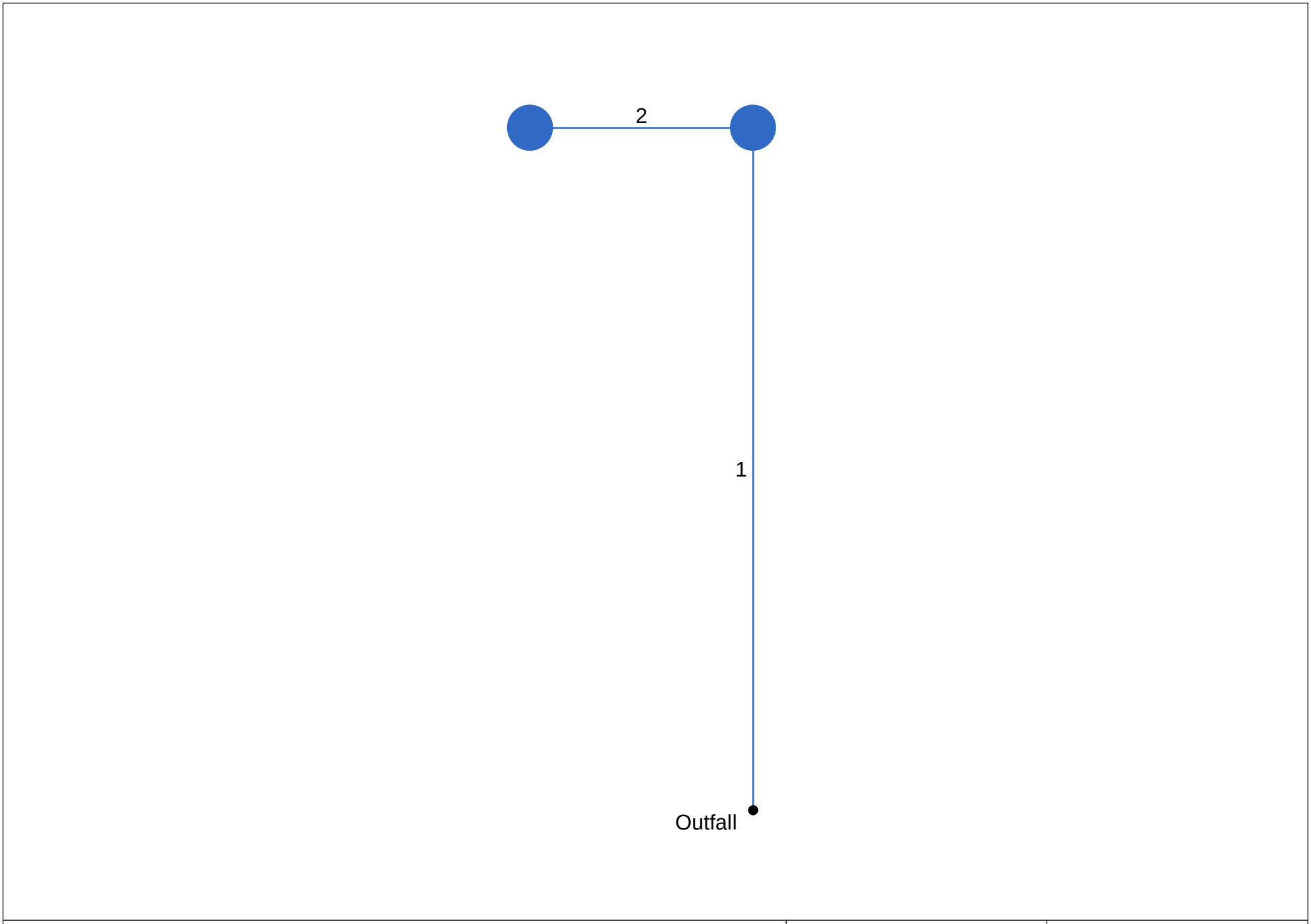
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	61.8	0.56	0.56	1.00	5.0	5.0	3.24	1.81	0.00	1.81	3.37	18	0.50	0.013	427.39	427.70	427.90	428.22	428.89	432.36	26a

DS_26_100% | Number of lines: 1 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

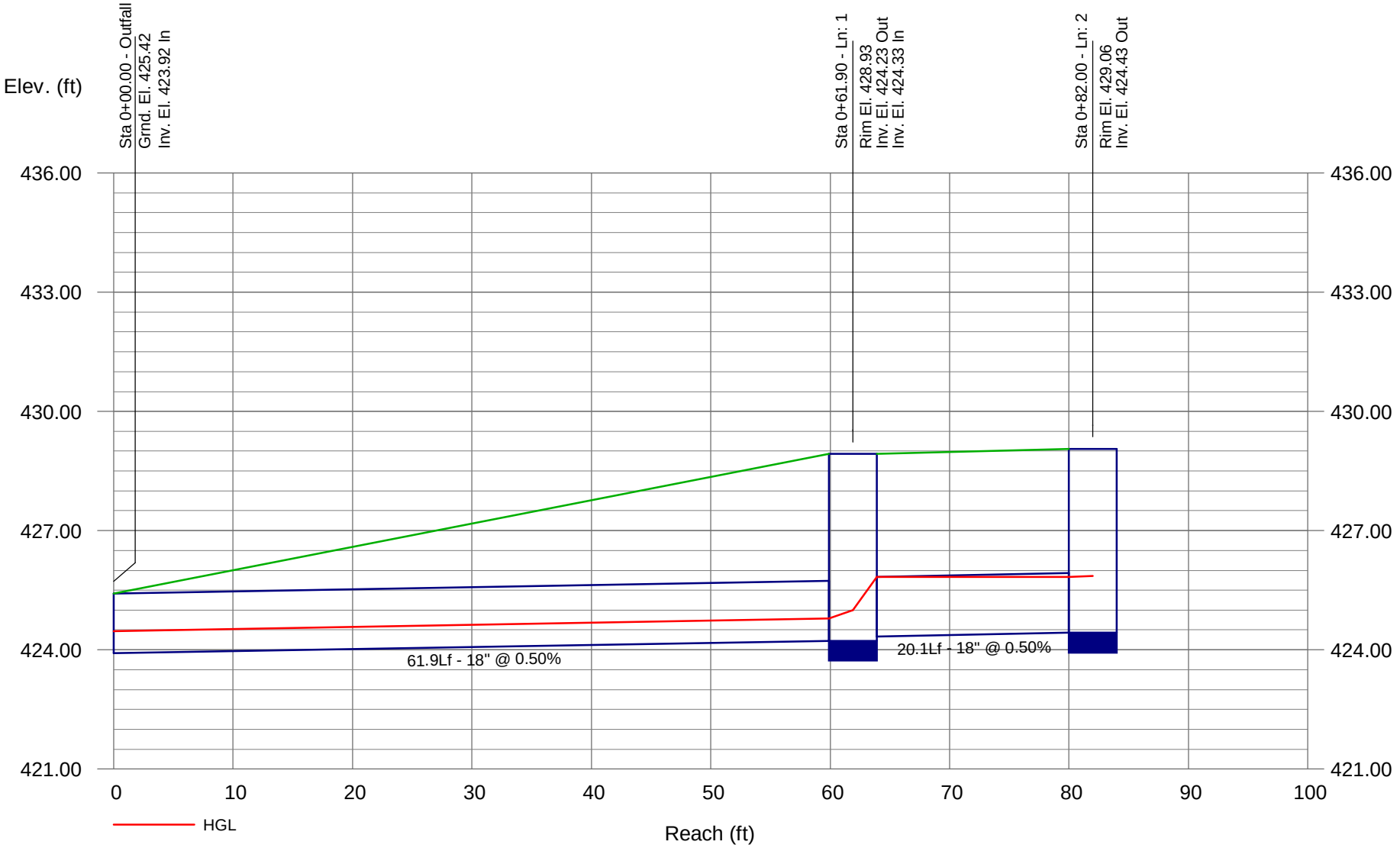
DS_29_100%



Project File: DS_29_100%.stm	Number of lines: 2	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_29_100%.stm



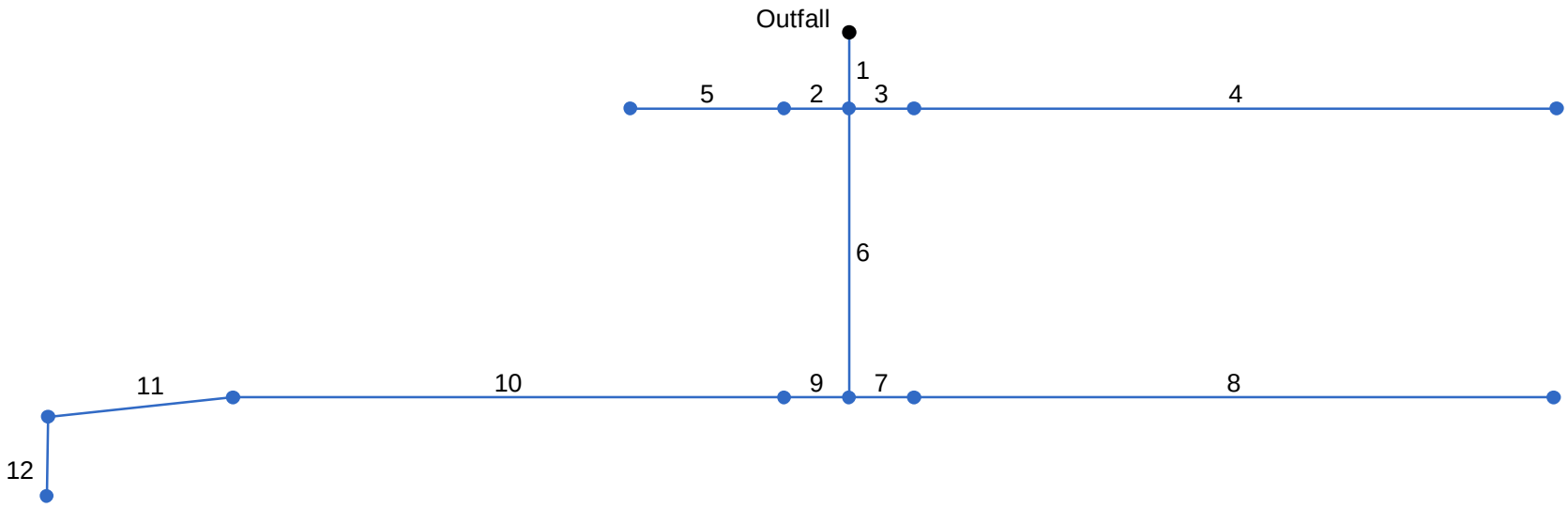
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	61.9	0.03	0.66	1.00	5.0	5.3	3.15	2.08	0.00	2.08	3.52	18	0.50	0.013	423.92	424.23	424.47	424.78	425.42	428.93	29c
2	1	20.1	0.63	0.63	1.00	5.0	5.0	3.24	2.04	0.00	2.04	1.17	18	0.50	0.013	424.33	424.43	425.83	425.84	428.93	429.06	29a

DS_29_100% | Number of lines: 2 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

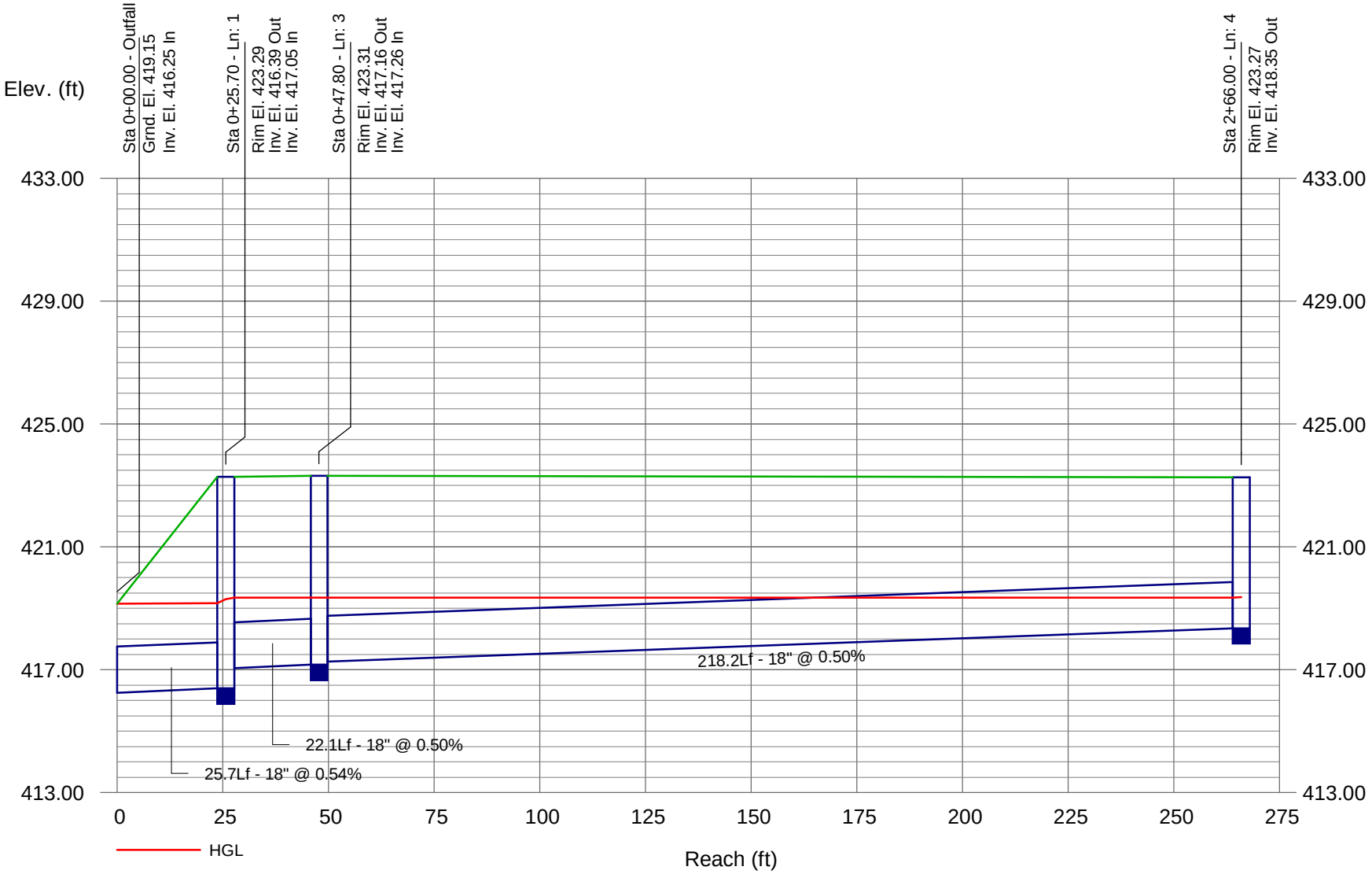
DS_33_100%



Project File: DS_33_100%.stm	Number of lines: 12	Date: 10-20-2010

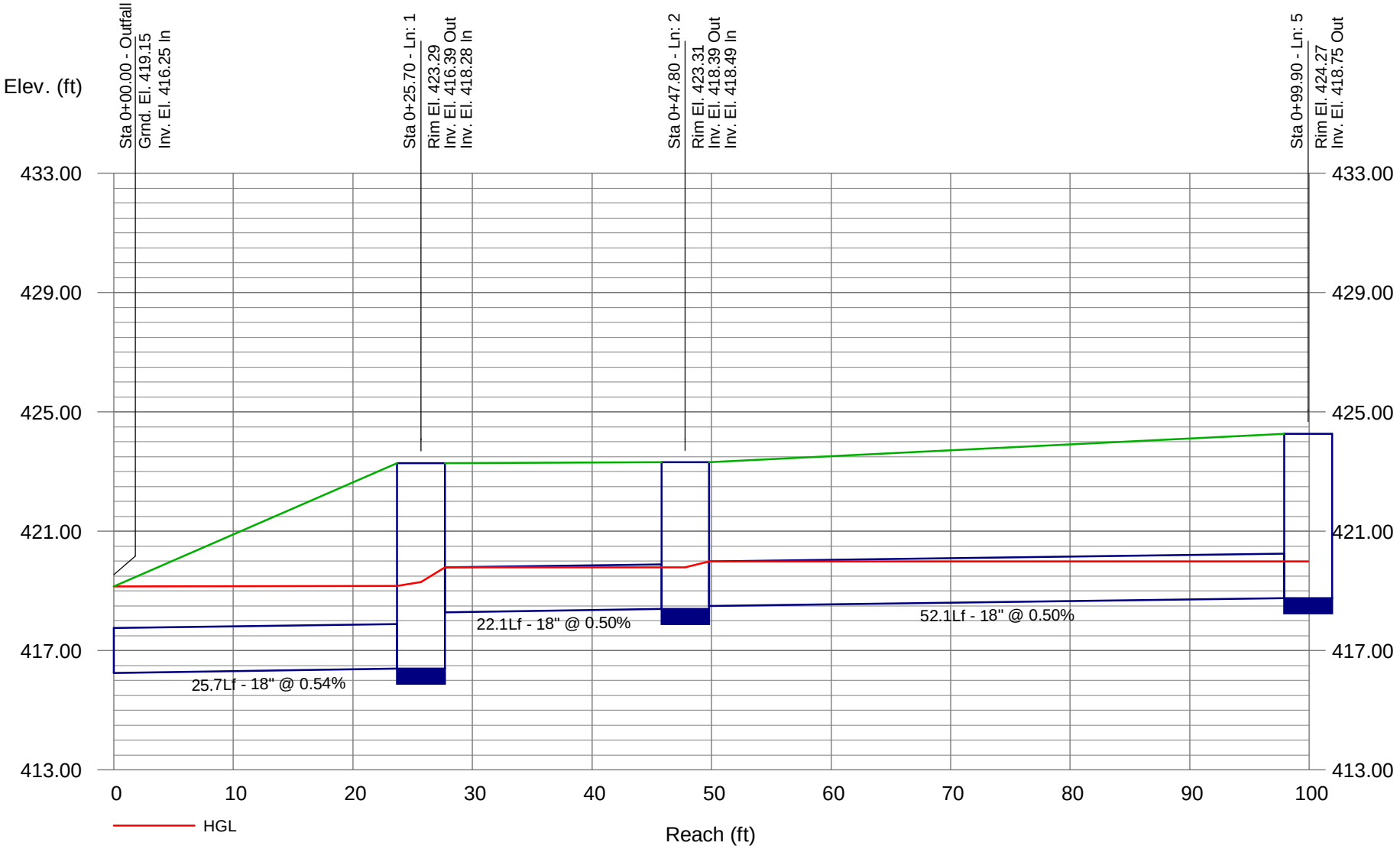
Storm Sewer Profile

Proj. file: DS_33_100%.stm



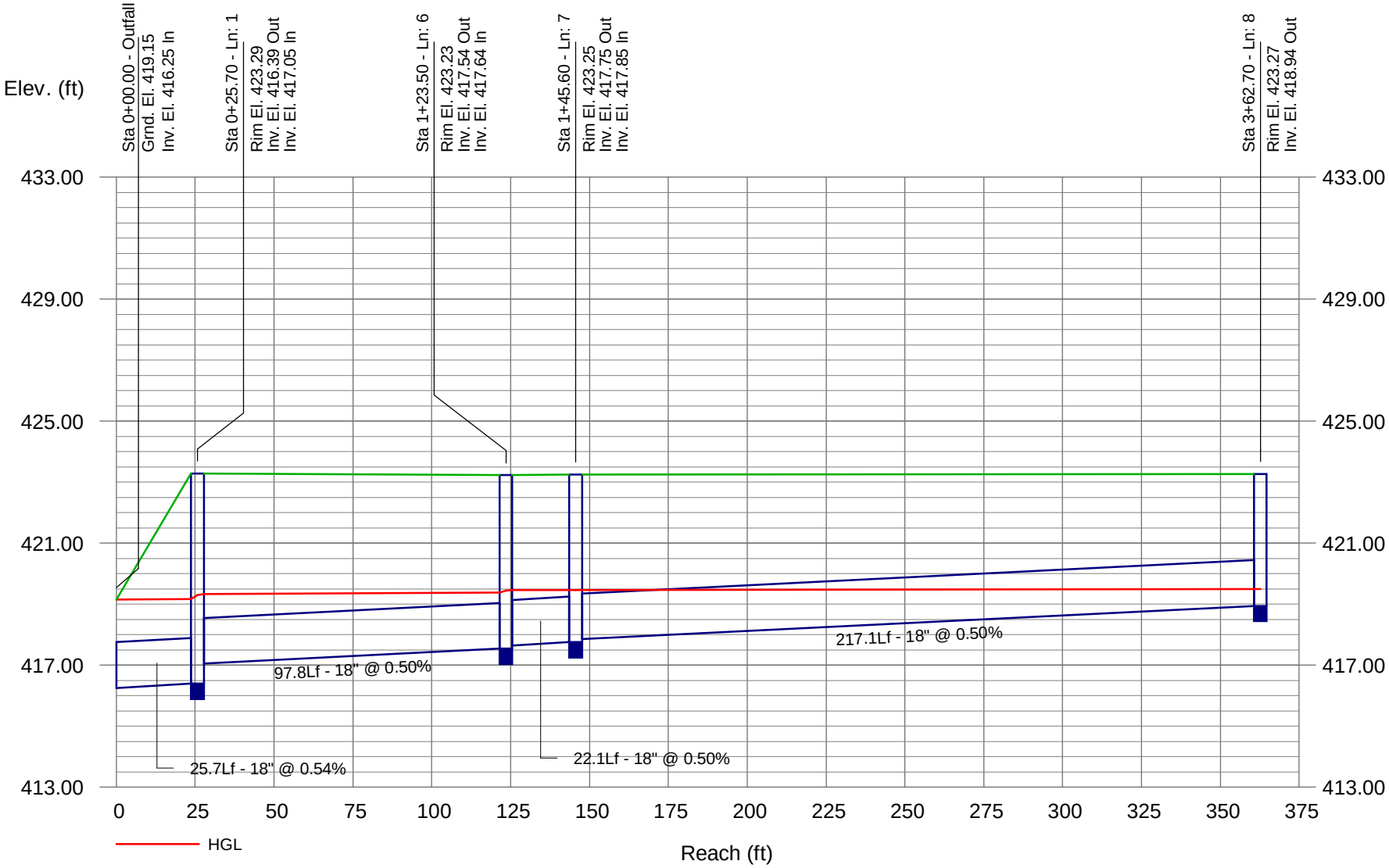
Storm Sewer Profile

Proj. file: DS_33_100%.stm



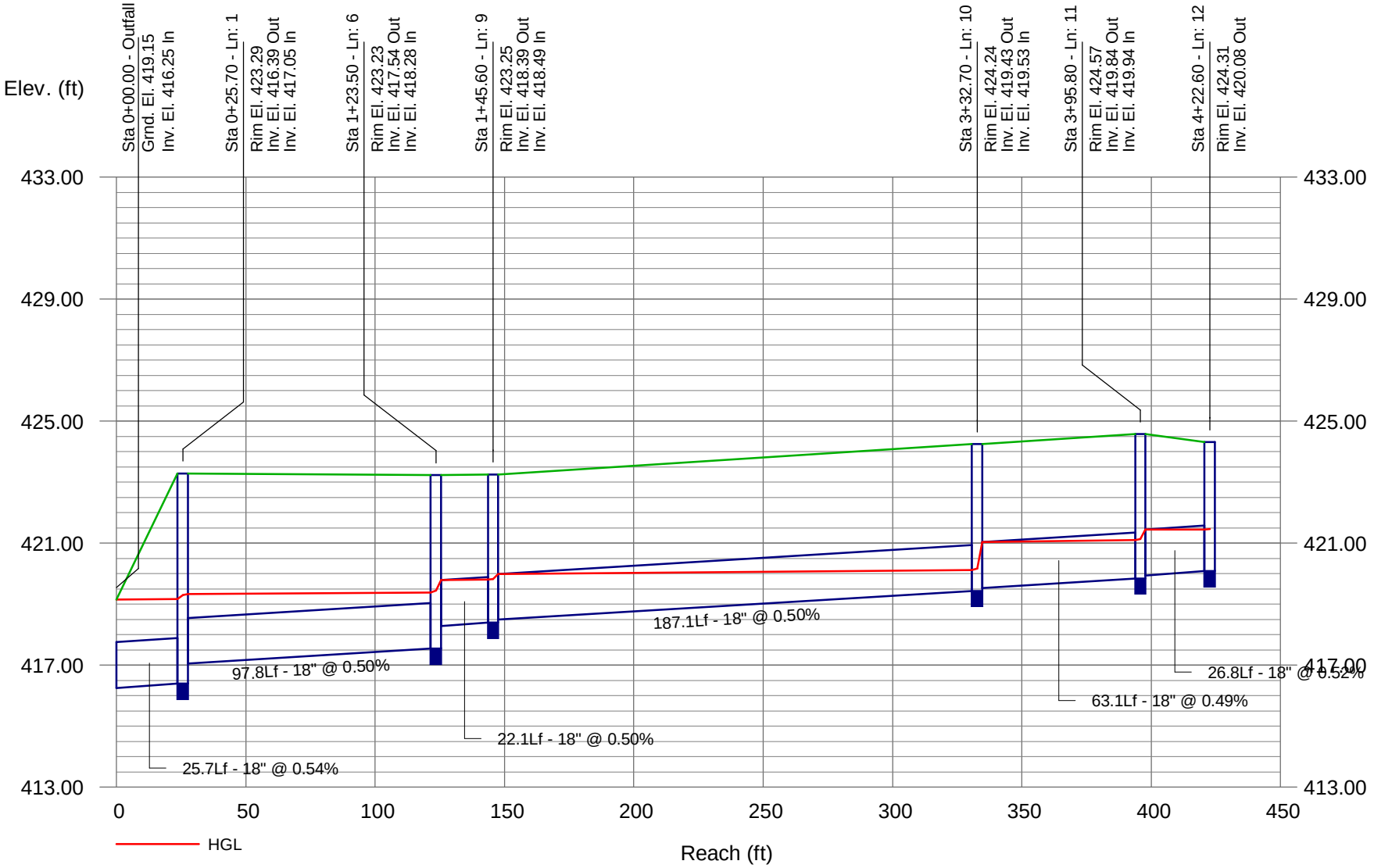
Storm Sewer Profile

Proj. file: DS_33_100%.stm



Storm Sewer Profile

Proj. file: DS_33_100%.stm



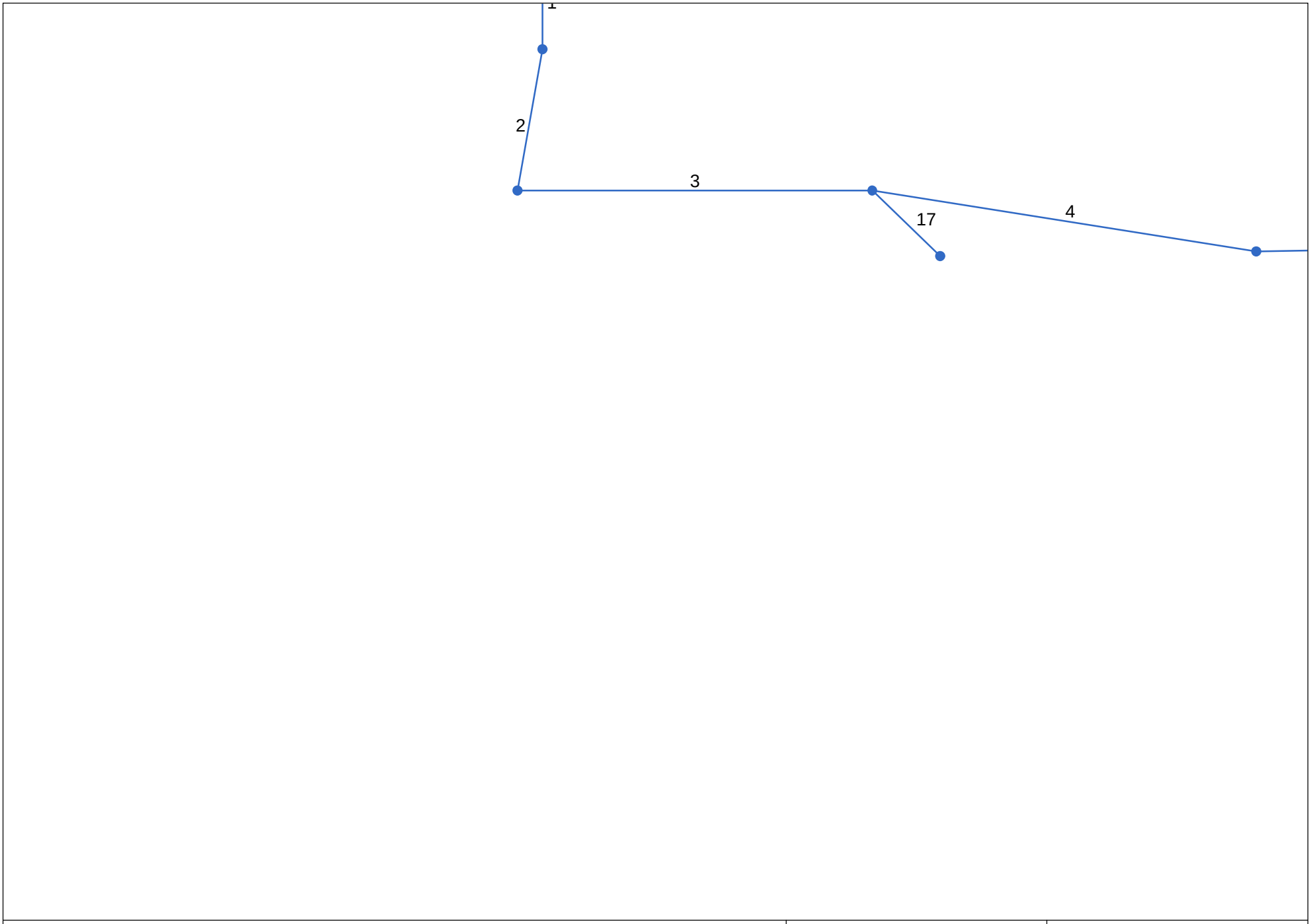
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	25.7	0.07	1.84	1.00	5.0	16.0	1.80	3.30	0.00	3.30	1.87	18	0.54	0.013	416.25	416.39	419.15	419.18	419.15	423.29	33q
2	1	22.1	0.20	0.30	1.00	5.0	9.5	2.35	0.70	0.00	0.70	0.41	18	0.50	0.013	418.28	418.39	419.78	419.78	423.29	423.31	33v
3	1	22.1	0.10	0.27	1.00	5.0	14.7	1.88	0.51	0.00	0.51	0.29	18	0.50	0.013	417.05	417.16	419.35	419.35	423.29	423.31	33y
4	3	218.2	0.17	0.17	1.00	5.0	5.0	3.24	0.55	0.00	0.55	0.37	18	0.50	0.013	417.26	418.35	419.35	419.36	423.31	423.27	33aa
5	2	52.1	0.10	0.10	1.00	5.0	5.0	3.24	0.32	0.00	0.32	0.20	18	0.50	0.025	418.49	418.75	419.99	419.99	423.31	424.27	33t
6	1	97.8	0.05	1.20	1.00	5.0	12.7	2.02	2.41	0.00	2.41	1.36	18	0.50	0.013	417.05	417.54	419.32	419.37	423.29	423.23	33i
7	6	22.1	0.08	0.23	1.00	5.0	11.2	2.16	0.50	0.00	0.50	0.28	18	0.50	0.024	417.64	417.75	419.47	419.47	423.23	423.25	33k
8	7	217.1	0.15	0.15	1.00	5.0	5.0	3.24	0.49	0.00	0.49	0.55	18	0.50	0.013	417.85	418.94	419.47	419.49	423.25	423.27	33m
9	6	22.1	0.23	0.92	1.00	5.0	8.3	2.50	2.28	0.00	2.28	1.31	18	0.50	0.024	418.28	418.39	419.78	419.81	423.23	423.25	33g
10	9	187.1	0.06	0.69	1.00	5.0	6.6	2.82	1.93	0.00	1.93	1.76	18	0.50	0.013	418.49	419.43	419.99	420.12	423.25	424.24	33e
11	10	63.1	0.26	0.63	0.97	5.0	5.6	3.05	1.90	0.00	1.90	1.14	18	0.49	0.024	419.53	419.84	421.03	421.09	424.24	424.57	33c
12	11	26.8	0.37	0.37	1.00	5.0	5.0	3.24	1.20	0.00	1.20	0.69	18	0.52	0.024	419.94	420.08	421.44	421.45	424.57	424.31	33a

DS_33_100% | Number of lines: 12 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

DS_35_100%



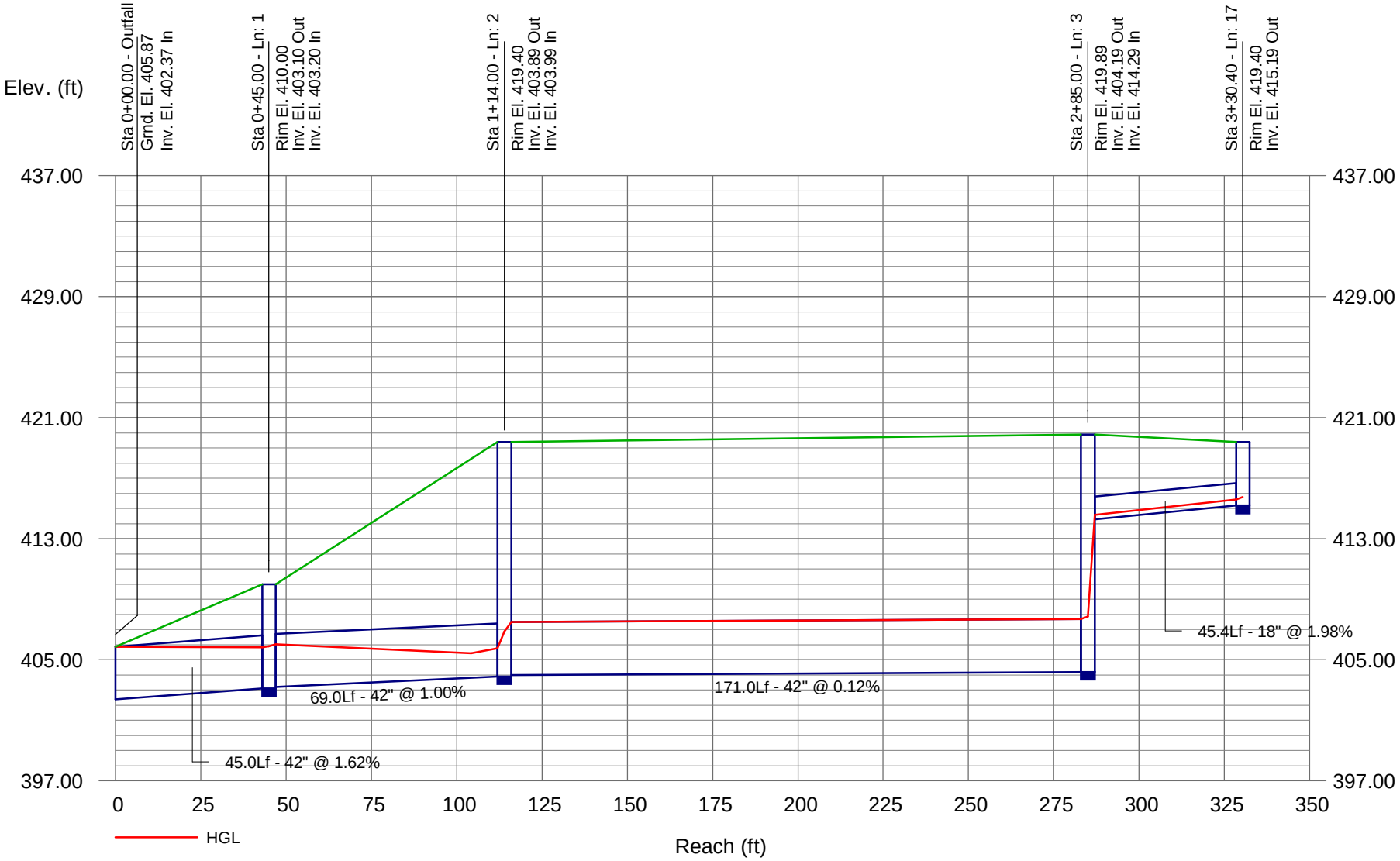
Project File: DS_35_100%.stm	Number of lines: 17	Date: 10-20-2010

DS_35_100%

Project File: DS_35_100%.stm	Number of lines: 17	Date: 10-20-2010

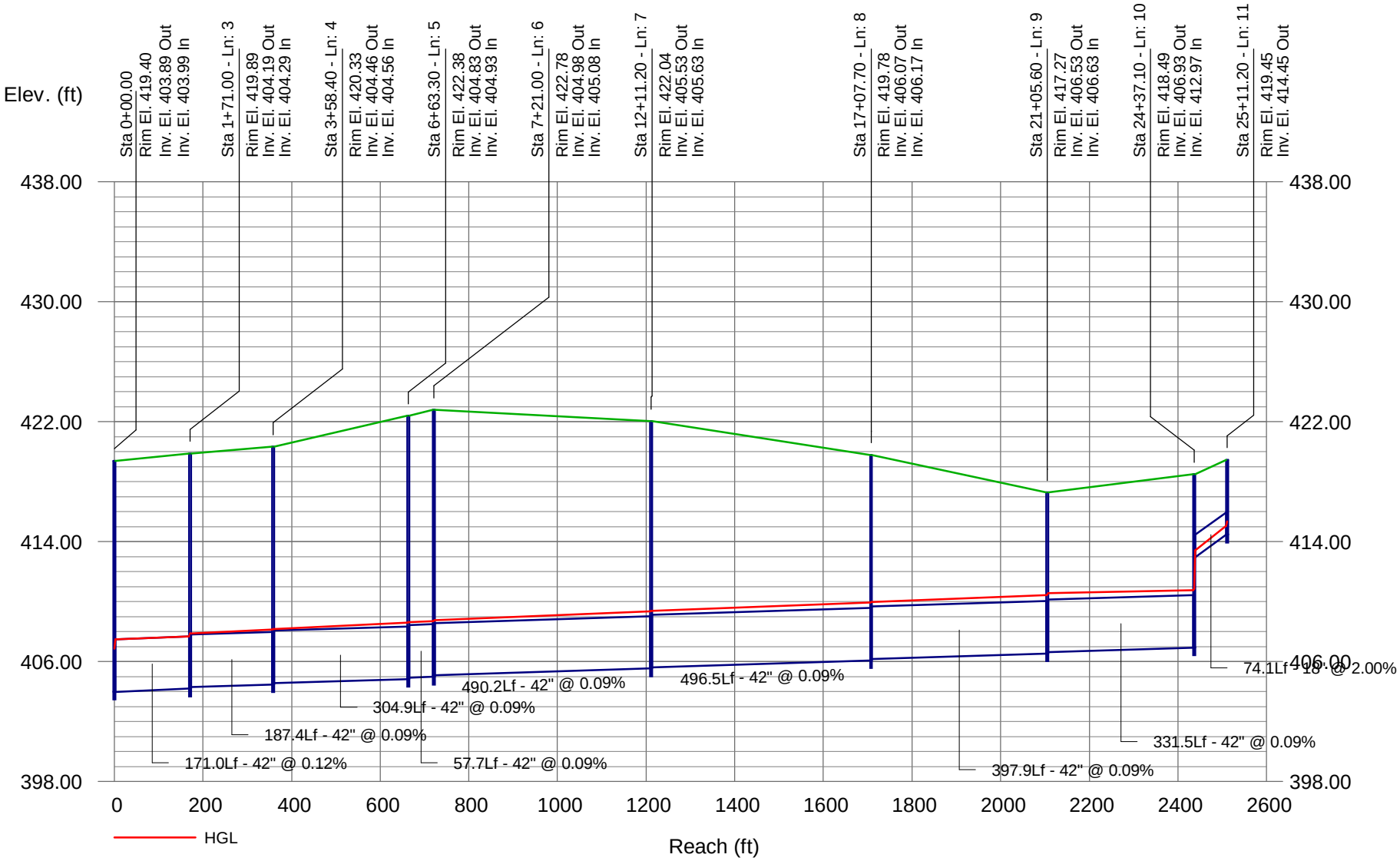
Storm Sewer Profile

Proj. file: DS_35_100%.stm



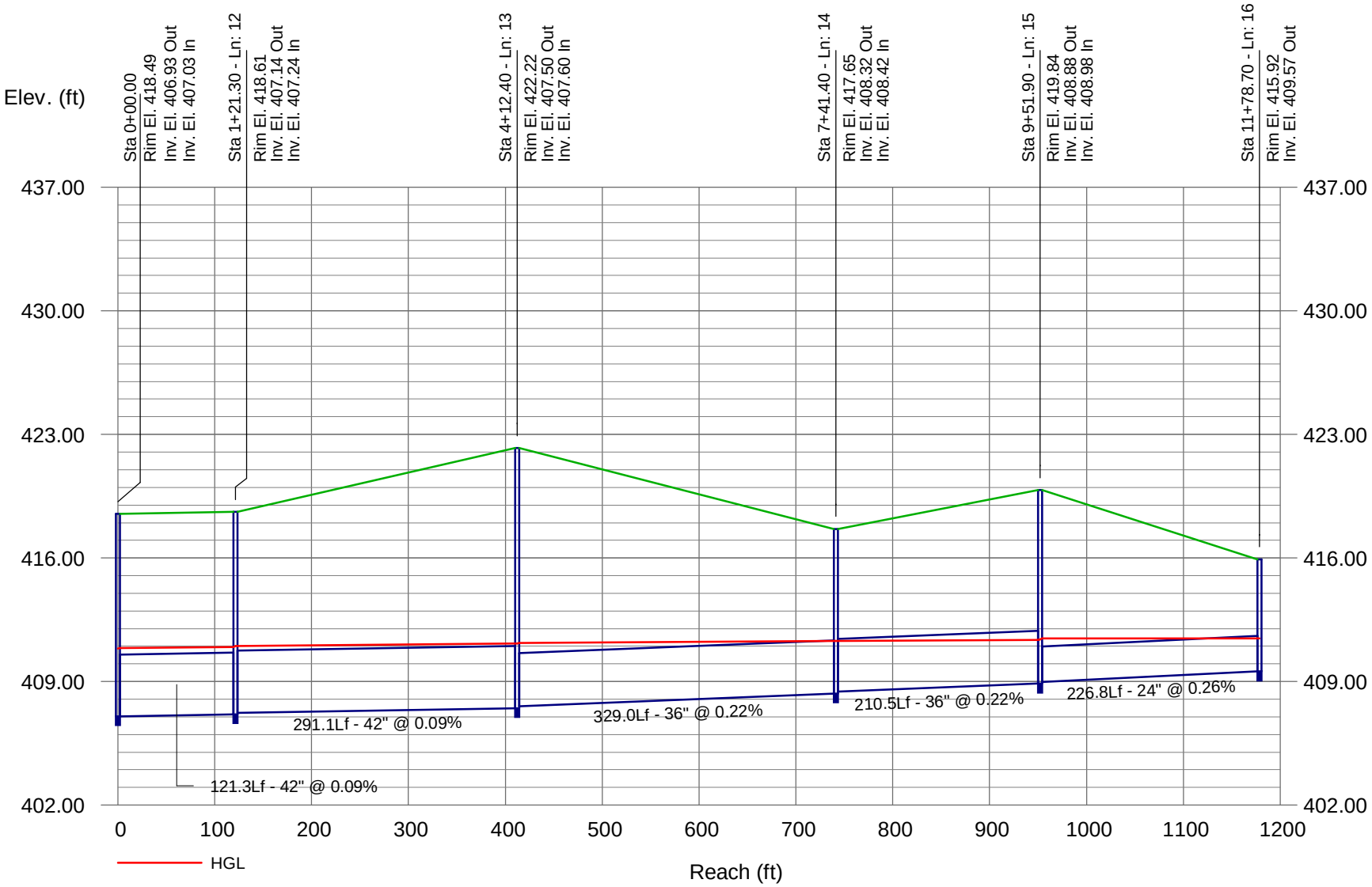
Storm Sewer Profile

Proj. file: DS_35_100%.stm



Storm Sewer Profile

Proj. file: DS_35_100%.stm



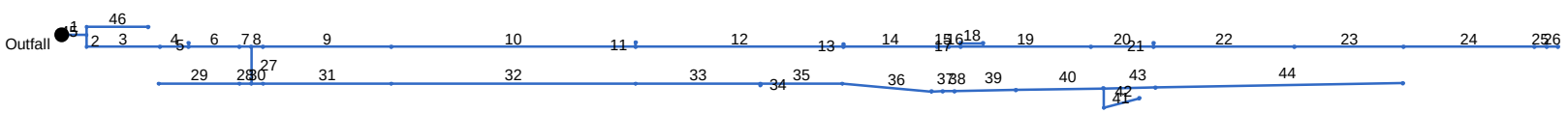
Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	45.0	0.00	0.64	0.00	0.0	604.8	0.28	0.11	0.00	37.31	4.25	42	1.62	0.013	402.37	403.10	405.87	405.84	405.87	410.00	35e
2	1	69.0	0.00	0.64	0.00	0.0	604.6	0.28	0.11	0.00	37.31	5.80	42	1.00	0.013	403.20	403.89	406.00	405.77 j	410.00	419.40	35g
3	2	171.0	0.00	0.64	0.00	0.0	603.9	0.28	0.11	0.00	37.31	3.88	42	0.12	0.013	403.99	404.19	407.49	407.69	419.40	419.89	35i
4	3	187.4	0.00	0.04	0.00	0.0	603.1	0.28	0.01	0.00	37.21	3.87	42	0.09	0.013	404.29	404.46	407.86	408.12	419.89	420.33	35m
5	4	304.9	0.00	0.04	0.00	0.0	601.8	0.28	0.01	0.00	37.21	3.87	42	0.09	0.013	404.56	404.83	408.17	408.59	420.33	422.38	35o
6	5	57.7	0.00	0.04	0.00	0.0	601.5	0.28	0.01	2.84	37.21	3.87	42	0.09	0.013	404.93	404.98	408.62	408.70	422.38	422.78	35q
7	6	490.2	0.00	0.04	0.00	0.0	599.2	0.28	0.01	0.00	34.37	3.57	42	0.09	0.013	405.08	405.53	408.77	409.34	422.78	422.04	35s
8	7	496.5	0.00	0.04	0.00	0.0	596.9	0.28	0.01	0.00	34.37	3.57	42	0.09	0.013	405.63	406.07	409.37	409.95	422.04	419.78	35u
9	8	397.9	0.00	0.04	0.00	0.0	595.1	0.28	0.01	9.32	34.37	3.57	42	0.09	0.013	406.17	406.53	409.98	410.44	419.78	417.27	35w
10	9	331.5	0.00	0.04	0.00	0.0	592.9	0.29	0.01	0.00	25.05	2.60	42	0.09	0.013	406.63	406.93	410.57	410.77	417.27	418.49	35y
11	10	74.1	0.00	0.00	0.00	0.0	0.0	0.00	0.00	2.63	2.63	5.08	18	2.00	0.013	412.97	414.45	413.40	415.07	418.49	419.45	35aa
12	10	121.3	0.04	0.04	0.60	10.0	592.1	0.29	0.01	0.00	22.42	2.33	42	0.09	0.013	407.03	407.14	410.90	410.96	418.49	418.61	35ac
13	12	291.1	0.00	0.00	0.00	0.0	590.0	0.00	0.00	9.99	22.41	2.33	42	0.09	0.013	407.24	407.50	411.00	411.14	418.61	422.22	35ae
14	13	329.0	0.00	0.00	0.00	0.0	586.9	0.00	0.00	0.00	12.42	1.76	36	0.22	0.013	407.60	408.32	411.19	411.30	422.22	417.65	35ag
15	14	210.5	0.00	0.00	0.00	0.0	585.0	0.00	0.00	12.40	12.42	1.88	36	0.22	0.013	408.42	408.88	411.31	411.36	417.65	419.84	35ai
16	15	226.8	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.02	0.02	0.01	24	0.26	0.013	408.98	409.57	411.44	411.44	419.84	415.92	(E) DI
17	3	45.4	0.60	0.60	0.60	5.0	5.0	3.24	1.17	0.00	1.17	3.97	18	1.98	0.013	414.29	415.19	414.58	415.60	419.89	419.40	35k

DS_35_100% | Number of lines: 17 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

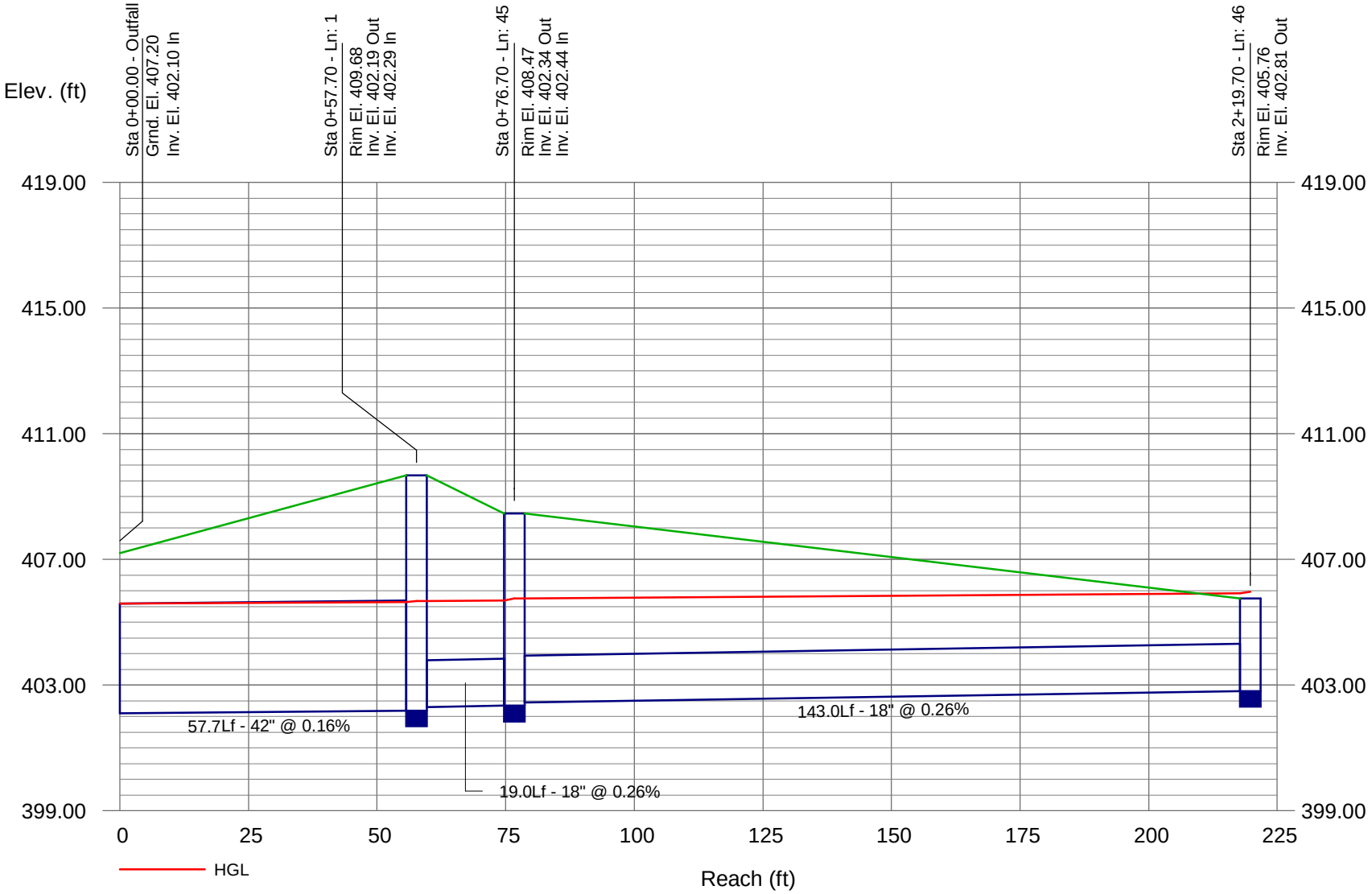
DS_36_39_100%



Project File: DS_36_39_100%.stm	Number of lines: 46	Date: 10-20-2010

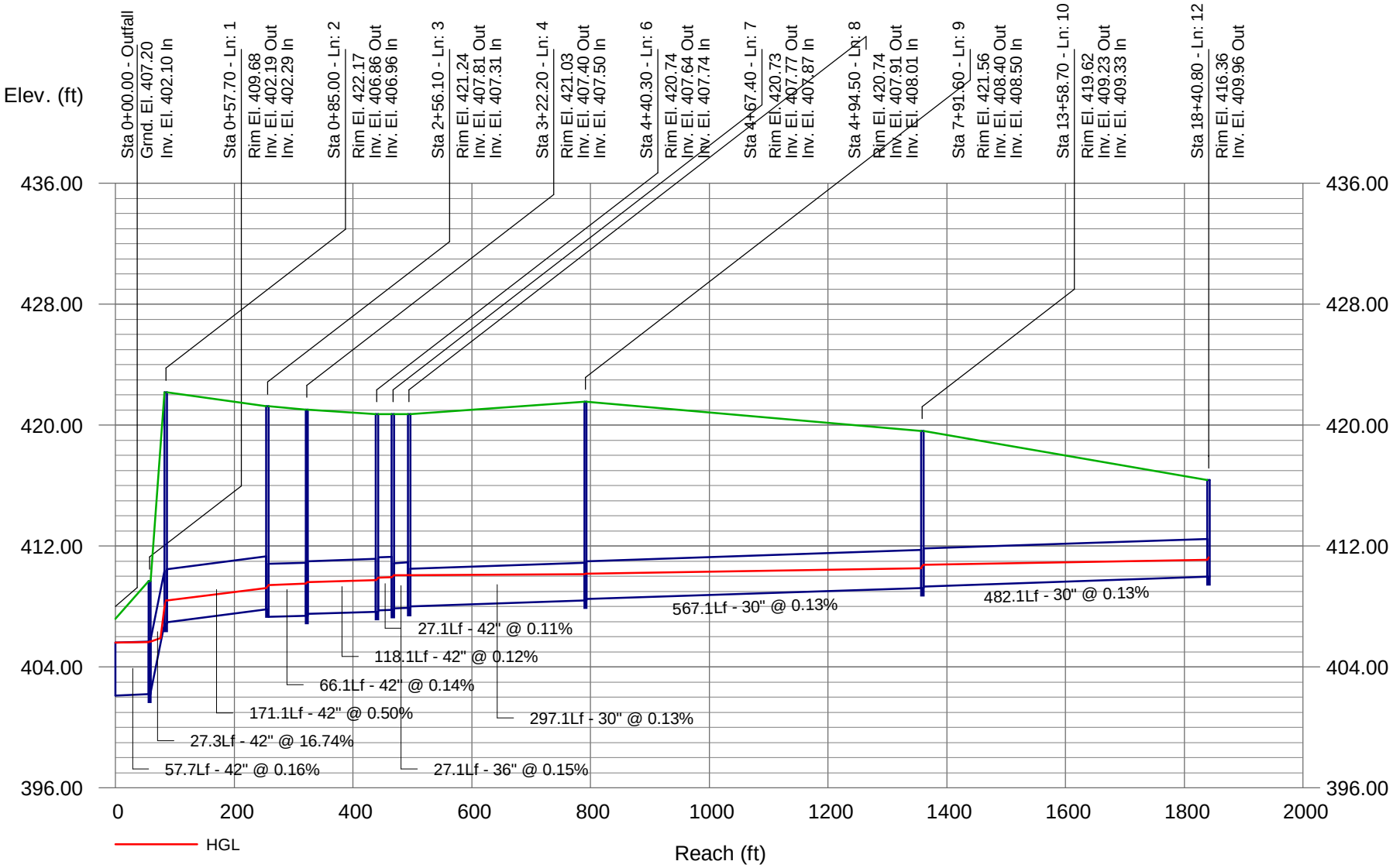
Storm Sewer Profile

Proj. file: DS_36_39_100%.stm



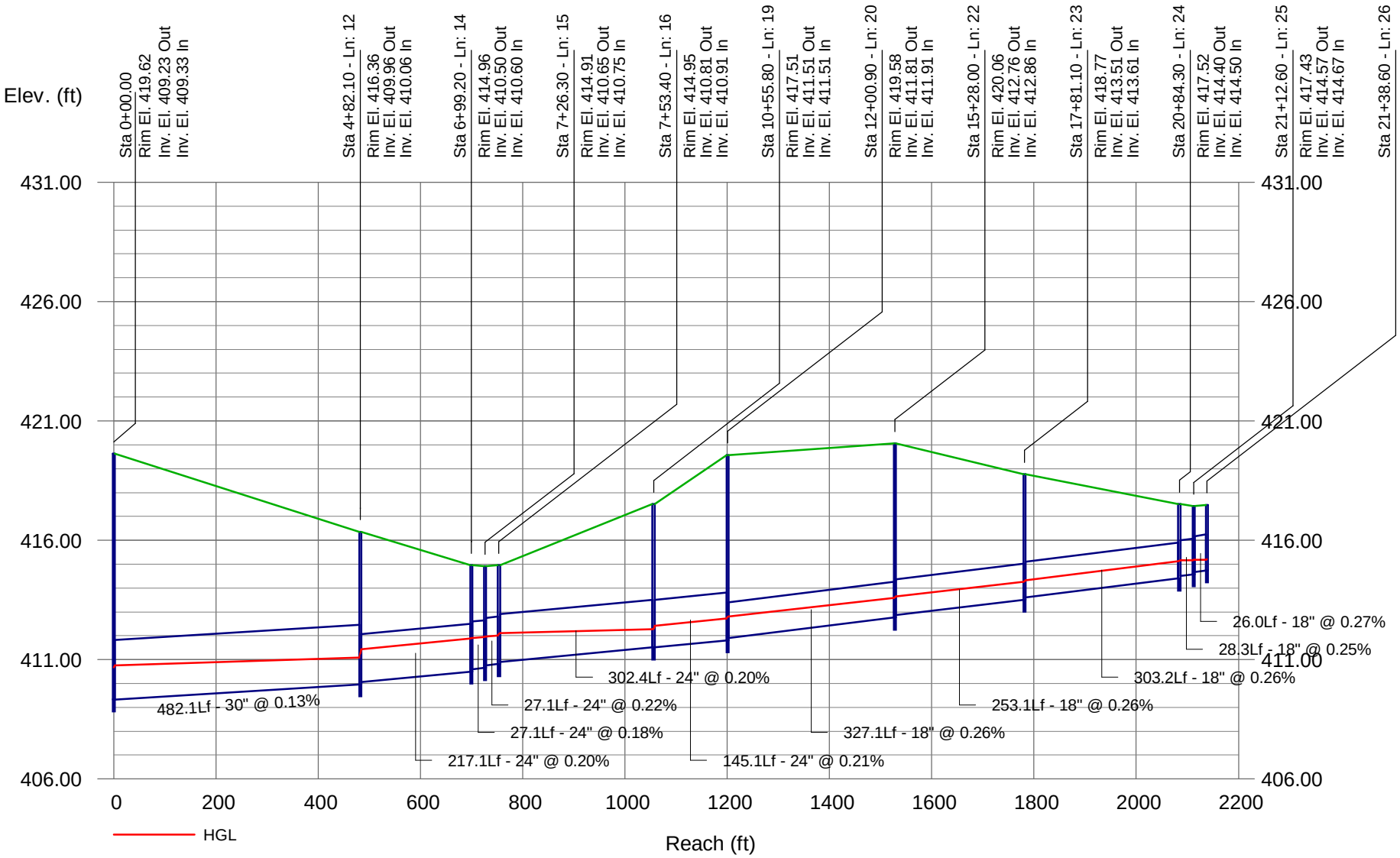
Storm Sewer Profile

Proj. file: DS_36_39_100%.stm



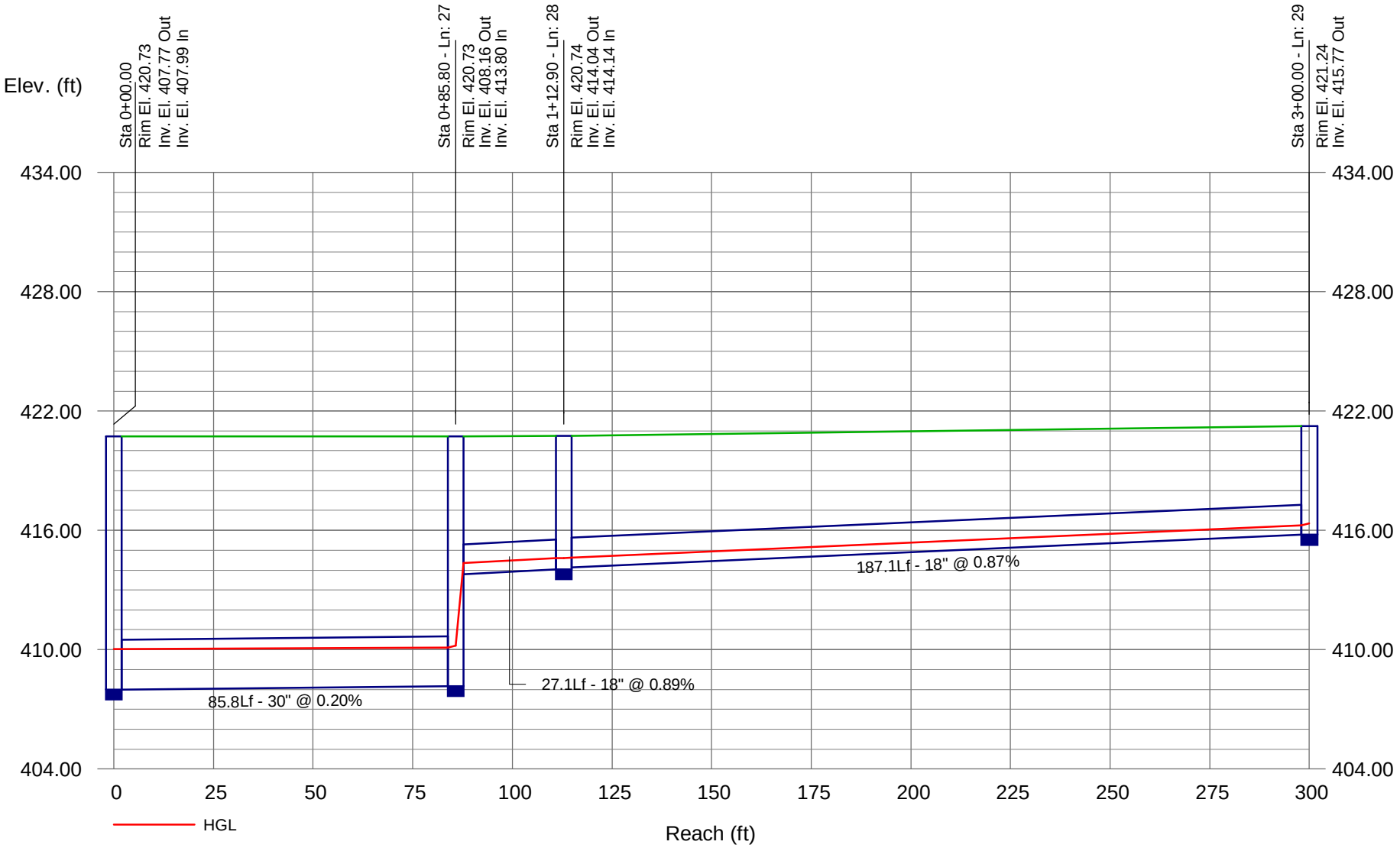
Storm Sewer Profile

Proj. file: DS_36_39_100%.stm



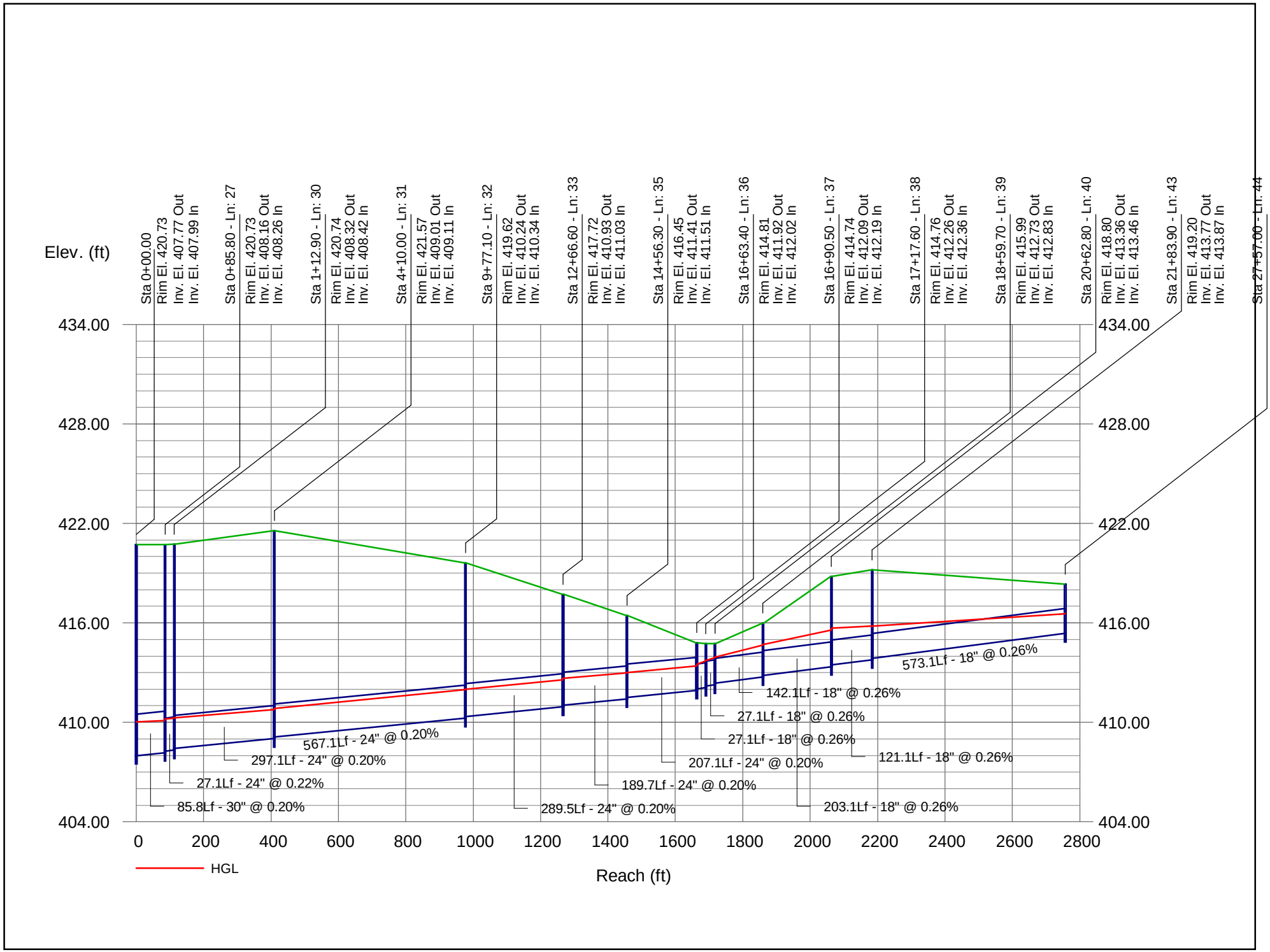
Storm Sewer Profile

Proj. file: DS_36_39_100%.stm



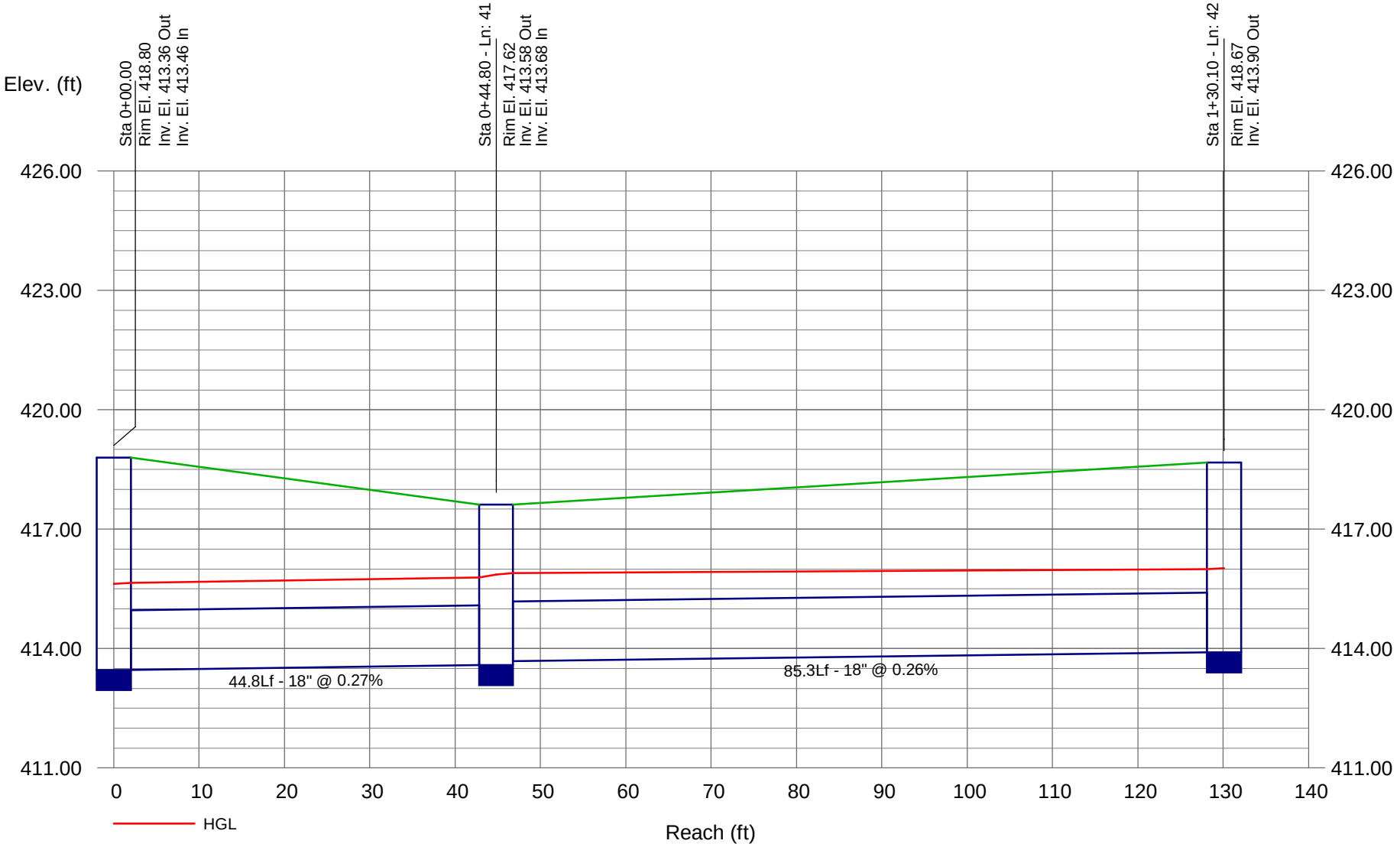
Storm Sewer Profile

Proj. file: DS_36_39_100%.stm



Storm Sewer Profile

Proj. file: DS_36_39_100%.stm



Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	57.7	0.00	12.12	0.00	5.0	36.4	1.18	14.11	0.00	14.11	1.47	42	0.16	0.024	402.10	402.19	405.60	405.64	407.20	409.68	36g
2	1	27.3	0.00	11.05	0.00	5.0	36.3	1.19	12.87	0.00	12.87	3.17	42	16.74	0.024	402.29	406.86	405.68	407.96 j	409.68	422.17	36i
3	2	171.1	0.00	11.05	0.00	5.0	35.5	1.20	13.02	0.00	13.02	3.54	42	0.50	0.024	406.96	407.81	408.41	409.21	422.17	421.24	36s
4	3	66.1	0.40	11.05	1.00	0.0	35.0	1.21	13.11	0.00	13.11	2.16	42	0.14	0.024	407.31	407.40	409.43	409.51	421.24	421.03	36w
5	4	9.2	0.11	0.11	1.00	5.0	5.0	3.24	0.36	0.00	0.36	2.19	18	2.07	0.024	416.25	416.44	416.46	416.67	421.03	420.49	36u
6	4	118.1	0.00	10.54	0.00	5.0	34.0	1.23	12.67	0.00	12.67	2.10	42	0.12	0.024	407.50	407.64	409.61	409.74	421.03	420.74	36y
7	6	27.1	0.06	10.54	1.00	5.0	33.8	1.23	12.71	0.00	12.71	2.04	42	0.11	0.024	407.74	407.77	409.90	409.93	420.74	420.73	36aa
8	7	27.1	0.31	5.18	1.00	5.0	33.3	1.24	6.42	0.00	6.42	1.17	36	0.15	0.013	407.87	407.91	410.06	410.06	420.73	420.74	36ac
9	8	297.1	0.15	4.87	1.00	5.0	30.2	1.30	6.34	0.00	6.34	1.60	30	0.13	0.013	408.01	408.40	410.07	410.15	420.74	421.56	36ae
10	9	567.1	0.61	4.72	1.00	5.0	26.0	1.41	6.64	0.00	6.64	2.24	30	0.13	0.013	408.50	409.23	410.19	410.52	421.56	419.62	36ai
11	10	10.4	0.39	0.39	1.00	5.0	5.0	3.24	1.26	0.00	1.26	3.16	18	2.02	0.024	413.19	413.40	413.59	413.83	419.62	417.39	36ag
12	10	482.1	0.42	3.72	1.00	5.0	22.5	1.51	5.63	0.00	5.63	2.28	30	0.13	0.013	409.33	409.96	410.76	411.09	419.62	416.36	36am
13	12	5.4	0.44	0.44	1.00	5.0	5.0	3.24	1.42	0.00	1.42	1.36	18	2.04	0.024	410.39	410.50	411.31	411.31	416.36	414.50	36ak
14	12	217.1	0.53	2.86	1.00	5.0	20.6	1.58	4.52	0.00	4.52	1.96	24	0.20	0.024	410.06	410.50	411.44	411.88	416.36	414.96	36ao
15	14	27.1	0.27	2.33	1.00	5.0	20.4	1.59	3.71	0.00	3.71	1.71	24	0.18	0.024	410.60	410.65	411.91	411.95	414.96	414.91	36aq
16	15	27.1	0.08	2.06	1.00	5.0	20.1	1.60	3.30	0.00	3.30	1.65	24	0.22	0.024	410.75	410.81	411.97	412.01	414.91	414.95	36au
17	16	8.3	0.27	0.69	1.00	5.0	5.9	2.99	2.06	0.00	2.06	1.40	18	0.36	0.024	410.91	410.94	412.08	412.10	414.95	413.45	36as
18	17	52.8	0.42	0.42	1.00	5.0	5.0	3.24	1.36	0.00	1.36	1.03	18	0.27	0.024	411.04	411.18	412.15	412.18	413.45	413.39	36aw
19	16	302.4	0.00	1.29	0.00	0.0	17.0	1.75	2.25	0.00	2.25	1.61	24	0.20	0.013	410.91	411.51	412.11	412.27	414.95	0.00	36ay
20	19	145.1	0.38	1.29	1.00	5.0	15.5	1.83	2.36	0.00	2.36	1.70	24	0.21	0.024	411.51	411.81	412.42	412.72	0.00	419.58	36bc
21	20	8.0	0.07	0.07	1.00	5.0	5.0	3.24	0.23	0.00	0.23	2.28	18	4.75	0.024	415.62	416.00	415.76	416.18	419.58	419.51	36ba
22	20	327.1	0.22	0.84	1.00	5.0	12.2	2.06	1.73	0.00	1.73	1.65	18	0.26	0.024	411.91	412.76	412.81	413.58	419.58	420.06	36be
23	22	253.1	0.15	0.62	1.00	5.0	9.6	2.33	1.45	0.00	1.45	1.60	18	0.26	0.024	412.86	413.51	413.64	414.25	420.06	418.77	36bg

DS_36_39_100% | Number of lines: 46 | Date: 10-20-2010

NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
24	23	303.2	0.32	0.47	1.00	5.0	6.4	2.85	1.34	0.00	1.34	1.61	18	0.26	0.024	413.61	414.40	414.33	415.12	418.77	417.52	36bi
25	24	28.3	0.06	0.15	1.00	5.0	5.7	3.03	0.45	0.00	0.45	0.64	18	0.25	0.024	414.50	414.57	415.16	415.17	417.52	417.43	36bk
26	25	26.0	0.09	0.09	1.00	5.0	5.0	3.24	0.29	0.00	0.29	0.60	18	0.27	0.024	414.67	414.74	415.18	415.19	417.43	417.48	36bm
27	7	85.8	0.06	5.30	1.00	5.0	32.9	1.25	6.36	0.00	6.36	1.51	30	0.20	0.024	407.99	408.16	410.04	410.11	420.73	420.73	39g
28	27	27.1	0.21	0.57	1.00	5.0	6.4	2.86	1.63	0.00	1.63	2.66	18	0.89	0.024	413.80	414.04	414.37	414.61	420.73	420.74	39e
29	28	187.1	0.36	0.36	1.00	5.0	5.0	3.24	1.17	0.00	1.17	2.41	18	0.87	0.024	414.14	415.77	414.62	416.25	420.74	421.24	39c
30	27	27.1	0.32	4.67	1.00	5.0	32.7	1.25	5.59	0.00	5.59	1.80	24	0.22	0.024	408.26	408.32	410.19	410.24	420.73	420.74	39i
31	30	297.1	0.15	4.35	1.00	5.0	30.1	1.31	5.42	0.00	5.42	1.82	24	0.20	0.024	408.42	409.01	410.27	410.78	420.74	421.57	39k
32	31	567.1	0.44	4.20	1.00	5.0	25.1	1.43	5.72	0.00	5.72	1.97	24	0.20	0.024	409.11	410.24	410.85	411.98	421.57	419.62	39m
33	32	289.5	0.31	3.76	1.00	5.0	22.4	1.51	5.39	0.00	5.39	1.95	24	0.20	0.024	410.34	410.93	412.01	412.56	419.62	417.72	39o
34	33	3.1	0.24	0.24	0.60	5.0	5.0	3.24	0.47	0.00	0.47	2.41	18	2.26	0.024	414.01	414.08	414.25	414.34	417.72	418.80	39q
35	33	189.7	0.21	3.21	1.00	5.0	20.5	1.59	4.92	0.00	4.92	1.84	24	0.20	0.024	411.03	411.41	412.65	412.97	417.72	416.45	39s
36	35	207.1	0.28	3.00	1.00	5.0	18.3	1.68	4.86	0.00	4.86	1.95	24	0.20	0.024	411.51	411.92	413.00	413.40	416.45	414.81	39u
37	36	27.1	0.09	2.72	1.00	5.0	18.2	1.69	4.41	0.00	4.41	2.50	18	0.26	0.024	412.02	412.09	413.52	413.68	414.81	414.74	39w
38	37	27.1	0.23	2.63	1.00	5.0	18.0	1.70	4.28	0.00	4.28	2.42	18	0.26	0.024	412.19	412.26	413.74	413.89	414.74	414.76	39y
39	38	142.1	0.28	2.40	1.00	5.0	17.0	1.75	4.01	0.00	4.01	2.27	18	0.26	0.024	412.36	412.73	413.95	414.65	414.76	415.99	39aa
40	39	203.1	0.00	2.12	0.00	5.0	15.4	1.84	3.70	0.00	3.70	2.09	18	0.26	0.024	412.83	413.36	414.70	415.56	415.99	418.80	39ac
41	40	44.8	0.54	1.20	0.89	5.0	6.3	2.89	3.16	0.00	3.16	1.79	18	0.27	0.024	413.46	413.58	415.65	415.79	418.80	417.62	39ae
42	41	85.3	0.66	0.66	0.93	5.0	5.0	3.24	1.99	0.00	1.99	1.12	18	0.26	0.024	413.68	413.90	415.89	416.00	417.62	418.67	39ag
43	40	121.1	0.30	0.92	1.00	5.0	13.4	1.97	1.81	0.00	1.81	1.02	18	0.26	0.024	413.46	413.77	415.68	415.81	418.80	419.20	39ai
44	43	573.1	0.62	0.62	1.00	5.0	5.0	3.24	2.01	0.00	2.01	1.24	18	0.26	0.024	413.87	415.36	415.81	416.54	419.20	418.33	39ak
45	1	19.0	0.00	1.07	0.00	0.0	6.2	2.90	3.11	0.00	3.11	1.76	18	0.26	0.013	402.29	402.34	405.67	405.69	409.68	408.47	36e
46	45	143.0	1.07	1.07	1.00	5.0	5.0	3.24	3.46	0.00	3.46	1.96	18	0.26	0.013	402.44	402.81	405.76	405.92	408.47	405.76	36k

DS_36_39_100% | Number of lines: 46 | Date: 10-20-2010

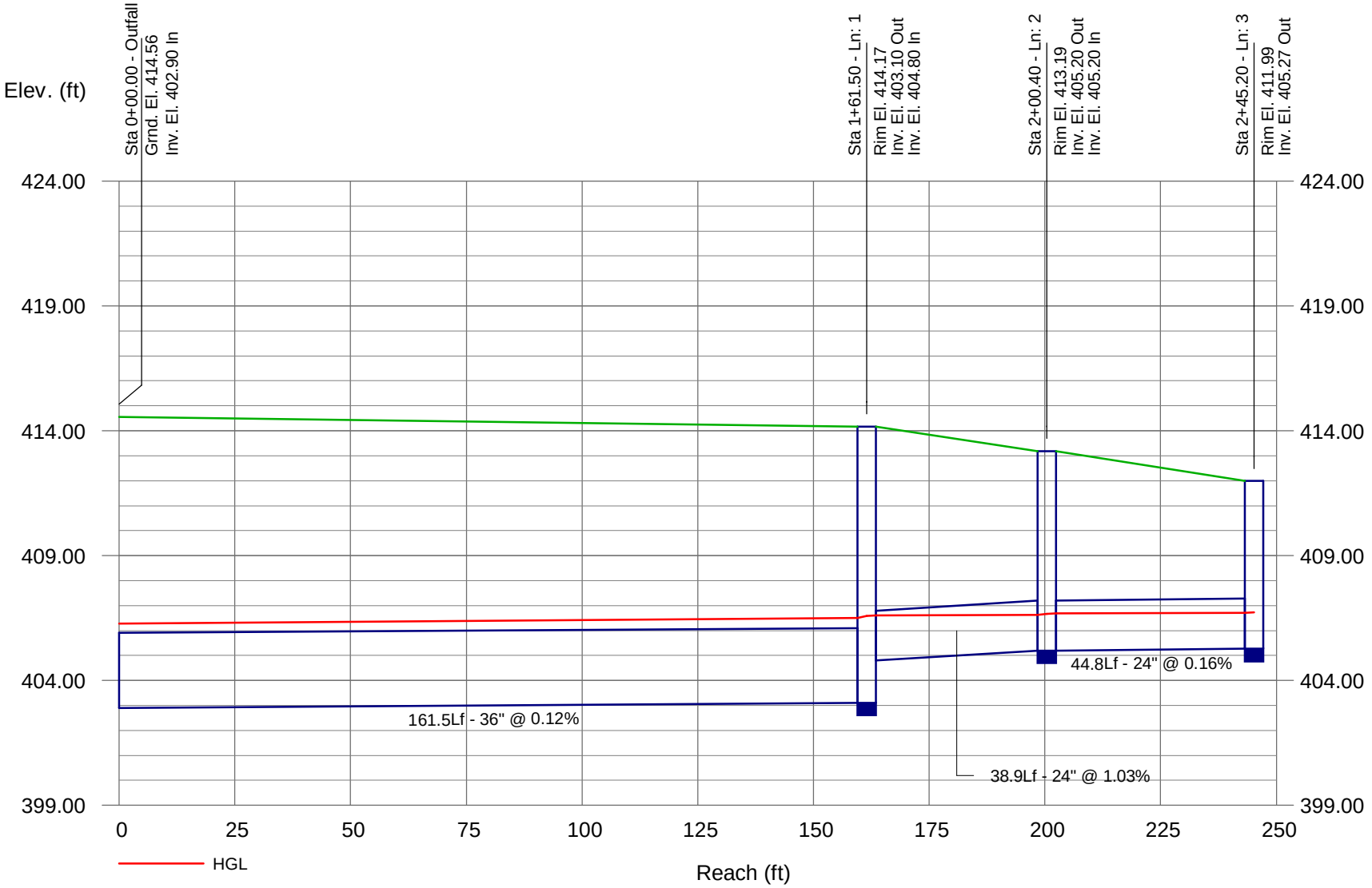
NOTES: Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

STA_357 to end of Project

Project File: DS_41_42_43_44_45_46_47_100%.stm	Number of lines: 41	Date: 10-20-2010

Storm Sewer Profile

Proj. file: DS_41_42_43_44_45_46_47_100%.stm



Storm Sewer Profile

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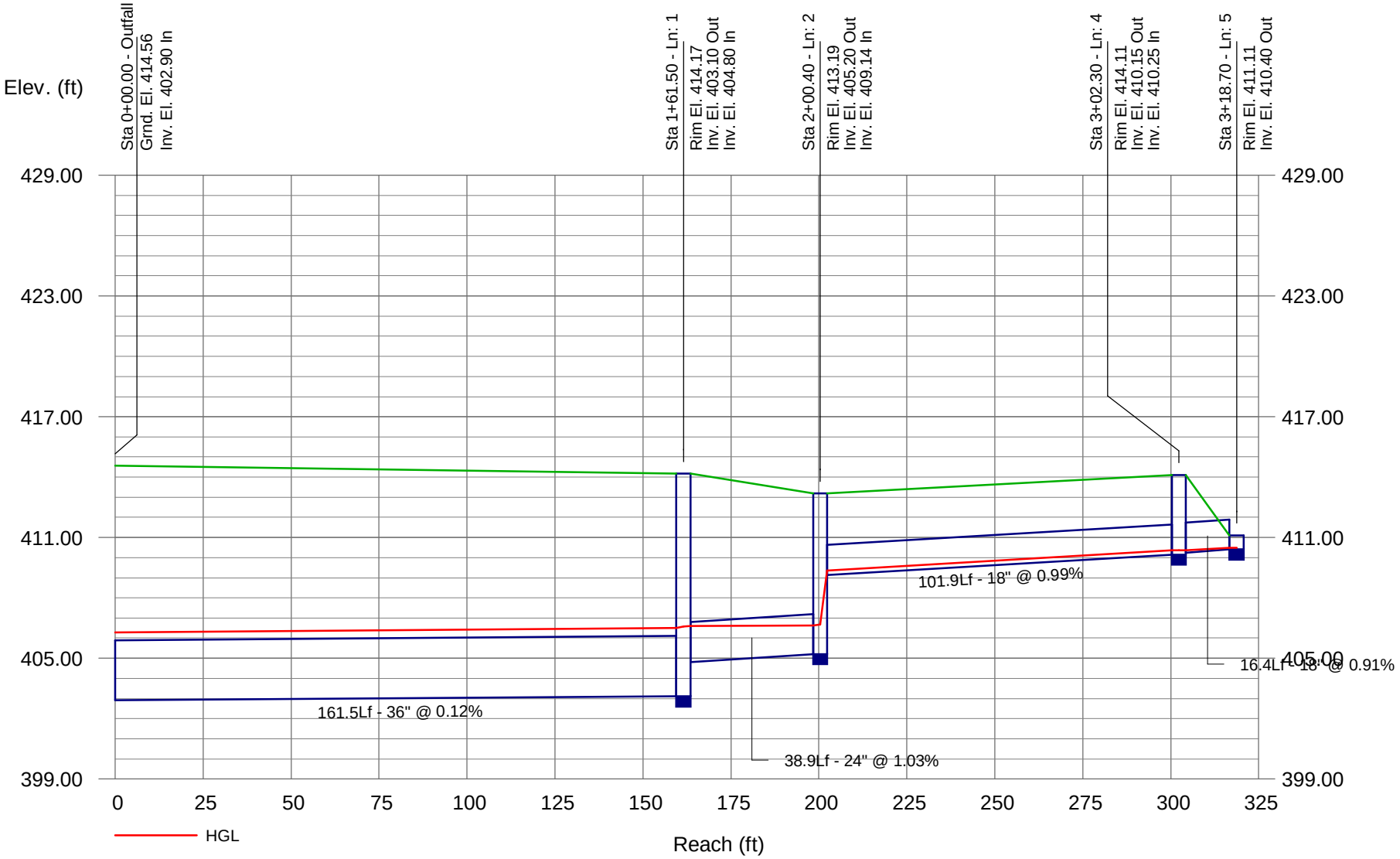
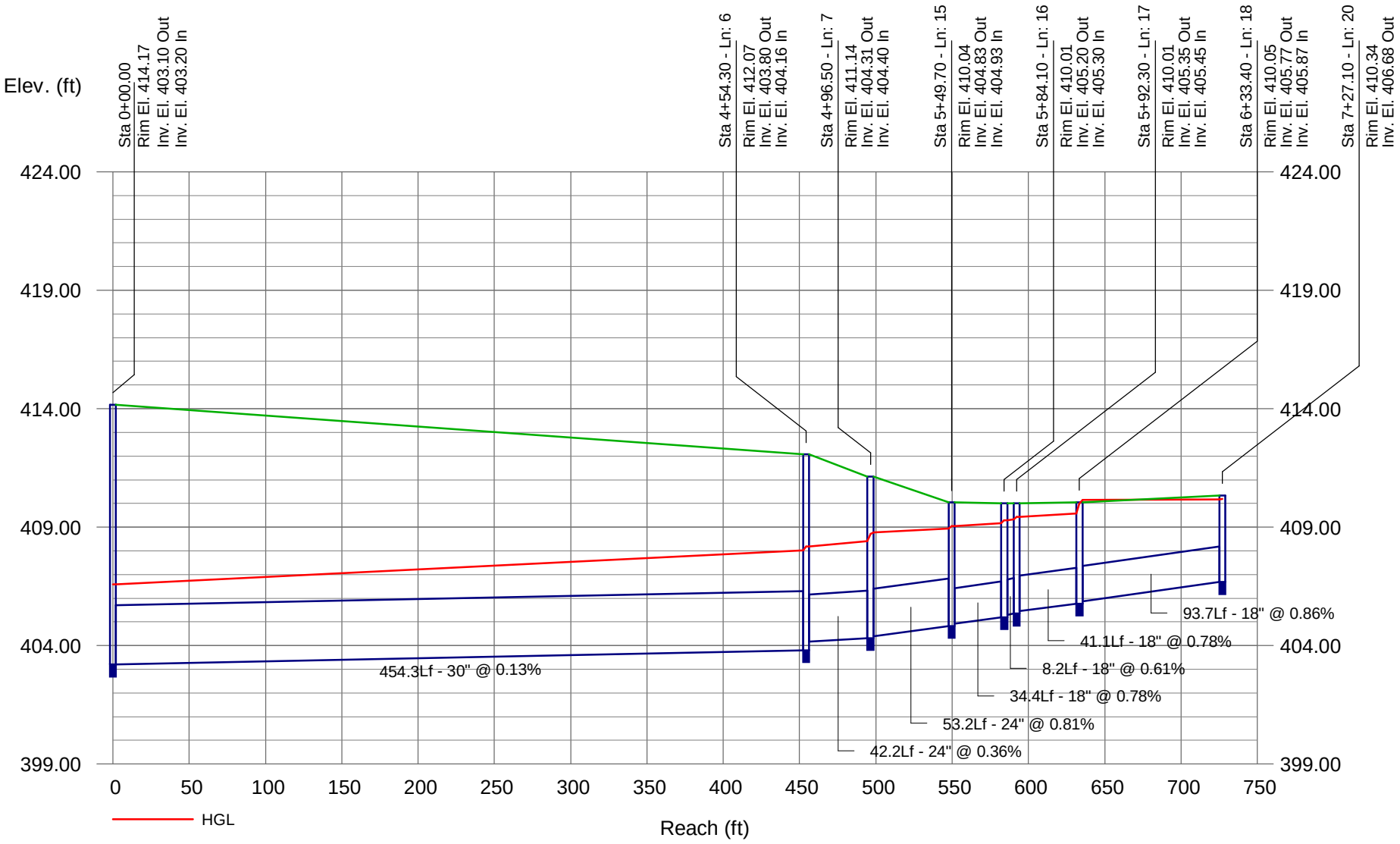


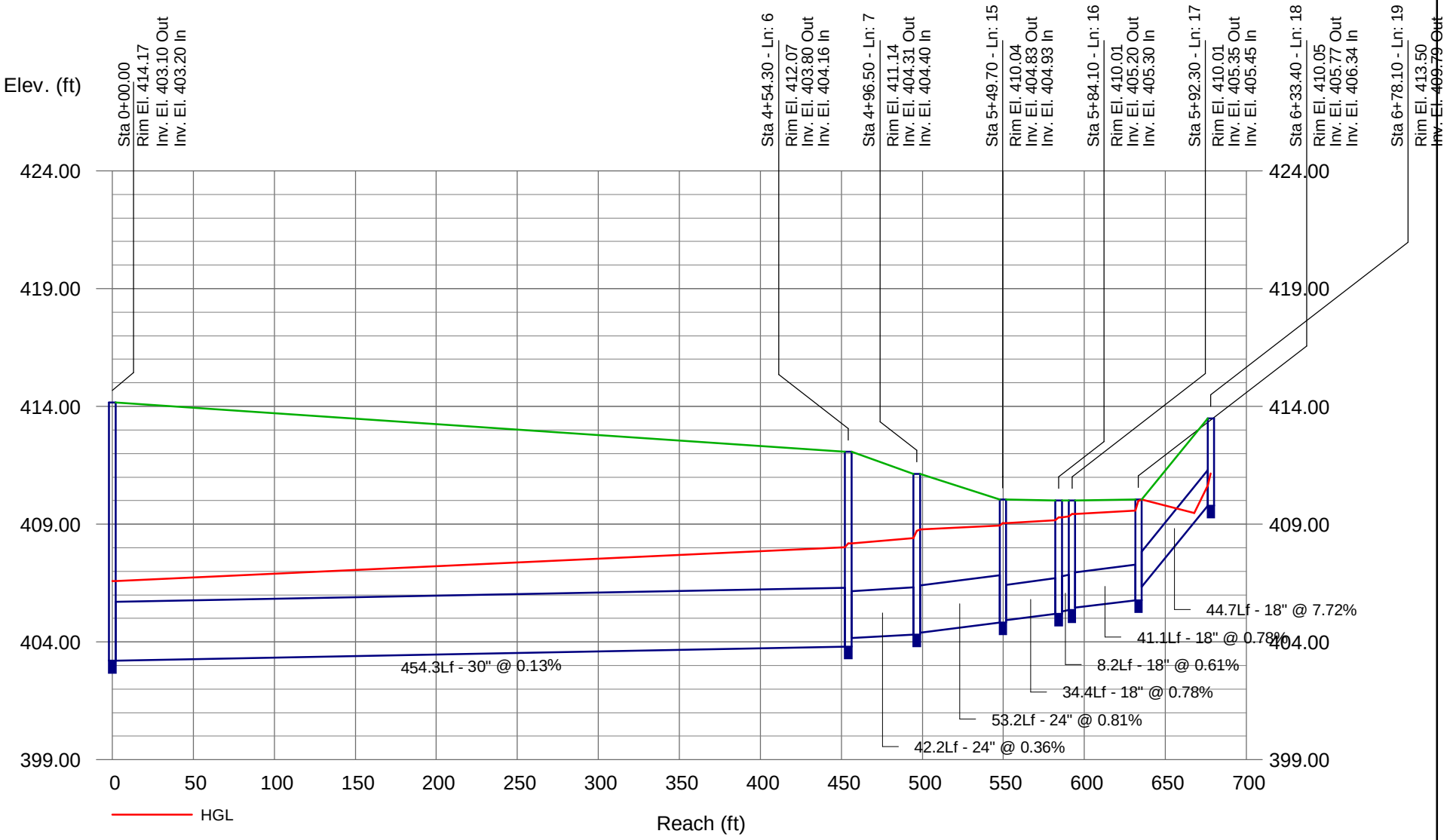
Storm Sewer Profile

Proj. file: DS_41_42_43_44_45_46_47_100%.stm



Storm Sewer Profile

Proj. file: DS_41_42_43_44_45_46_47_100%.stm



Storm Sewer Profile

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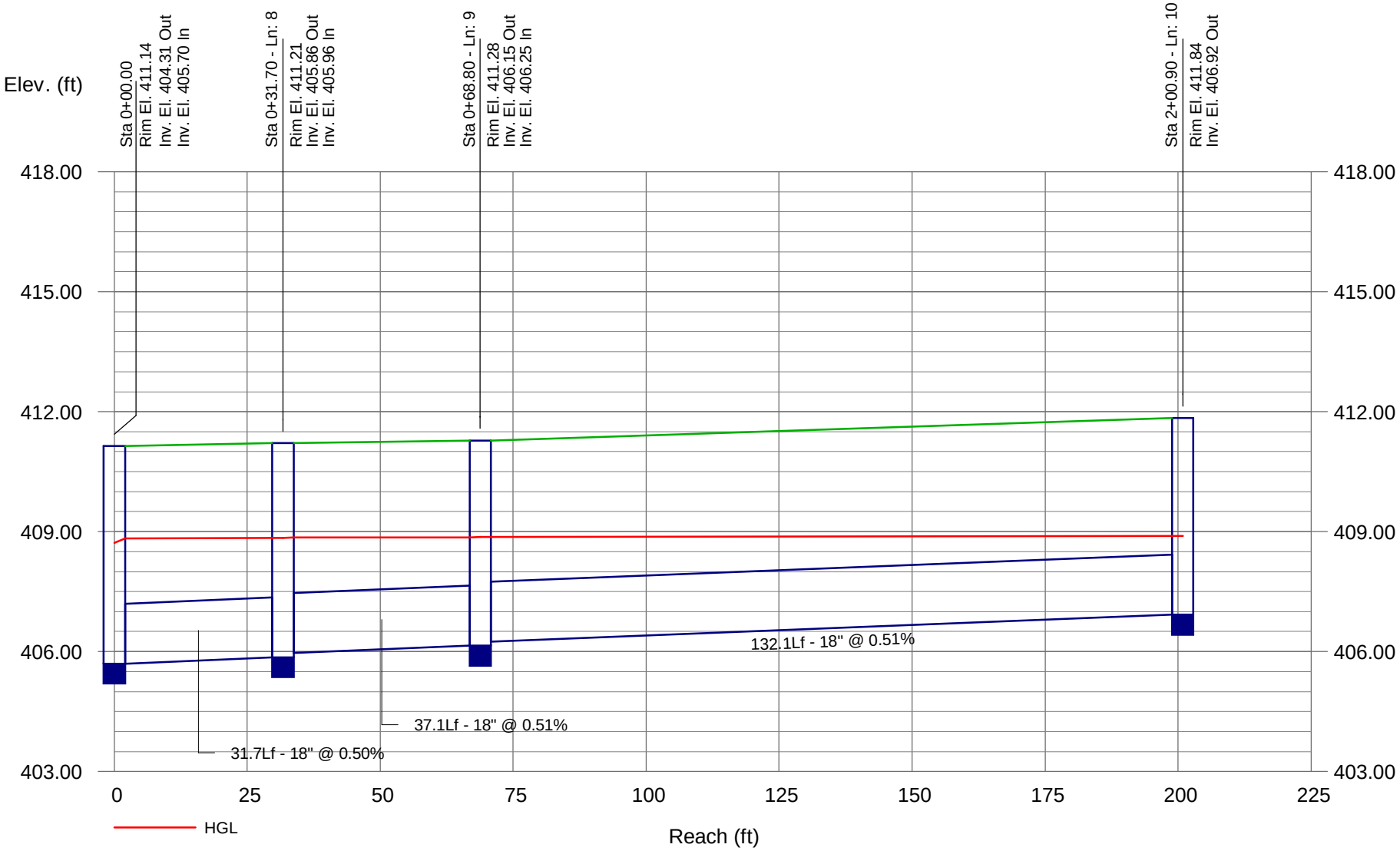

Storm Sewer Profile

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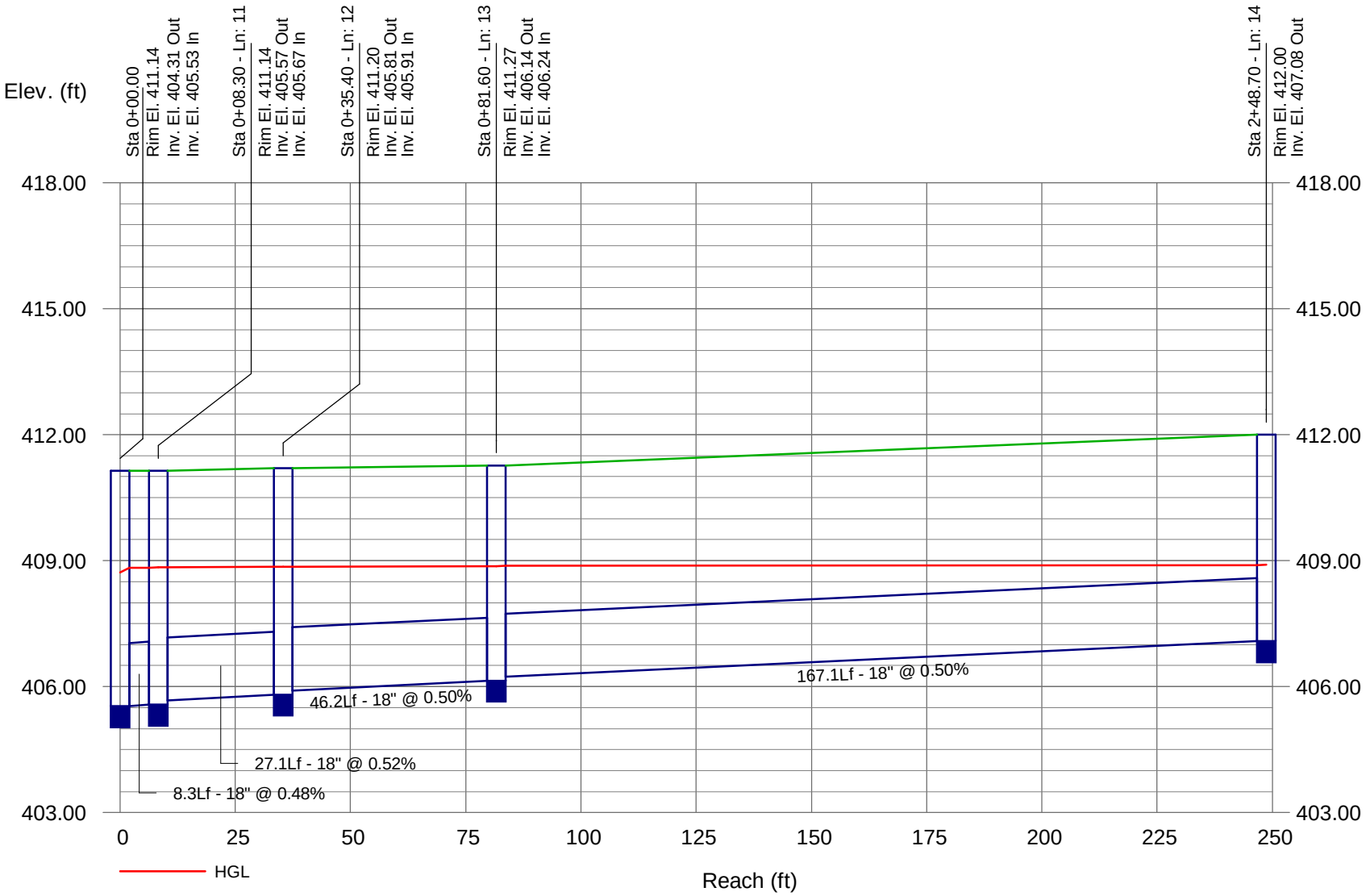
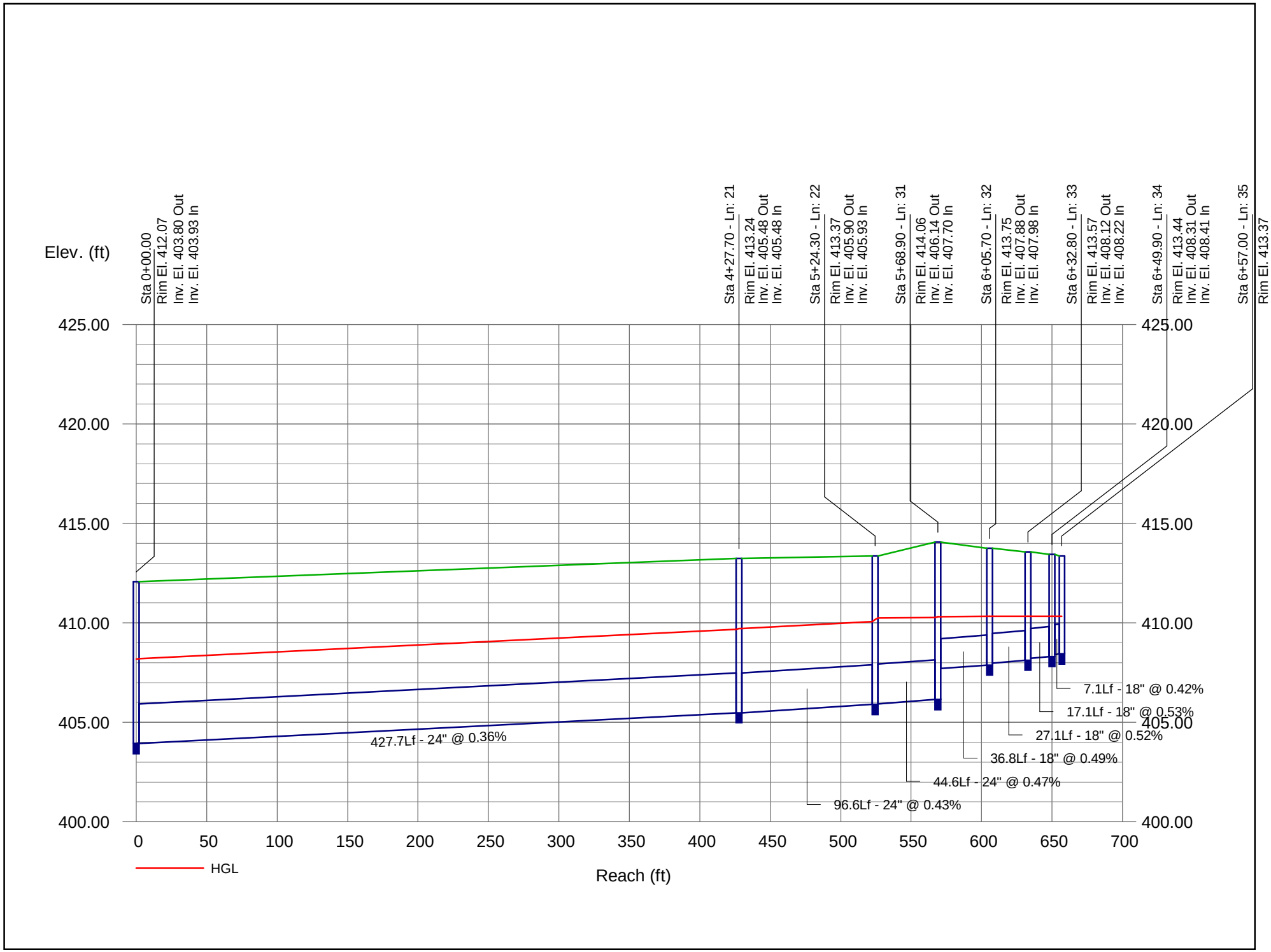


Storm Sewer Profile

Proj. file: DS_41_42_43_44_45_46_47_100%.stm



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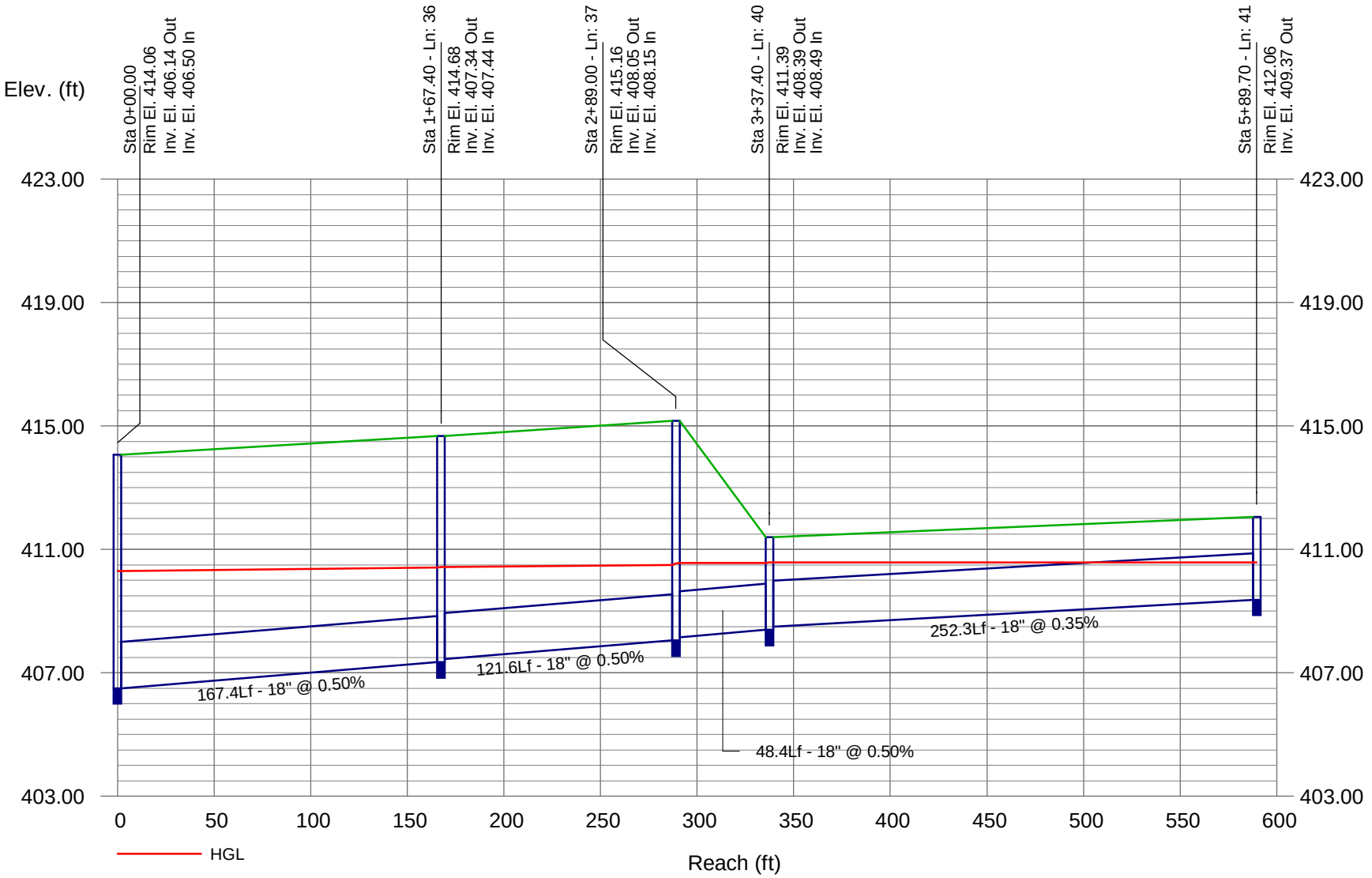

Storm Sewer Profile

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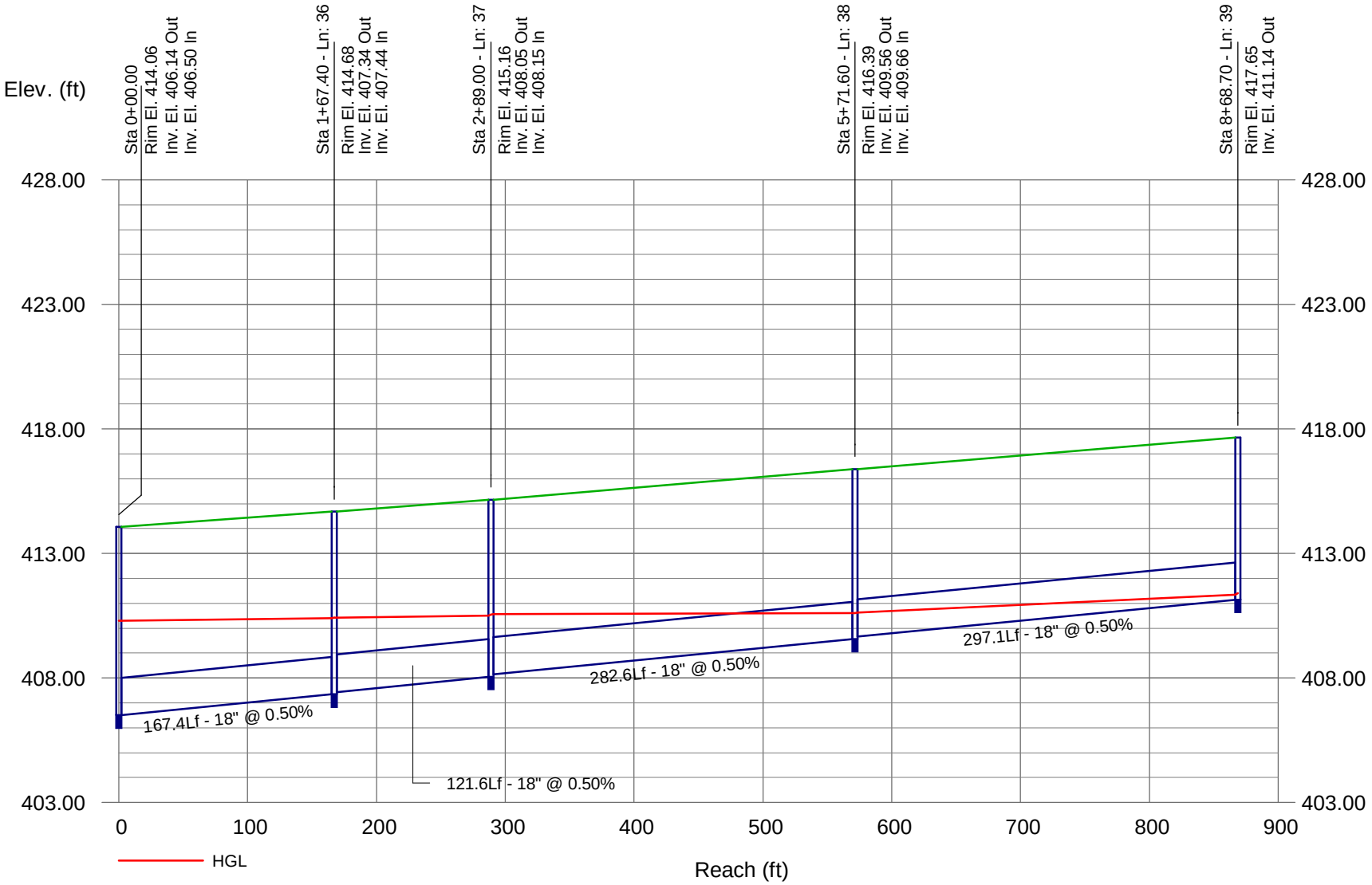

Storm Sewer Profile

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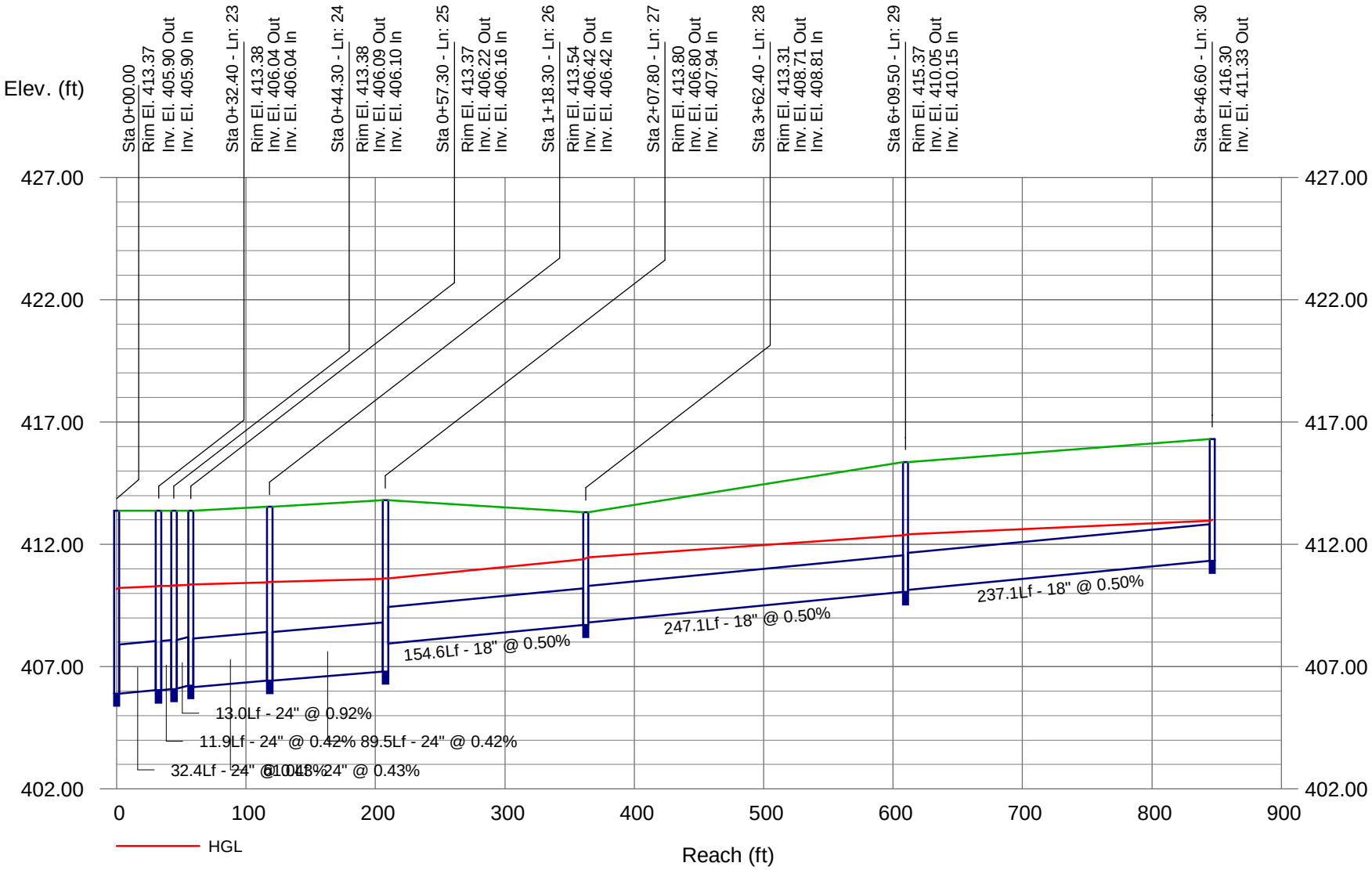

Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
1	Outfall	161.5	0.18	10.74	0.94	0.0	25.6	1.63	13.43	0.00	13.43	1.90	36	0.12	0.024	402.90	403.10	406.28	406.50	414.56	414.17	(E) DI
2	1	38.9	0.25	1.15	0.96	5.0	6.4	3.24	3.53	0.00	3.53	1.33	24	1.03	0.024	404.80	405.20	406.60	406.63	414.17	413.19	(E) DI
3	2	44.8	0.82	0.82	0.94	5.0	5.0	3.66	2.82	0.00	2.82	1.15	24	0.16	0.024	405.20	405.27	406.68	406.71	413.19	411.99	(E) DI
4	2	101.9	0.07	0.08	0.97	5.0	5.4	3.53	0.28	0.00	0.28	1.66	18	0.99	0.024	409.14	410.15	409.37	410.37	413.19	414.11	(E) DI
5	4	16.4	0.01	0.01	1.00	5.0	5.0	3.66	0.04	0.00	0.04	0.75	18	0.91	0.024	410.25	410.40	410.37	410.48	414.11	411.11	(E) DI
6	1	454.3	0.00	9.41	0.00	5.0	21.2	1.79	12.51	0.00	12.51	2.55	30	0.13	0.024	403.20	403.80	406.59	408.03	414.17	412.07	47i
7	6	42.2	0.06	5.67	0.93	5.0	9.7	2.64	9.17	0.00	9.17	2.92	24	0.36	0.024	404.16	404.31	408.18	408.42	412.07	411.14	47h
8	7	31.7	0.06	0.61	0.94	5.0	8.2	2.87	1.66	0.00	1.66	0.94	18	0.50	0.013	405.70	405.86	408.83	408.84	411.14	411.21	47e
9	8	37.1	0.21	0.55	0.94	5.0	7.4	3.01	1.57	0.00	1.57	0.89	18	0.51	0.013	405.96	406.15	408.85	408.86	411.21	411.28	47c
10	9	132.1	0.34	0.34	0.95	5.0	5.0	3.66	1.18	0.00	1.18	0.67	18	0.51	0.013	406.25	406.92	408.87	408.89	411.28	411.84	47a
11	7	8.3	0.06	0.69	0.93	5.0	9.6	2.66	1.72	0.00	1.72	0.98	18	0.48	0.013	405.53	405.57	408.83	408.83	411.14	411.14	47k
12	11	27.1	0.07	0.63	0.94	5.0	9.0	2.74	1.62	0.00	1.62	0.92	18	0.52	0.013	405.67	405.81	408.84	408.85	411.14	411.20	47m
13	12	46.2	0.26	0.56	0.94	5.0	8.0	2.90	1.52	0.00	1.52	0.86	18	0.50	0.013	405.91	406.14	408.86	408.87	411.20	411.27	47o
14	13	167.1	0.30	0.30	0.94	5.0	5.0	3.66	1.03	0.00	1.03	0.58	18	0.50	0.013	406.24	407.08	408.88	408.90	411.27	412.00	47q
15	7	53.2	0.11	4.31	0.97	5.0	7.2	3.06	6.71	0.00	6.71	2.14	24	0.81	0.024	404.40	404.83	408.78	408.94	411.14	410.04	(E) DI
16	15	34.4	0.06	4.20	0.96	5.0	7.0	3.09	6.46	0.00	6.46	3.65	18	0.78	0.013	404.93	405.20	409.04	409.17	410.04	410.01	(E) DI
17	16	8.2	0.09	4.14	0.95	5.0	7.0	3.10	6.29	0.00	6.29	3.56	18	0.61	0.013	405.30	405.35	409.30	409.33	410.01	410.01	(E) DI
18	17	41.1	0.17	4.05	0.93	5.0	6.8	3.14	6.12	0.00	6.12	3.46	18	0.78	0.013	405.45	405.77	409.44	409.58	410.01	410.05	(E) DI
19	18	44.7	3.42	3.42	0.40	5.0	5.0	3.66	5.00	0.00	5.00	3.82	18	7.72	0.013	406.34	409.79	410.04	410.64 j	410.05	413.50	(E) DI
20	18	93.7	0.46	0.46	0.91	5.0	5.0	3.66	1.53	0.00	1.53	0.87	18	0.86	0.013	405.87	406.68	410.16	410.18	410.05	410.34	(E) DI
21	6	427.7	0.14	3.74	0.93	5.0	16.0	2.06	7.21	0.00	7.21	2.29	24	0.36	0.024	403.93	405.48	408.20	409.68	412.07	413.24	46a
22	21	96.6	0.04	3.60	0.92	5.0	14.8	2.14	7.21	0.00	7.21	2.30	24	0.43	0.024	405.48	405.90	409.72	410.05	413.24	413.37	44b
23	22	32.4	0.05	2.07	1.00	5.0	11.3	2.45	4.87	0.00	4.87	1.55	24	0.43	0.024	405.90	406.04	410.22	410.27	413.37	413.38	44a

STA_357 to end of Project | Number of lines: 41 | Date: 10-20-2010

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50 -- Return period = 50 Yrs. ; i Inlet control; ** Critical depth

Report

Line No.	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Total Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	n-val Pipe	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Inlet ID
24	23	11.9	0.03	2.02	0.94	5.0	11.1	2.47	4.77	0.00	4.77	1.52	24	0.42	0.024	406.04	406.09	410.29	410.31	413.38	413.38	43b
25	24	13.0	0.12	1.99	0.95	5.0	11.0	2.48	4.73	0.00	4.73	1.51	24	0.92	0.024	406.10	406.22	410.33	410.35	413.38	413.37	42b
26	25	61.0	0.14	1.87	0.94	5.0	10.3	2.56	4.59	0.00	4.59	1.46	24	0.43	0.024	406.16	406.42	410.37	410.46	413.37	413.54	42a
27	26	89.5	0.24	1.73	0.94	5.0	9.4	2.68	4.45	0.00	4.45	1.42	24	0.42	0.024	406.42	406.80	410.47	410.59	413.54	413.80	41g
28	27	154.6	0.37	1.49	0.94	5.0	8.4	2.83	4.06	0.00	4.06	2.30	18	0.50	0.024	407.94	408.71	410.61	411.40	413.80	413.31	41e
29	28	247.1	0.36	1.12	0.95	5.0	6.7	3.17	3.44	0.00	3.44	1.95	18	0.50	0.024	408.81	410.05	411.46	412.37	413.31	415.37	41c
30	29	237.1	0.76	0.76	0.98	5.0	5.0	3.66	2.72	0.00	2.72	1.54	18	0.50	0.024	410.15	411.33	412.42	412.96	415.37	416.30	41a
31	22	44.6	0.19	1.49	1.00	5.0	13.5	2.24	3.02	0.00	3.02	0.96	24	0.47	0.024	405.93	406.14	410.25	410.27	413.37	414.06	45n
32	31	36.8	0.04	0.08	1.00	5.0	5.7	3.44	0.27	0.00	0.27	0.16	18	0.49	0.013	407.70	407.88	410.32	410.32	414.06	413.75	45o
33	32	27.1	0.02	0.04	1.00	5.0	5.4	3.54	0.14	0.00	0.14	0.08	18	0.52	0.013	407.98	408.12	410.32	410.32	413.75	413.57	45p
34	33	17.1	0.01	0.02	1.00	5.0	5.1	3.62	0.07	0.00	0.07	0.04	18	0.53	0.013	408.22	408.31	410.32	410.32	413.57	413.44	45q
35	34	7.1	0.01	0.01	1.00	5.0	5.0	3.66	0.04	0.00	0.04	0.02	18	0.42	0.013	408.41	408.44	410.32	410.32	413.44	413.37	45r
36	31	167.4	0.12	1.22	1.00	5.0	11.5	2.43	2.62	0.00	2.62	1.48	18	0.50	0.013	406.50	407.34	410.30	410.41	414.06	414.68	45m
37	36	121.6	0.30	1.10	1.00	5.0	10.6	2.52	2.41	0.00	2.41	1.37	18	0.50	0.013	407.44	408.05	410.43	410.50	414.68	415.16	45i
38	37	282.6	0.36	0.44	1.00	5.0	8.1	2.89	1.27	0.00	1.27	0.84	18	0.50	0.013	408.15	409.56	410.56	410.61	415.16	416.39	45c
39	38	297.1	0.08	0.08	1.00	5.0	5.0	3.66	0.29	0.00	0.29	1.12	18	0.50	0.013	409.66	411.14	410.63	411.35	416.39	417.65	45a
40	37	48.4	0.25	0.36	0.60	5.0	7.6	2.97	0.64	0.00	0.64	0.36	18	0.50	0.013	408.15	408.39	410.57	410.57	415.16	411.39	45g
41	40	252.3	0.11	0.11	0.60	5.0	5.0	3.66	0.24	0.00	0.24	0.15	18	0.35	0.013	408.49	409.37	410.57	410.57	411.39	412.06	45e

STA_357 to end of Project | Number of lines: 41 | Date: 10-20-2010

NOTES: Intensity = 8.23 / (Inlet time + 0.10) ^ 0.50 -- Return period = 50 Yrs. ; i Inlet control; ** Critical depth

Appendix H RSP Recommendations for Culvert Outfalls

Table 4. RSP Recommendation for Culvert Outfalls (Segment B Only)

Proposed Culvert Outfall						Recommended RSP				
RSP ID	Culvert ID	Culvert Diameter	Culvert Slope	Design Discharge	Flow Velocity	Class	Min Pad Length	Min Pad Width	Min Depth	Max Depth
		(in)	(%)	(cfs)	(ft/s)		(ft)	(ft)	(ft)	(ft)
4ab	4z	30	0.15	6.83	3.10	Backing No. 2	17.0	7.5	1.0	1.5
6r	6p	18	0.57	2.71	2.59	Backing No. 2	11.0	4.5	1.0	1.5
20l	20j	18	0.42	2.22	3.44	Backing No. 2	11.0	4.5	1.0	1.5
22h	22f	18	0.49	2.91	3.91	Backing No. 2	11.0	4.5	1.0	1.5
26d	26b	18	0.50	1.81	3.37	Backing No. 2	11.0	4.5	1.0	1.5
29f	29d	18	0.50	2.08	3.53	Backing No. 2	11.0	4.5	1.0	1.5
35a	35d	42	1.62	37.31	4.25	Light	23.0	10.5	1.5	2.0
36a	36d	42	0.16	14.11	1.47	Light	23.0	10.5	1.5	2.0

Appendix I Drainage Cost Estimate

Segment A
(PM 25.5 to PM 27.1)

BID ITEMS LIST -

(For Drainage Plans Only)

State Route 84 Expressway Widening - Segment A

Project No. & Phase 04000205801

Final% Cost Estimate

January 12, 2011

Item No.	Item Code		Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
1	034225	A	Fall Prevention System	EA	3	$1,200.00	$3,600
2	073006		18" Temporary Culvert	LF	37	$90.00	$3,300
3	150206		Abandon Culvert	LF	337	$22.00	$7,400
4	150804	A	Remove Underdrain System	LF	1,777	$15.00	$26,700
5	150805		Remove Culvert	LF	3,456	$30.00	$103,700
6	150820		Remove Inlet	EA	27	$900.00	$24,300
7	150826		Remove Manhole	EA	5	$2,500.00	$12,500
8	152430		Adjust Inlet	EA	9	$1,600.00	$14,400
9	152432		Adjust Manhole	EA	1	$1,070.00	$1,100
10	152609		Modify Inlet to Manhole	EA	1	$2,300.00	$2,300
11	155003		Cap Inlet	EA	15	$1,350.00	$20,300
12	192001		Structure Excavation	CY	3,346	$105.00	$351,300
13	192502	A	Filter Media	CY	190	$105.00	$20,000
14	193001		Structure Backfill	CY	364	$115.00	$41,900
15	193114		Sand Backfill	CY	59	$125.00	$7,400
16	194001		Ditch Excavation	CY	444	$45.00	$20,000
17	510050	A	Concrete Structures (Austin Vault)	CY	544	$1,700.00	$924,800
18	510502		Minor Concrete (Minor Structure)	CY	295	$1,600.00	$472,000
19	510526		Minor Concrete (Backfill)	CY	112	$250.00	$28,000
20	520101		Bar Reinforcing Steel	LB	135,683	$2.00	$271,400
21	620101		18" Alternative Pipe Culvert (Type A)	LF	1,670	$105.00	$175,400
22	620102		18" Alternative Pipe Culvert (Type B)	LF	1,931	$110.00	$212,400
23	620141		24" Alternative Pipe Culvert (Type A)	LF	225	$110.00	$24,800
24	620142		24" Alternative Pipe Culvert (Type B)	LF	395	$120.00	$47,400
25	620181		30" Alternative Pipe Culvert (Type A)	LF	1,102	$130.00	$143,300
26	620221		36" Alternative Pipe Culvert (Type A)	LF	1,361	$150.00	$204,200
27	620710		12" Alternative Slotted Pipe	LF	53	$320.00	$17,000
28	620715		18" Alternative Slotted Pipe	LF	393	$320.00	$125,800
29	655324		Jacked 36" Reinforced Concrete Pipe	LF	77	$826.00	$63,600
30	665012		12" Corrugated Steel Pipe (.079" Thick)	LF	3	$190.00	$600
31	680902	A	Plastic Pipe Underdrain (Austin Vault)	LF	627	$45.00	$28,200
32	680905		8" Perforated Plastic Pipe Underdrain	LF	6,223	$55.00	$342,300
33	681023		6" Plastic Pipe	LF	7	$65.00	$500
34	681030		8" Plastic Pipe	LF	116	$75.00	$8,700
35	681103		3" Plastic Pipe (Edge Drain)	LF	10,326	$15.00	$154,900
36	681107		3" Plastic Pipe (Edge Drain Oultet)	LF	233	$34.00	$7,900
37	681990		Filter Fabric	SQ YD	420	$7.00	$2,900
38	682001	A	Permeable Material (Austin Vault)	CY	175	$85.00	$14,900

BID ITEMS LIST -

(For Drainage Plans Only)

State Route 84 Expressway Widening - Segment A

Project No. & Phase 04000205801

Final% Cost Estimate

January 12, 2011

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
39	705311	18" Alternative Flared End Section	EA	2	$490.00	$1,000
40	700617	Drainage Inlet Marker	EA	113	$100.00	$11,300
41	703531	12" Welded Steel Pipe (0.134" Thick)	LF	455	$100.00	$45,500
42	703551	18" Welded Steel Pipe (0.134" Thick)	LF	8	$105.00	$800
43	705517	18" Automatic Drainage Gate	EA	1	$4,075.00	$4,100
44	722020	Gabion	CY	30	$500.00	$15,000
45	731502	Minor Concrete (Miscellaneous Construction)	CY	2	$450.00	$900
46	731517	Minor Concrete (Gutter)	LF	292	$53.00	$15,500
47	750001	Miscellaneous Iron And Steel	LB	38,554	$2.50	$96,400
48	750001 A	Miscellaneous Metal (Austin Vault)	LB	115	$2.50	$300
49	839521	Cable Railing	LF	289	$22.00	$6,400
			DRAINAGE TOTAL			$4,128,400
		SUPPLEMENTAL DRAINAGE FUND				
49	66621	Drainage Revisions	LS	1	$412,840.00	$412,840
			SUPPLEMENTAL DRAINAGE FUND			$412,800

Note: 1. This cost estimate is based on Final PS&E design

2. This estimate includes the cost of the austin vault sand filter

3. This estimate does not include any Right of Way costs

4. Supplemental drainage funds were added for potential adjustments to drainage design for altering field conditions.

Segment B
(PM 22.9 to PM 25.7)

BID ITEMS LIST -

(For Drainage Plans Only)

State Route 84 Expressway Widening - Segment B

Project No. & Phase 04000205811

100% Cost Estimate

October 19, 2010

Item No.	Item Code		Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
1	034845		18" Temporary Slotted Pipe Culvert	LF	873	$200.00	$174,600
2	073004		12" Temporary Culvert	LF	56	$70.00	$3,900
3	073006		18" Temporary Culvert	LF	105	$90.00	$9,500
4	150206		Abandon Culvert	LF	437	$22.00	$9,600
5	150221		Abandon Inlet	EA	1	$800.00	$800
6	150668		Remove Flared End Section	EA	1	$300.00	$300
7	150801		Remove Overside Drain	EA	2	$150.00	$300
8	150804	A	Remove Rock Slope Protection	CY	22	$180.00	$4,000
9	150805		Remove Culvert	LF	6418	$30.00	$192,500
10	150820		Remove Inlet	EA	31	$900.00	$27,900
11	150821		Remove Headwall	EA	1	$1,500.00	$1,500
12	150826		Remove Manhole	EA	14	$2,500.00	$35,000
13	152430		Adjust Inlet	EA	12	$1,600.00	$19,200
14	152432		Adjust Manhole	EA	1	$1,070.00	$1,100
15	192001		Structure Excavation	CY	3456	$105.00	$362,900
16	192502	A	Filter Media	CY	192	$105.00	$20,200
17	193001		Structure Backfill	CY	450	$115.00	$51,800
18	193114		Sand Backfill	CY	26	$125.00	$3,300
19	194001		Ditch Excavation	CY	1363	$45.00	$61,300
20	394090		Place Hot Mix Asphalt (Miscellaneous Area)	SQ YD	13	$15.00	$200
21	510050	A	Concrete Structures (Austin Vault)	CY	556	$1,700.00	$945,200
22	510135		Class 2 Concrete (Headwall)	CY	89	$2,200.00	$195,800
23	510502		Minor Concrete (Minor Structure)	CY	342	$1,600.00	$547,200
24	510526		Minor Concrete (Backfill)	CY	532	$250.00	$133,000
25	520101		Bar Reinforcing Steel	LB	149210	$2.00	$298,400
26	620101		18" Alternative Pipe Culvert (Type A)	LF	3005	$105.00	$315,500
27	620102		18" Alternative Pipe Culvert (Type B)	LF	6824	$110.00	$750,600
28	620141		24" Alternative Pipe Culvert (Type A)	LF	655	$110.00	$72,100
29	620142		24" Alternative Pipe Culvert (Type B)	LF	2525	$120.00	$303,000
30	620181		30" Alternative Pipe Culvert (Type A)	LF	1038	$130.00	$134,900
31	620182		30" Alternative Pipe Culvert (Type B)	LF	2179	$130.00	$283,300
32	620221		36" Alternative Pipe Culvert (Type A)	LF	756	$150.00	$113,400
33	620222		36" Alternative Pipe Culvert (Type B)	LF	923	$150.00	$138,500
34	620260		42" Alternative Pipe Culvert	LF	3634	$220.00	$799,500
35	655211	A	Jacked 18" Reinforced Concrete Pipe	LF	72	$350.00	$25,200
36	655220	A	Jacked 30" Reinforced Concrete Pipe	LF	181	$600.00	$108,600
37	655324	A	Jacked 36" Reinforced Concrete Pipe	LF	78	$800.00	$62,400
38	680902	A	Plastic Pipe Underdrain (Austin Vault)	LF	627	$45.00	$28,200

BID ITEMS LIST -

(For Drainage Plans Only)

State Route 84 Expressway Widening - Segment B

Project No. & Phase 04000205811

100% Cost Estimate

October 19, 2010

Item No.	Item Code		Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
39	680905		8" Perforated Plastic Pipe Underdrain	LF	1259	$55.00	$69,200
40	681023		6" Plastic Pipe	LF	7	$65.00	$500
41	681030		8" Plastic Pipe	LF	1782	$75.00	$133,700
42	681103		3" Plastic Pipe (Edge Drain)	LF	9158	$15.00	$137,400
43	681107		3" Plastic Pipe (Edge Drain Oultet)	LF	786	$34.00	$26,700
44	681990		Filter Fabric	SQ YD	3139	$7.00	$22,000
45	682001		Permeable Material	CY	314	$85.00	$26,700
46	682001	A	Permeable Material (Austin Vault)	CY	201	$85.00	$17,100
47	700617		Drainage Inlet Marker	EA	135	$100.00	$13,500
48	700641		36" Corrugated Steel Pipe Inlet (0.168" Thick)	LF	14	$470.00	$6,600
49	703531		12" Welded Steel Pipe (0.134" Thick)	LF	48	$100.00	$4,800
50	705309		15" Alternative Flared End Section	EA	1	$600.00	$600
51	705311		18" Alternative Flared End Section	EA	10	$550.00	$5,500
52	705319		30" Alternative Flared End Section	EA	1	$1,000.00	$1,000
53	705500		Automatic Drainage Gate	EA	2	$3,000.00	$6,000
54	707050	A	City of Livermore Field Inlet	EA	2	$5,000.00	$10,000
55	707050	B	City of Livermore Curb Inlet	EA	3	$5,000.00	$15,000
56	707051	A	City of Livermore Manhole (Type I)	EA	2	$8,000.00	$16,000
57	707051	B	City of Livermore Manhole (Type II)	EA	13	$8,000.00	$104,000
58	721008		Rock Slope Protection (Light, Method B)	CY	99	$200.00	$19,800
59	721011		Rock Slope Protection (Backing No. 2, Method B)	CY	52	$200.00	$10,400
60	722020		Gabion	CY	20	$500.00	$10,000
61	727901		Minor Concrete (Ditch Lining)	CY	512	$500.00	$256,000
62	729010		Rock Slope Protection Fabric	SQ YD	1129	$10.00	$11,300
63	731502		Minor Concrete (Miscellaneous Construction)	CY	542	$450.00	$243,900
64	750001		Miscellaneous Iron And Steel	LB	45122	$2.50	$112,800
65	750001	A	Miscellaneous Metal (Austin Vault)	LB	115	$2.50	$300
66	839521		Cable Railing	LF	361	$22.00	$7,900
67			Temporary Creek Diversion System	LS			$10,000
				DRAINAGE TOTAL			$7,533,400

Note: 1. This cost estimate is based on preliminary design only

2. This estimate includes the cost of the austin vault sand filter

3. This estimate does not include any Right of Way costs

Appendix J Project Photographs

Photo 1.
Inlet at the southwest corner of the intersection of SR 84 and Ruby Hill Drive (approx. Sta "A1" 234+12).

Photo 2.
Inlet at the southwest corner of the intersection of SR 84 and Ruby Hill Drive (approx. Sta "A1" 233+53).

Photo 3.
Basin at the northwest corner of the intersection of SR 84 and Ruby Hill Drive.

Photo 4.
60-in RCP culvert entrance at the southeast corner of the intersection of SR 84 and Kalthoff Com.

Photo 5.
60-in RCP culvert at Kalthoff Com.

Photo 6.
60-in RCP culvert outfall at the northeast corner of the intersection of SR 84 and Kalthoff Com.

Photo 7.
78-in by 42-in Oval culvert entrance at Vallecitos Road (approx. Sta “V” 111+00).

Photo 8.
78-in by 42-in Oval culvert outfall at Vallecitos Road (approx. Sta “V” 111+50).

Photo 9.
78-in by 42-in Oval culvert at Vallecitos Road.

Photo 10.
Cross culvert at Sta “A1” 242+40.

Photo 11.
Off-site emergency overflow culvert from Cabonia Court in the city of Pleasanton at SR 84 (approx. Sta “A1” 272+30)

Photo 12.
Outfall of 60-in. RCP under Vineyard Avenue (approx. Sta “A1” 316+50).

Photo 13.
Off-site emergency overflow culvert from Sangro Court in the city of Pleasanton at SR 84 (approx. Sta “A1” 267+50)

Photo 14.
Roadside ditch downstream of the emergency overflow culvert from Sangro Court in the city of Pleasanton.

Photo 15.
Inlet located in Stanley connector loop ramp at SR 84 (approx. Sta "A3" 400+50, offset 310 ft Rt).

Photo 16.
Inlet along side of bike path (approx. Sta "A3" 400+09).

Photo 17.
Depressed section of SR 84 at Stanley Boulevard.

Photo 18.
Isabel Pump Station Building at Stanley Boulevard at SR 84 (approx. Sta "A3" 402+00).

Photo 19.
City of Livermore cross culvert draining into Arroyo Mocho upstream of the SR 84 Bridge (approx. Sta “A3” 408+75).

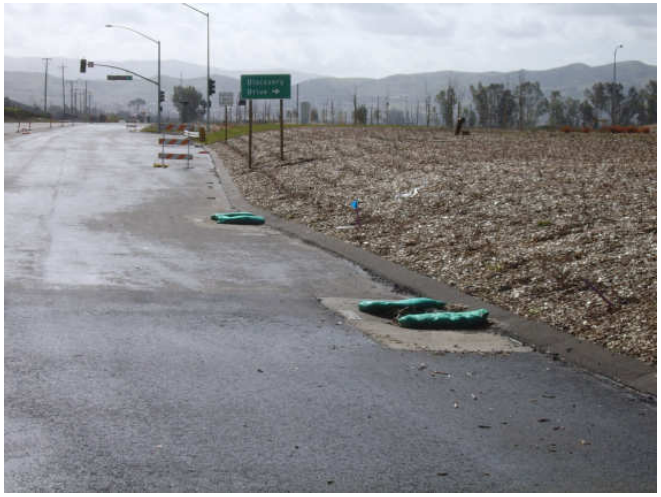

Photo 20.
SR 84 Sta “A3” 430+00 (looking south near Discovery Drive)

Photo 21.
Access road under Arroyo del Valle Bridge

Photo 22.
Concrete slab at access road downstream of existing 42" RCP outfall

Photo 23.
Upstream face of SR 84 Bridge at Arroyo Mocho.

Photo 24.
Outfall at Arroyo Mocho downstream of the SR 84 Bridge.

FOR CONTRACT NO. 297614

DRAINAGE/HYDRAULIC INFORMATION

HYDROMODIFICATION REPORT

DATED 01/2011

04-ALA-84
EA 297601

State Route 84 Expressway Widening Project
Alameda County, California

Hydromodification Report

Prepared for:

Caltrans
ACTIA
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY
URS

Prepared by:

WRECO

January 2011

04-ALA-84
EA 297601
PM 22.9/27.1

State Route 84 Expressway Widening Project
Alameda County, California

Hydromodification Report

Submitted to:
Alameda County Transportation Improvement Authority and California Department of Transportation

This report has been prepared by or under the supervision of the following Registered Engineer. The Registered Civil Engineer attests to the technical information contained herein and has judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

Analette Ochoa

Analette Ochoa, P.E.
Registered Civil Engineer

1/17/11
Date

January 2011

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Executive Summary

The Alameda County Transportation Improvement Authority (ACTIA), with cooperation from the California Department of Transportation (Caltrans), proposes to widen the State Route 84 (SR 84) Expressway from Ruby Hill Drive to Jack London Boulevard. The Project is located partially in the City of Livermore and partially in the City of Pleasanton, both of which are located in Alameda County, California. The Project is within the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). The purpose of the SR 84 Expressway Widening Project (Project) is to improve the route as a regional connection between State Routes 680 (SR 680) and 580 (SR 580), improve the local traffic circulation, upgrade the route to expressway standards, and improve pedestrian and bicycle access. The Project proposes to add 27.73 ac of impervious area and anticipates the need to submit a 401 Certification application for proposed impacts to Waters of the United States and wetlands from the widening of SR 84.

As a result of the *Memorandum of California Department of Transportation Post-Construction Stormwater and Hydromodification Standards* (July 2008) from the SFBRWQCB, Caltrans, District 4, has been tasked to study hydrograph modification (hydromodification) impacts from projects submitting a 401 Certification application and lying within the boundary of a municipality subject to hydromodification requirements (as stated in the municipality's National Pollutant Discharge Elimination System [NPDES] Permit and Hydrograph Modification Management Plan [HMP]).

Based on the Project's location, the Alameda Countywide Clean Water Program (ACCWP) is the program that manages compliance with the San Francisco Bay's Municipal Regional NPDES Permit (Oct. 2009). This report addresses the hydromodification concerns from the Project and uses the ACCWP's C.3 Stormwater Technical Guidance (August, 2006) to propose mitigation measures to address the potential impacts.

The immediate receiving water bodies of the Project include Arroyo Del Valle, Arroyo Mocho, and Arroyo Las Positas (which is 0.3 mi north of the Project limit). Arroyo Las Positas eventually joins Arroyo Mocho, which, along with Arroyo Del Valle, discharges into Arroyo De La Laguna approximately 9 mi west of the Project.

The various receiving water bodies of the Project, which were further divided into outfalls (defined as flow converging every quarter mile), were analyzed to determine their susceptibility to hydromodification. Exemptions to susceptibility include water discharging from the Project via a lined channel or pipe to a tidally influenced waterway. Outfalls that were neither exempt nor were able to provide hydromodification mitigation due to budget restraints (pollution treatment and hydromodification mitigation costs are limited to two percent of the total Project cost) were further analyzed for hydromodification risk.

Water bodies that are at a low risk for hydromodification would demonstrate characteristics such as aggradation, shallow longitudinal slopes, and little evidence of erosion. Water bodies that are defined as high risk for hydromodification would display evidence of degradation and erosion and have steep longitudinal slopes.

All four outfalls are susceptible to hydromodification because the waterways are not tidally influenced. According to the ACCWP HMP Map, a majority of the Project site is within a special consideration area (see map in Appendix E), and the outfalls are all designated as susceptible.

From field visit conducted in June 2008 and July 2010, it was observed that Arroyo Del Valle has extremely dense vegetation, which would act as an energy dissipater, causing velocities to reduce and sediment to deposit. Based on calculations, the added impervious area is greater than 5% of the total watershed area going to this outfall. Therefore, it has been determined that Arroyo Del Valle is at moderate risk for hydromodification. For Arroyo Mocho, a comparison between historical survey and existing conditions was conducted, and it was demonstrated that the channel bed of the creek is aggrading, and therefore, not at risk for erosion caused by hydromodification. Also Arroyo Mocho is lined at the Project site as well as heavily protected by rock slope protection (RSP), making it an even lower risk for hydromodification. The vegetation is sparse however, and the added impervious area is almost 10% of the total watershed area, therefore this outfall is considered to be at moderate risk for hydromodification. Based on topographic data gathered from the United States Geological Survey (USGS), the longitudinal slope of Arroyo Las Positas is relatively shallow, which reduces its risk for hydromodification. However, downstream of the SR 84 crossing, Arroyo Las Positas has a variation of sparse to dense vegetation, which may enable higher velocities, which is one less barrier against erosion.

Of the 27.21 ac of added impervious areas from the Project, all are susceptible to hydromodification. The Project has a total of four outfalls, all of which (Tributary to Arroyo Del Valle, Arroyo Del Valle, Arroyo Mocho, and 48-in. High Density Polyethylene [HDPE] to Arroyo Las Positas) are susceptible to hydromodification and were therefore evaluated for potential mitigation. Table 1 shows the summary of added impervious area to each outfall and the proposed hydromodification mitigation.

Table 1. Hydromodification Summary

Segment	Outfall	Proposed Hydromodification Mitigation	Total AIA[1] per Outfall (ac)	Total AIA Treated by Outfall (ac)	Treatment Percentage By Outfall (%)
B	Tributary to Arroyo Del Valle	Two biofiltration swales	2.82	1.02	36%
B	Arroyo Del Valle	Five biofiltration swales	12.17	6.13	50%
B	Arroyo Mocho	Pump station	3.08	1.69	55%
A	Arroyo Mocho	Pump station	5.41	5.41	100%
A	48 in. HDPE to Arroyo Las Positas	-	3.73	0.00	0%
Notes:		**Totals:**	**27.21**	**14.25**	**52%**

1. AIA = Added Impervious Area

Acronyms

ACCWP	Alameda Countywide Clean Water Program
ACTIA	Alameda County Transportation Improvement Authority
ASTM	American Society for Testing and Materials
BAHM	Bay Area Hydrology Model
BATEA	Best Available Technology Economically Achievable
BCT	Best Conventional Technology
Caltrans	California Department of Transportation
CHP	California Highway Patrol
DMA	Drainage Management Area
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
HMP	Hydrograph Modification Management Plan
HOV	High Occupancy Vehicle
HSG	Hydrologic Soil Group
IDF	Intensity-Duration-Frequency
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
PM	Post Mile
POC	Point of compliance
Q_{25}	25-year peak flow
R/W	Right-of-way
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SR 84	State Route 84
SWMP	Storm Water Management Program
U.S.	United States
USGS	United States Geological Survey
WQV	Water Quality Volume
WSE	Water Surface Elevation
WSS	Web Soil Survey

1 PROJECT DESCRIPTION

The Project, located in Livermore/Pleasanton in Alameda County, proposes to widen and upgrade State Route 84 (SR 84) from Ruby Hill Drive to Jack London Boulevard. The widening would: 1) improve the route as a regional connection between State Routes 680 (SR 680) and 580 (SR 580); 2) improve the local traffic circulation; 3) upgrade the route to expressway standards; and 4) improve pedestrian and bicycle access.

SR 84 would be widened to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment. Improvements would include: 1) the widening of the Arroyo del Valle and Arroyo Mocho bridges; 2) the widening and upgrading of signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Discovery Drive and Jack London Boulevard; 3) relocating existing private driveway access to signalized intersections on SR 84; and 4) constructing new bridge crossings at Arroyo Mocho and Arroyo del Valle for private and recreational access.

The roadway cross section would consist of 12-ft wide traveled lanes and 10-ft wide shoulders, divided by a concrete median barrier. Where practical, side slopes would be 4:1 (H:V) or flatter to provide a Clear Recovery Zone (CRZ) for errant vehicles. Outside the CRZ, side slopes would be 2:1 (H:V) or flatter. The roadway median at intersections would be widened up to 36 ft to accommodate left-turn lanes.

The Project has been split into two segments for construction. Segment A begins 0.4 miles (mi.) north of Concannon Boulevard and ends at Jack London Boulevard. Segment B begins 0.1 mi. south of Ruby Hill Drive and ends 0.6 mi. north of Concannon Boulevard. The two segments overlap one another for 0.2 mi. This report covers both segments of the Project.

1.1 Project Purpose

The purpose of this Project is to: improve SR 84 as a regional route, consistent with other committed projects on the route; improve local traffic circulation; upgrade SR 84 to an expressway facility with access control; and improve bicycle and pedestrian access.

1.2 Project History

Beginning in March 2005, the development of the SR 84 Widening Project was under the management of the Alameda County Transportation Improvement Authority (ACTIA) and the city of Livermore's sponsorship. Monthly Project Development Team (PDT) meetings provided the forum for coordination, issue resolution, and feedback from ACTIA, the cities of Livermore and Pleasanton, the California Department of Transportation (Caltrans), the Alameda County Congestion Management Agency (ACCMA), Alameda County, Zone 7 Water Agency (Zone 7), and other affected agencies. Traffic studies were closely coordinated with the ACCMA Tri-Valley Triangle

Traffic Study to ensure consistency in regional planning efforts. Extensive design studies were performed on the Project Study Report (PSR)/PDS alternatives to help reduce environmental impacts, identify right-of-way and find cost saving refinements to the proposed improvements. Additional design options were investigated including a new alignment between Ruby Hill Drive and Vallecitos Road; a modified Stanley Boulevard intersection in lieu of a full interchange facility; and other Vallecitos/Isabel intersection options.

1.3 Project Need

The objectives of this Project are to:

- Improve SR 84 as a regional connection between Interstate 680 (I-680) and Interstate 580 (I-580) using expressway standards to the maximum extent feasible. This would be consistent with other programmed projects, assisting the completion of a continuous four- to six-lane facility between Pigeon Pass and the I-580/Isabel Avenue interchange.
- Improve local traffic circulation through added capacity on SR 84 and intersection improvements, thereby attracting regional traffic currently using local streets onto the SR 84 corridor.
- Complete the statutory designation of this section of SR 84 as an expressway facility by providing partial access control and relocating private utilities out of the state's right-of-way.
- Improve pedestrian and bicycle access along this section of SR 84 by connecting multi-use trails.

1.4 Project Impacts

The Project proposes to add 27.21 ac of impervious area from the widening of SR 84 (18.07 ac for Segment B and 9.14 ac for Segment A). An increase in impervious area would result in more storm water runoff due to a decrease in infiltration by previously pervious areas. The additional runoff would cause a faster and larger peak in the Project's hydrograph, which potentially could increase downstream erosion to unlined channels. Therefore, hydromodification mitigation is proposed to prevent this additional erosion.

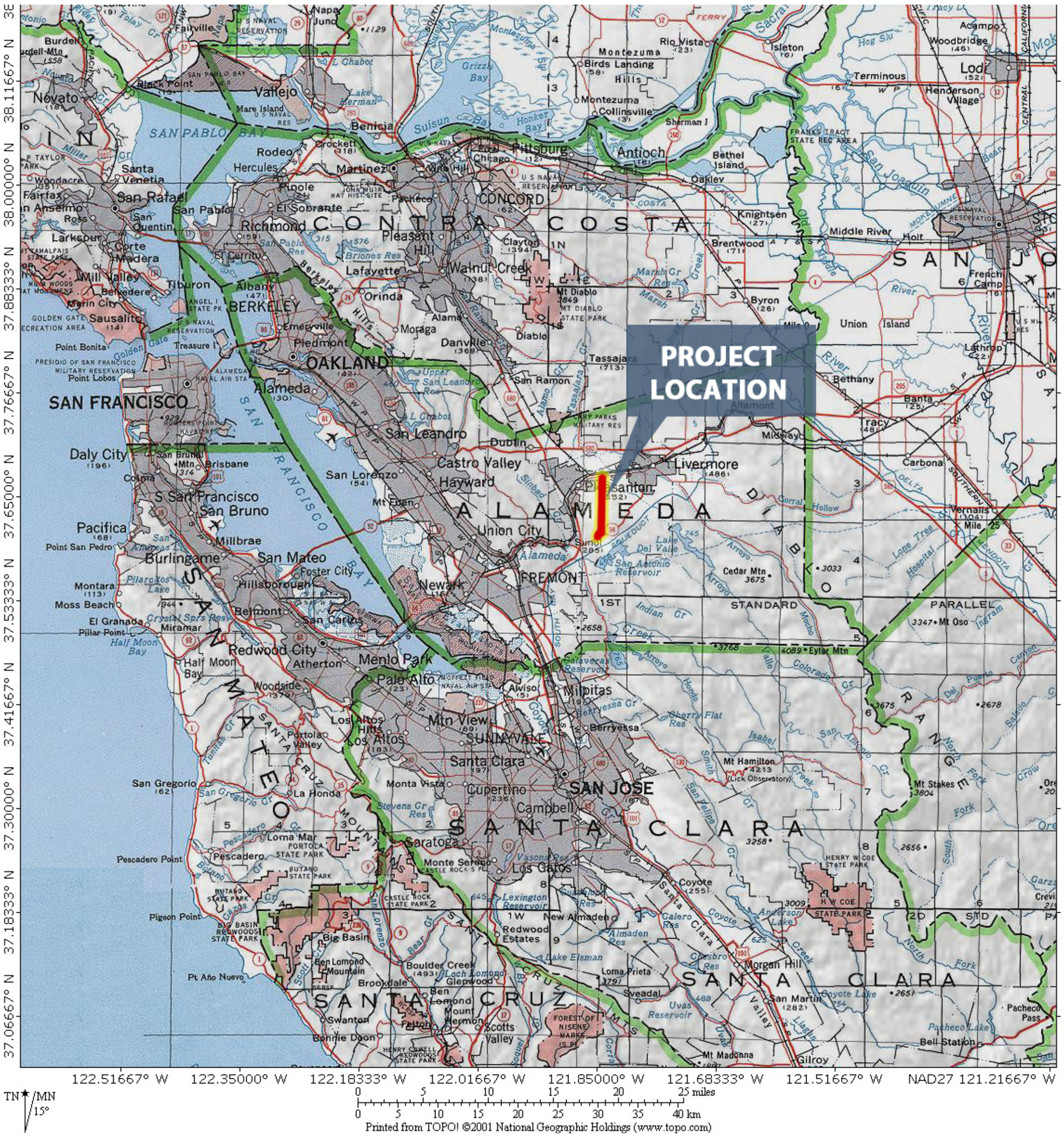

Figure 1. Project Location Map

Source: United States Geological Survey (USGS)

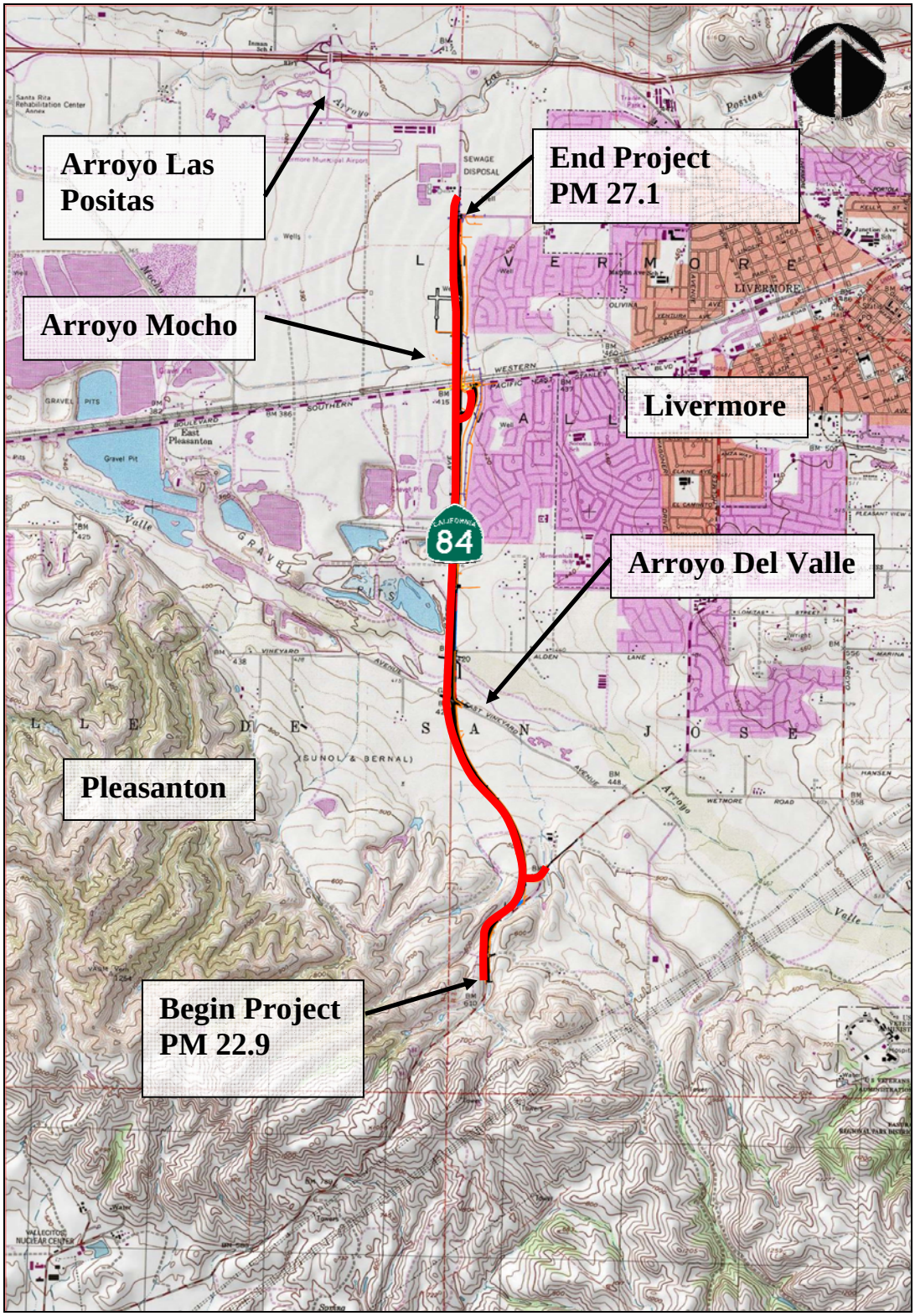

Figure 2. Project Vicinity Map

Source: USGS

2 REGULATORY SECTION

2.1 Purpose of Study

The purpose of this report is to present the general water quality impacts associated with the proposed widening and the overall mitigation strategy of Caltrans and ACTIA to address the hydromodification concerns of the Project. The Project is within the jurisdiction of the SFBRWQCB. Based on the *Memorandum of California Department of Transportation Post-Construction Stormwater and Hydromodification Standards* (July 2008) from the SFBRWQCB, Caltrans, District 4, has been tasked to study hydromodification impacts from projects submitting a 401 Certification application that lie within the boundary of a municipality subject to hydromodification requirements (as stated in the municipality's National Pollutant Discharge Elimination System [NPDES] Permit and Hydrograph Modification Management Plan [HMP]).

Based on the Project's location, the Alameda Countywide Clean Water Program (ACCWP) is the program that manages compliance with the Municipal Regional Stormwater NPDES Permit. This report addresses the hydromodification concerns from the Project and uses the ACCWP's C.3 Stormwater Technical Guidance (August, 2006) to propose mitigation measures to address the potential impacts.

As determined by the SFBRWQCB and ACCWP, located in hydromodification control areas are required to implement the hydromodification standard for flow duration control starting June 12, 2007. Under command from ACTIA and Caltrans, WRECO has been tasked to perform a hydromodification analysis of the Project under the ACCWP's HMP.

2.2 Caltrans NPDES Permit

In 1999, Caltrans was issued a NPDES Statewide Permit (Order No. 99-06 DWQ), which covers Caltrans' highways, highway-related properties, facilities, and activities (e.g., maintenance stations, roadside rest areas, weigh stations, park-and-ride lots, and construction sites). In general, Caltrans is required to reduce, to the maximum extent practicable, pollutants in storm water discharge. Pollutants must be reduced using the Best Available Technology Economically Achievable (BATEA) and the Best Conventional Technology (BCT).

Caltrans has a Storm Water Management Plan (SWMP) that describes how the Department complies with its NPDES Permit (Caltrans, 2007). In Section 5.4.3 of the SWMP, Caltrans includes provisions to evaluate and remediate any hydromodification effects of highway projects, including participation with other permittees in developing watershed-scale approaches for addressing hydromodification.

2.3 Alameda County MS4

Alameda County is under the San Francisco Bay's Municipal Regional Stormwater NPDES Permit from the SFBRWQCB (Order R2-2009-0074) that includes requirements

for discharges of storm water runoff from storm drains and watercourses within the County's jurisdictions. The county wide program (ACCWP) includes the cities of Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, Union City, Zone 7, and the Zone 7 Water Agency. This Permit requires hydromodification management provisions under section C.3.g. According to the Municipal Permit, Alameda County shall also abide by its own existing hydromodification management control requirements, under Attachment B of the Permit.

3 WATERSHED CHARACTERISTICS

3.1 Precipitation

Intensity-Duration-Frequency (IDF) curves and rainfall intensities were obtained from the WINIDF computer program based on locations within the Project site. Rainfall intensities at the Project site used in this report are shown in Table 2 below. Rainfall intensities varied within the Project and were separated according to where the runoff eventually drained (i.e., Drainage Location in Table 2). As required by the Caltrans Highway Design Manual (Table 831.3) for all flows draining to the pump station, the 50-year storm reoccurrence interval was used.

Table 2. Rainfall Intensities

Drainage Location	Design Year	Rainfall Intensity, *i* (in/hr)
Arroyo Del Valle	25	3.266
Arroyo Moch and Arroyo Las Positas	25	3.137
Pump Station	50	3.524

3.2 Land Use

In the Project vicinity, the land use is primarily residential, agricultural, mining, and commercial. From aerial photographs, the land use from the northern Project limits to Alden Lane (at the south side of SR 84) is residential. The Ruby Hill Development is located on the west side of SR 84, from Vineyard Road to the southern Project limits. The land use from Alden Lane to the southern end of the Project limits, west of SR 84, is primarily agricultural. Gravel mining activity is present along Arroyo Del Valle on both sides of SR 84 and adjacent to the western side of SR 84, between Arroyo Del Valle and Stanley Boulevard.

3.3 Creek and Stream Crossings

There are two creek crossings, Arroyo Del Valle and Arroyo Mocho, and one tributary crossing, Tributary to Arroyo Del Valle, within the Project limits. A 48-in. HDPE culvert at the north end of the Project (at Jack London Boulevard) eventually drains to Arroyo Las Positas approximately 0.3 mi north of the Project's northern limit. These waterways are depicted in Figure 3 and are listed south to north in Table 3.

Table 3. Waterway Crossings

USGS Blue Line	Approximate Station
Tributary to Arroyo Del Valle	Line "V" 111+50
Arroyo Del Valle	Line "A1" 319+50
Arroyo Mocho	Line "A3" 414+50
48" HDPE to Arroyo Las Positas	Line "A3" 450+00

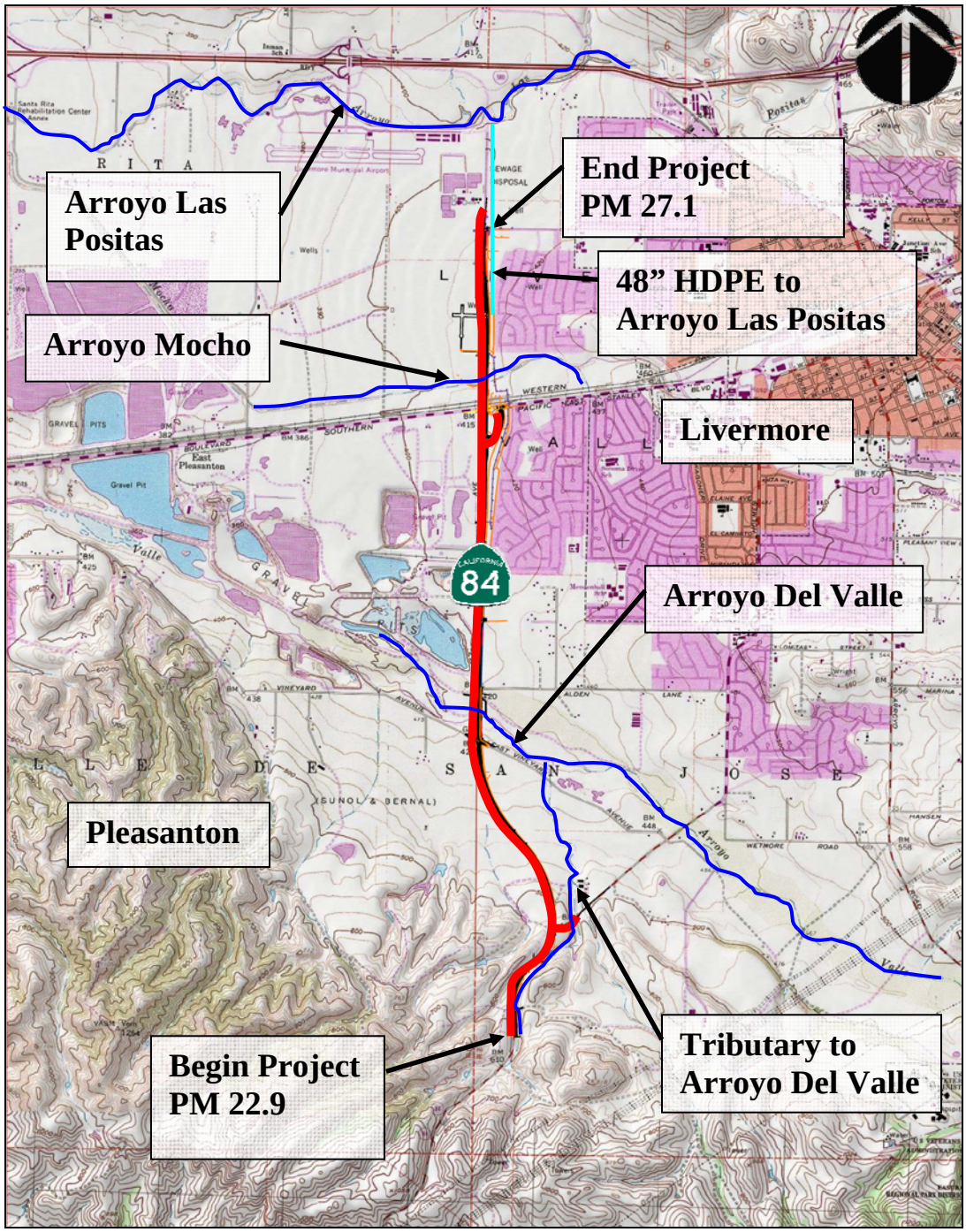

Figure 3. Creek Crossings

Source: USGS

3.4 Soils

Soil characteristics were described in the *Final Geotechnical Impact Assessment.* AGS, Inc. evaluated soil characteristics with soil surveys from the Natural Resources Conservation Service (NRCS). WRECO also used the NRCS, Web Soil Survey (WSS) to determine Hydrologic Soil Groups (HSGs) for the off-site watershed areas within the Project area. HSGs are divided into four groups, identified as A, B, C, and D. Three HSGs (Group A, Group B, and Group D) were found to be predominantly in the pervious watershed areas, which drain to the Project area.

The following is a summary of characteristics of each group:

- Group A soils have characteristically low runoff potential due to high infiltration rates even when thoroughly wetted. These soils consist primarily of deep, well-drained to excessively drained sands and gravels with high water transmission rates (at approximately 0.30 in./hr).

- Group B soils have characteristically moderately low runoff potential due to moderate infiltration rates when thoroughly wetted. These soils consist primarily of moderately deep to deep, and moderately well to well-drained soils. These soils have moderate water transmission rates (at approximately 0.15-0.30 in./hr).

- Group D soils have characteristically high runoff potential due to very slow infiltration rates. These soils consist primarily of clays with high swelling potential, soils with permanently high water tables, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material. These soils have very low water transmission rates (at approximately 0-0.05 in./hr).

Soils underlying the Project, with reaches identified by intersections, are listed in Table 4. The identified soil properties include the soil types, soil groups, permeability ranges, and percent slopes.

Table 4. Soil Properties

Location	Soil Symbol	Soil Type	Soil Group	Permeability Range	Slope	Erosion Hazard	Shrink/Swell Potential	Corrosivity	Prime and Other Important Farmlands
W Jack London Boulevard to Stanley Boulevard	Lg	Livermore gravelly loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Prime if Irrigated
	Lm	Livermore very gravelly coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	Rh	Riverwash	A	10 in./hr	---	None	Low	High	---
	YmA	Yolo loam	A	0.8 to 2.5 in./hr	0 to 3%	Moderate	Low	High	Prime if Irrigated
	Yr	Yolo gravelly loam	A	0.8 to 2.5 in./hr	0 to 3%	Moderate	Low	Moderate	Prime if Irrigated
	Za	Zamora silt loam	A	0.2 to 0.8 in./hr	0 to 4%	Very High	Low-Moderate	High	Prime if Irrigated
Stanley Boulevard to Lilienthal Road	Gp	Gravel Pits	A	-	---	Moderate	Low	Moderate	---
	Lg	Livermore gravelly loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Prime if Irrigated
	Lm	Livermore very gravelly coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	PtB2	Positas gravelly loam, thick surface	D	<0.05 to 10 in./hr	2 to 10%	High	High	High	---
	Rh	Riverwash	A	10 in./hr	---	None	Low	High	---
	Za	Zamora silt loam	A	0.2 to 0.8 in./hr	0 to 4%	Very High	Low-Moderate	High	Prime if Irrigated
Lilienthal Road to Ruby Hill Drive	Gp	Gravel Pits	A	-	---	Moderate	Low	Moderate	---
	Lm	Livermore very gravely coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	PgA	Pleasanton gravelly loam	B	0.2 to 0.8 in./hr	0 to 3%	Moderate-High	Moderate	High	Prime if Irrigated
	PoC2	Positas gravelly loam	D	0.8 to 2.5 in./hr	2 to 20%	High	High	High	---
	Rh	Riverwash	A	10 in./hr	---	None	Low	High	---
	YmA	Yolo loam	A	0.8 to 2.5 in./hr	0 to 3%	Moderate	Low	High	Prime if Irrigated
Ruby Hill Drive to Vallecitos Road	Lm	Livermore very gravelly coarse sandy loam	B	2.5 to 5 in./hr	---	Moderate	Low	Moderate	Statewide Importance
	PgA	Pleasanton gravelly loam	B	0.2 to 0.8 in./hr	0 to 3%	Moderate-High	Moderate	High	Prime if Irrigated
	PgB	Pleasanton gravelly loam	A	0.2 to 0.8 in./hr	3 to 12%	Moderate-High	Moderate	Moderate	Statewide Importance
	PoC2	Positas gravelly loam	D	<0.05 to 10 in./hr	2 to 20%	High	High	High	---
	PoE2	Positas gravelly loam	D	<0.05 to 10 in/hr	20 to 40%				
	Sa	San Ysidro Loam	D	<0.05 in/hr	---				

Source: AGS, Inc. and NCRS, WSS

3.5 Water Quality

The Project area lies within the cities of Pleasanton and Livermore, which is within the San Francisco Bay Region's South Bay Hydrologic Planning Area. Regulations for discharges within the area are included in the Water Quality Control Plan for the San Francisco Bay Basin (January 2007). Storm water discharges from Caltrans' Right of Way (R/W) within the Project area are regulated by the NPDES Statewide Storm Water Permit issued by the SWRCB.

The 2006 Clean Water Act (CWA) Section 303(d) List of Water Quality Limited Segments (U.S. Environmental Protection Agency, June 28, 2007) lists Arroyo Mocho, Arroyo Del Valle, and Arroyo Las Positas as impaired water bodies due to diazinon. However, Diazinon is not generated by the highway within the State's right-of-way (R/W) (see attached 2006 CWA Section 303[d] List of Water Quality Limited Segments).

There are currently Total Maximum Daily Loads (TMDLs) for diazinon and pesticides for the Arroyo Mocho, Arroyo Del Valle, and Arroyo Las Positas. These TMDLs were approved by the U.S. Environmental Protection Agency (EPA) on May 16, 2007. The TMDLs can be found and referenced in the San Francisco Bay Area Urban Creeks TDML Report. However, Caltrans is not a listed stake holder for this TMDL.

4 DESIGN APPROACH AND METHODOLOGY

4.1 Points of Compliance

Points of compliance (POCs) were identified within the Project limits as locations where runoff either left Caltrans' R/W or entered a creek within Caltrans' R/W. The POCs for the Project are listed in and indicated on the Watershed Maps (see Appendix B). There are 22 POCs for the Project. The POCs for the pre- and post-Project conditions are the same.

4.2 Outfalls

The POCs, listed in Table 5, were also grouped by their downstream outfalls. Outfalls were defined at the receiving waters, where the runoff converges within 0.25 mi of the Project site. The added impervious area was analyzed relative to these outfalls. There are four outfalls for the Project: Tributary to Arroyo Del Valle, Arroyo Del Valle, Arroyo Mocho, and 48–in. HDPE to Arroyo Las Positas. Of these outfalls, all are susceptible to hydromodification and must therefore be considered for hydromodification mitigation.

4.3 Watershed Delineations

Once POCs and outfalls were defined, watersheds were delineated for each of the drainage inlets and ditches. Watersheds for both the pre-construction and post-construction conditions were compared to determine the added impervious area to each outfall. The watersheds of the inlets that led to the same POC were combined. Because the watersheds were ultimately analyzed by outfall, this combination of areas would not have an effect on the overall analysis. The entire area would reach the same POC, and therefore, the same outfall. Watershed maps for existing and proposed conditions are shown in Appendix A.

4.4 Exemption Criteria and Susceptibility

After the added impervious area to each outfall was determined, the outfalls were examined to determine whether they met any of the hydromodification exemption criteria. Exemptions include outfalls that are either 1) piped or lined all the way to a designated gray area in the HMP map (see Appendix E); or 2) the outfall is a tidally influenced area. Of the four outfalls, none are exempt because the exemptions do not apply.

Because no outfalls were categorized as exempt, they were all analyzed for hydromodification susceptibility. This analysis looked at the fluvial geomorphology of the outfalls and their downstream receiving water bodies and categorized the outfalls as having either low, moderate, or high susceptibility. This analysis is discussed in further detail in Section 5.

4.5 Design Criteria

The biofiltration swales were designed to meet the hydromodification mitigation goals and to contain the 25-year storm event. The biofiltration swales were designed so that

runoff discharge rates and durations matched the pre-Project discharge rates and durations, from 10% of the pre-project 2-year peak flows up through the pre-Project 10-year peak flows. The post-Project discharge rates could not exceed the pre-Project rates by more than 10% for more than 10% of the record duration. The Austin vault sand filters was designed according to the most recent Caltrans' standards and the May 2007 Project Planning and Design Guide (PPDG) in addition to meeting hydromodification mitigation requirements. The biofiltration swales were modeled using the Bay Area Hydrology Model (BAHM).

Table 5. Points of Compliance and Outfalls

Segment	Outfall	POC	Left/ Right	Increase in Impervious Area (ac)	Exemptions[1]	Total AIA[2] per Outfall (ac)
B	Tributary to Arroyo Del Valle	A1 233+50	R	3.26	none	2.82
		VEX 48+00	R	-0.32		
		VEX 53+50	R	-0.52		
		V 110+70	L	0.17		
		V 111+80	L	0.24		
	Arroyo Del Valle	A1 303+30	R	0.00	none	12.17
		A1 305+30	L	0.00		
		VIN 22+50	L	6.74		
		A1 314+80	L	0.00		
		A1 316+50	L	0.92		
		A1 319+70	R	0.00		
		A1 319+90	L	0.99		
		A1 321+05	L	0.00		
		A1 325+05	L	0.56		
		A1 329+05	L	3.47		
		A1 344+95	R	-0.02		
	Arroyo Mocho	A3 402+00	R	3.08	none	3.08
A	Arroyo Mocho	A3 402+00	R	0.00	none	5.41
		A3 402+45[3]	R	7.10		
		A3 415+50	L	1.14		
	48 inch HDPE to Arroyo Las Positas	A3 448+95	R	3.40	none	3.73
		A3 449+30	L	0.00		
		A3 453+00	R	0.00		

Notes:

1. Exemption criteria is any one of the following:
   a. Culvert or lined channel all the way to the gray area marked on the HMP map
2. AIA = Added Impervious Area
3. All area going to this POC travels through the Stanley Blvd Pump Station

4.6 Treatment Methods

Because the biofiltration swales, and Austin vault sand filters serve a dual purpose (pollutant removal as well as hydromodification mitigation), they were initially designed to meet the pollutant removal requirements as specified in the PPDG. Their design can

be found in the *Storm Water Data Report* (WRECO, 2011) for the Project. After the designs were finalized, these treatment Best Management Practices (BMPs) were tested for hydromodification mitigation. The biofiltration swales were modeled in the BAHM to test for hydromodification mitigation.

4.6.1 Biofiltration Swales

Biofiltration swales were sized initially as standard biofiltration swales to carry the 25-year storm event as well as meet water quality flow (WQF) pollution treatment requirements. The water surface elevations (WSEs) in the swales during the peak flow of a 25-year storm event were determined using the Rational Method and Manning's equation as shown in the *Storm Water Data Report* (WRECO, 2010).

Per direction from the SFRWQCB, all biofiltration swales must now include a 1.5 ft layer of imported biofiltration topsoil as well as a 1 ft. layer of class 2 permeable material. All biofiltration swales would also have a perforated plastic pipe (PPP) placed 26 in. below the flow line of the swale in order to capture and transfer infiltrated flow. These PPPs would be constructed along the length of the swale longitudinally until they can be connected back into the proposed drainage system. If additional mitigation was still required, a water quality berm would be added at the downstream end of the biofiltration swale. This berm would consist of layers of RSP placed within the swale and small plastic pipes to allow for low flows to travel through the berm. The RSP would aid in detaining the runoff for further hydromodification mitigation. Biofiltration swales were modeled in BAHM to test for hydromodification mitigation (Appendix C). Design details for the biofiltration swales can be found in the drainage detail sheets in the Project Plans (WRECO, 2011).

4.6.2 Austin Vault Sand Filter

The Austin vault sand filters (AVSFs) were initially sized to treat the pollutant BMP WQF and Water Quality Volume (WQV) as shown in the *Storm Water Data Report* (WRECO, 2010). Because the AVSFs will only receive the WQV runoff and the remaining flow will bypass the filter via an overflow pipe system, the filter will not see the full range of flows required to be considered for hydromodification mitigation (up to the 10-year flow). Therefore, AVSFs were not considered for hydromodification and not analyzed further.

4.6.3 Pump Station

The existing pump station at the SR 84 and Stanley Boulevard interchange has adequate capacity to handle the runoff caused by the additional 7.65 ac of added impervious area that drains to it, as shown in the *Pump Station Memo* (WRECO, 2009). The pump station acts as a type of detention facility because the pumps will not turn on until the water reaches a certain level in the pump station, and the pump station will store the water until it pumps it to the discharge point in Arroyo Mocho. This delay in discharge will improve the hydrograph and therefore mitigates hydromodification caused by added impervious area from the Project.

4.7 Potential Mitigation Locations

Within the Project limits, the topography near the outfalls was examined in order to identify potential mitigation areas. Between Vineyard Avenue and Jack London Boulevard, in the northern half of the Project, infiltration is not permitted because of its location adjacent to Zone 7's right of way. Therefore, between these locations, only mitigation that does not require infiltration was considered. Some locations had no available area or required extensive drainage improvements to implement. Therefore, mitigation at these sites could not be provided.

From the southern end of the Project to Vineyard Avenue, a significant portion of the roadway is proposed to allow sheet flow to drain toward the shoulder. These locations are ideal to incorporate biofiltration strips and/or biofiltration swales. Therefore biofiltration strips and biofiltration swales were considered on the eastern side of SR 84, between "A1" 231+00 R to "A1" 244+50 R, along the northern side of the Vallecitos Road off ramp, and on both the western and eastern sides of SR 84 between "A1" 285+00 and "A1" 312+00. North of Vineyard Avenue, AVSFs were considered at "A1" 322+00 L and at "A2" 391+50 R. Basins were not considered due to topography and Zone 7's criteria.

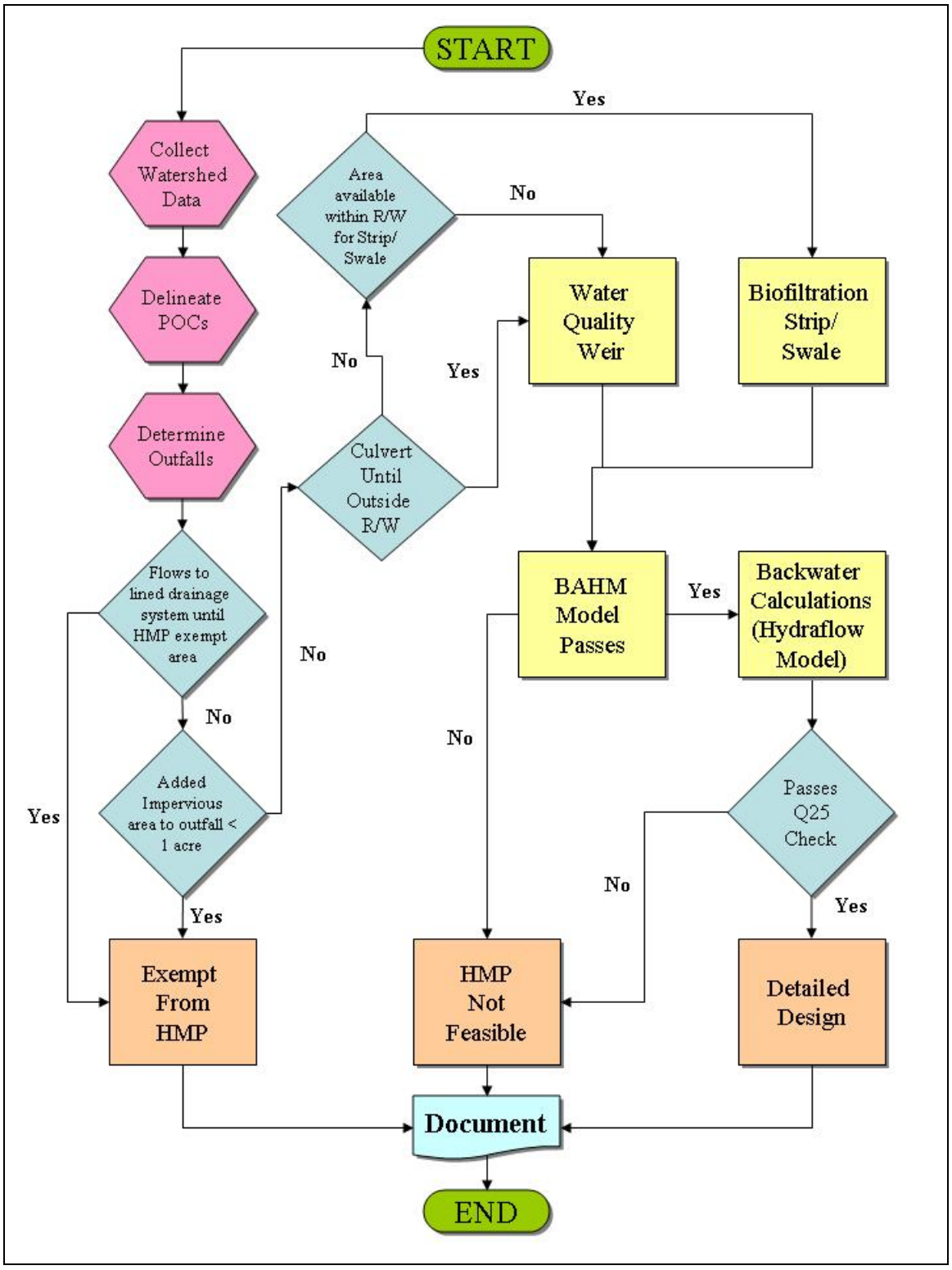

Figure 4. Methodology Schematic

5 HYDROMODIFICATION SUSCEPTABILITY

The susceptibility of the receiving waterways is dependent on several factors: channel lining, channel slope, watershed size, and watershed composition. Information regarding the hydromodification susceptibility of the waterways downstream of the Project site was gathered from aerial photos of the Project vicinity, two site inspections performed by WRECO on February 1, 2008 and July 8, 2010, and USGS topographic data.

Channel susceptibility risk level was first evaluated using a similar approach as Option 4 of the flow control requirements from the Contra Costa Clean Water Program's S*tormwater C.3 Guidebook*, (September 2008). Channel armor, signs of aggradation, existing vegetation, and channel slope were considered as parameters affecting the susceptibility ranking of receiving water bodies. See Table 6 for ranges of the parameters used in the evaluation of the outfalls.

Table 6. Hydromodification Susceptibility: Water Body Characteristics

Channel Slope	Vegetation/Deposition		
	Heavy Vegetation/Aggradation/ Armor[1]	Moderate Vegetation/Little Armor	Signs of Erosion/No Armor
0-1%	Low	Low	Moderate
1-10%	Low	Moderate	High
>10%	Moderate	High	High

[1] Armoring: exposed aggregates, bed rock, or any other material that would resist erosive forces

The watershed sizes of the receiving waters at the outfalls were also compared to the added impervious area (AIA). See Table 7 for the channel susceptibility ranking based on watershed risk level.

Table 7. Hydromodification Susceptibility: AIA vs. WSA

Percent AIA of overall outfall WSA[1]	Channel Susceptibility
0-5%	Low
5-15%	Moderate
>15%	High

[1] AIA = added impervious area, WSA = watershed area

5.1 Physical Characteristics of Outfalls

The immediate Project outfalls are Tributary to Arroyo Del Valle, Arroyo Del Valle, Arroyo Mocho, and Arroyo Las Positas. Arroyo Las Positas discharges into Arroyo Mocho. Approximately 9 mi east of the Project, both Arroyo Mocho and Arroyo Del Valle discharge into Arroyo de la Laguna.

Lined and tidal portions of channels are considered to be at low risk for hydromodification. Generally, unlined channels with steeper slopes are at a higher risk for hydromodification than those with flatter slopes. This is because at greater slopes, the bed material is closer to its angle of repose and is therefore easier to lift into suspension.

Also, steeper slopes generally result in higher water velocities. Water traveling at higher velocities has more energy to impart on bed material. Because of this, the bed material is suspended in the water. Storage, formed by unevenness in the channel flowline, also reduces hydromodification risk. This is because flow entering the storage would be slowed down, allowing particles to settle out (aggrade).

Both Arroyo Del Valle and Arroyo Las Positas are unlined. Directly under the SR 84 bridge at Arroyo Mocho, the creek is lined and the banks are also protected with RSP up until 360 ft along the creek downstream of the Project. All three receiving water bodies have relatively shallow slopes (ranging from 0.1% to 0.4%). They eventually discharge into Arroyo de la Laguna. Arroyo de la Laguna's channel slope becomes steeper as it eventually becomes Alameda Creek and travels through a hilly range of mountains before discharging into the San Francisco Bay in Fremont, California.

5.1.1 Tributary to Arroyo Del Valle

Tributary to Arroyo Del Valle is unlined and the headwall at the outfall is surrounded by dense vegetation and brush. There is some evidence of erosion slightly downstream of the headwall (Photo 1) which is a possible indication of hydromodification risk. As the channel flows away from the Project it takes the shape of a narrow meander through vineyards with a large floodplain. The floodplain has sporadic trees and the main low-flow channel appears to have dense brush throughout (Photo 2). According to the topographic map, the channel slope is relatively at approximately 0.3% where it leaves the Project right of way.

Photo 1. Tributary to Arroyo Del Valle Project Outfall

Photo 2. Tributary to Arroyo Del Valle North of Vineyard Dr.

5.1.2 Arroyo Del Valle

Based on aerial views and Project site visits, Arroyo Del Valle is unlined from where it crosses SR 84 (Photo 3) to where it discharges into Arroyo Del Valle. According to USGS maps, the channel slope is relatively shallow in this reach, approximately 0.3%. The presence of dense vegetation (Photo 4) downstream of the Project would cause head loss in the channel, resulting in increased storage and aggradation upstream. This increased storage would reduce hydromodification risk.

Photo 3. Arroyo Del Valle Undercrossing at SR 84

Photo 4. Arroyo Del Valle Downstream of SR 84

5.1.3 Arroyo Mocho

Arroyo Mocho is PCC concrete lined, and its banks are protected with RSP where it crosses the Project at SR 84 (Photo 5 and Photo 6) up to approximately 360 ft downstream of the SR 84 crossing. After this point, it remains unlined until it discharges into Arroyo de la Laguna. After its realignment, to make room for the pump station at Stanley Boulevard, Arroyo Mocho has a very flat longitudinal slope (around 0.1%). As seen in Photo 3, Arroyo Mocho has minimal vegetation for a significant reach downstream of the Project crossing. The fact that Arroyo Mocho is lined and un-vegetated may increase velocities and potentially cause erosion downstream of the lined portion. However, all of the locations where SR 84 drainage discharges into Arroyo Mocho occur within the lined and RSP-protected reach. The RSP should dissipate energy at these discharge points, therefore reducing the hydraulic head and the risk for hydromodification.

Also, when comparing As-Builts from an earlier project on SR 84 (designed in 1999 and accepted in 2002) with a survey conducted by GTS, Inc. in 2007, the flowline of Arroyo Mocho at SR 84 increased by a maximum of 2.4 ft and an average over the Project site of 0.6 ft. This demonstrates that the creek is aggrading, which, according to Zone 7, is a verified occurrence. Zone 7 plans on eventually dredging the creek to bring the flowline back down to the where it was in the aforementioned project; however the future date of this dredging is unknown at this time.

Photo 5. Arroyo Mocho Downstream of SR 84 Crossing

Photo 6. Arroyo Mocho Lined and RSP-Protected Reach Downstream of SR 84 Crossing

5.1.4 Arroyo Las Positas

Although Arroyo Las Positas does not cross SR 84 within the Project limits, a portion of the drainage from the Project discharges to Arroyo Las Positas via a 48-in. HDPE culvert (that starts at "A3" 409+20 R); therefore, Arroyo Las Positas needs to be evaluated for hydromodification risk. Based on measurements taken from the USGS topographic map, the longitudinal slope of Arroyo Las Positas ranges from 0.1% to 0.4% downstream of the SR 84 crossing; hence, it has a shallow longitudinal slope. The creek is assumed to be unlined; however, from aerial photography (Figure 5), it is evident that vegetation is minimal for approximately three quarters of a mile downstream of the SR 84 crossing (Photo 7). The shallow slope would help to maintain lower velocities, but the lack of significant vegetation may still leave Arroyo Las Positas susceptible to hydromodification.

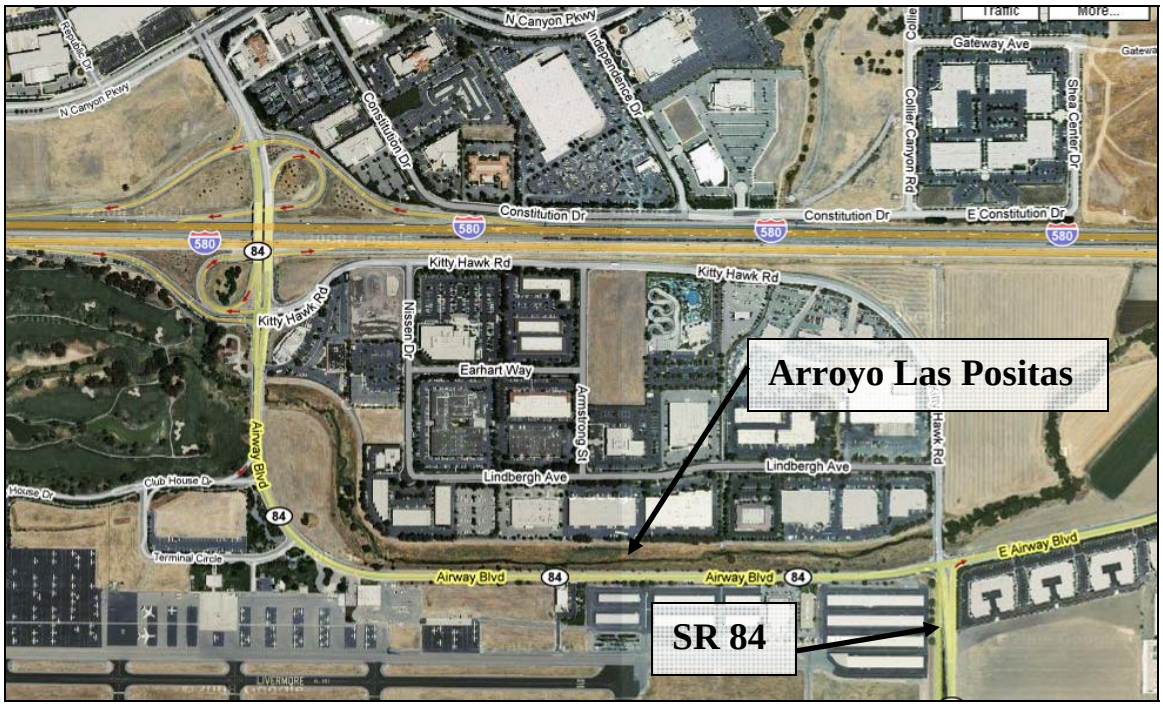

Figure 5. Arroyo Las Positas Crossing SR 84 0.3 mi North of the Project

Source: Google Maps

Photo 7. Arroyo Las Positas at Airway Boulevard

5.2 Downstream Watershed Properties

The greater the extent to which the downstream watershed is impervious, the less the relative impact of the additional unmitigated runoff from the Project would be. Arroyo Del Valle, Arroyo Las Positas, and Arroyo Mocho all drain to Arroyo de la Laguna which eventually becomes Alameda Creek. Approximately 60% of the watershed that feeds Alameda Creek is impervious, while the remaining 40% is pervious.

5.3 Hydromodification Susceptibility Assessment

Based on field visits, topographic analysis, existing surveys, and anecdotal evidence, the four outfalls taking drainage from the Project were evaluated for hydromodification susceptibility. It was determined that all four outfalls—Tributary to Arroyo Del Valle, Arroyo Del Valle, Arroyo Mocho, and Arroyo Las Positas—are susceptible to hydromodification to some varying degree. The level of hydromodification risk associated with each creek is shown in Table 8.

Table 8. Hydromodification Susceptibility Summary

Outfall	A.I.A. (ac)	Exempt	Total Watershed Area (ac)	A.I.A. Percentage of Total Watershed Area	Lined/Unlined/ Culvert	Slope (%)	Vegetation	Aggrading/Degrading	Risk Level
Tributary to Arroyo Del Valle	2.82	No	100	2.82%	Unlined	0.3	Dense	Degrading	low
Arroyo Del Valle	12.17	No	168.35	7.23%	Unlined	0.3	Dense	Unknown	moderate
Arroyo Mocho	5.41	No	56.47	9.58%	Lined	0.1	Sparse	Aggrading	moderate
Arroyo Las Positas	3.73	No	100	3.73%	Unlined	0.1-0.4	Dense	Aggrading	low

6 MITIGATION AND RESULTS

6.1 Hydromodification Models and Design

6.1.1 Biofiltration Swales Design

Biofiltration swales were sized to treat the WQF and the 25-year storm. All biofiltration swales proposed in the *SWDR* (WRECO, 2010) were considered for hydromodification mitigation. Detention layers of imported biofiltration topsoil and class 2 permeable material were added to all swales. The material type and layers of the biofiltration swales considered for hydromodification mitigation can be seen in the drainage details of the Project Plans (WRECO, 2010). The layers consist of 1.5 feet of imported biofiltration topsoil and a 1 foot layer of class 2 permeable material. The PPP, where proposed, was sized at 8 in. The locations and dimensions of the proposed biofiltration swales are listed in Table 9 below. The amount of impervious area being treated by the swales and the outfall locations are also shown.

Table 9. Proposed Hydromodification Swales

Seg	Drainage Item	Begin Station	End Station	L/R	Bottom Width (ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Height (ft)	Outfall	A.I.A. Treated (ac)
B	4 ac	"V" Line 105+50	"V" Line 107+00	L	5	4	2	1	Tributary to Arroyo Del Valle	1.02
B	6 s	"VEX" Line 53+76	"VEX" Line 54+59	L	5	4	2	2.5	Tributary to Arroyo Del Valle	
B	20 m	"A1" Line 285+14	"A1" Line 287+64	R	5	4	2	1.4	Arroyo Del Valle	
B	22 i	"A1" Line 296+04	"A1" Line 298+04	R	5	4	2	1.4	Arroyo Del Valle	
B	25 b	"A1" Line 299+00	"A1" Line 301+50.85	L	8	2	4	1.4	Arroyo Del Valle	6.13
B	26 e	"A1" Line 301+04	"A1" Line 302+54	R	5	4	2	1.4	Arroyo Del Valle	
B	29 g	"A1" Line 306+77	"A1" Line 308+27	R	5	4	2	1.4	Arroyo Del Valle	
									Total:	**7.15**

6.1.2 Pump Station

The existing capacity of the pump station at Stanley Boulevard was analyzed to verify it could accommodate the proposed improvements from the Project and the findings were documented in the *Pump Station Memo* (WRECO, 2009). As stated in the memo, the pump station is adequately sized to withstand the additional impervious area proposed in the Project without changing the storage or pump rate of the existing system. A summary of the pump station is shown in Table 10 . The pump station was not modeled in BAHM because it was determined by Caltrans and the Project Team that it would mitigate all of the added impervious area that drains to it.

Table 10. Pump Station

Seg	Station	L/R	Added Impervious Area Treated (ac)	Outfall
A/B	"A3" Line 402+00	R	7.1	Arroyo Mocho

6.2 Backwater Calculation

6.2.1 Hydrology and Normal Depth

The 25-year peak flow (Q_{25}) and the normal depths through each of the biofiltration swales were calculated to determine their capacity and to verify their WSEs would not cause objectionable backwater on the highway. The Q_{25} was calculated using the Rational Method. The normal depths of the 25-year storm event peak flows were estimated using Manning's equation. These WSEs were also the downstream conditions for the backwater calculations for the upstream pipes discharging to the swales. All calculations pertaining to the biofiltration swales can be seen in the *Storm Water Data Report* (WRECO, 2010). The Q_{25} and normal depths are summarized in Table 11.

Table 11. Biofiltration Swale Hydrology and Normal Depth

Seg	Drainage Item	Begin Station	End Station	L/R	Q_{25} (cfs)	WSE_{25} (ft)	Q_{WQF} (cfs)	WSE_{WQF} (ft)	Outfall
B	4 ac	"VEX" Line 53+76	"VEX" Line 54+59	L	4.37	0.524	0.35	0.266	Tributary to Arroyo Del Valle
B	6 s	"V" Line 105+50	"V" Line 107+00	L	16.78	0.499	1.03	0.253	Tributary to Arroyo Del Valle
B	20 m	"A1" Line 285+14	"A1" Line 287+64	R	12.55	0.3679	0.77	0.344	Arroyo Del Valle
B	22 i	"A1" Line 296+04	"A1" Line 298+04	R	5.22	0.552	0.32	0.277	Arroyo Del Valle
B	25 b	"A1" Line 299+00	"A1" Line 301+50.85	L	32.94	1.03	1.51	0.455	Arroyo Del Valle
B	26 e	"A1" Line 301+04	"A1" Line 302+54	R	2.44	0.36	0.15	0.178	Arroyo Del Valle
B	29 g	"A1" Line 306+77	"A1" Line 308+27	R	2.78	0.328	0.17	0.192	Arroyo Del Valle

6.3 Results

6.3.1 Outfall Specific Results

Please see Table 12 for detailed results. Based on current estimations, the percentage of the total project cost for both hydromodification mitigation and storm water pollution treatment exceeds the required 2% limit (see Appendix E). Discussions with Caltrans on what will actually be utilized for hydromodification mitigation are forthcoming.

- The Tributary to Arroyo Del Valle outfall has 2.82 ac of added impervious area. Two biofiltration swales will mitigate 1.02 (36% of the 2.82 ac) of the outfall's added impervious area. The receiving waterway, Arroyo Del Valle, is at low risk for hydromodification.

- Mitigation for 50 % (6.13 ac) of the 12.17 ac of added impervious area to Arroyo Del Valle outfall would be provided by five biofiltration swales with water quality berms. The receiving waterway is at moderate risk for hydromodification.

- 83 % (7.1 ac) of the additional impervious area (8.49 ac) to Arroyo Mocho would be mitigated by the pump station. Arroyo Mocho is at a moderate risk for hydromodification.

- No mitigation is proposed for the 48-in. HDPE to Arroyo Las Positas. Despite being underlain by HSGs of A and B, this outfall is in Zone 7 which does not allow infiltration. Therefore, biofiltration swales and/or strips could not be proposed. Hydromodification mitigation was proposed to the maximum extent practicable (proposed mitigation for hydromodification and storm water treatment

exceeds 2% of the overall cost of the project). Arroyo Las Positas is at low risk for hydromodification.

6.3.2 Overall Results

A total of 14.25 ac of added impervious area would be mitigated by the proposed, biofiltration swales, and pump station. This is 52% of the total additional impervious area to the Project (27.21 ac). Hydromodification mitigation was proposed to the maximum extent practicable (proposed mitigation for hydromodification and storm water treatment exceeds 2% of the overall cost of the project). The total hydromodification mitigation results as well as associated costs are summarized in Table 12. Estimated BMP treatment and hydromodification quantities and costs are shown in Appendix D.

Table 12. Hydromodification Summary

Segment	Outfall	POC	Left/ Right	Increase in Impervious Area (ac)	Exemptions[1]	Total AIA[2] per Outfall (ac)	Treatment Methods	Total AIA Treated by Outfall (ac)	Treatment Percentage by Outfall	Cost
B	Tributary to Arroyo Del Valle	A1 233+50	R	3.26	none	2.82	2 Biofiltration Swales	1.02	36.2%	$58,687
		VEX 48+00	R	-0.32						
		VEX 53+50	R	-0.52						
		V 110+70	L	0.17						
		V 111+80	L	0.24						
	Arroyo Del Valle	A1 303+30	R	0.00	none	12.17	5 Biofiltration Swales w/ Water Quality Berms	6.13	50.4%	$270,718
		A1 305+30	L	0.00						
		VIN 22+50	L	6.74						
		A1 314+80	L	0.00						
		A1 316+50	L	0.92						
		A1 319+70	R	0.00						
		A1 319+90	L	0.99						
		A1 321+05	L	0.00						
		A1 325+05	L	0.56						
		A1 329+05	L	3.47						
		A1 344+95	R	-0.02						
	Arroyo Mocho	A3 402+00	R	3.08	none	3.08	Pump Station	1.69	54.9%	$0
A	Arroyo Mocho	A3 402+00	R	0.00	none	5.41	Pump Station	5.41	100.0%	$0
		A3 402+45[3]	R	7.10						
		A3 415+50	L	1.14						
	48 inch HDPE to Arroyo Las Positas	A3 448+95	R	3.40	none	3.73	None	0.0	0.0%	$0
		A3 449+30	L	0.00						
		A3 453+00	R	0.00						
Notes:					**Project Totals:**	**27.21**		**14.25**	**52%**	**$379,000**
								Treatment BMP Cost:		**$5,341,005**
								Percentage of Total Project Cost:		**6.75%**

1. Exemption criteria is any one of the following:
   a. Culvert or lined channel all the way to the gray area marked on the HMP map
2. AIA = Added Impervious Area
3. All area going to this POC travels through the Stanley Blvd Pump Station
4. Total Project cost, from BEES: $84,700,000
5. Total hydromodification costs include 15% contingency

7 CONCLUSIONS AND RECOMMENDATIONS

Seven biofiltration swales are proposed along with the existing pump station to provide hydromodification mitigation to a total of 14.25 ac of added impervious area. The biofiltration swales would have two levels (imported biofiltration topsoil and class 2 permeable material). A perforated plastic pipe acting as an underdrain would be provided for all swales. All of the biofiltration swales would have a minimum of 1 ft of freeboard and not cause any backwater. The water quality berm would be designed according to a new drainage detail approved by Caltrans and would also not cause objectionable backwater.

Five biofiltration swales with water quality weirs would mitigate a total of 6.13 ac of added impervious area. Four swales would have a bottom width of 5 ft and one would have a bottom width of 8 ft. Four swales would have left and right side slopes of 4:1 and 2:1 respectively. One swale would have left side slopes of 2:1 and right side slopes of 4:1.

Six biofiltration swales have a bottom width of 5 ft and one with a bottom width of 8 ft. Six swales would have left and right side slopes of 4:1 and 2:1 respectively. One would have left and right side slopes of 2:1 and 4:1 respectively. Combined the seven biofiltration swales would mitigate 7.15 ac of added impervious area.

No changes are required of the existing pump station, and it would mitigate 7.1 ac of added impervious area.

No additional area within Caltrans R/W was available for hydromodification mitigation. Plans, profiles, and details of the proposed hydromodification systems can be found in the corresponding 100% Drainage Plan Set (WRECO, 2011).

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Appendix A Watershed Data

Outlet Point Station Line	Outlet Point Station	West/Left/Median/Right/East	Ordinal*	Shed ID	POC ID	Slope Category **	NRCS Hydrologic Soil Group ***	Pre-project Area by Cover Type		Post-project Area by Cover Type	
								Grass (acres)	Road (acres)	Grass (acres)	Road (acres)
A1	231+00	L	1	A123100.L.1	VEX 48+00	FLAT	D				**1.60**
A1	231+00	R	2	A123100.R.2	VEX 48+00	FLAT	D				**0.36**
A1	231+00	L	3	A123100.L.3	VEX 48+00	VERY STEEP	D			**1.18**	
A1	233+00	L	1	A123300.L.1	VEX 48+00	FLAT	D				**0.21**
A1	233+00	L	2	A123300.L.2	A1 233+50	FLAT	D			**0.09**	
A1	233+40	R	1	A123340.R.1	A1 233+50	FLAT	D		**0.60**		**0.27**
A1	233+80	L	1	A123380.L.1	A1 233+50	FLAT	D				**0.01**
A1	233+80	L	2	A123380.L.2	A1 233+50	FLAT	D			**0.03**	
A1	233+80	L	3	A123380.L.3	VEX 48+00	VERY STEEP	D	**5.79**	**2.32**	**3.10**	
A1	234+00	R	1	A123400.R.1	VEX 48+00	VERY STEEP	D	**2.14**		**2.14**	
A1	234+10	L	1	A123410.L.1	VEX 48+00	VERY STEEP	D				**0.01**
R	008+50	R	1	R850.R.1	VEX 48+00						**0.30**
R	008+50	L	2	R850.L.2	VEX 48+00						**0.29**
R	009+00	R	1	R900.R.1	VEX 48+00	FLAT	D			**1.34**	**0.08**
R	009+00	L	2	R900.L.2	VEX 48+00	FLAT	D			**0.19**	**0.08**
R	009+24	L	1	R924.L.1	VEX 48+00	FLAT	D			**0.01**	**0.00**
A1	235+00	L	1	A123500.L.1	VEX 48+00	VERY STEEP	D	**0.22**	**0.32**		
A1	235+12	R	1	A123512.R.1	VEX 48+00	FLAT	D				**0.49**
A1	235+70	W	1	A123570.W.1	VEX 48+00	VERY STEEP	D			**0.14**	
A1	239+50	W	1	A123950.W.1	VEX 48+00	VERY STEEP	D				
A1	240+00	W	1	A124000.W.1	VEX 48+00	VERY STEEP	D			**0.21**	
A1	240+00	L	2	A124000.L.2	VEX 48+00	VERY STEEP	D			**0.17**	**0.04**
A1	242+10	L	1	A124210.L.1	VEX 48+00	MOD	D	**1.91**			
A1	243+40	L	1	A124340.L.1	VEX 48+00	MOD	D			**0.02**	
A1	244+00	L	1	A124400.L.1	VEX 48+00		D			**0.02**	
A1	244+00	R	1	A124400.R.1	VEX 48+00	MOD	D				**1.94**
A1	245+00	W	1	A1245+00.W.1	VEX 48+00		D			**1.20**	
A1	245+00	R	1	A124500.R.1	VEX 48+00	MOD	D				
A1	246+00	L	1	A124600.L.1	VEX 48+00		D			**0.04**	
A1	246+40	R	1	A124640.R.1	VEX 48+00	MOD	D				**0.49**
A1	246+40	L	1	A124640.L.1	VEX 48+00		D			**0.14**	
A1	247+30	R	1	A124730.R.1	VEX 53+50	MOD	D				**0.19**
A1	247+60	R	1	A124760.R.1	VEX 53+50	MOD	D				**0.06**
A1	249+00	R	1	A124900.R.1	VEX 53+50	FLAT	D	**1.54**	**2.08**		
A1	251+34	L	1	A125134.L.1	VEX 53+50	FLAT	D				**1.04**
A1	252+05	M	1	A125205.M.1	VEX 53+50	FLAT	D	**0.94**	**0.49**		
VEX	050+90	R	1	VEX5090.R.1	VEX 53+50	FLAT	D				**0.01**
VEX	051+40	R	1	VEX5140.R.1	VEX 53+50	FLAT	D				**0.10**
VEX	053+40	L	1	VEX5340.L.1	VEX 53+50	FLAT	D				**0.15**
VEX	056+10	L	1	VEX5610.L.1	VEX 53+50	FLAT	D			**0.81**	
A1	253+00	L	1	A125300.L.1	VEX 53+50	FLAT	D			**0.17**	**0.35**
A1	254+20	L	1	A125420.L.1	V 110+70	MOD	B				**0.29**
A1	254+46	L	1	A125445.83.L.1	V 110+70	MOD	B				**0.18**
A1	254+70	L	1	A125470.L.1	V 110+70	MOD	B	**0.45**	**0.45**	**0.61**	**0.80**
A1	255+30	L	1	A125530.L.1	V 110+70	MOD	B	**0.09**	**0.25**		
A1	255+30	R	2	A125530.R.2	V 110+70	MOD	D				**0.16**
A1	255+90	L	1	A125590.L.1	V 110+70	MOD	B	**0.10**	**0.20**	**0.12**	
V	101+00	L	1	V10100.L.1	VEX 53+50	MOD	D	**0.58**			
V	102+30	L	1	V10230.L.1	VEX 53+50	MOD	D			**0.20**	**0.15**
V	105+00	W	1	V10500.W.1	VEX 53+50		D	**1.72**		**1.72**	
V	109+00	L	1	V10900.L.1	V 110+70	MOD	D				**0.59**
V	109+90	L	1	V10990.L.1	V 110+70	STEEP	D		**0.95**		
V	111+50	L	1	V11150.L.1	V 110+70	STEEP	D				
V	112+25	R	1	V11225.R.1	V 111+80	MOD	D	**3.41**	**0.23**	**3.71**	
V	113+15	R	1	V11315.R.1	V 111+80	MOD	D				**0.50**
V	113+50	R	1	V11350.R.1	V 111+80	VERY STEEP	D				**0.25**
V	116+00	L	1	V11600.L.1	V 111+80	VERY STEEP	D		**0.28**		

A1	264+00	W	1	A126400.W.1	VIN 22+50	FLAT	B		***2.15***		***2.15***
A1	266+50	W	1	A126650.W.1	VIN 22+50		B	**3.63**		**3.65**	
A1	267+40	M	1	A126740.M.1	VIN 22+50	MOD	B				**0.70**
A1	267+40	R	2	A126740.R.2	VIN 22+50	MOD	B			**0.57**	**0.08**
A1	267+40	W	3	A126740.W.3	VIN 22+50		B			**1.40**	
A1	270+10	W	1	A127010.W.1	VIN 22+50		B	**2.78**		**2.78**	
A1	272+00	M	1	A127200.M.1	VIN 22+50	MOD	B				**0.47**
A1	272+00	R	2	A127200.R.2	VIN 22+50		B			**0.32**	
A1	277+00	R	1	A127700.R.1	VIN 22+50		B			**0.36**	
A1	277+00	M	2	A127700.M.2	VIN 22+50	MOD	B				**0.52**
A1	282+00	M	1	A128200.M.1	VIN 22+50	MOD	B				**0.51**
A1	283+50	M	1	A128350.M.1	VIN 22+50	MOD	B				**0.15**
A1	284+50	M	1	A128450.M.1	VIN 22+50	MOD	B				**0.10**
A1	284+90	M	1	A128490.M.1	VIN 22+50	MOD	B				**0.04**
A1	285+10	M	1	A128510.M.1	VIN 22+50	MOD	B				**0.02**
A1	285+10	R	2	A128510.R.2	VIN 22+50		B			**0.64**	
A1	285+20	L	1	A128520.L.1	VIN 22+50	STEEP/MOD	B		**2.79**	**2.82**	**3.10**
A1	290+10	R	1	A129010.R.1	VIN 22+50		B			**0.38**	
A1	291+00	M	1	A129100.M.1	VIN 22+50	MOD	B				**0.58**
A1	292+50	W	1	A129250.W.1	VIN 22+50	MOD	B				
A1	293+50	M	1	A129350.M.1	VIN 22+50	MOD	B				**0.27**
A1	295+00	L	1	A129500.L.1	VIN 22+50		B				**0.02**
A1	295+90	R	1	A129590.R.1	VIN 22+50	FLAT	B			**0.46**	**1.10**
A1	296+00	M	1	A129600.M.1	VIN 22+50	FLAT	B				**0.25**
A1	296+00	E	2	A129600.E.2	VIN 22+50	FLAT	B				
A1	298+00	E	1	A129800.E.1	VIN 22+50		B			**0.17**	
A1	300+90	R	1	A130090.R.1	VIN 22+50	FLAT	B				**0.51**
A1	301+00	M	1	A130100.M.1	VIN 22+50	FLAT	A				**0.52**
A1	301+00	E	1	A130100.E.1	VIN 22+50	FLAT	B			**0.25**	
A1	302+50	E	1	A130250.E.1	VIN 22+50		A			**0.13**	
A1	306+50	M	1	A130650.M.1	VIN 22+50	FLAT	A				**0.59**
A1	306+73	M	1	A130673.M.1	VIN 22+50	FLAT	A				**0.02**
A1	306+73	E	1	A130673.E.1	VIN 22+50	FLAT	A			**0.42**	
A1	306+80	R	1	A130680.R.1	VIN 22+50	FLAT	A				**0.61**
A1	307+70	W	1	A130770.W.1	VIN 22+50	STEEP	A			**2.82**	
A1	308+30	R	1	A130830.R.1	VIN 22+50	STEEP	A			**0.19**	**0.36**
A1	310+00	W	1	A131000.W.1	VIN 22+50	FLAT	A				
A1	312+10	R	1	A131210.R.1	VIN 22+50	FLAT	A				**0.94**
A1	312+10	E	2	A131210.E.2	VIN 22+50	FLAT	A			**0.49**	
A1	312+80	W	1	A131280.W.1	VIN 22+50	FLAT	A	**8.83**	***0.88***	**0.89**	***0.88***
VIN	017+50	L	1	VIN1750.L.1	VIN 22+50	MOD	B				**0.13**
VIN	017+75	L	1	VIN1775.L.1	VIN 22+50		B				**0.24**
VIN	020+80	L	1	VIN2080.L.1	VIN 22+50	MOD	B		**2.88**		***0.11***
VIN	021+50	R	1	VIN2150.R.1	VIN 22+50	MOD	B	**10.96**			***0.43***
VIN	022+40	R	1	VIN2240.R.1	VIN 22+50	MOD	B		**0.04**		**0.04**
VIN	022+40	L	2	VIN2240.L.2	VIN 22+50	MOD	B				**0.24**
A1	313+00	L	1	A131300.L.1	VIN 22+50	STEEP	A		**0.16**		
A1	313+00	R	2	A131300.R.2	VIN 22+50	FLAT	A		**0.05**		
A1	313+60	R	1	A131360.R.1	A1 316+50	FLAT	A				***0.11***
A1	313+75	R	1	A131375.R.1	A1 316+50	FLAT	A			**0.28**	***0.80***
A1	314+00	R	1	A131400.R.1	A1 316+50	MOD	B	**0.55**	**0.32**		**0.06**
A1	314+00	L	2	A131400.L.2	A1 316+50	MOD	B		**0.20**		
A1	316+27	L	1	A131627.L.1	A1 316+50	MOD	B				**0.28**
A1	316+27	R	2	A131627.R.2	A1 316+50	MOD	B				**0.23**
A1	316+50	R	1	A131650.R.1	A1 316+50	MOD	B	**0.38**			**0.05**
A1	316+50	L	2	A131650.L.2	A1 316+50	FLAT	B	**0.40**			**0.07**
A1	316+80	L	1	A131680.L.1	A1 316+50	FLAT	B				**0.12**
A1	316+80	R	2	A131680.R.2	A1 316+50	FLAT	B				**0.09**
A1	318+50	L	1	A131850.L.1	A1 316+50	FLAT	A		**0.25**		
A1	318+50	M	2	A131850.M.2	A1 316+50	MOD	A		**0.40**		
A1	319+00	R	1	A131900.R.1	A1 316+50	FLAT	A				**0.13**
A1	319+00	E	1	A131900.E.1	A1 316+50	FLAT	A				
A1	319+00	L	2	A131900.L.2	A1 316+50	FLAT	A				**0.15**
A1	319+30	W	1	A131930.W.1	A1 316+50	FLAT	A				
A1	319+30	R	2	A131930.R.2	A1 316+50	FLAT	A				
A1	320+00	L	1	A132000.L.1	A1 316+50	FLAT	A				
A1	320+00	R	2	A132000.R.2	A1 316+50	FLAT	A				
A1	320+20	L	1	A132020.L.1	A1 319+90	FLAT	A				
A1	321+20	L	1	A132120.L.1	A1 319+90	FLAT	A		**0.13**		
A1	321+50	M	1	A132150.M.1	A1 319+90	FLAT	A		**0.13**		
AC1	120+00	R	1	AC1120+00.R.1	A1 319+90		A				
AC1	122+50	R	1	AC112250.R.1	A1 319+90		A				
A1	322+80	L	1	A132280.L.1	A1 319+90	FLAT	A				**0.40**
A1	322+80	R	2	A132280.R.2	A1 319+90		A				**0.39**

Outlet Point Station Line	Outlet Point Station	West/Left/Median/Right/East	Ordinal*	Shed ID	POC ID	Slope Category **	NRCS Hydrologic Soil Group ***	Pre-project Area by Cover Type		Post-project Area by Cover Type	
								Grass (acres)	Road (acres)	Grass (acres)	Road (acres)
A1	320+00	R	2	A132000.R.2	A1 316+50	FLAT	A				
A1	320+20	L	1	A132020.L.1	A1 319+90	FLAT	A				
A1	321+20	L	1	A132120.L.1	A1 319+90	FLAT	A		**0.13**		
A1	321+50	M	1	A132150.M.1	A1 319+90	FLAT	A		**0.13**		
AC1	120+00	R	1	AC1120+00.R.1	A1 319+90		A				
AC1	122+50	R	1	AC112250.R.1	A1 319+90		A				
A1	322+80	L	1	A132280.L.1	A1 319+90	FLAT	A				**0.40**
A1	322+80	R	2	A132280.R.2	A1 319+90		A				**0.39**
A1	322+80	E	3	A132280.E.3	A1 319+90					**0.20**	**0.45**
A1	323+50	L	1	A132350.L.1	A1 325+05	FLAT	A			**0.45**	**0.11**
A1	324+75	R	1	A132475.R.1	A1 325+05	MOD	A				**0.21**
A1	324+75	L	2	A132475.L.2	A1 325+05	MOD	A				**0.11**
A1	325+00	L	1	A132500.L.1	A1 325+05	FLAT	A	**0.84**			**0.06**
A1	325+00	R	2	A132500.R.2	A1 325+05	FLAT	A	**0.54**			**0.06**
A1	325+10	L	1	A132510.L.1	A1 325+05	FLAT	A		**0.48**		
A1	325+10	R	2	A132510.R.2	A1 325+05	FLAT	A		**0.44**		
A1	325+30	L	1	A132530.L.1	A1 325+05	FLAT	A				**0.31**
A1	325+30	R	2	A132530.R.2	A1 325+05	FLAT	A				**0.31**
A1	328+30	L	1	A132830.L.1	A1 325+05	FLAT	A				**0.15**
A1	328+30	R	2	A132830.R.2	A1 325+05	FLAT	A			**0.12**	**0.15**
A1	334+00	L	1	A133400.L.1	A1 329+05	FLAT	A			**0.15**	**0.45**
A1	334+00	R	2	A133400.R.2	A1 329+05	MOD	A	**1.85**			**0.44**
AC1	134+00	R	1	AC1134+00.R.1	A1 329+05	MOD	A				**0.28**
A1	336+90	R	1	A133690.R.1	A1 329+05	MOD	A			**0.24**	**0.31**
A1	336+90	E	1	A133690.E.1	A1 329+05						
A1	338+80	L	1	A133880.L.1	A1 329+05	FLAT	A			**0.10**	**0.53**
A1	338+80	R	1	A133880.R.1	A1 329+05	FLAT	A			**0.06**	**0.21**
AC1	139+00	R	1	AC1139+00.R.1	A1 329+05	FLAT	A				**0.33**
A1	341+10	L	1	A134110.L.1	A1 329+05	FLAT	A				**0.27**
A1	341+10	R	2	A134110.R.2	A1 329+05	VERY STEEP	A				**0.29**
A1	341+36	L	1	A134136.L.1	A1 329+05	FLAT	A		**0.99**		**0.08**
A1	341+36	R	2	A134136.R.2	A1 329+05	FLAT	A		**0.97**		**0.09**
A1	341+60	L	1	A134160.L.1	A1 329+05	FLAT	A			**0.04**	**0.45**
A1	341+60	R	2	A134160.R.2	A1 329+05	FLAT	A				**0.22**
AC1	141+75	R	1	AC1141+75.R.1	A1 329+05	FLAT	A				**0.18**
AC1	142+30	R	1	AC1142+30.R.1	A1 329+05		A				**0.35**
TR2	541+00	L	1	TR2541+00.L.1	A1 329+05		A				**0.14**
A1	342+50	L	1	A134250.L.1	A1 329+05		A			**0.05**	
A1	342+50	R	2	A134250.R.2	A1 329+05	FLAT	A		**0.56**		
A1	343+00	R	1	A134300.R.1	A1 329+05	MOD	A			**0.16**	**0.28**
A1	345+00	R	1	A134500.R.1	A1 329+05	FLAT	B	**0.38**	**0.63**	**0.15**	**0.39**
A2	345+90	R	1	A234590.R.1	A1 329+05	FLAT	B				**0.54**
A2	346+00	L	1	A234600.L.1	A1 329+05	FLAT	B			**0.02**	**0.25**
A2	346+00	R	2	A234600.R.2	A1 344+95	FLAT	B	**0.57**		**0.12**	
AC1	146+00	R	1	AC114600.R.1	A1 344+95	FLAT	B		**0.35**		**0.07**
A2	346+10	R	1	A234610.R.1	A1 344+95		B			**0.03**	
A2	346+30	R	1	A234630.R.1	A1 329+05	MOD	B		**0.19**	**0.21**	**0.30**
A2	349+50	R	1	A234950.R.1	A1 344+95	VERY STEEP	B	**0.15**			
A2	349+50	L	2	A234950.L.2	A1 344+95						**0.14**
TR2	549+00	L	1	TR2549+00.L.1	A1 344+95		B				**0.13**
A2	351+50	E	1	A235150.E.1	A1 329+05	FLAT	B		**0.05**		
A2	352+06	L	1	A235206.L.1	A1 329+05	FLAT	B	**2.32**	**0.23**		**0.27**
A2	352+06	R	2	A235206.R.2	A1 329+05	MOD	B		**0.51**		**0.62**
A2	355+10	L	1	A235510.L.1	A1 329+05	MOD	B		**0.09**		**0.32**
A2	355+40	L	1	A235540.L.1	A1 329+05	FLAT	B				**0.06**
A2	355+70	L	1	A235570.L.1	A1 329+05	FLAT	B				**0.09**
AC1	155+77	R	1	AC115577.R.1	A1 329+05		B				**0.05**
A2	356+10	W	1	A235610.W.1	A1 329+05	FLAT	B			**0.13**	
A2	356+70	R	1	A235670.R.1	A1 344+95	STEEP	B	**0.43**	**0.46**		
TR2	552+38	R	1	TR255238.R.1	A1 344+95		B				**0.08**
TR2	556+80	R	1	TR255680.R.1	A1 344+95	STEEP	B		***0.04***		***0.04***
A2	359+70	E	1	A235970.E.1	A1 344+95	MOD	B		***0.07***		***0.07***
A2	361+80	E	1	A236180.E.1	A1 344+95	FLAT	A		**0.06**		**0.31**

Outlet Point Station Line	Outlet Point Station	West/Left/Median/Right/East	Ordinal*	Shed ID	POC ID	Slope Category **	NRCS Hydrologic Soil Group ***	Pre-project Area by Cover Type		Post-project Area by Cover Type	
								Grass (acres)	Road (acres)	Grass (acres)	Road (acres)
A2	357+00	R	1	A235700.R.1	A3 402+45	MOD	B			**0.08**	**0.69**
A2	359+50	R	1	A235950.R.1	A3 402+45		B			**0.10**	**0.26**
A2	360+00	M	1	A236000.M.1	A3 402+45	FLAT	A				**0.36**
A2	360+30	L	1	A236030.L.1	A3 402+45		A			**0.06**	
A2	362+00	R	1	A236200.R.1	A3 402+45	MOD	A			**0.12**	**0.26**
A2	362+85	M	1	A236285.M.1	A3 402+45	FLAT	A				**0.30**
A2	362+40	W	1	A236240.W.1	A3 402+45	FLAT	A			**0.05**	
A2	363+30	M	1	A236330.M.1	A3 402+45	MOD	A		**0.47**		
A2	363+30	R	2	A236330.R.2	A3 402+45	MOD	A	**0.07**	**0.60**		
A2	363+40	R	1	A236340.R.1	A3 402+45	MOD	A			**0.07**	**0.16**
A2	364+10	M	1	A236410.M.1	A3 402+45	MOD	A				**0.12**
A2	364+70	R	1	A236470.R.1	A3 402+45	MOD	A			**0.05**	**0.12**
A2	365+15	R	1	A236515.R.1	A3 402+45	FLAT	A			**0.02**	**0.04**
A2	365+45	R	1	A236545.R.1	A3 402+45	FLAT	A			**0.02**	**0.04**
A2	365+80	L	1	A236580.L.1	A3 402+45	FLAT	A	**2.18**			
A2	365+80	R	2	A236580.R.2	A3 402+45	FLAT	A			**0.02**	**0.03**
A2	365+80	M	3	A236580.M.3	A3 402+45	FLAT	A			**0.02**	**0.18**
A2	365+90	R	1	A236590.R.1	A3 402+45	MOD	A	**0.14**	**0.15**		
A2	366+10	R	1	A236610.R.1	A3 402+45	FLAT	A				**0.03**
A2	366+10	M	2	A236610.M.2	A3 402+45	FLAT	A				**0.04**
A2	366+70	R	1	A236670.R.1	A3 402+45	MOD	A			**0.04**	**0.05**
A2	366+70	M	2	A236670.M.2	A3 402+45	FLAT	A				**0.04**
A2	366+78	M	1	A236678.M.1	A3 402+45	FLAT	A				**0.02**
A2	366+78	R	2	A236678.R.2	A3 402+45		A			**0.10**	
A2	369+00	M	1	A236900.M.1	A3 402+45	FLAT	A				**0.25**
A2	370+50	M	1	A237050.M.1	A3 402+45	FLAT	A				**0.16**
A2	370+50	L	2	A237050.L.2	A3 402+45		A			**0.15**	**0.41**
A2	370+50	R	3	A237050.R.3	A3 402+45		A			**0.08**	
A2	371+00	R	1	A237100.R.1	A3 402+45	VERY STEEP	A	**0.64**		**0.16**	
A2	371+10	M	1	A237110.M.1	A3 402+45	FLAT	A	**1.21**	**1.25**		**0.06**
A2	371+10	L	2	A237110.L.2	A3 402+45	FLAT	A			**0.31**	**0.08**
A2	371+21	M	1	A237120.83.M.1	A3 402+45	MOD	A				**0.04**
A2	371+40	M	1	A237140.M.1	A3 402+45	MOD	A				**0.05**
A2	371+47	L	1	A237147.L.1	A3 402+45	MOD	A				**0.07**
A2	371+70	L	1	A237170.L.1	A3 402+45	MOD	A				**0.04**
A2	371+90	M	1	A237190.M.1	A3 402+45	FLAT	A				**0.18**
A2	372+00	L	1	A237200.L.1	A3 402+45	MOD	B				**0.38**
A2	372+30	W	1	A237230.W.1	A3 402+45		B			**3.42**	
A2	373+70	M	1	A237370.M.1	A3 402+45	FLAT	B			**0.10**	**0.21**
A2	375+66	L	1	A237566.L.1	A3 402+45	MOD	B			**0.25**	**0.57**
A2	375+66	M	2	A237566.M.2	A3 402+45	MOD	B	**1.28**	**0.16**	**0.07**	**0.18**
A2	375+66	R	3	A237566.R.3	A3 402+45	MOD	B	**0.35**	**0.37**		
A2	377+30	R	1	A237730.R.1	A3 402+45	MOD	B			**0.03**	**0.06**
A2	378+05	R	1	A237805.R.1	A3 402+45	MOD	B			**0.03**	**0.08**
A2	378+80	R	1	A237880.R.1	A3 402+45	FLAT	B			**0.06**	**0.12**
A2	380+00	R	1	A238000.R.1	A3 402+45		B			**0.06**	**0.06**
A2	381+10	L	1	A238110.L.1	A3 402+45	MOD	B	**1.71**			
A2	381+25	L	1	A238125.L.1	A3 402+45	MOD	B	**1.26**		**0.17**	**0.44**
A2	381+25	R	2	A238125.R.2	A3 402+45	FLAT	B	**0.29**	**0.41**	**0.31**	**0.43**
A2	386+10	R	1	A238610.R.1	A3 402+45	FLAT	B			**0.08**	**0.07**
A2	386+10	E	2	A238610.E.2	A3 402+45	FLAT	B			**1.43**	
A2	386+60	R	1	A238660.R.1	A3 402+45		B			**0.02**	**0.05**
A2	388+90	R	1	A238890.R.1	A3 402+45		B			**0.10**	**0.30**
A2	391+00	R	1	A239100.R.1	A3 402+45	MOD	B			**0.11**	**0.36**
A2	391+07	R	1	A239107.R.1	A3 402+45	MOD	B	**1.89**	**0.68**	**0.01**	**0.02**
A2	391+08	L	1	A239107.5.L.1	A3 402+45	FLAT	B	**1.29**	**0.51**	**0.22**	**0.82**
A2	391+08	E	2	A239107.5.E.2	A3 402+45		B			**0.05**	
A2	392+15	R	1	A239215.R.1	A3 402+45		B			**0.12**	**0.15**
A2	392+30	R	1	A239230.R.1	A3 402+45	STEEP	B	**0.29**	**0.22**		
A2	392+30	E	2	A239230.E.2	A3 402+45		B			**0.38**	
ST1	094+75	L	1	ST19475.L.1	A3 402+45	MOD	B		**0.29**		
ST1	095+00	L	1	ST19500.L.1	A3 402+45	MOD	B	**0.08**		**0.29**	**0.58**
ST1	095+50	L	1	ST19550.L.1	A3 402+45	MOD	B	**0.65**	**0.25**	**0.21**	**0.17**
ST1	096+00	L	1	ST19600.L.1	A3 402+45	MOD	B	**0.93**	**1.63**	**0.88**	**1.99**
ST1	103+00	E	1	ST110300.E.1	A3 402+45	MOD	B		***0.94***		***1.08***
ST1	103+00	W	2	ST110300.W.2	A3 402+00	MOD	B	**0.70**		**0.12**	
A3	395+00	R	1	A339500.R.1	A3 402+45	MOD	B	**0.12**	**0.14**	**0.13**	**0.21**
A3	395+02	L	1	A339501.5.L.1	A3 402+45	FLAT	B	**0.72**	**0.46**	**0.54**	**0.73**
A3	399+75	R	1	A339975.R.1	A3 402+45	FLAT	B				**0.67**
A3	399+93	R	1	A339993.R.1	A3 402+45	FLAT	B			**0.81**	**0.06**
A3	399+93	L	2	A339993.L.2	A3 402+45	FLAT	B			**0.68**	**0.76**

Outlet Point Station Line	Outlet Point Station	West/Left/Median/Right/East	Ordinal*	Shed ID	POC ID	Slope Category **	NRCS Hydrologic Soil Group ***	Pre-project Area by Cover Type		Post-project Area by Cover Type	
								Grass (acres)	Road (acres)	Grass (acres)	Road (acres)
ST1	103+00	E	1	ST110300.E.1	A3 402+45	MOD	B		***0.94***		***1.08***
ST1	103+00	W	2	ST110300.W.2	A3 402+00	MOD	B	**0.70**		**0.12**	
A3	395+00	R	1	A339500.R.1	A3 402+45	MOD	B	**0.12**	**0.14**	**0.13**	**0.21**
A3	395+02	L	1	A339501.5.L.1	A3 402+45	FLAT	B	**0.72**	**0.46**	**0.54**	**0.73**
A3	399+75	R	1	A339975.R.1	A3 402+45	FLAT	B				**0.67**
A3	399+93	R	1	A339993.R.1	A3 402+45	FLAT	B			**0.81**	**0.06**
A3	399+93	L	2	A339993.L.2	A3 402+45	FLAT	B			**0.68**	**0.76**
A3	400+00	L	1	A340000.L.1	A3 402+45	MOD	B	**0.89**	**0.56**		
A3	400+00	R	2	A340000.R.2	A3 402+45	MOD	B	**0.71**	**0.50**		
A3	400+05	E	1	A340005.E.1	A3 402+45	MOD	B	**0.30**	**0.31**	**0.38**	**0.11**
A3	400+65	E	1	A340065.E.1	A3 402+45	FLAT	B	**0.23**	**0.23**		**0.23**
A3	400+98	R	1	A340098.R.1	A3 402+45	FLAT	B				**0.11**
A3	400+98	L	2	A340098.L.2	A3 402+45	FLAT	B				**0.11**
A3	401+00	R	1	A340100.R.1	A3 402+45	FLAT	A		**0.28**		**0.09**
A3	401+00	L	2	A340100.L.2	A3 402+45	FLAT	A		**0.19**		**0.08**
A3	401+40	R	1	A340140.R.1	A3 402+45	FLAT	A				**0.41**
A3	401+40	L	2	A340140.L.2	A3 402+45	FLAT	A				**0.26**
A3	401+50	E	1	A340150.E.1	A3 402+45	FLAT	A	**0.45**	**0.18**		**0.21**
A3	401+56	E	1	A340156.E.1	A3 402+45		A				**0.19**
A3	402+50	L	1	A340250.L.1	A3 402+45	MOD	A	**0.54**	**0.21**		
A3	402+50	R	2	A340250.R.2	A3 402+45	STEEP	A		**0.21**	**0.44**	
A3	403+00	L	1	A340300.L.1	A3 402+45	STEEP	A				**0.32**
A3	403+00	W	2	A340300.W.2	A3 402+45	STEEP	A			**0.18**	
A3	404+00	R	1	A340400.R.1	A3 402+45		A			**0.29**	**0.16**
A3	405+18	R	1	A340518.R.1	A3 402+45	MOD	A		**1.10**		**0.40**
A3	405+18	L	2	A340518.L.2	A3 402+45	MOD	A		**0.16**		**0.42**
A3	405+20	L	1	A340520.L.1	A3 402+45	VERY STEEP	A	**0.33**			
A3	408+20	L	1	A340820.L.1	A3 402+45		A				**0.50**
A3	408+20	R	2	A340820.R.2	A3 402+45		A				**0.46**
A3	411+75	L	1	A341175.L.1	A3 402+45		A				**0.51**
A3	411+75	R	2	A341175.R.2	A3 402+45		A				**0.48**
A3	413+60	R	1	A341360.R.1	A3 415+50	STEEP	A	**0.39**			
A3	415+00	W	1	A341500.W.1	A3 415+50	STEEP	A	**3.07**			**0.64**
A3	415+49	L	1	A341549.L.1	A3 415+50	FLAT	B				**0.02**
A3	415+49	R	2	A341549.R.2	A3 415+50	FLAT	B	**0.16**	**0.53**	**0.14**	**0.02**
A3	415+59	L	1	A341559.L.1	A3 415+50	FLAT	B				**0.49**
A3	415+59	R	2	A341559.R.2	A3 415+50	FLAT	B				**0.41**
A3	420+60	R	1	A342060.R.1	A3 448+95	FLAT	B			**0.10**	**0.28**
A3	421+00	R	1	A342100.R.1	A3 448+95	FLAT	B			**0.02**	**0.06**
A3	421+50	R	1	A342150.R.1	A3 448+95	FLAT	B			**0.02**	**0.06**
A3	422+00	R	1	A342200.R.1	A3 448+95	VERY STEEP	B	**0.14**	**0.28**		
A3	424+36	L	1	A342435.8.L.1	A3 448+95	FLAT	B			**0.38**	**1.18**
A3	424+36	R	2	A342435.8.R.2	A3 448+95	STEEP	B	**0.04**		**0.14**	
A3	424+40	M	1	A342440.M.1	A3 448+95	FLAT	B	**0.10**	**0.55**		
A3	424+86	L	1	A342486.L.1	A3 448+95	FLAT	B		**0.80**		
A3	425+00	R	1	A342500.R.1	A3 448+95	VERY STEEP	B	**0.01**		**0.04**	
D	039+00	R	1	D3900.R.1	A3 448+95		B				**0.83**
D	039+00	L	2	D3900.L.2	A3 448+95		B				**0.53**
A3	425+66	L	1	A342566.L.1	A3 448+95	FLAT	B		**0.49**		
A3	426+17	L	1	A342617.L.1	A3 448+95		B				**0.15**
A3	429+00	L	1	A342900.L.1	A3 448+95	FLAT	B			**0.18**	**0.93**
A3	429+50	L	1	A342950.L.1	A3 448+95	FLAT	B	**0.19**	**0.71**	**0.03**	**0.15**
A3	429+75	L	1	A342975.L.1	A3 448+95	FLAT	B			**0.03**	**0.15**
A3	430+00	L	1	A343000.L.1	A3 448+95	FLAT	B	**0.02**	**0.08**	**0.07**	**0.29**
A1	430+00	R	2	A143000.R.2	A3 448+95	VERY STEEP	B	**0.01**		**0.19**	
A3	431+00	L	1	A343100.L.1	A3 448+95	FLAT	B			**0.03**	**0.11**
A3	432+00	L	1	A343200.L.1	A3 448+95		B			**0.22**	**0.38**
A3	434+00	R	1	A343400.R.1	A3 448+95	FLAT	A	**0.19**	**0.60**	**0.20**	**0.38**
A3	436+00	R	1	A343600.R.1	A3 448+95	FLAT	A			**0.09**	**0.58**
A3	436+00	L	2	A343600.L.2	A3 448+95		A			**0.03**	
A3	438+00	R	1	A343800.R.1	A3 448+95	FLAT	A	**0.21**	**0.73**	**0.09**	**0.68**
A3	440+30	R	1	A344030.R.1	A3 448+95		A			**0.07**	**0.68**
A3	441+20	R	1	A344120.R.1	A3 448+95	STEEP	A	**0.18**	**0.49**		
A3	442+80	R	1	A344280.R.1	A3 448+95	FLAT	A				**0.74**
A3	443+80	R	1	A344380.R.1	A3 448+95		A				**0.27**
A3	445+50	R	1	A344550.R.1	A3 448+95	VERY STEEP	A			**0.12**	**0.27**
A1	446+10	R	1	A144610.R.1	A3 448+95	STEEP	A	**0.41**	**0.85**		
A1	446+20	L	1	A144620.L.1	A3 448+95	FLAT	A		**0.18**		
A3	447+10	L	1	A344710.L.1	A3 448+95	FLAT	A	**3.04**	**0.09**	**0.03**	**0.63**
A3	447+10	R	2	A344710.R.2	A3 448+95	FLAT	A	**0.07**	**0.16**	**0.04**	**0.28**
A3	447+40	R	1	A344740.R.1	A3 448+95	FLAT	A				**0.32**
A3	448+00	R	1	A344800.R.1	A3 448+95	FLAT	A		**0.57**		**0.16**
A3	448+00	L	2	A344800.L.2	A3 448+95	FLAT	A		**0.10**		

A3	395+00	R	1	A339500.R.1
A3	395+02	L	1	A339501.5.L.1
A3	399+75	R	1	A339975.R.1
A3	399+93	R	1	A339993.R.1
A3	399+93	L	2	A339993.L.2
A3	400+00	L	1	A340000.L.1

Outfall	Existing Impervious Area (ac)	Total Pavement Area (ac)	Overlay Impervious Area (ac)	Additional Impervious Area (ac)	Removed Impervious Area (ac)	Net Additional Impervious Area, AIA (ac)	Reworked Impervious Area, AIA (ac)
Tributary to Arroyo Del Valle	6.49	9.31	3.44	3.61	0.79	**2.82**	2.26
Arroyo Del Valle	12.47	24.65	8.94	12.19	0.02	**12.17**	3.51
Arroyo Mocho	11.41	19.90	7.96	8.49	0.00	**8.49**	3.45
48" HDPE to Arroyo Las Positas	5.52	9.25	4.89	3.73	0.00	**3.73**	0.63
Totals	**35.90**	**63.11**	**25.24**	**28.02**	**0.81**	**27.22**	**9.86**

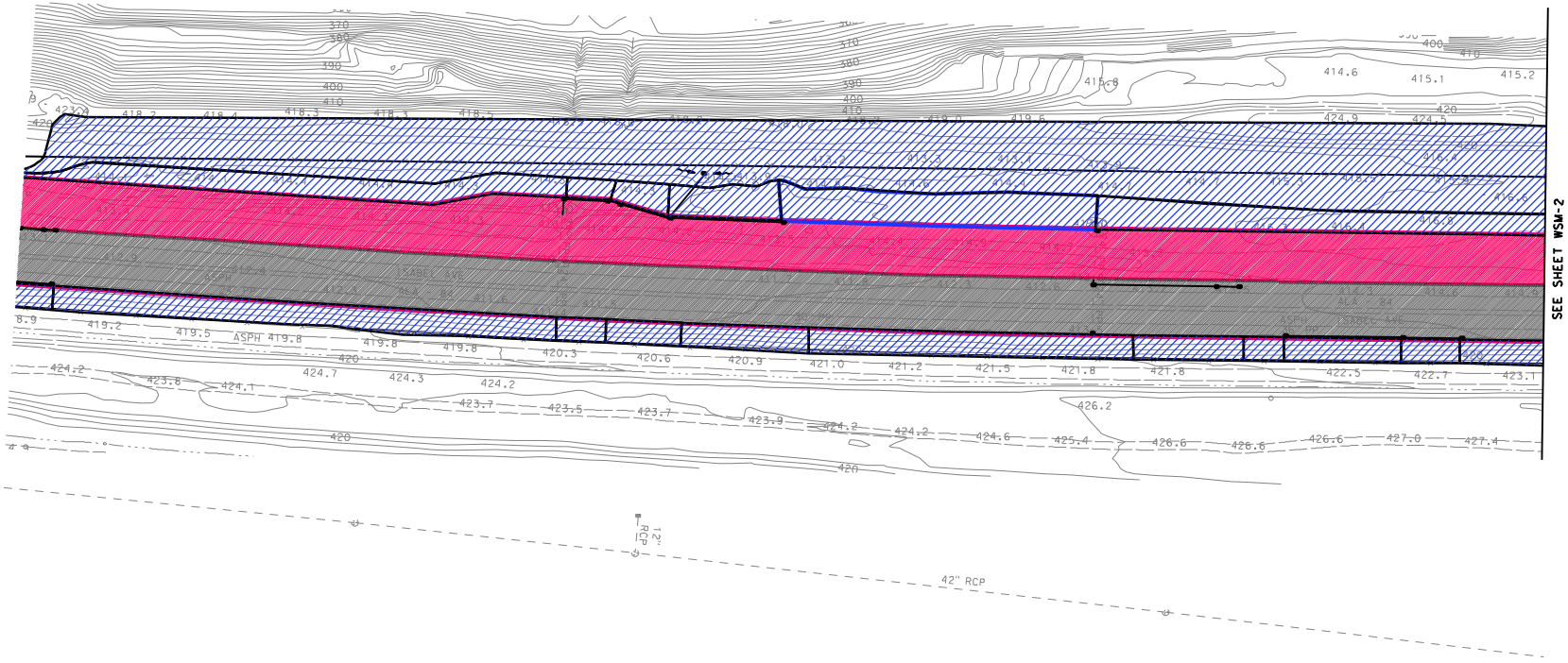
Appendix B Watershed Maps

Appendix B.1 Segment A Watershed Maps

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

- POINT OF COMPLIANCE (POC)
- OUTFALL
- BIOFILTRATION STRIP
- BIOFILTRATION SWALE
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- PERVIOUS WATERSHED BOUNDARY
- ADDED IMPERVIOUS AREA (A.I.A.)
- EXISTING IMPERVIOUS AREA
- REMOVED IMPERVIOUS AREA



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	14	

Analette Ochoa — 10/19/10
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

WATERSHED MAP

SCALE 1"=50'

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WSM-1

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	15	

Analette Ochoa — 10/19/10
REGISTERED CIVIL ENGINEER — DATE

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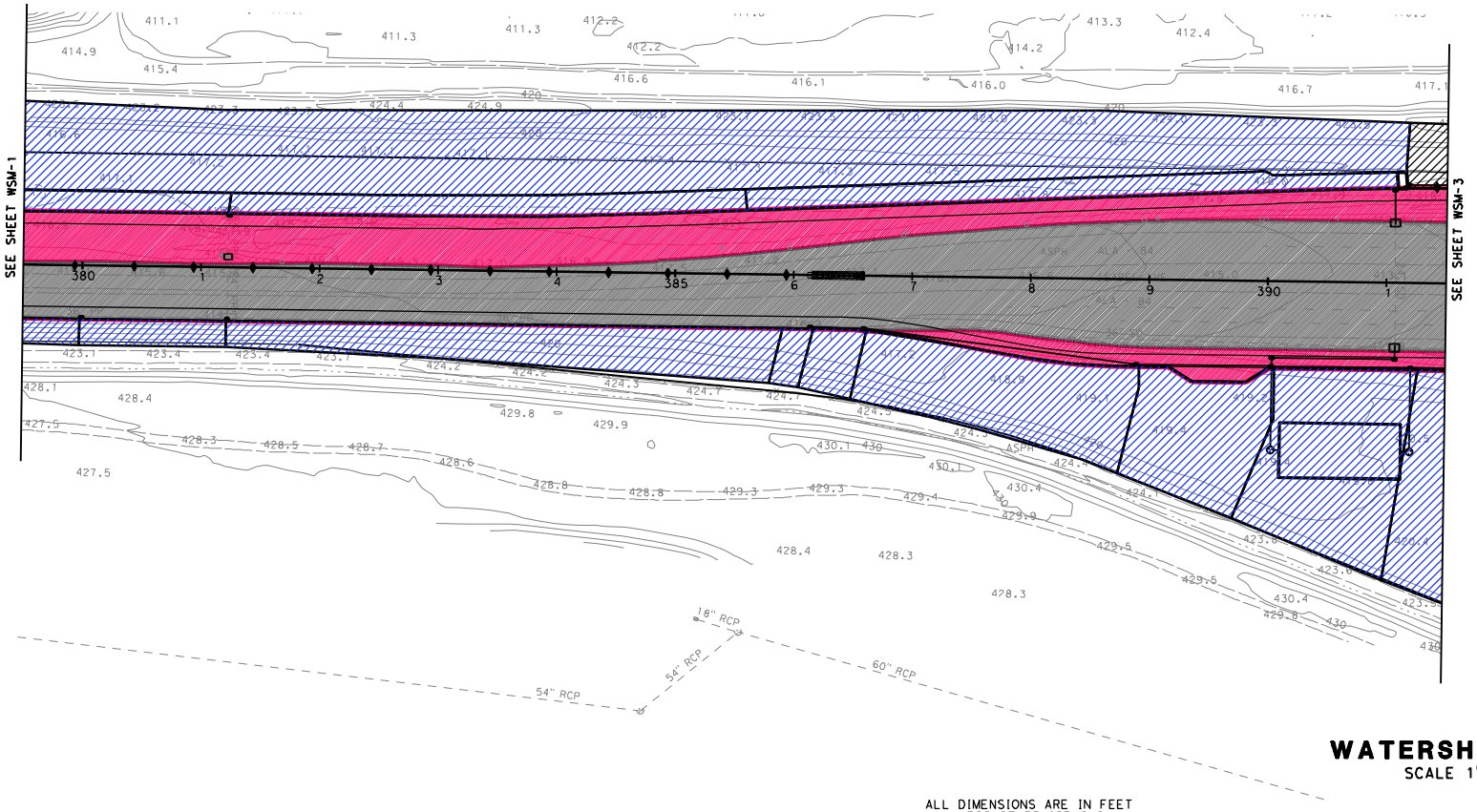

WATERSHED MAP
SCALE 1"=50'

WSM-2

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Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	16	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/10
CIVIL
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STANLEY BLVD

SEE SHEET WSM-2

SEE SHEET WSM-4

POC A3
402+45R

POC A3
402+00R

E STANLEY BLVD

WATERSHED MAP
SCALE 1"=50'

WSM-3

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UNIT 0733

PROJECT NUMBER & PHASE 04000205801

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	17	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

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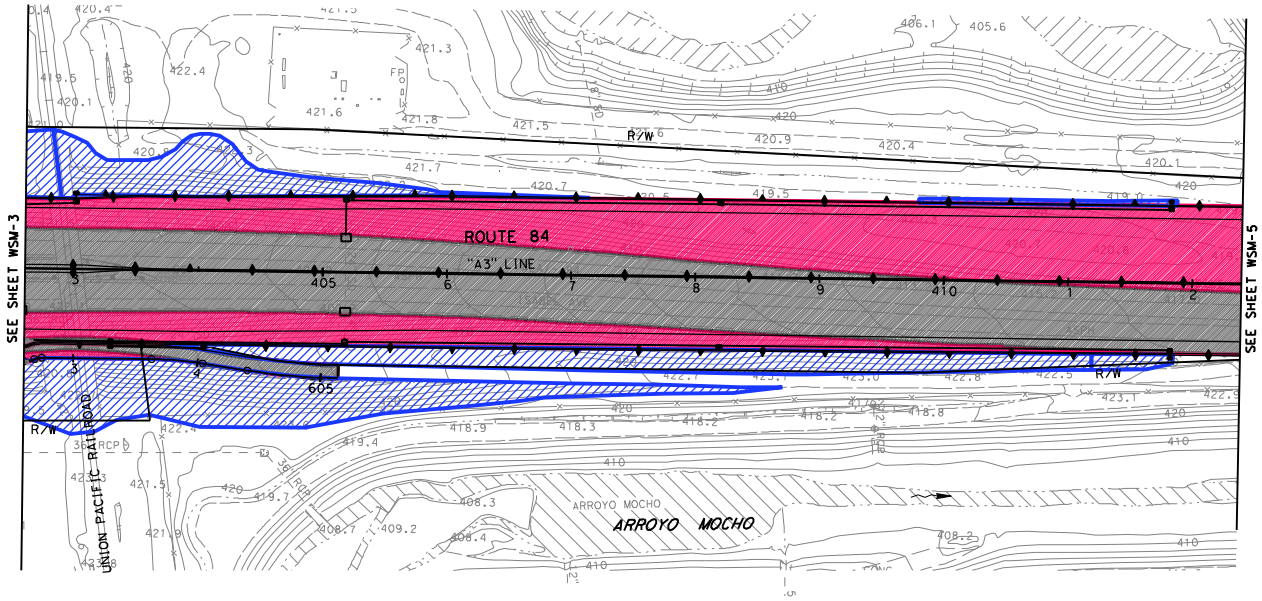

WATERSHED MAP

SCALE 1"=50'

WSM- 4

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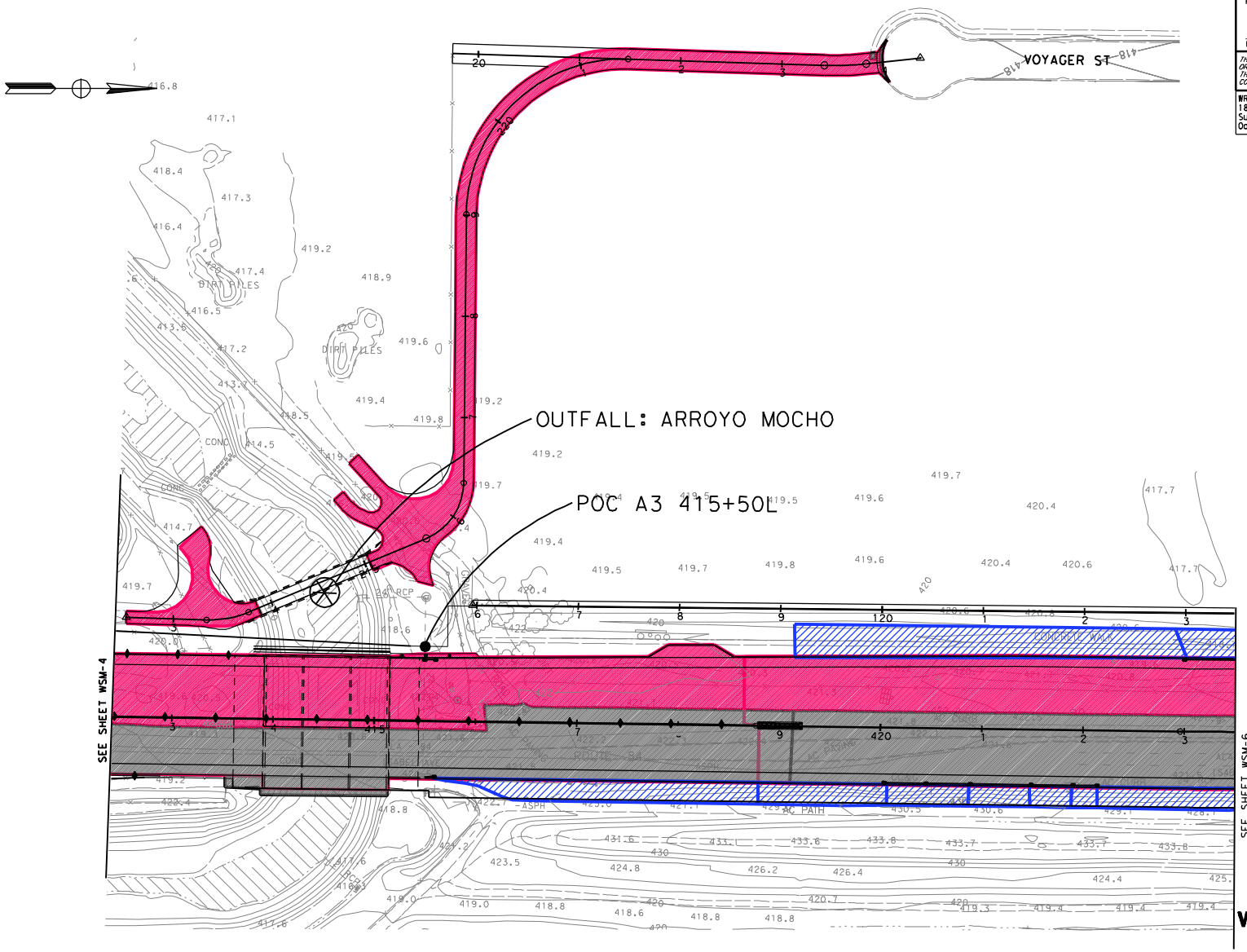

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	18	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

WATERSHED MAP
SCALE 1"=50'

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	19	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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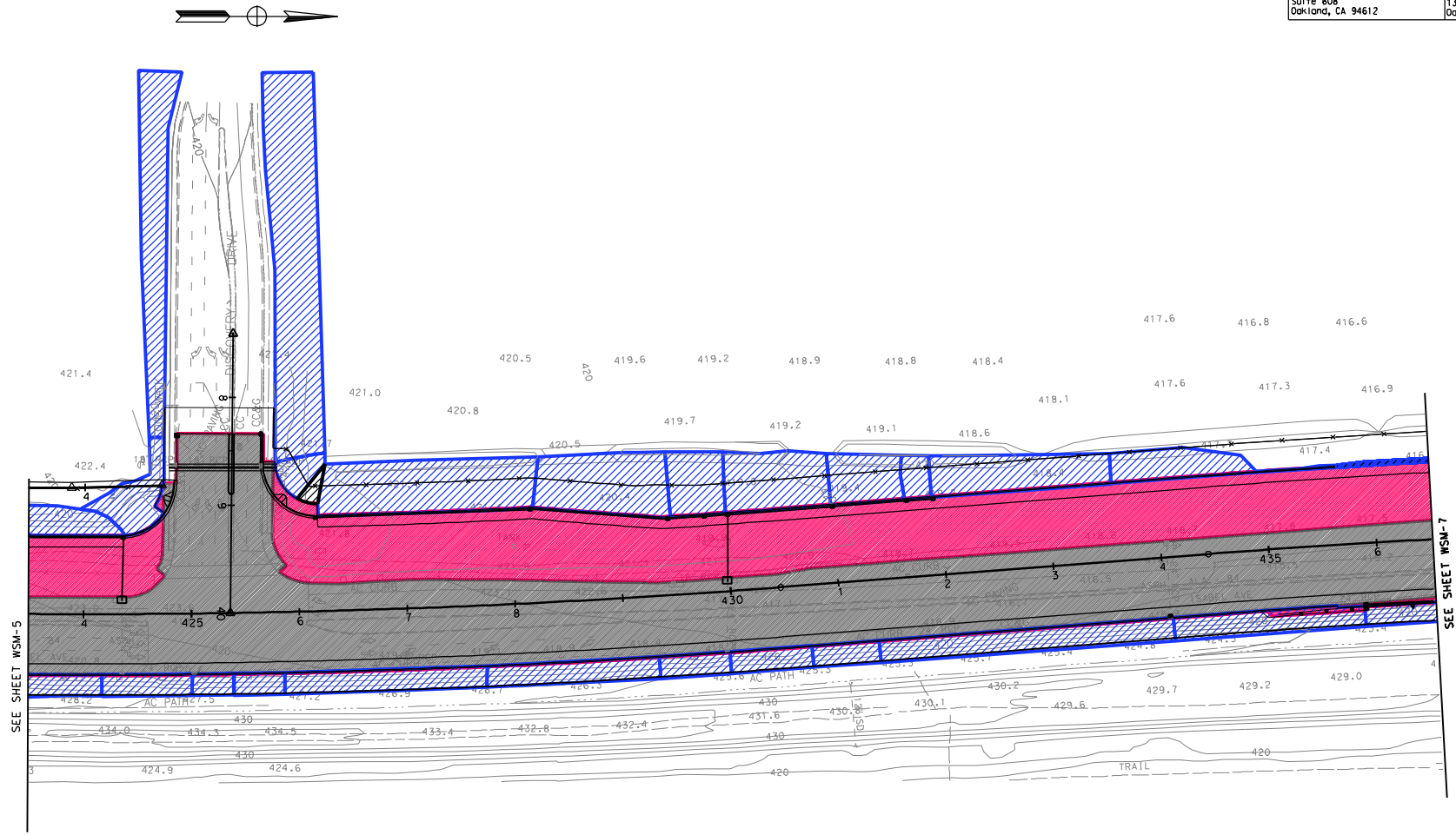

WATERSHED MAP
SCALE 1"=50'

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WSM- 6

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	20	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

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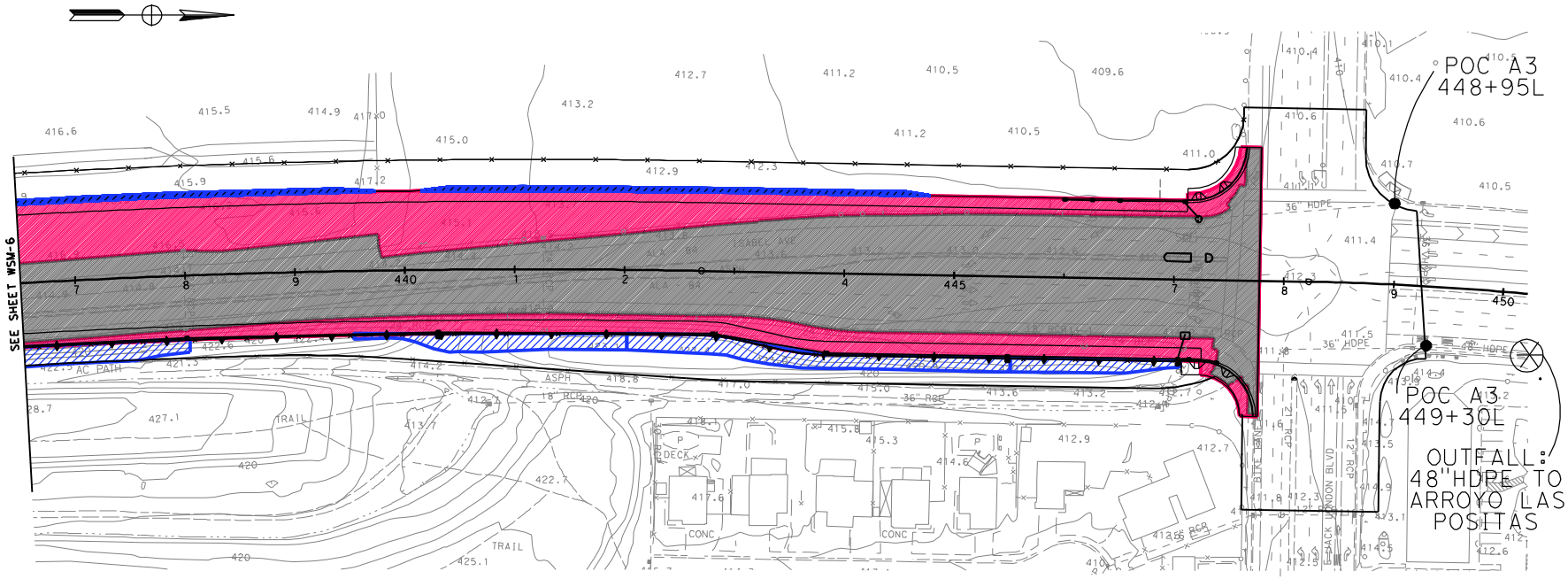

WATERSHED MAP
SCALE 1"=50'

WSM- 7

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	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

LAST REVISION 10-19-10 | DATE PLOTTED => 10/19/2010 | TIME PLOTTED => 10:43:36 PM

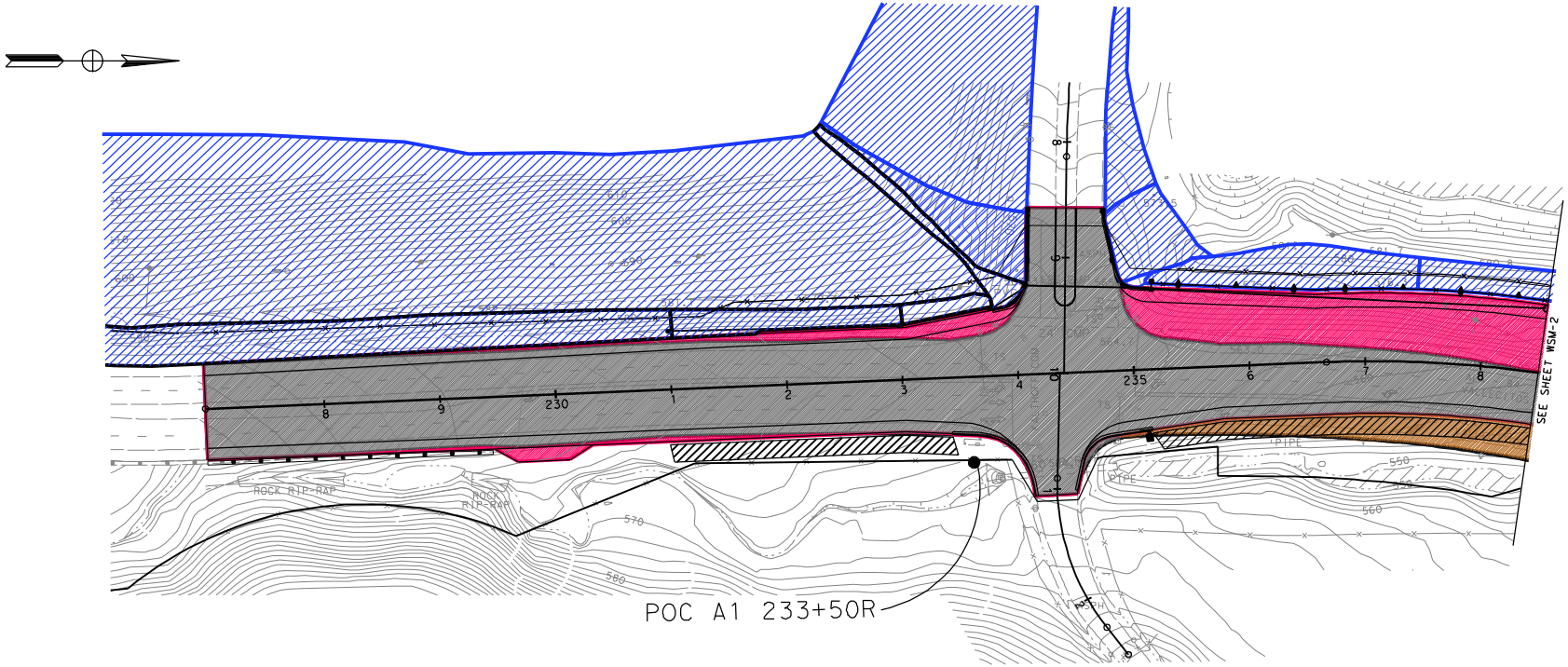
BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\hydromod wsm\seg a\WSM-7.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Appendix B.2 Segment B Watershed Maps

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

- POINT OF COMPLIANCE (POC)
- OUTFALL
- BIOFILTRATION STRIP
- BIOFILTRATION SWALE
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- PERVIOUS WATERSHED BOUNDARY
- ADDED IMPERVIOUS AREA (A.I.A.)
- EXISTING IMPERVIOUS AREA
- REMOVED IMPERVIOUS AREA



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		1

Analette Ochoa — REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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REVISED BY	DATE REVISED
IL	10/19/10

CALCULATED-DESIGNED BY	CHECKED BY
JESSICA POLLITZ	ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

WATERSHED MAP

SCALE 1"=50'

WSM-1

THIS PLAN ACCURAT

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

LAST REVISION 10-19-10 — DATE PLOTTED => 10/19/2010 — TIME PLOTTED => 10:45:14 PM

BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
DGN FILE => ...\hydromod wsm\seg b\WSM-01.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	2	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/10
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STATE OF CALIFORNIA

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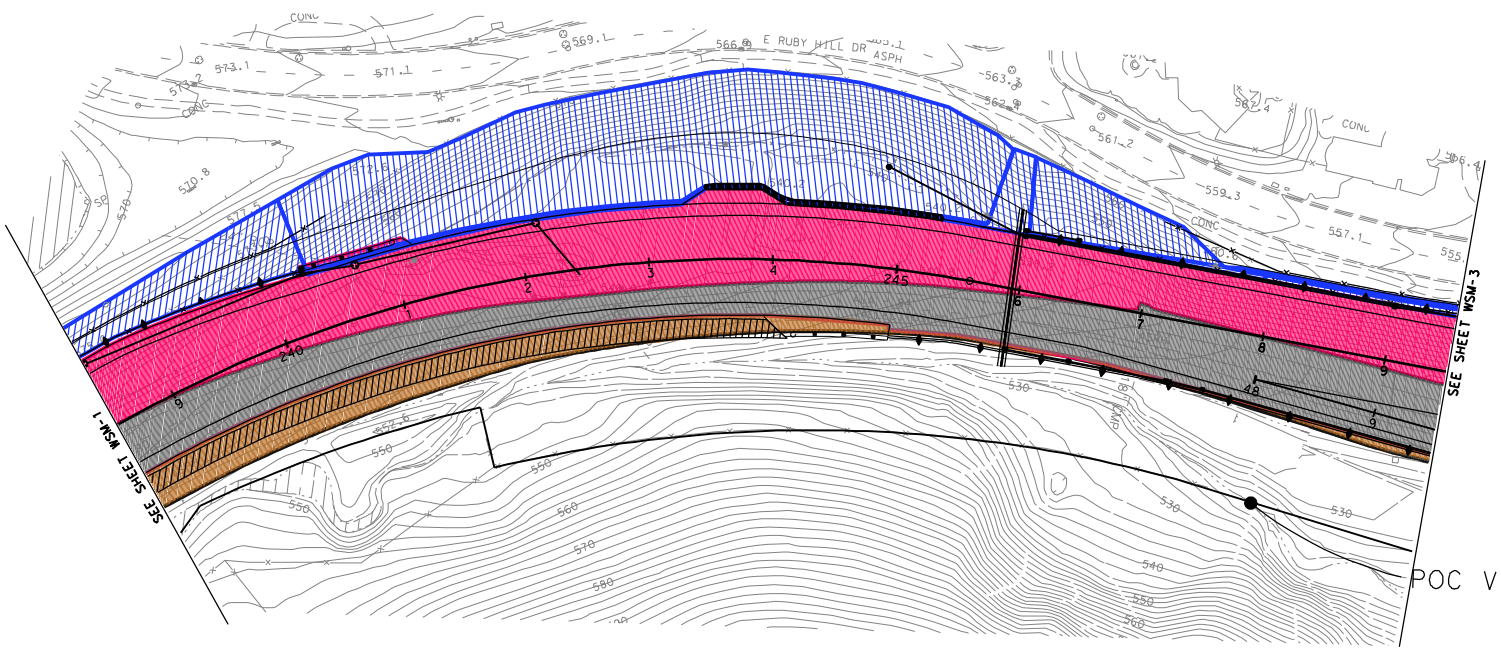

WATERSHED MAP
SCALE 1"=50'

WSM-2

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	CHECKED BY	JESSICA POLLITZ	10/19/10
			ANALETTE OCHOA	IL

LAST REVISION 10-19-10
DATE PLOTTED => 10/19/2010
TIME PLOTTED => 10:45:19 PM

BORDER LAST REVISED 7/2/2010

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DGN FILE => ...\hydromod wsm\seg b\WSM-02.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	3	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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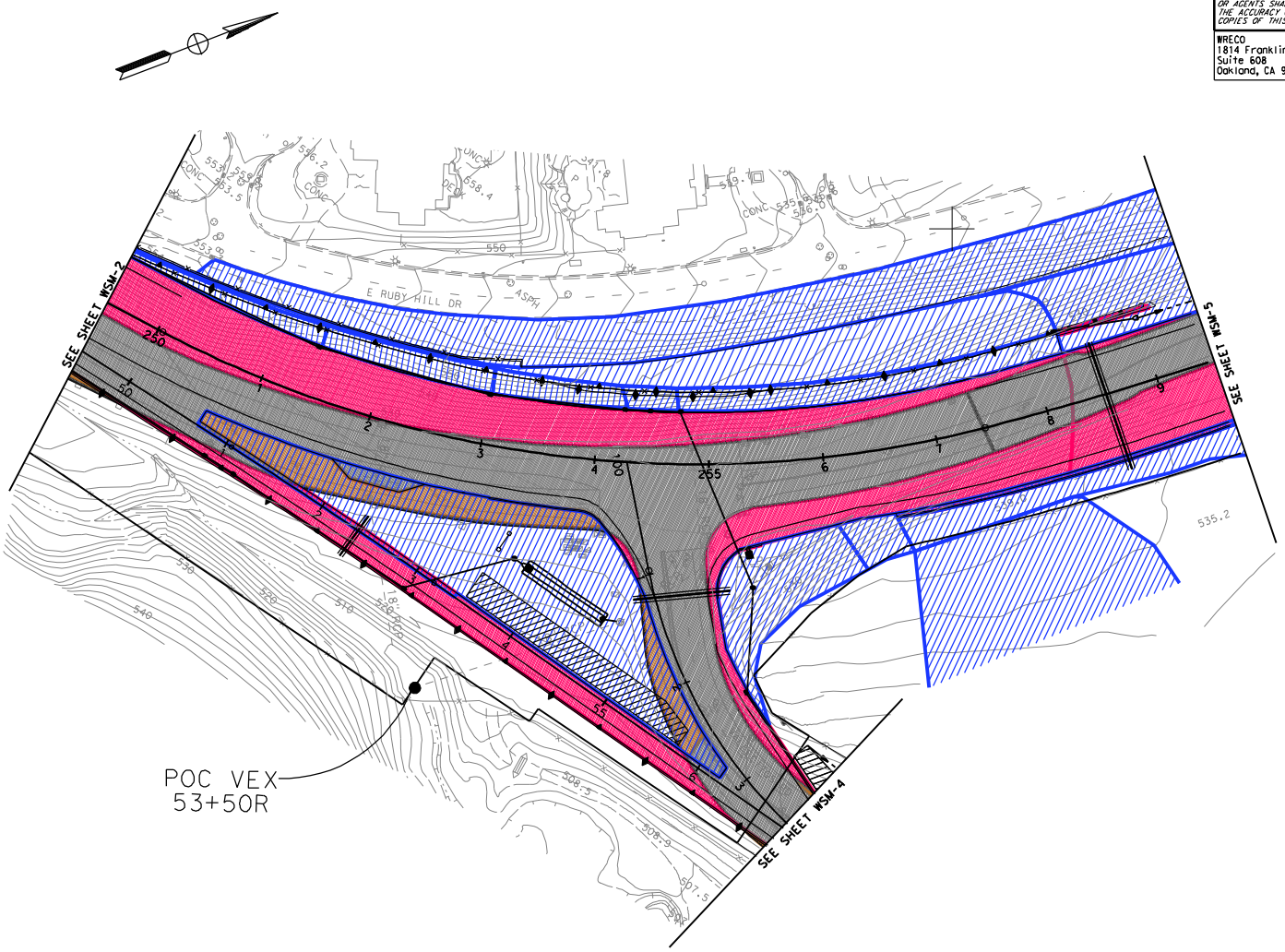

WATERSHED MAP
SCALE 1"=50'

WSM-3

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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DATE PLOTTED => 10/19/2010
TIME PLOTTED => 10:45:24 PM

BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	4	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/10
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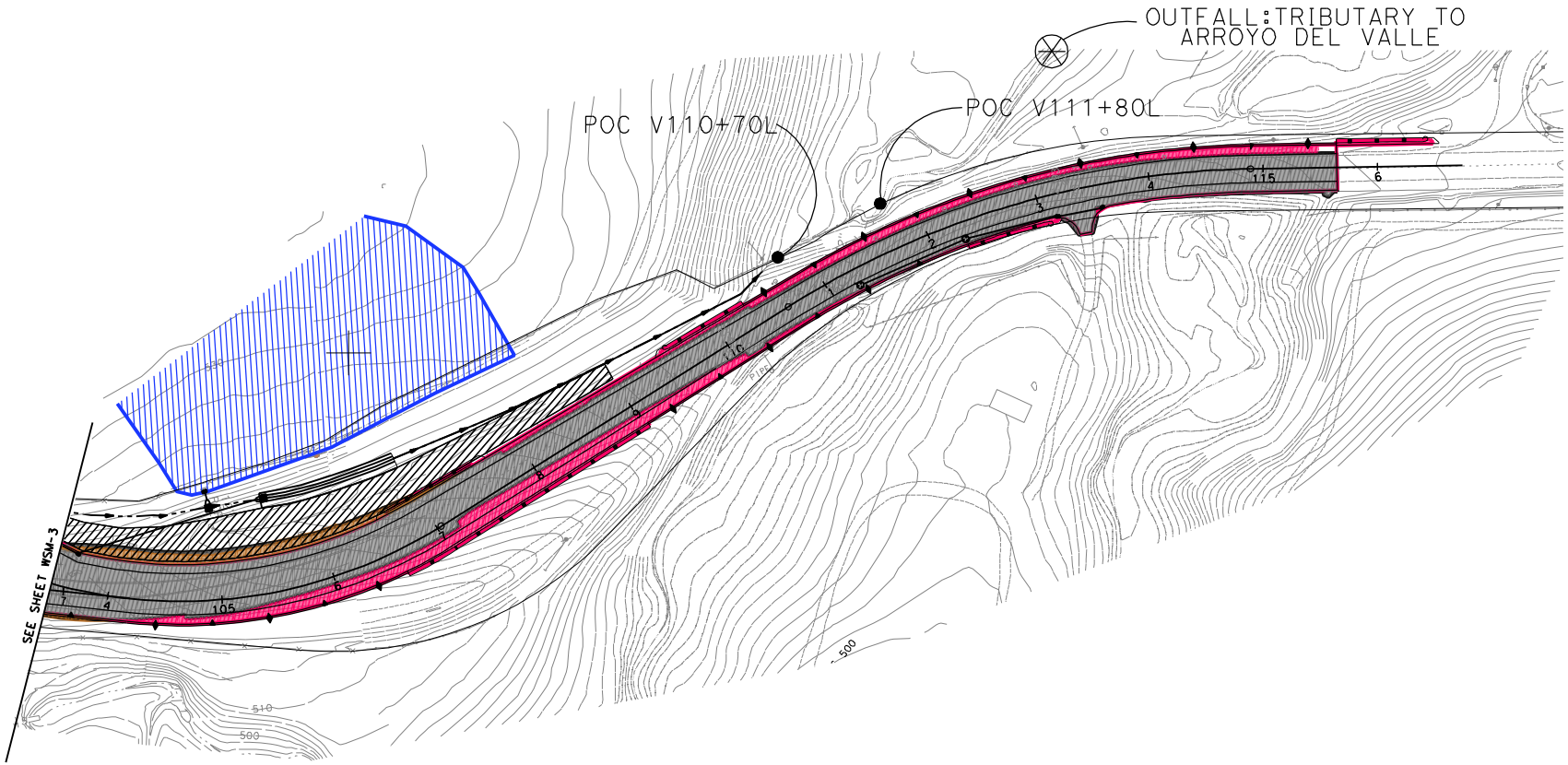

WATERSHED MAP
SCALE 1"=50'

WSM- 4

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

LAST REVISION
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TIME PLOTTED => 10:45:31 PM

BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	5	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/10
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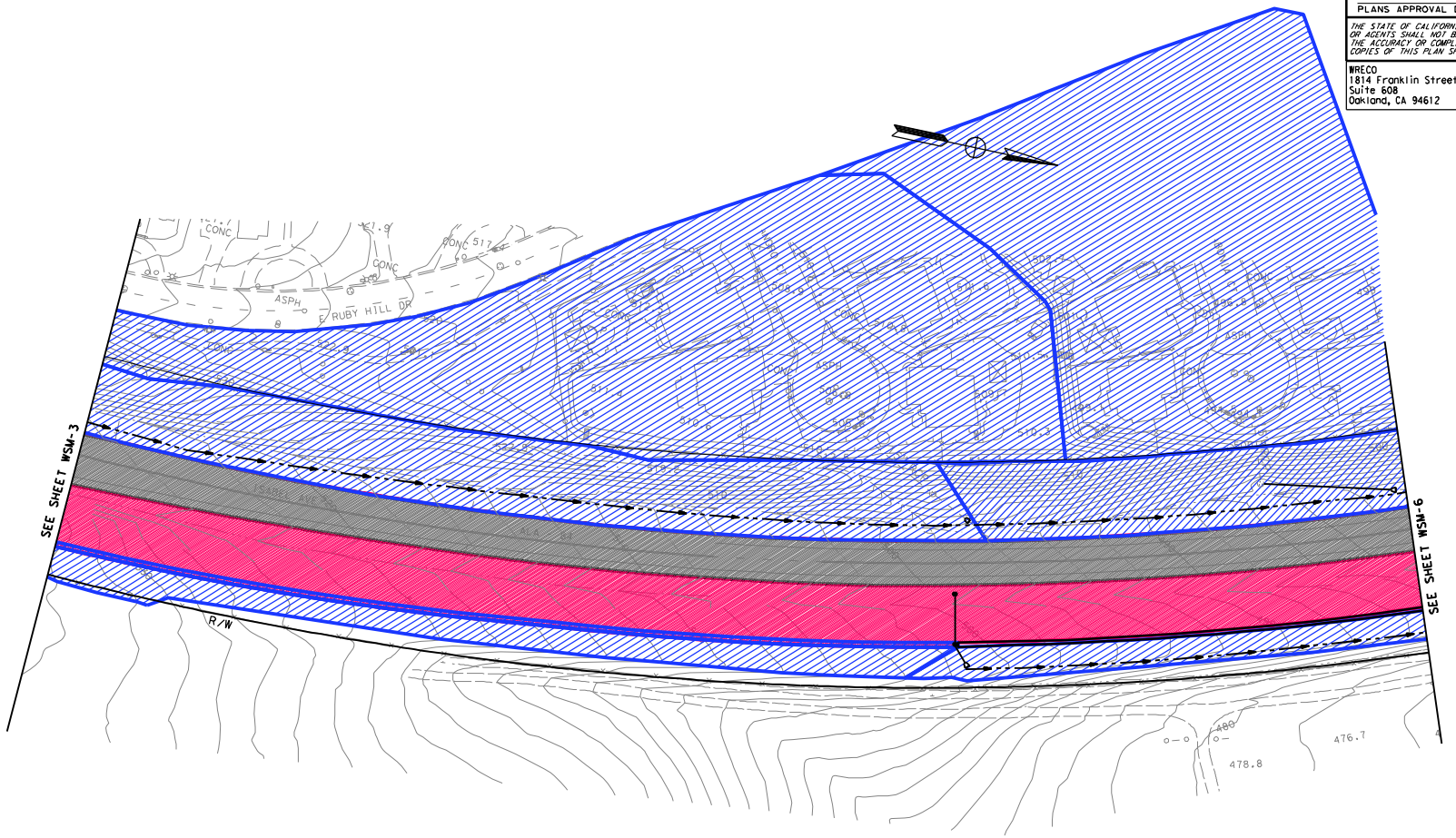

WATERSHED MAP
SCALE 1"=50'

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WSM-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\hydromod wsm\seg b\WSM-05.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	6	

Analette Ochoa — REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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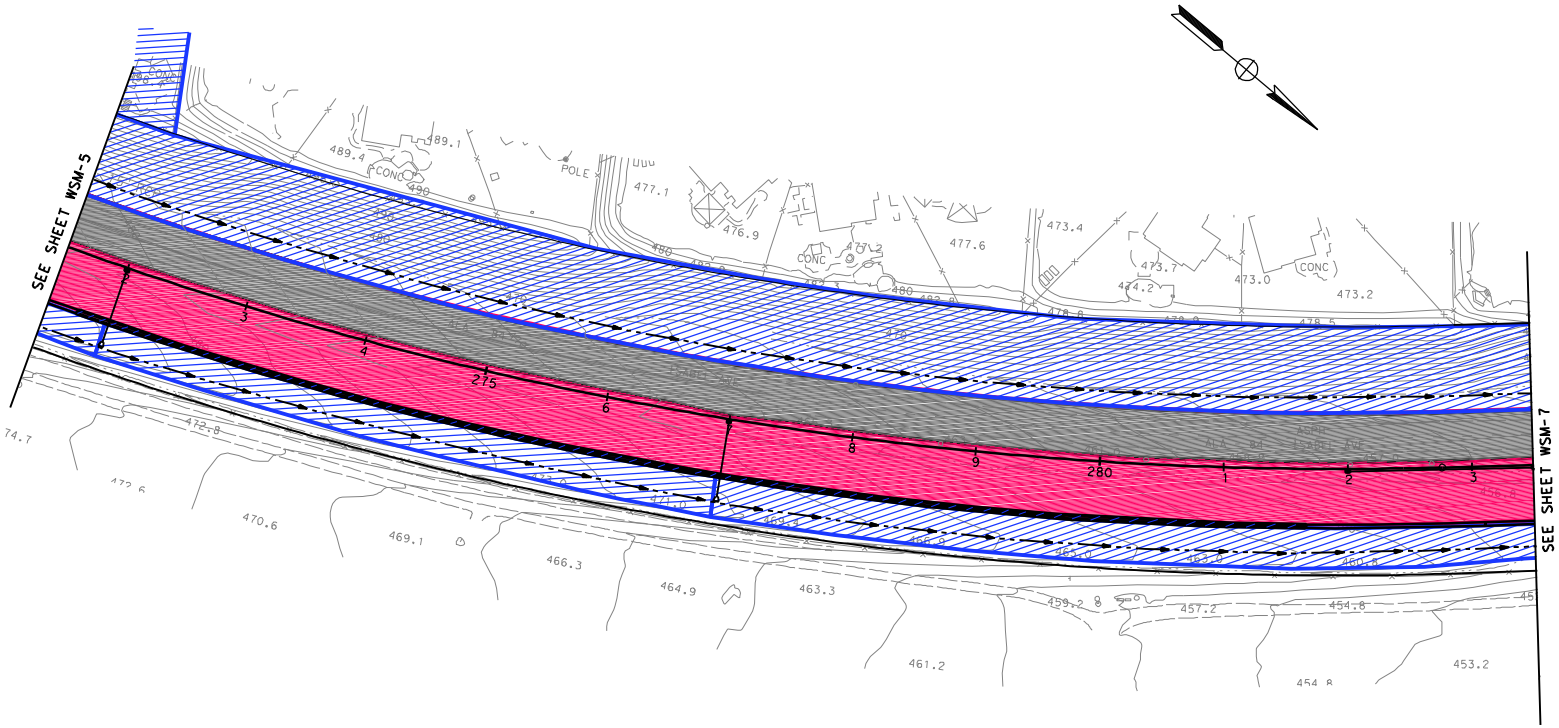

WATERSHED MAP

SCALE 1"=50'

WSM-6

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	7	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/10
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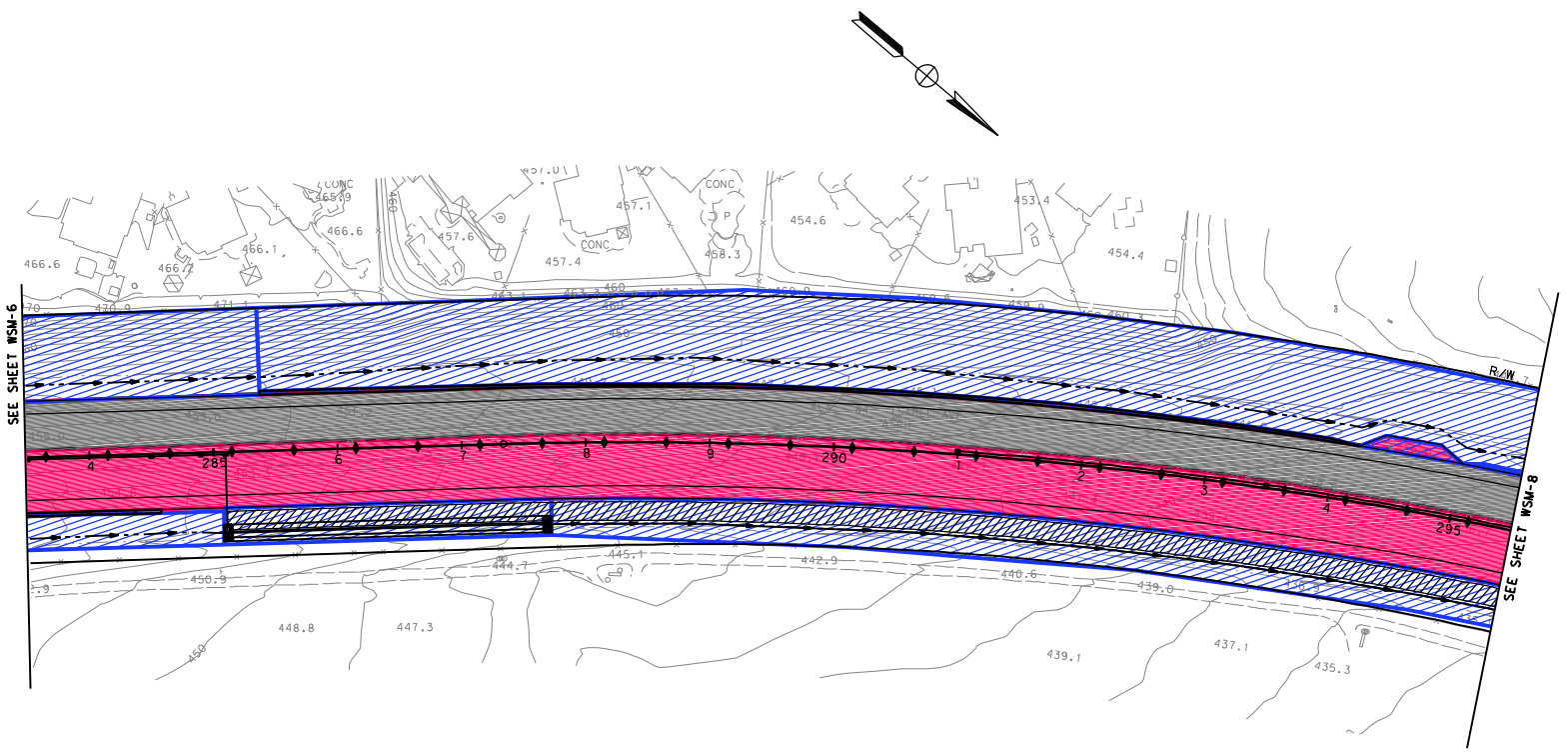

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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WSM-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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DATE PLOTTED => 10/19/2010
TIME PLOTTED => 10:45:47 PM

BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	8	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/10
CIVIL
STATE OF CALIFORNIA

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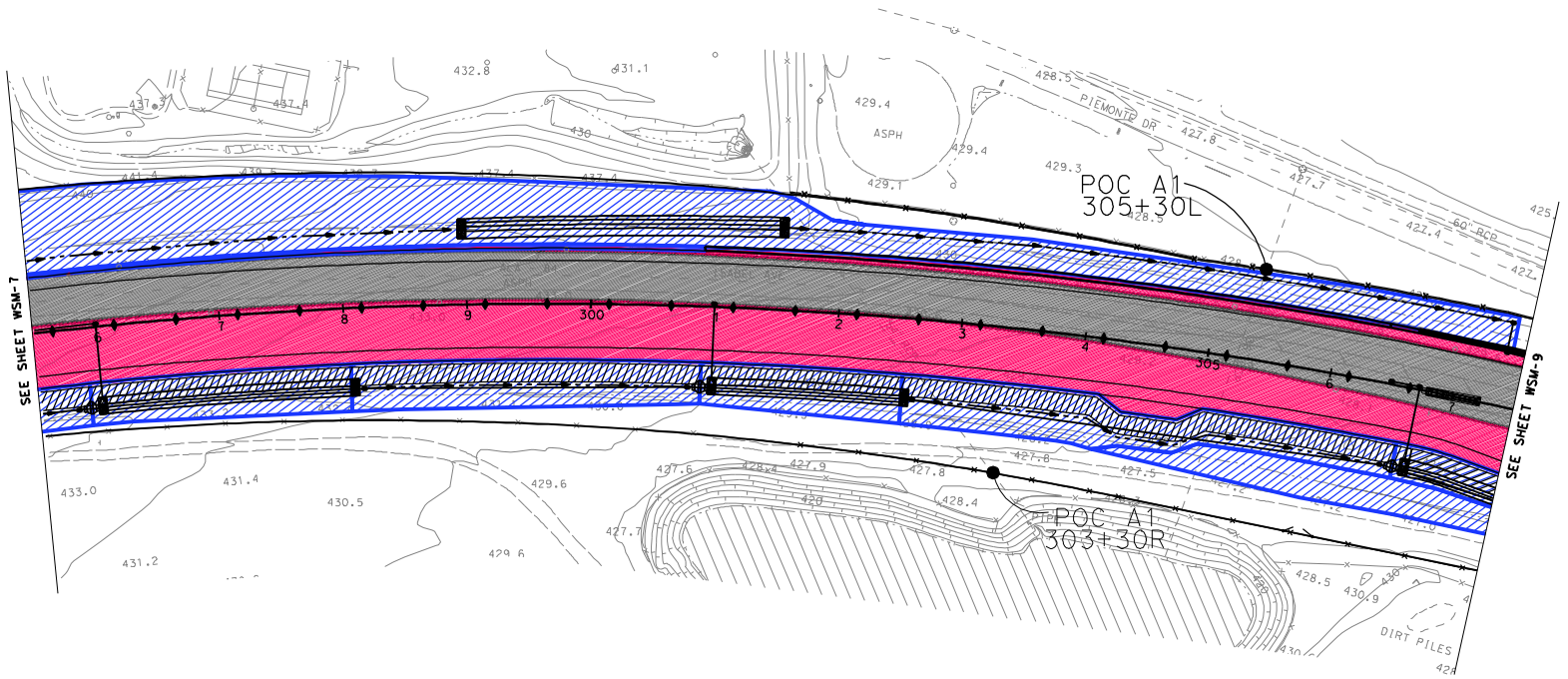

WATERSHED MAP
SCALE 1"=50'

WSM-8

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Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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TIME PLOTTED => 10:45:53 PM

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DGN FILE => ...\hydromod wsm\seg b\WSM-08.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	9	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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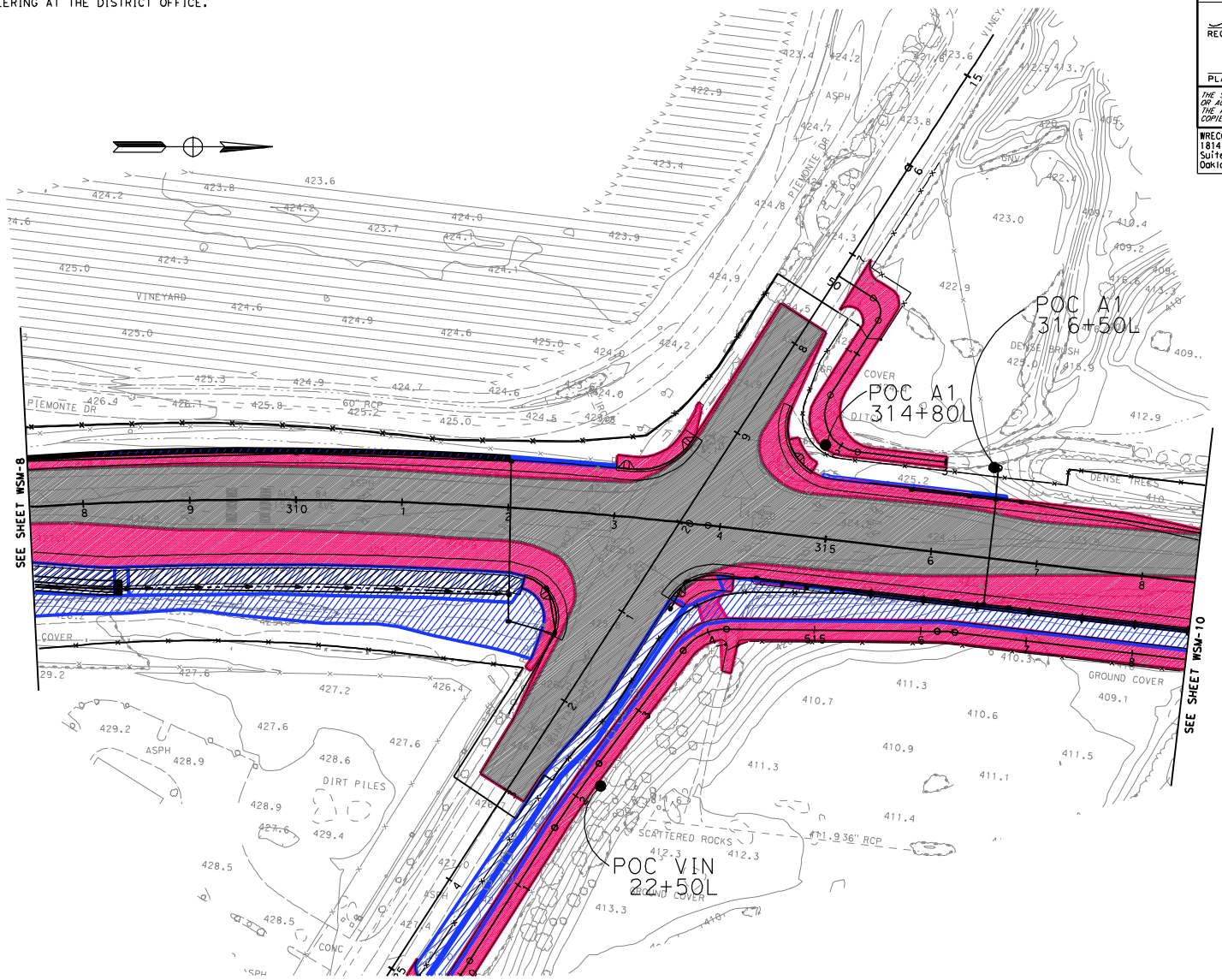

WATERSHED MAP
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	10	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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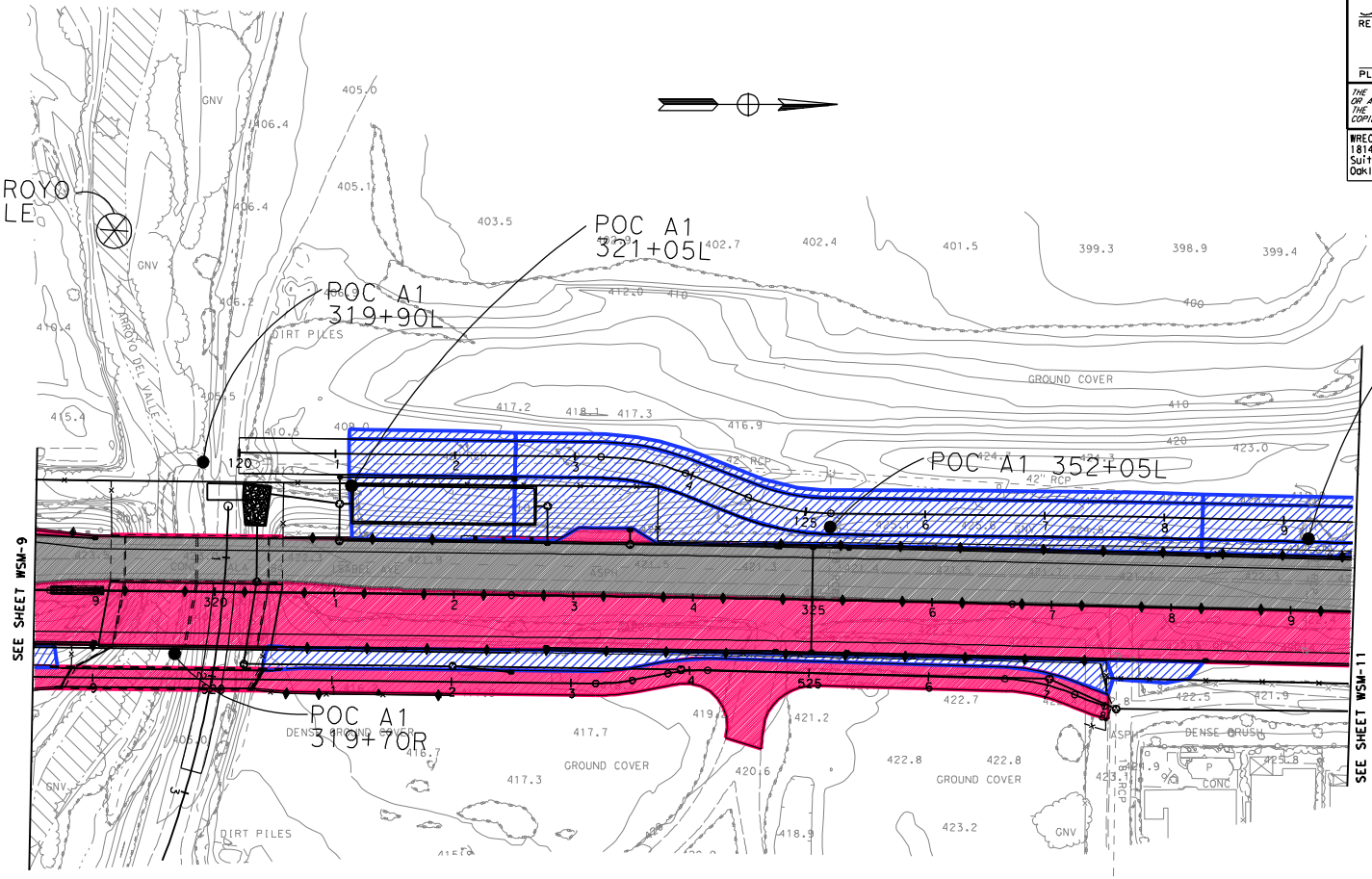
OUTFALL: ARROYO DEL VALLE



WATERSHED MAP
SCALE 1"=50'

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WSM-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED
		JESSICA POLLITZ	IL
		ANALETTE OCHOA	10/19/10

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	11	

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/10
CIVIL
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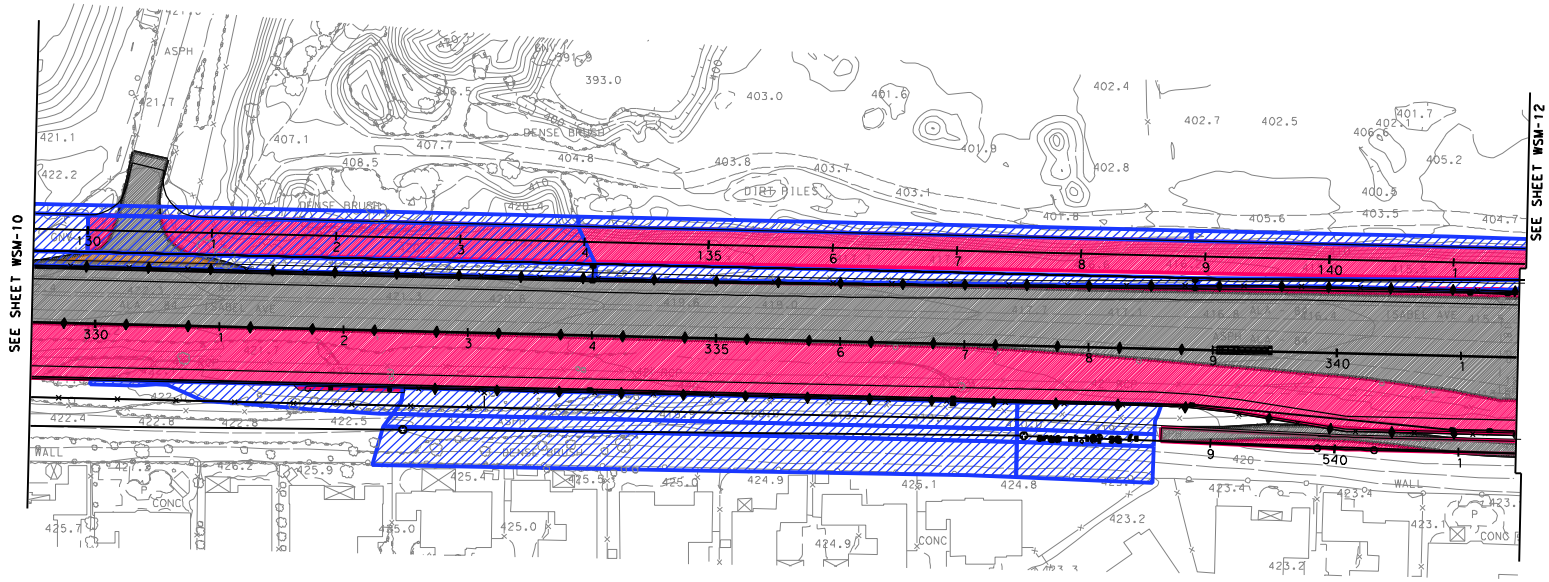

WATERSHED MAP
SCALE 1"=50'

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ALL DIMENSIONS ARE IN FEET
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WSM-11

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

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DATE PLOTTED => 10/19/2010
TIME PLOTTED => 10:46:12 PM

BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	12	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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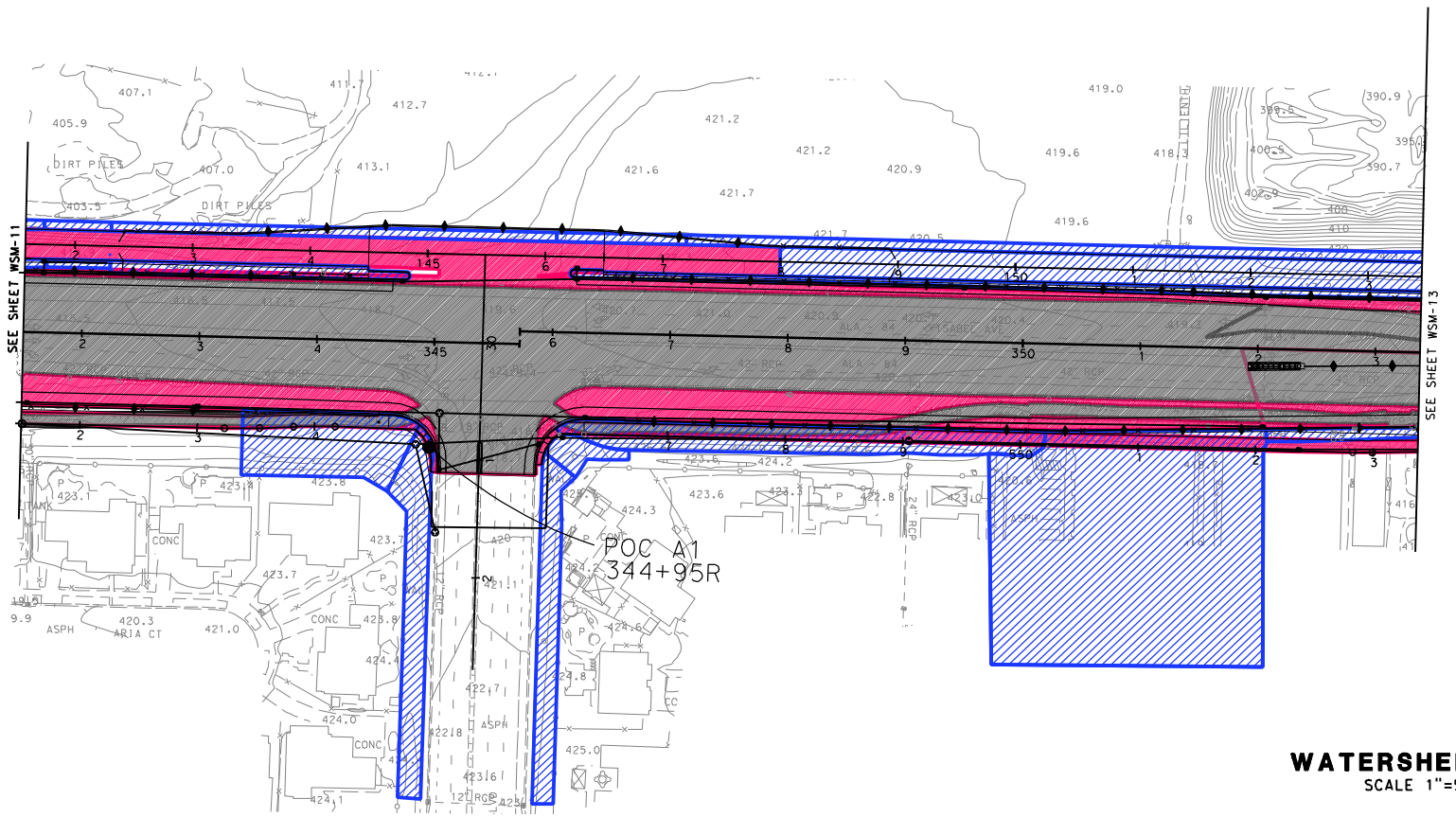
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	CHECKED BY	JESSICA POLLITZ	10/19/10
			ANALETTE OCHOA	IL



WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

WSM-12

LAST REVISION 10-19-10 | DATE PLOTTED => 10/19/2010 | TIME PLOTTED => 10:46:18 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\hydromod wsm\seg b\WSM-12.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	13	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

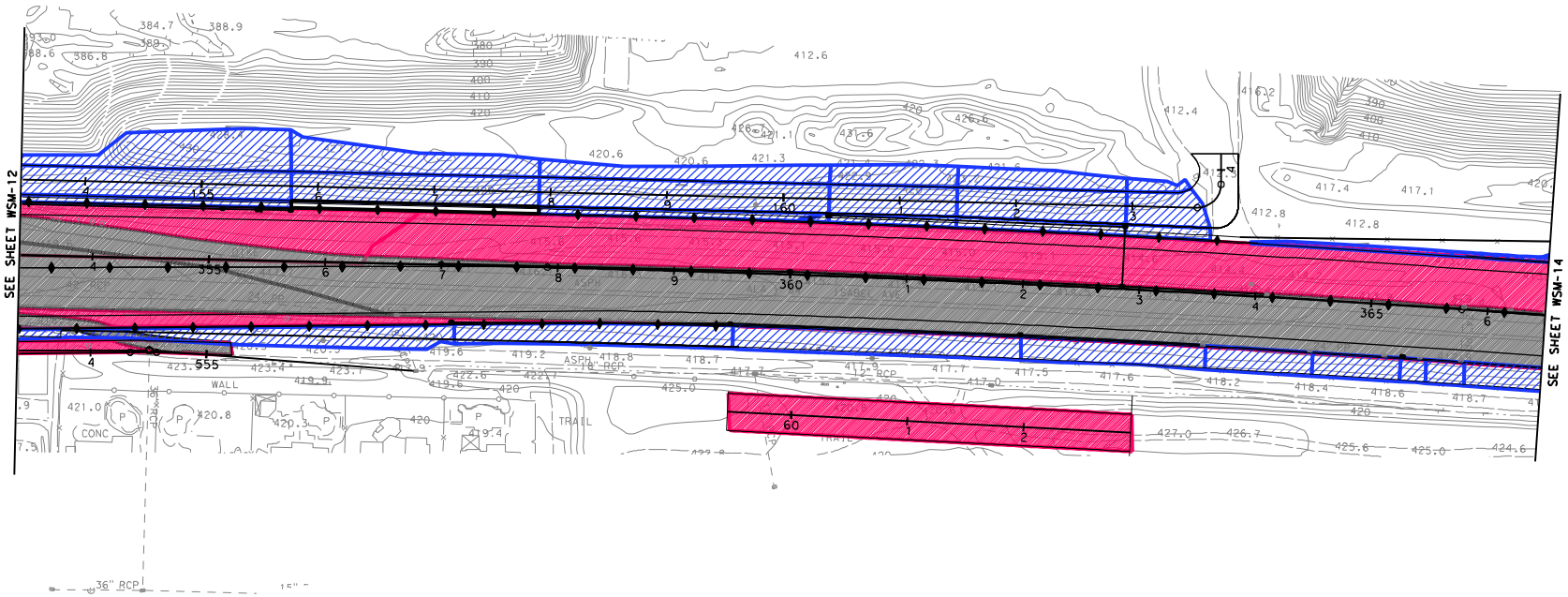
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1814 Franklin Street
Suite 608
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612



WATERSHED MAP

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

WSM-13

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
	HAN-BIN LIANG	JESSICA POLLITZ	ANALETTE OCHOA	IL	10/19/10

LAST REVISION 10-19-10 | DATE PLOTTED => 10/19/2010 | TIME PLOTTED => 10:46:25 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\hydromod wsm\seg b\WSM-13.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	14	

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

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Suite 608
Oakland, CA 94612

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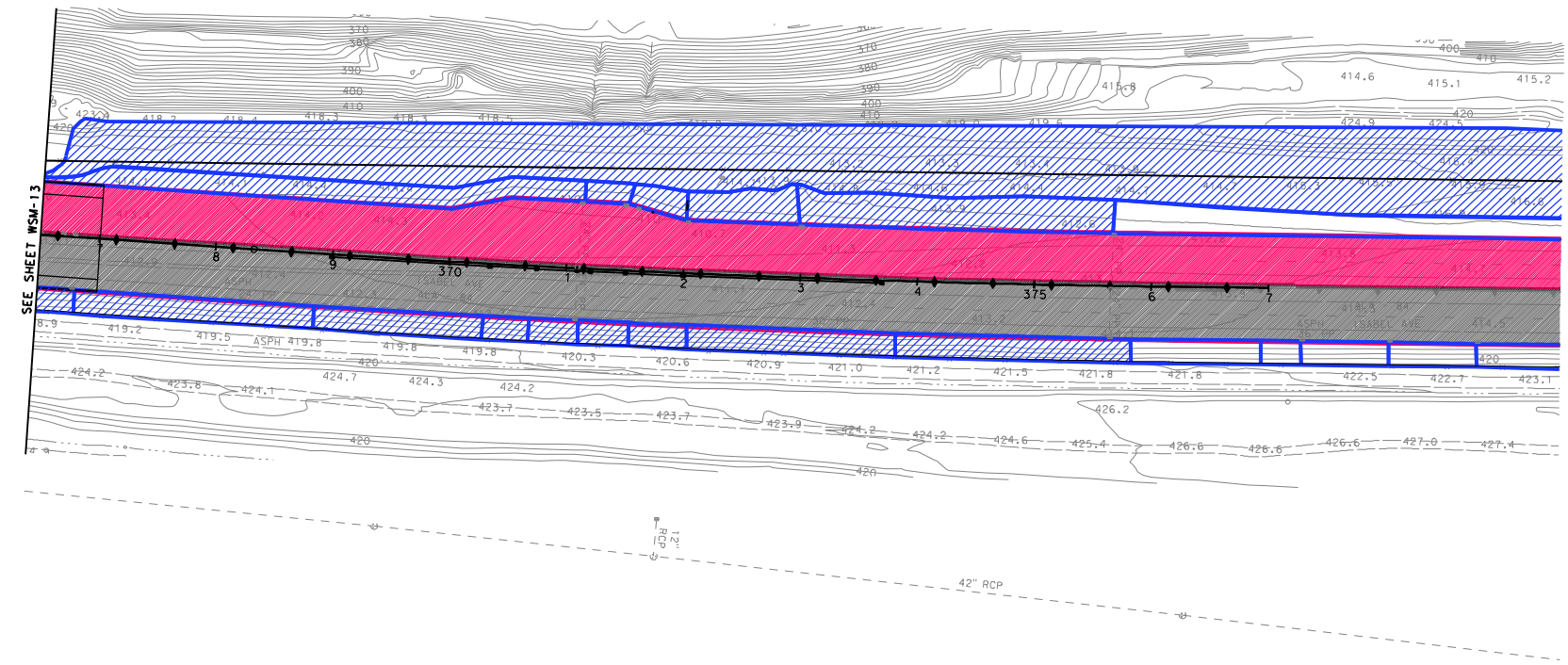
Oakland, CA 94612



WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

WSM-14

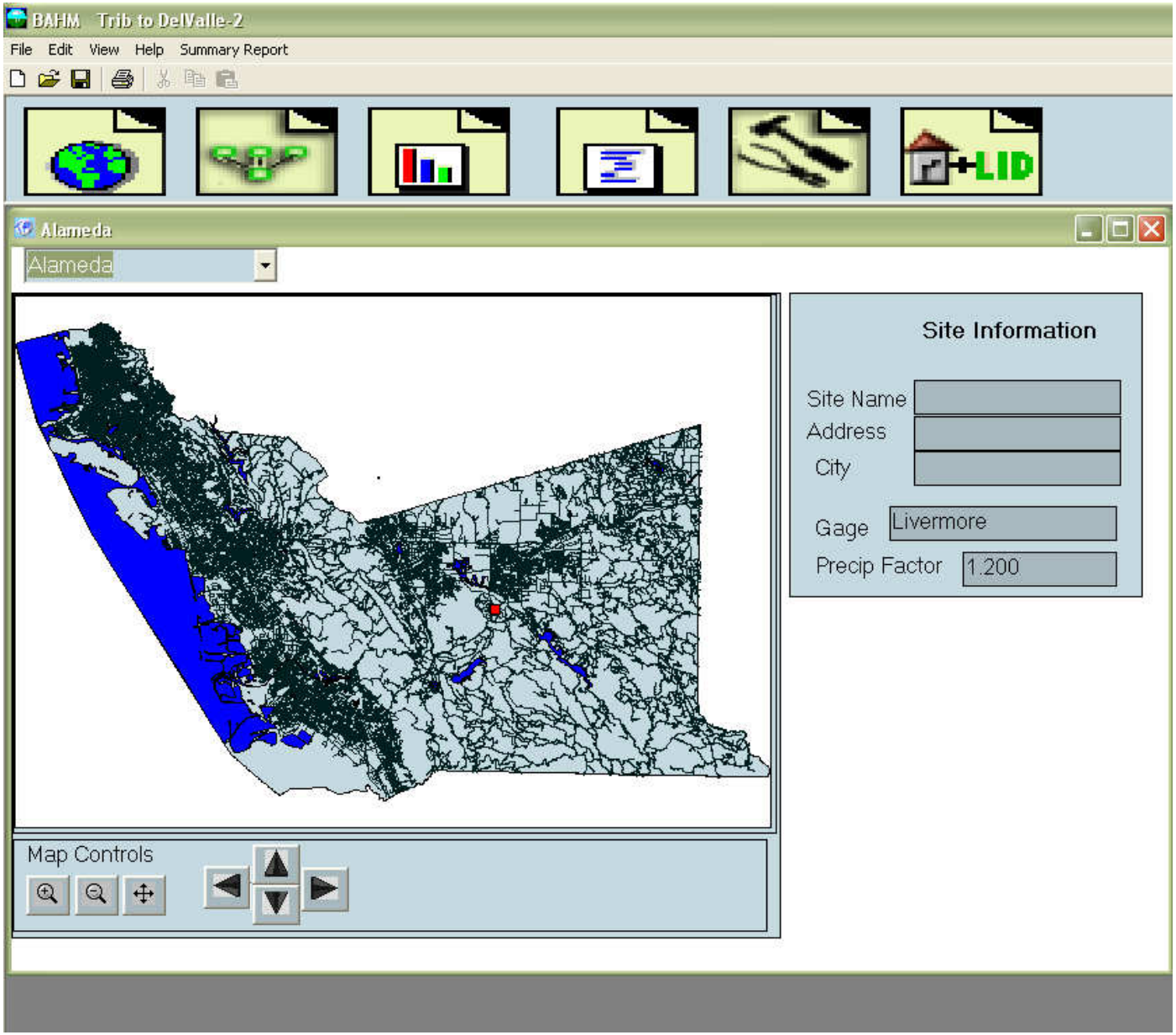
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY
Caltrans	HAN-BIN LIANG	CHECKED BY
	JESSICA POLLITZ	REVISED BY
	ANALETTE OCHOA	DATE REVISED
	IL	10/19/10

LAST REVISION 10-19-10 — DATE PLOTTED => 10/19/2010 — TIME PLOTTED => 10:46:31 PM

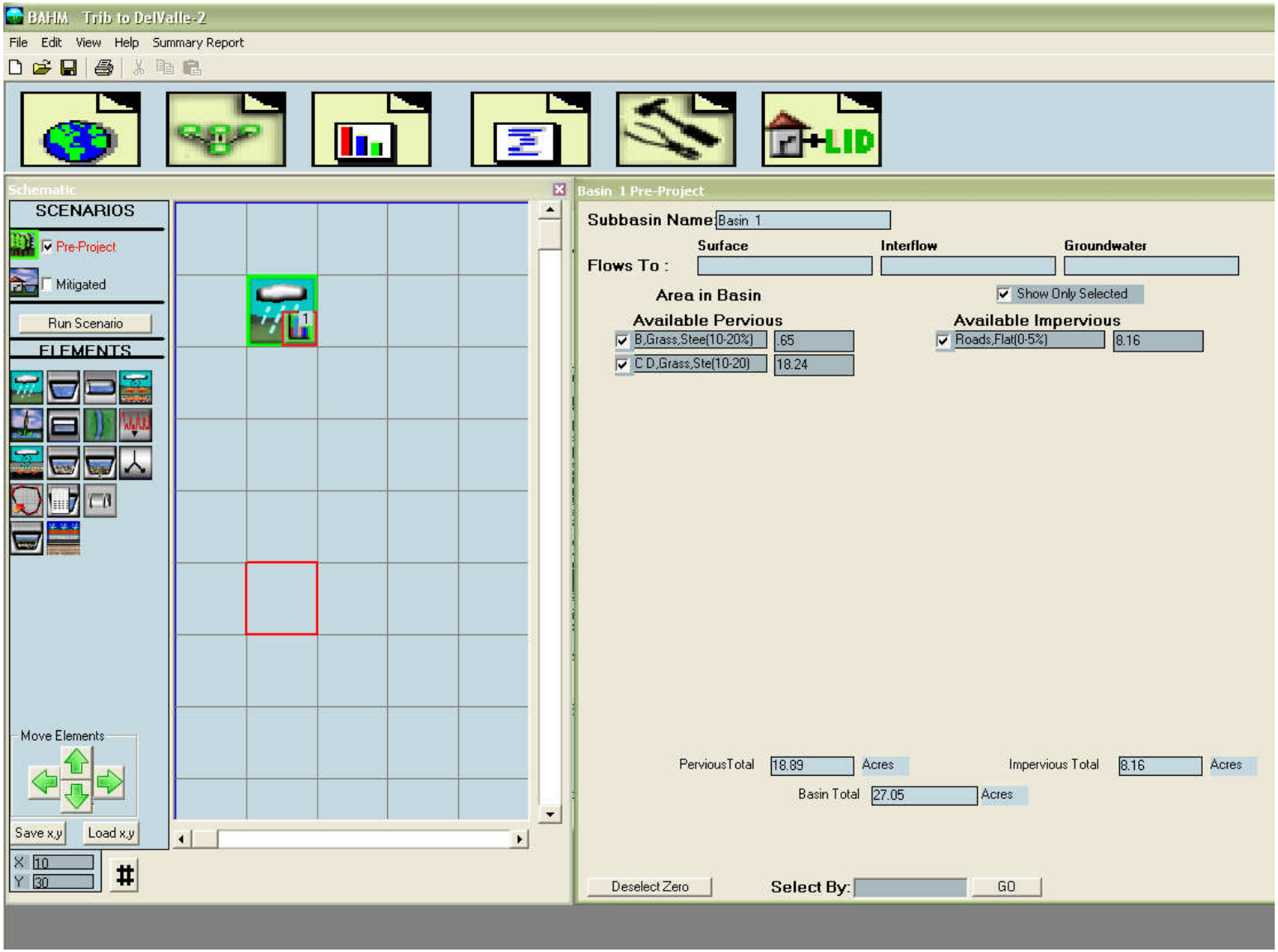
BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\hydromod wsm\seg b\WSM-14.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Appendix C BAHM Models

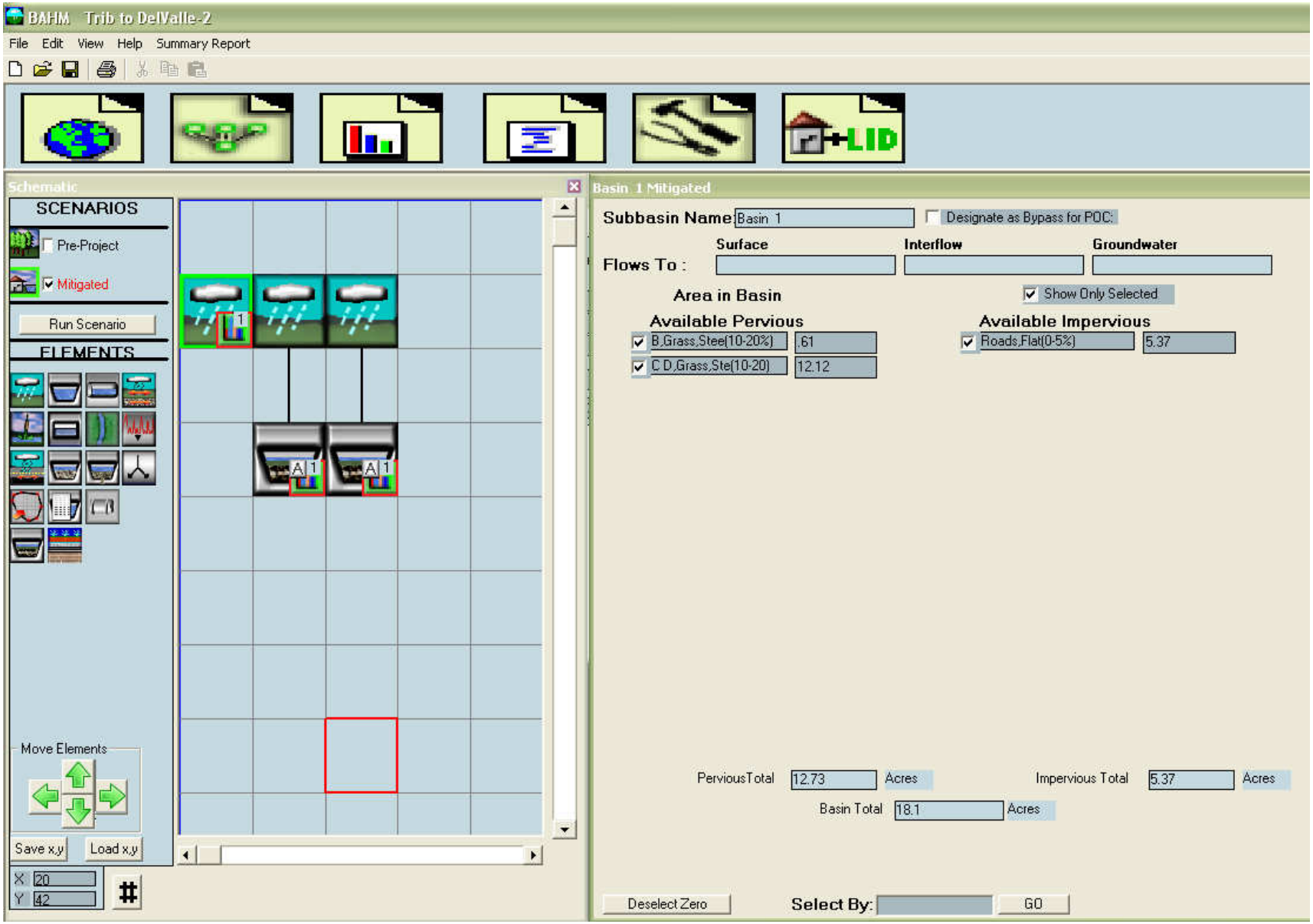
Outfall: Tributary to Arroyo Del Valle



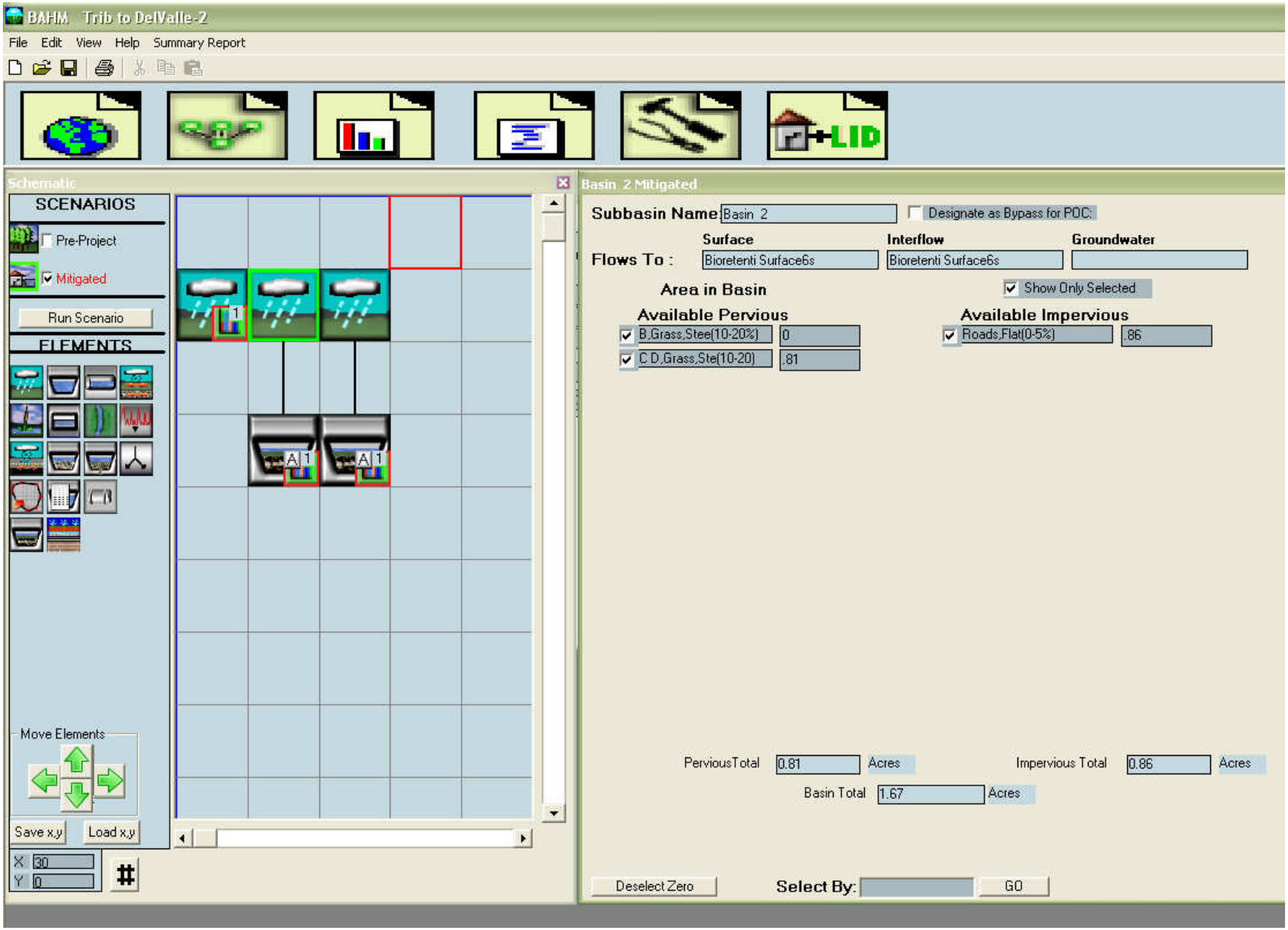
Outfall: Tributary to Arroyo Del Valle



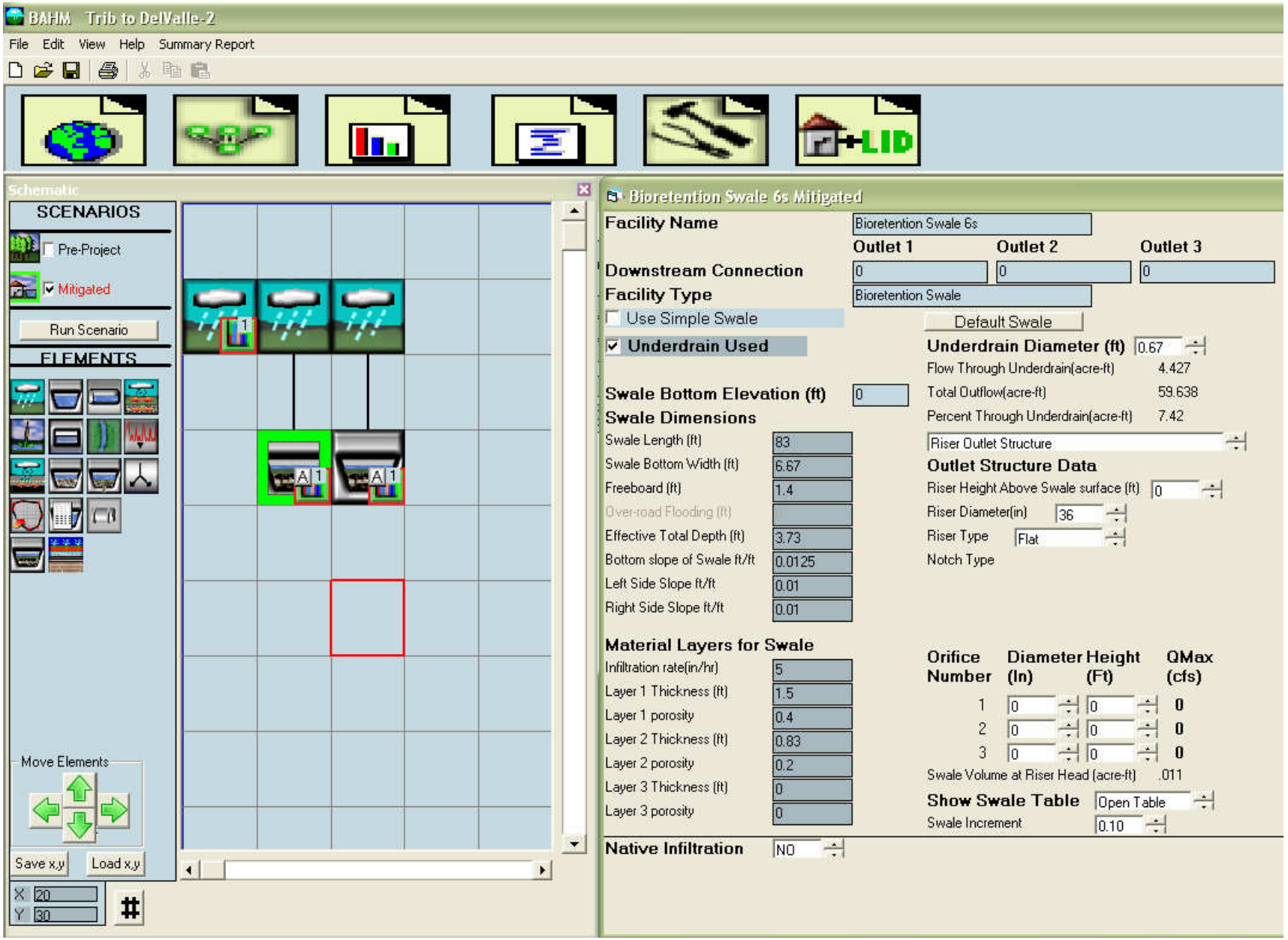
Outfall: Tributary to Arroyo Del Valle



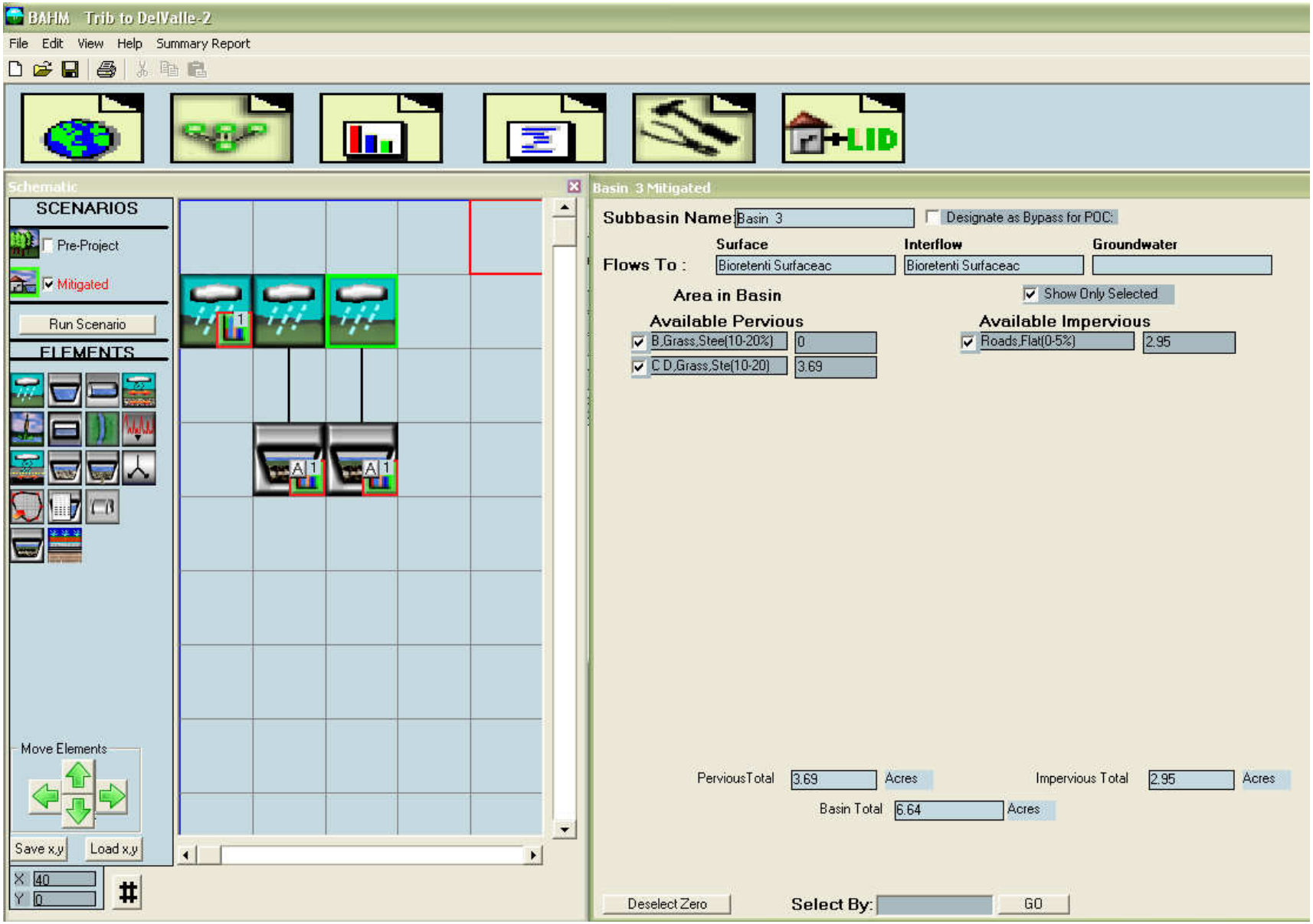
Outfall: Tributary to Arroyo Del Valle



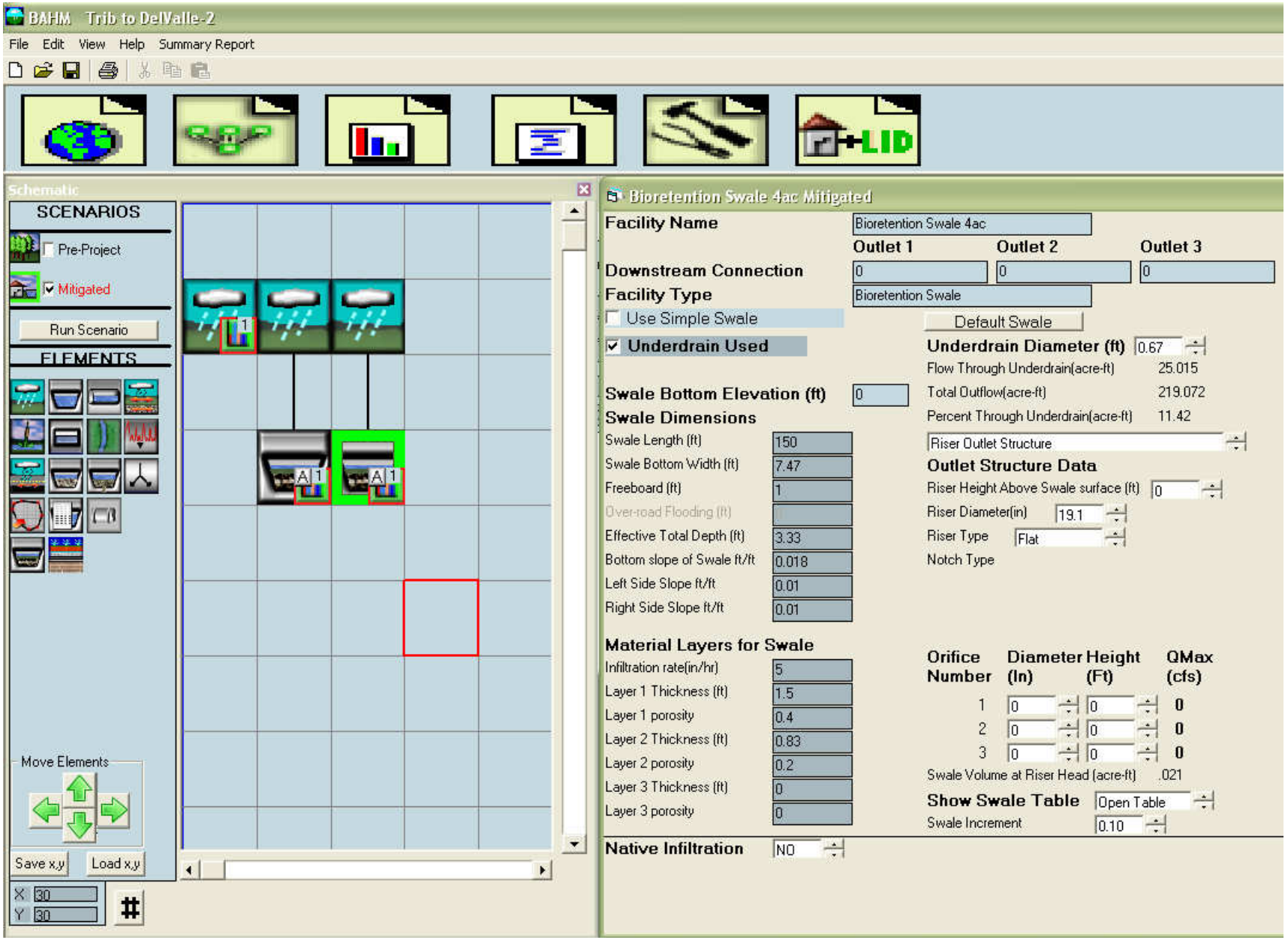
Outfall: Tributary to Arroyo Del Valle



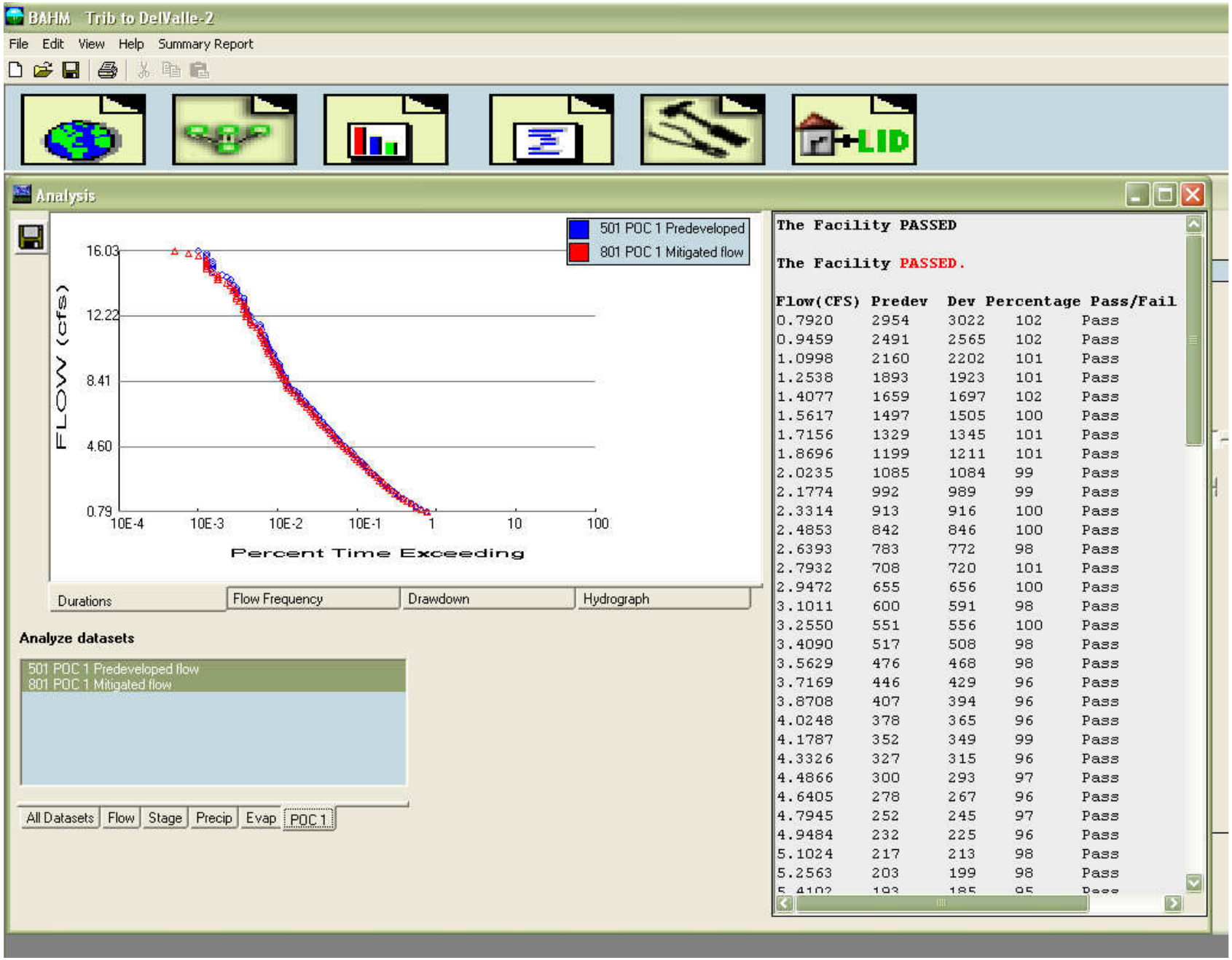
Outfall: Tributary to Arroyo Del Valle



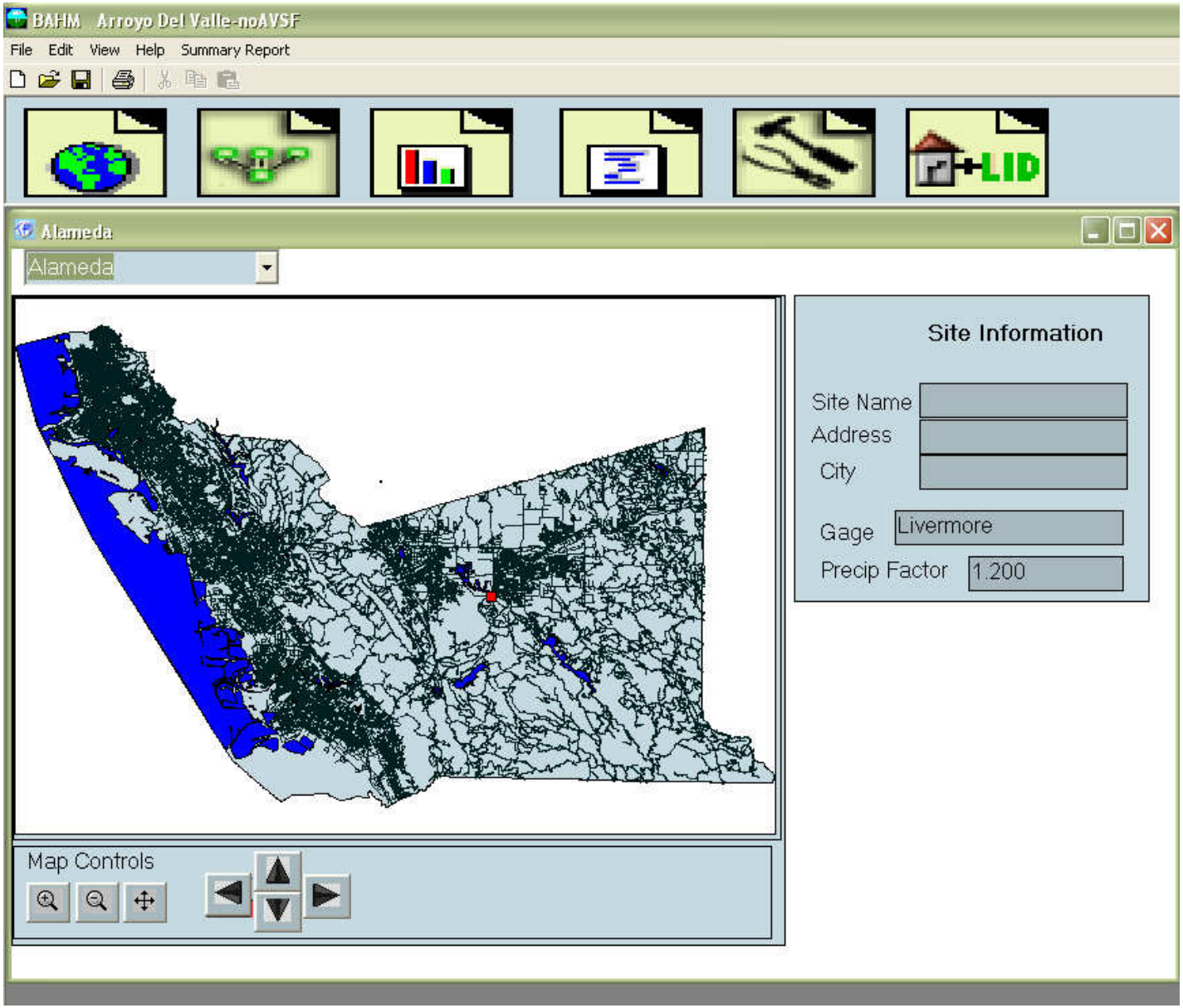
Outfall: Tributary to Arroyo Del Valle

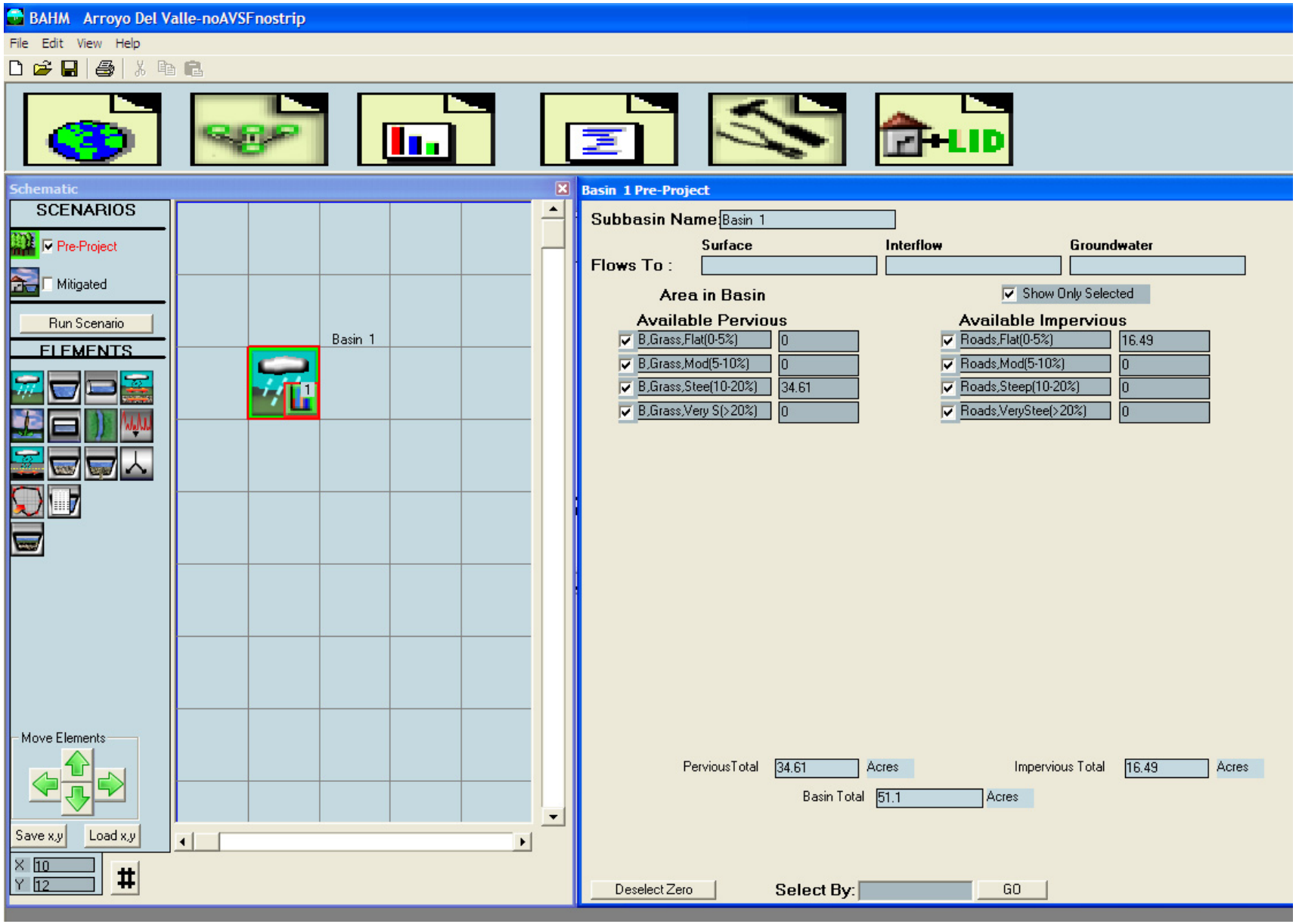


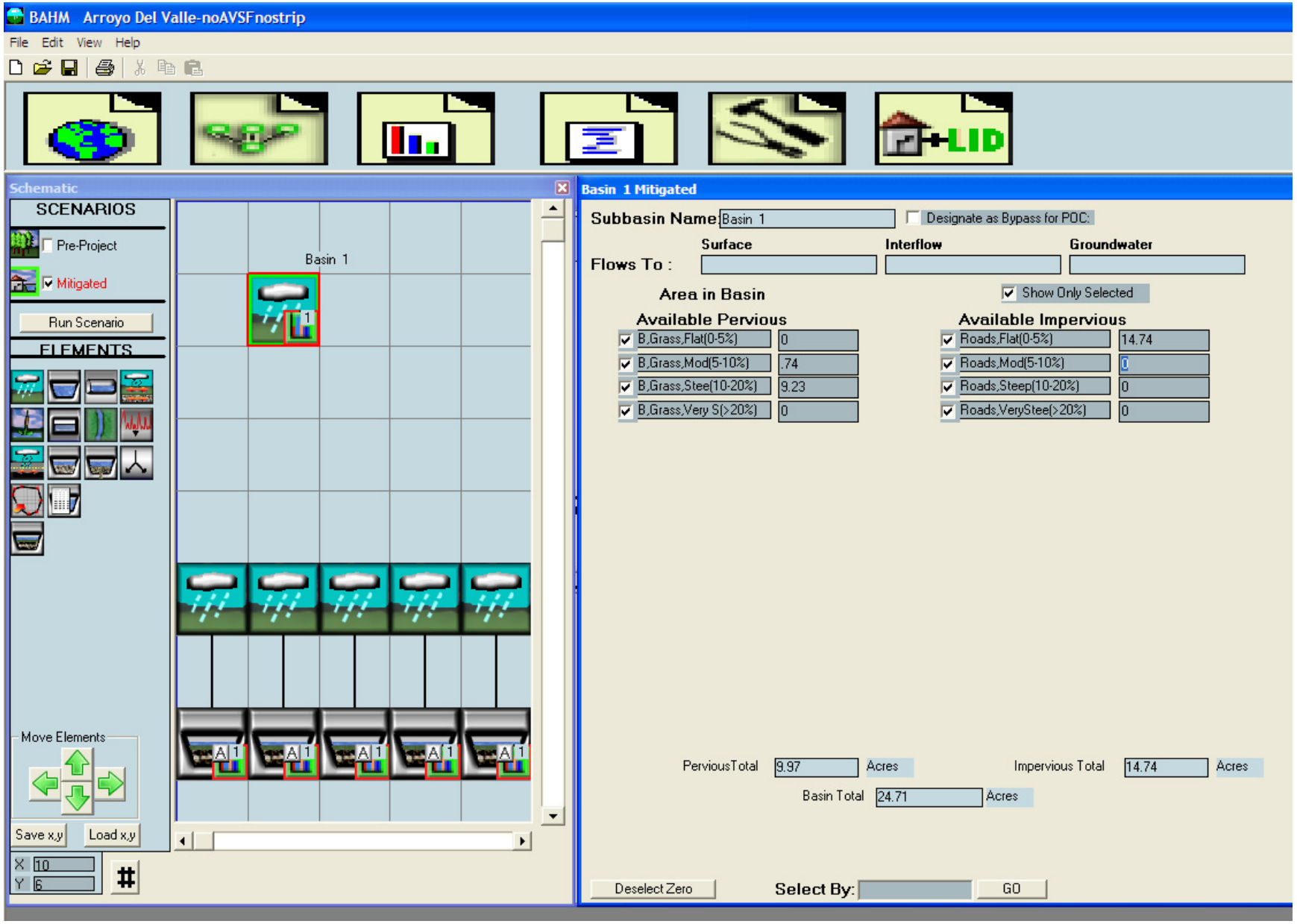
Outfall: Tributary to Arroyo Del Valle



Outfall: Arroyo Del Valle




BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Basin 1
Move Elements
Save x,y
Load x,y
X 10
Y 12
Basin 1 Pre-Project
Subbasin Name: Basin 1
Flows To :
Surface
Interflow
Groundwater
Area in Basin
Show Only Selected
Available Pervious
B,Grass,Flat(0-5%) 0
B,Grass,Mod(5-10%) 0
B,Grass,Stee(10-20%) 34.61
B,Grass,Very S(>20%) 0
Available Impervious
Roads,Flat(0-5%) 16.49
Roads,Mod(5-10%) 0
Roads,Steep(10-20%) 0
Roads,VeryStee(>20%) 0
PerviousTotal 34.61 Acres
Impervious Total 16.49 Acres
Basin Total 51.1 Acres
Deselect Zero
Select By:
GO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File Edit View Help
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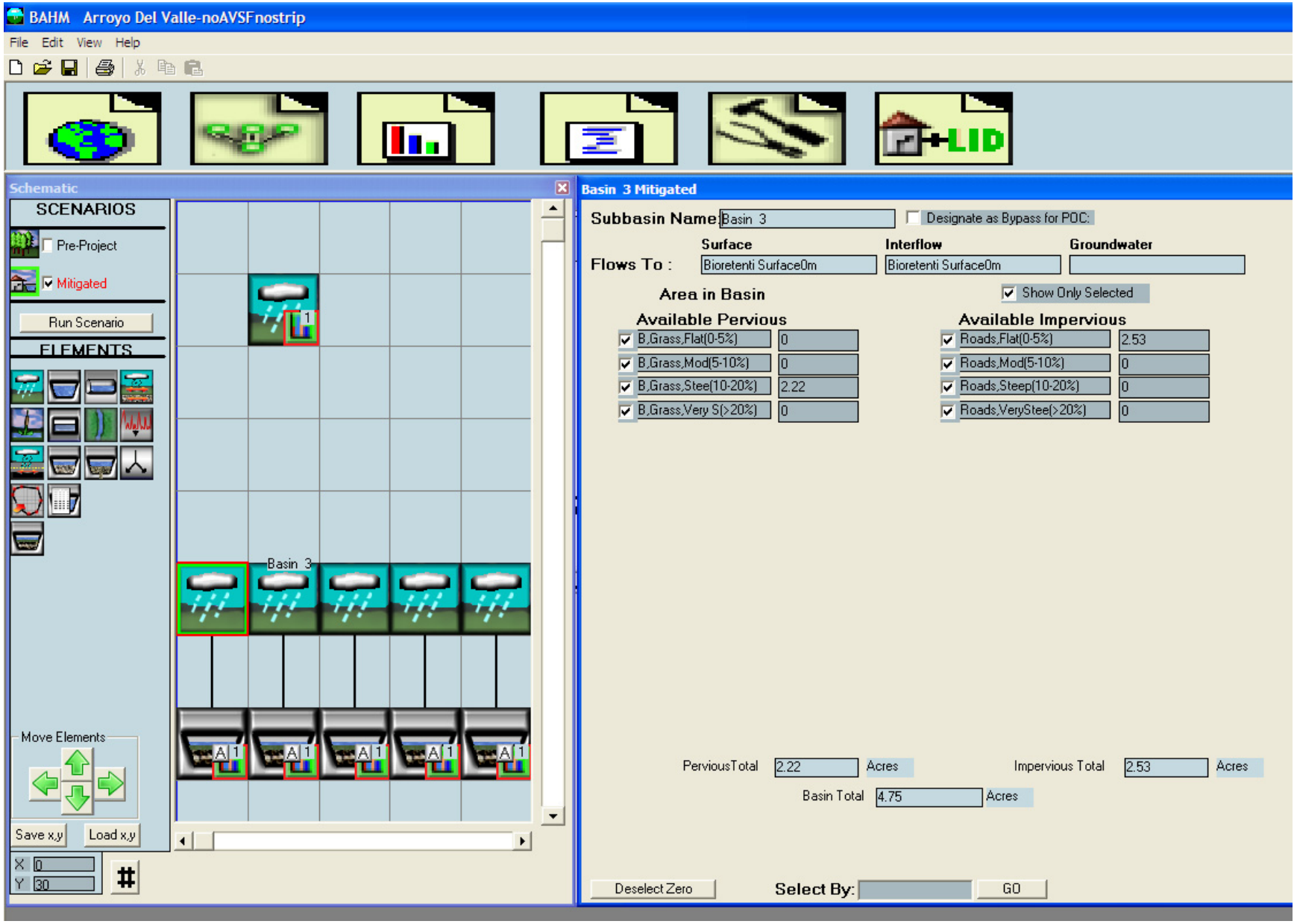
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Basin 1
Move Elements
Save x,y
Load x,y
X 10
Y 6
Basin 1 Mitigated
Subbasin Name: Basin 1
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Area in Basin
Show Only Selected
Available Pervious
B,Grass,Flat(0-5%) 0
B,Grass,Mod(5-10%) .74
B,Grass,Stee(10-20%) 9.23
B,Grass,Very S(>20%) 0
Available Impervious
Roads,Flat(0-5%) 14.74
Roads,Mod(5-10%) 0
Roads,Steep(10-20%) 0
Roads,VeryStee(>20%) 0
PerviousTotal 9.97 Acres
Impervious Total 14.74 Acres
Basin Total 24.71 Acres
Deselect Zero
Select By:
GO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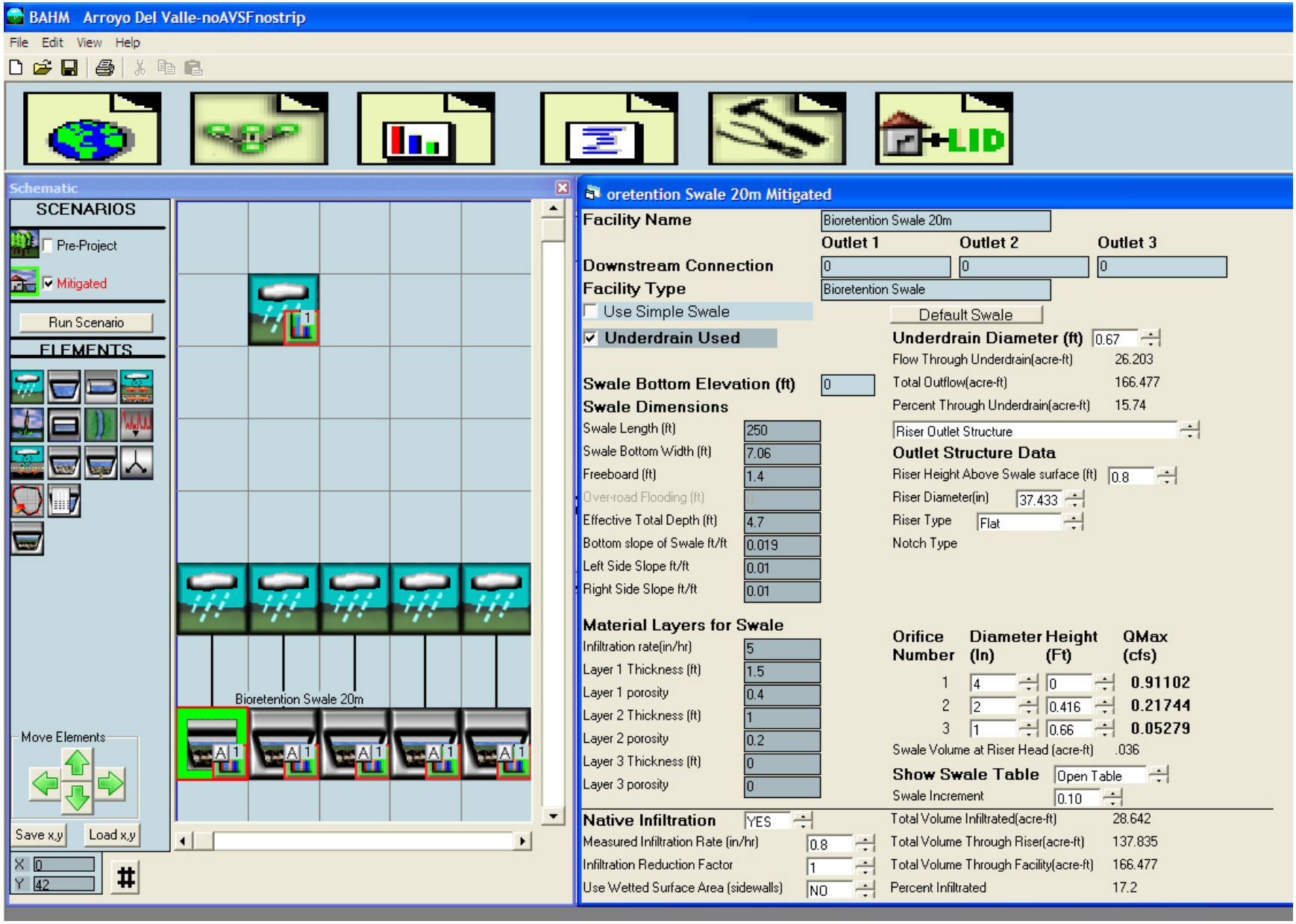
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Basin 3
Move Elements
Save x,y
Load x,y
X 0
Y 30
Basin 3 Mitigated
Subbasin Name: Basin 3
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Bioretenti Surface0m
Bioretenti Surface0m
Area in Basin
Show Only Selected
Available Pervious
B,Grass,Flat(0-5%) 0
B,Grass,Mod(5-10%) 0
B,Grass,Stee(10-20%) 2.22
B,Grass,Very S(>20%) 0
Available Impervious
Roads,Flat(0-5%) 2.53
Roads,Mod(5-10%) 0
Roads,Steep(10-20%) 0
Roads,VeryStee(>20%) 0
PerviousTotal 2.22 Acres
Impervious Total 2.53 Acres
Basin Total 4.75 Acres
Deselect Zero
Select By:
GO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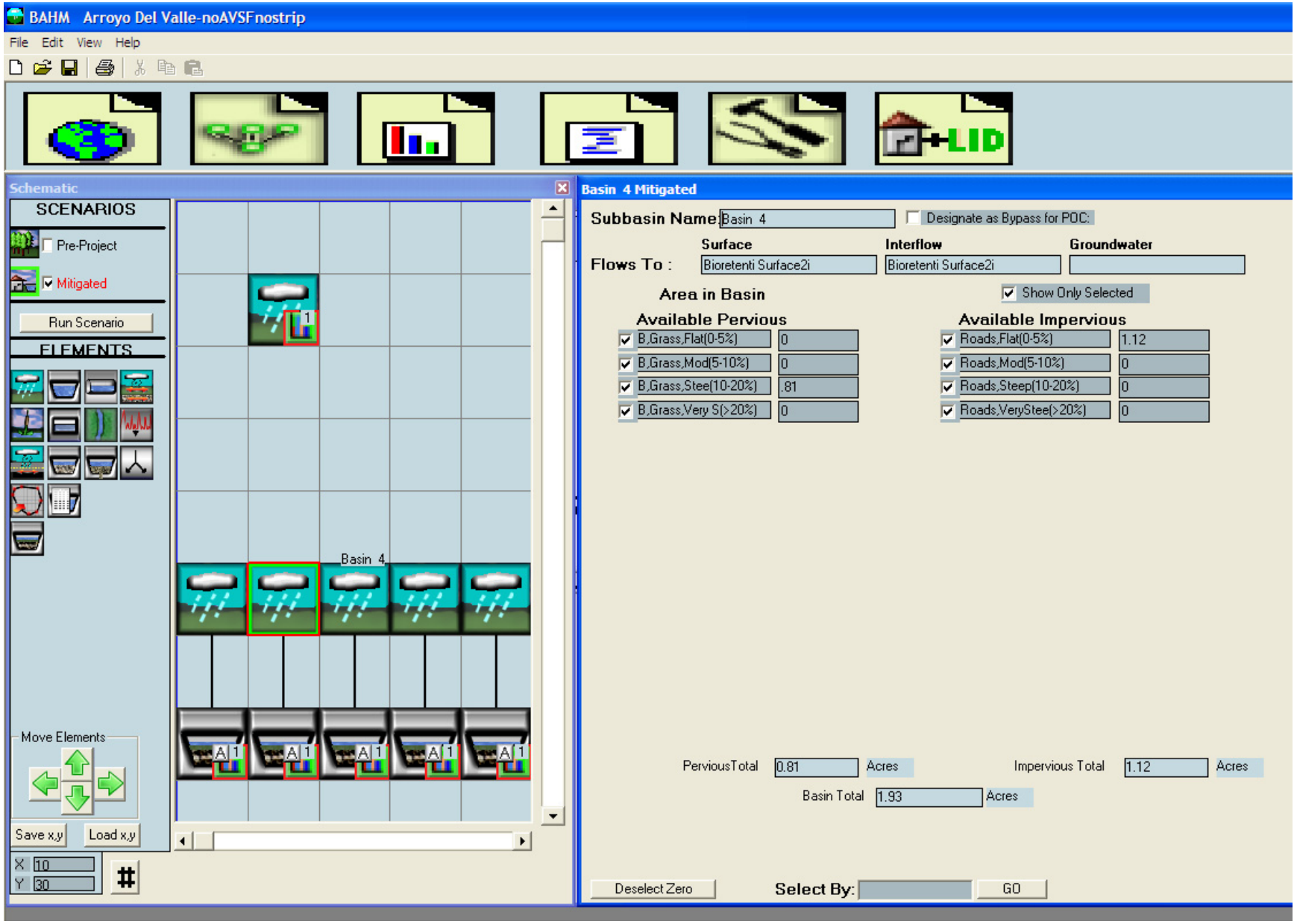
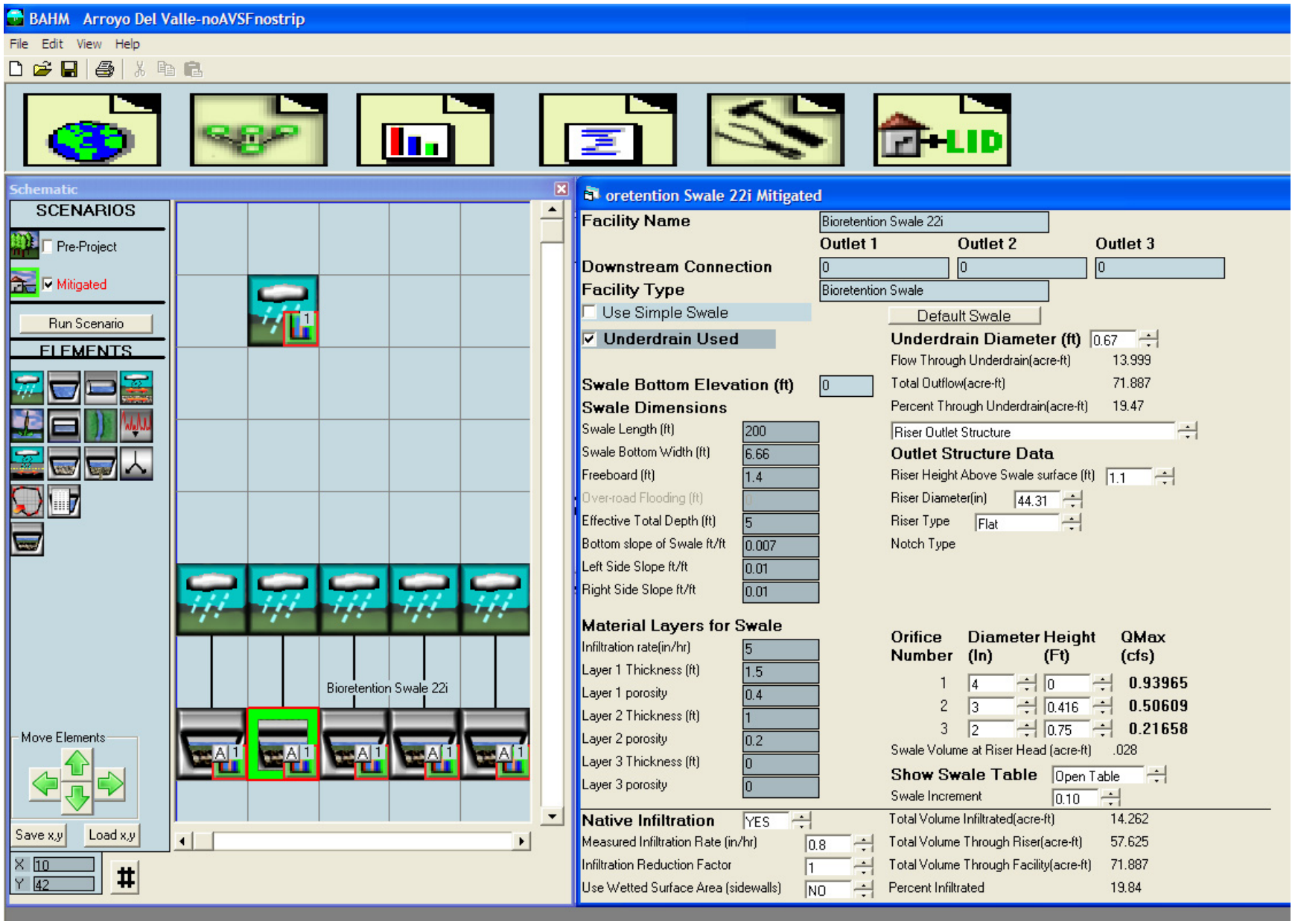
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Move Elements
Save x,y
Load x,y
X 0
Y 42
Bioretention Swale 20m
oretention Swale 20m Mitigated
Facility Name
Bioretention Swale 20m
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
0
0
0
Facility Type
Bioretention Swale
Use Simple Swale
Default Swale
Underdrain Used
Underdrain Diameter (ft) 0.67
Flow Through Underdrain(acre-ft) 26.203
Total Outflow(acre-ft) 166.477
Percent Through Underdrain(acre-ft) 15.74
Swale Bottom Elevation (ft) 0
Swale Dimensions
Swale Length (ft) 250
Swale Bottom Width (ft) 7.06
Freeboard (ft) 1.4
Over-road Flooding (ft)
Effective Total Depth (ft) 4.7
Bottom slope of Swale ft/ft 0.019
Left Side Slope ft/ft 0.01
Right Side Slope ft/ft 0.01
Riser Outlet Structure
Outlet Structure Data
Riser Height Above Swale surface (ft) 0.8
Riser Diameter(in) 37.433
Riser Type Flat
Notch Type
Material Layers for Swale
Infiltration rate(in/hr) 5
Layer 1 Thickness (ft) 1.5
Layer 1 porosity 0.4
Layer 2 Thickness (ft) 1
Layer 2 porosity 0.2
Layer 3 Thickness (ft) 0
Layer 3 porosity 0
Orifice Number
Diameter (In)
Height (Ft)
QMax (cfs)
1 4 0 0.91102
2 2 0.416 0.21744
3 1 0.66 0.05279
Swale Volume at Riser Head (acre-ft) .036
Show Swale Table Open Table
Swale Increment 0.10
Native Infiltration YES
Measured Infiltration Rate (in/hr) 0.8
Infiltration Reduction Factor 1
Use Wetted Surface Area (sidewalls) NO
Total Volume Infiltrated(acre-ft) 28.642
Total Volume Through Riser(acre-ft) 137.835
Total Volume Through Facility(acre-ft) 166.477
Percent Infiltrated 17.2


BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Move Elements
Save x,y
Load x,y
X 10
Y 30
Basin 4
Basin 4 Mitigated
Subbasin Name: Basin 4
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Bioretenti Surface2i
Bioretenti Surface2i
Area in Basin
Show Only Selected
Available Pervious
B,Grass,Flat(0-5%) 0
B,Grass,Mod(5-10%) 0
B,Grass,Stee(10-20%) .81
B,Grass,Very S(>20%) 0
Available Impervious
Roads,Flat(0-5%) 1.12
Roads,Mod(5-10%) 0
Roads,Steep(10-20%) 0
Roads,VeryStee(>20%) 0
PerviousTotal 0.81 Acres
Impervious Total 1.12 Acres
Basin Total 1.93 Acres
Deselect Zero
Select By:
GO


BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Help
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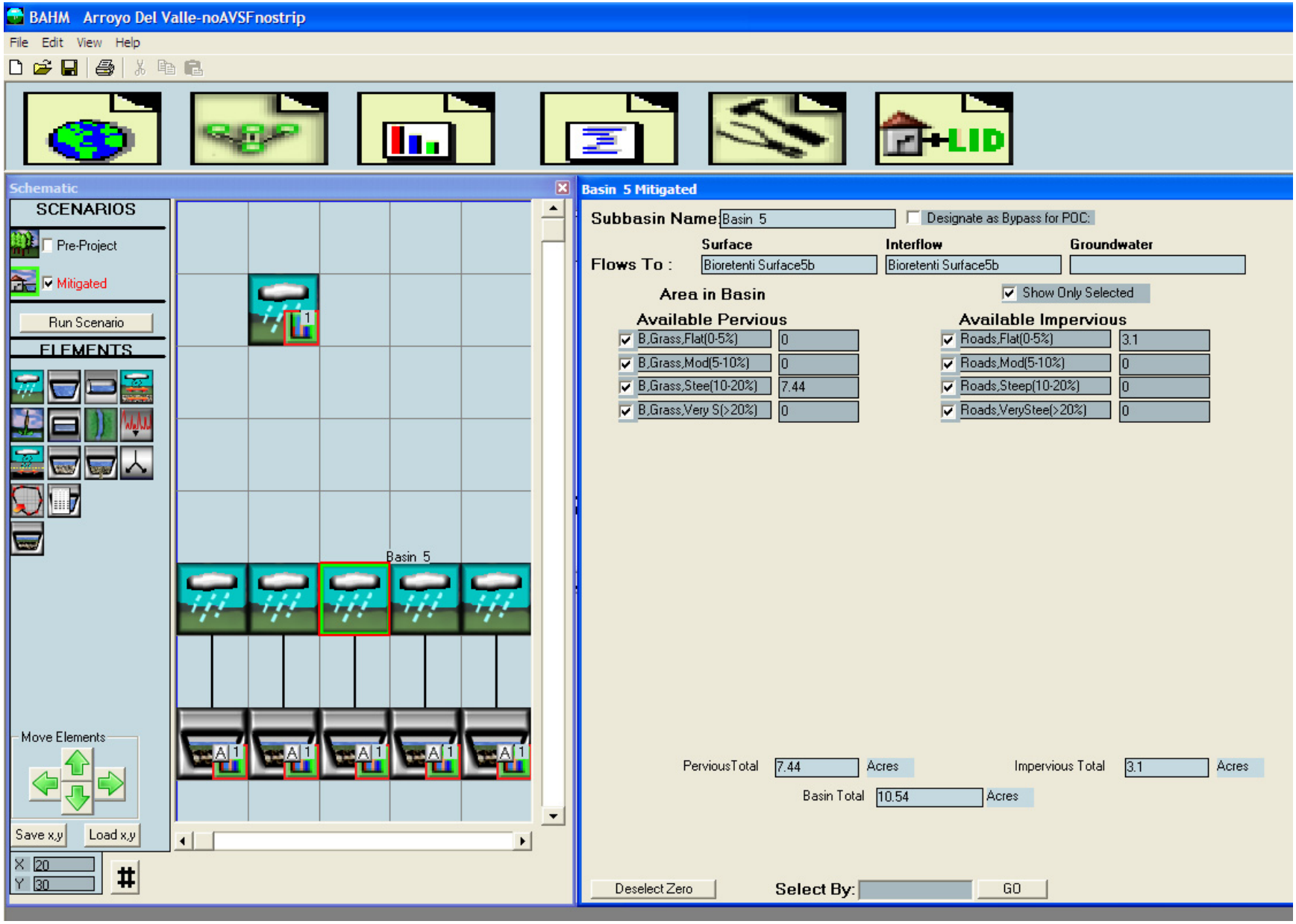
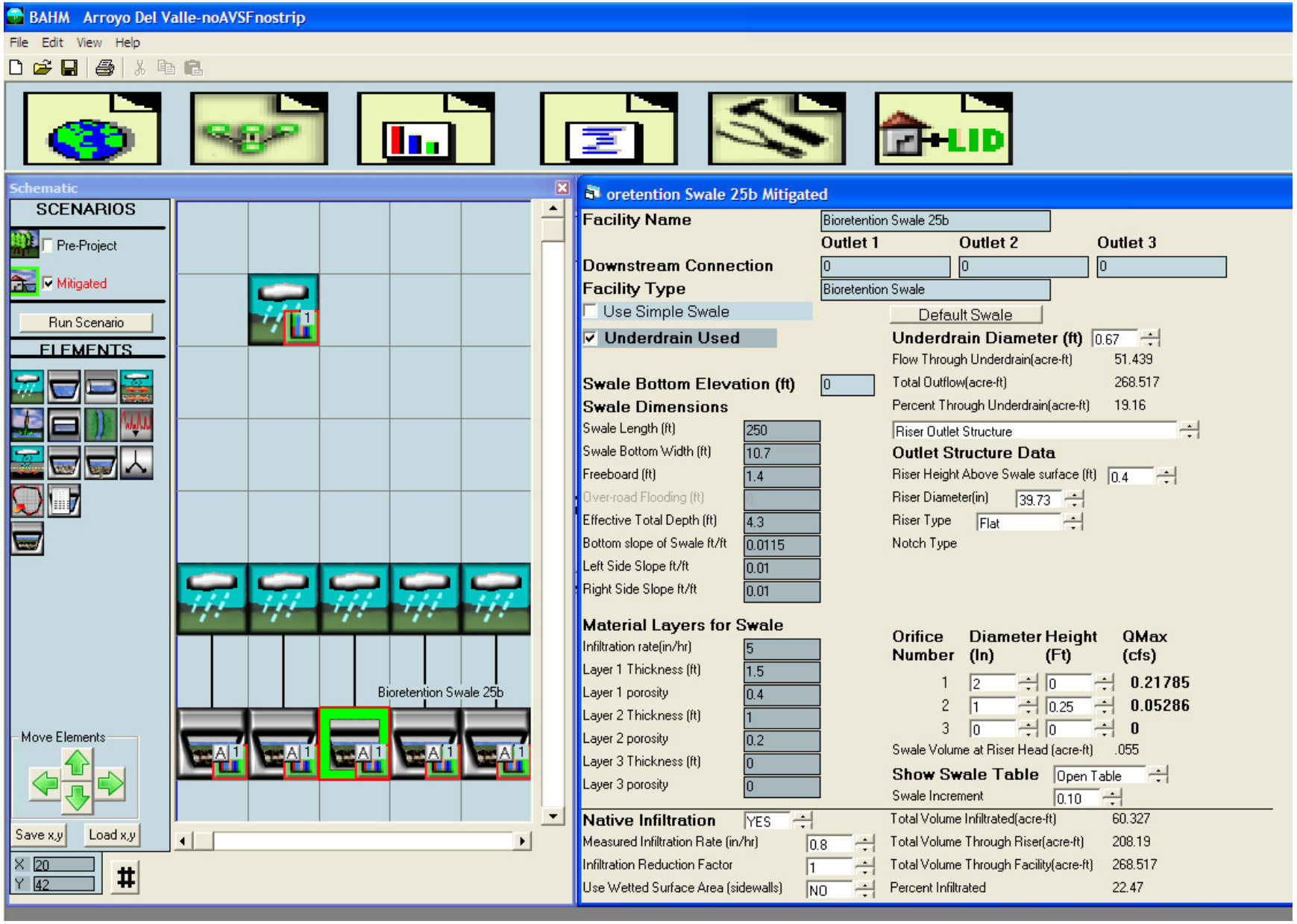
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Move Elements
Save x,y
Load x,y
X 10
Y 42
Bioretention Swale 22i
oretention Swale 22i Mitigated
Facility Name
Bioretention Swale 22i
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
0
0
0
Facility Type
Bioretention Swale
Use Simple Swale
Default Swale
Underdrain Used
Underdrain Diameter (ft) 0.67
Flow Through Underdrain(acre-ft) 13.999
Total Outflow(acre-ft) 71.887
Percent Through Underdrain(acre-ft) 19.47
Swale Bottom Elevation (ft) 0
Swale Dimensions
Swale Length (ft) 200
Swale Bottom Width (ft) 6.66
Freeboard (ft) 1.4
Over-road Flooding (ft)
Effective Total Depth (ft) 5
Bottom slope of Swale ft/ft 0.007
Left Side Slope ft/ft 0.01
Right Side Slope ft/ft 0.01
Riser Outlet Structure
Outlet Structure Data
Riser Height Above Swale surface (ft) 1.1
Riser Diameter(in) 44.31
Riser Type Flat
Notch Type
Material Layers for Swale
Infiltration rate(in/hr) 5
Layer 1 Thickness (ft) 1.5
Layer 1 porosity 0.4
Layer 2 Thickness (ft) 1
Layer 2 porosity 0.2
Layer 3 Thickness (ft) 0
Layer 3 porosity 0
Orifice Number
Diameter (In)
Height (Ft)
QMax (cfs)
1 4 0 0.93965
2 3 0.416 0.50609
3 2 0.75 0.21658
Swale Volume at Riser Head (acre-ft) .028
Show Swale Table Open Table
Swale Increment 0.10
Native Infiltration YES
Measured Infiltration Rate (in/hr) 0.8
Infiltration Reduction Factor 1
Use Wetted Surface Area (sidewalls) NO
Total Volume Infiltrated(acre-ft) 14.262
Total Volume Through Riser(acre-ft) 57.625
Total Volume Through Facility(acre-ft) 71.887
Percent Infiltrated 19.84


BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Basin 5
Move Elements
Save x,y
Load x,y
X 20
Y 30
Basin 5 Mitigated
Subbasin Name: Basin 5
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Bioretenti Surface5b
Bioretenti Surface5b
Area in Basin
Show Only Selected
Available Pervious
B,Grass,Flat(0-5%) 0
B,Grass,Mod(5-10%) 0
B,Grass,Stee(10-20%) 7.44
B,Grass,Very S(>20%) 0
Available Impervious
Roads,Flat(0-5%) 3.1
Roads,Mod(5-10%) 0
Roads,Steep(10-20%) 0
Roads,VeryStee(>20%) 0
PerviousTotal 7.44 Acres
Impervious Total 3.1 Acres
Basin Total 10.54 Acres
Deselect Zero
Select By:
GO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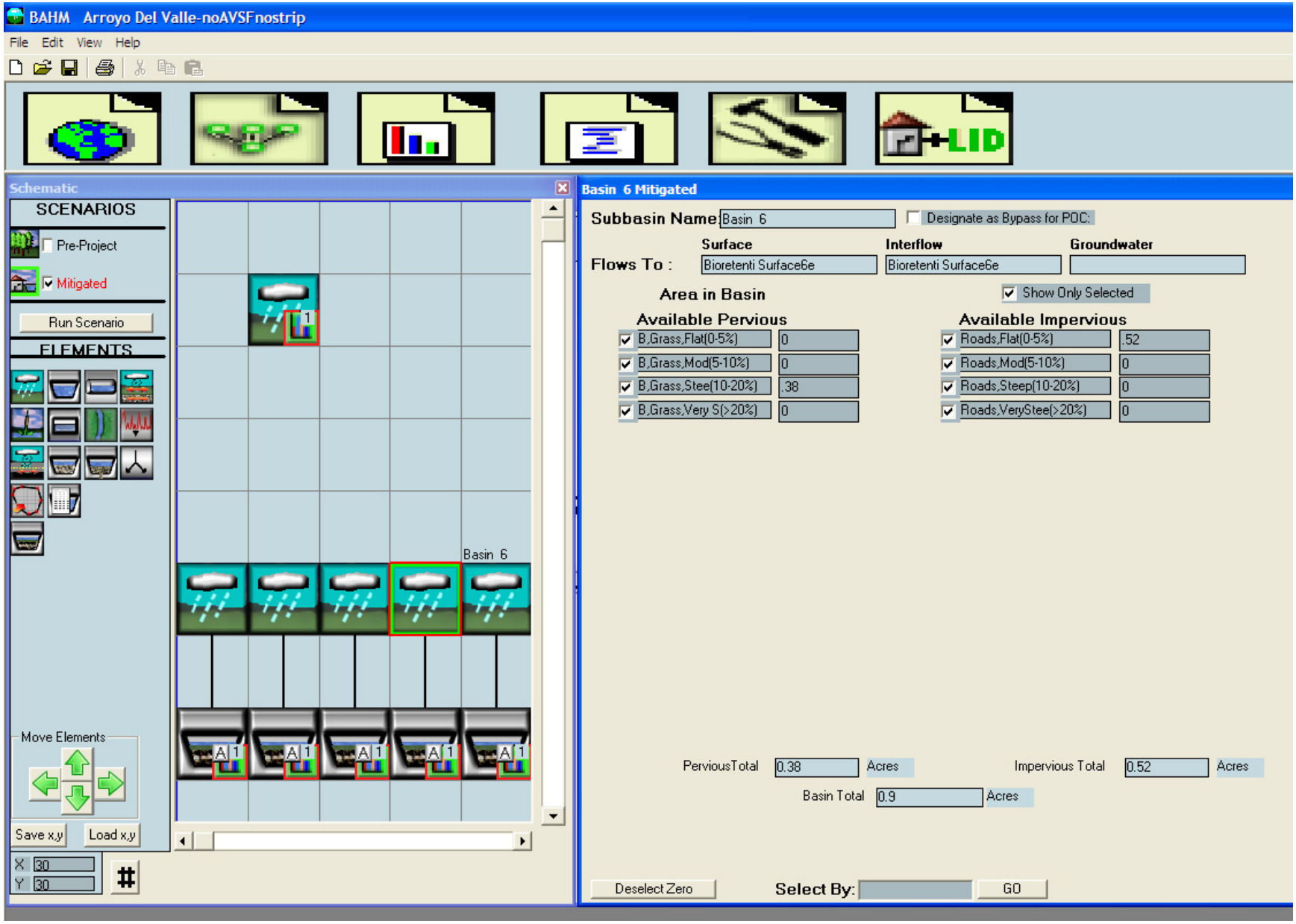
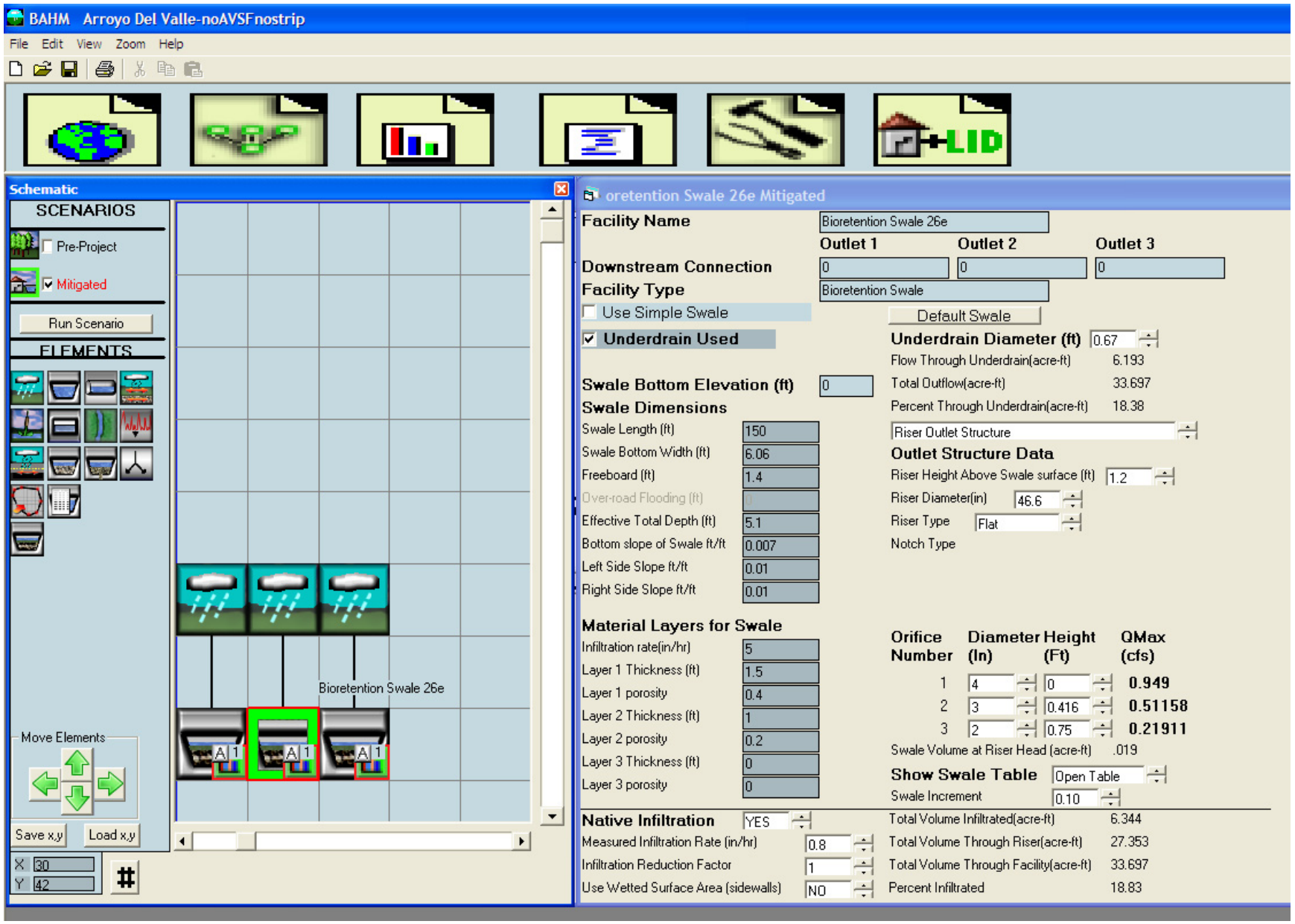
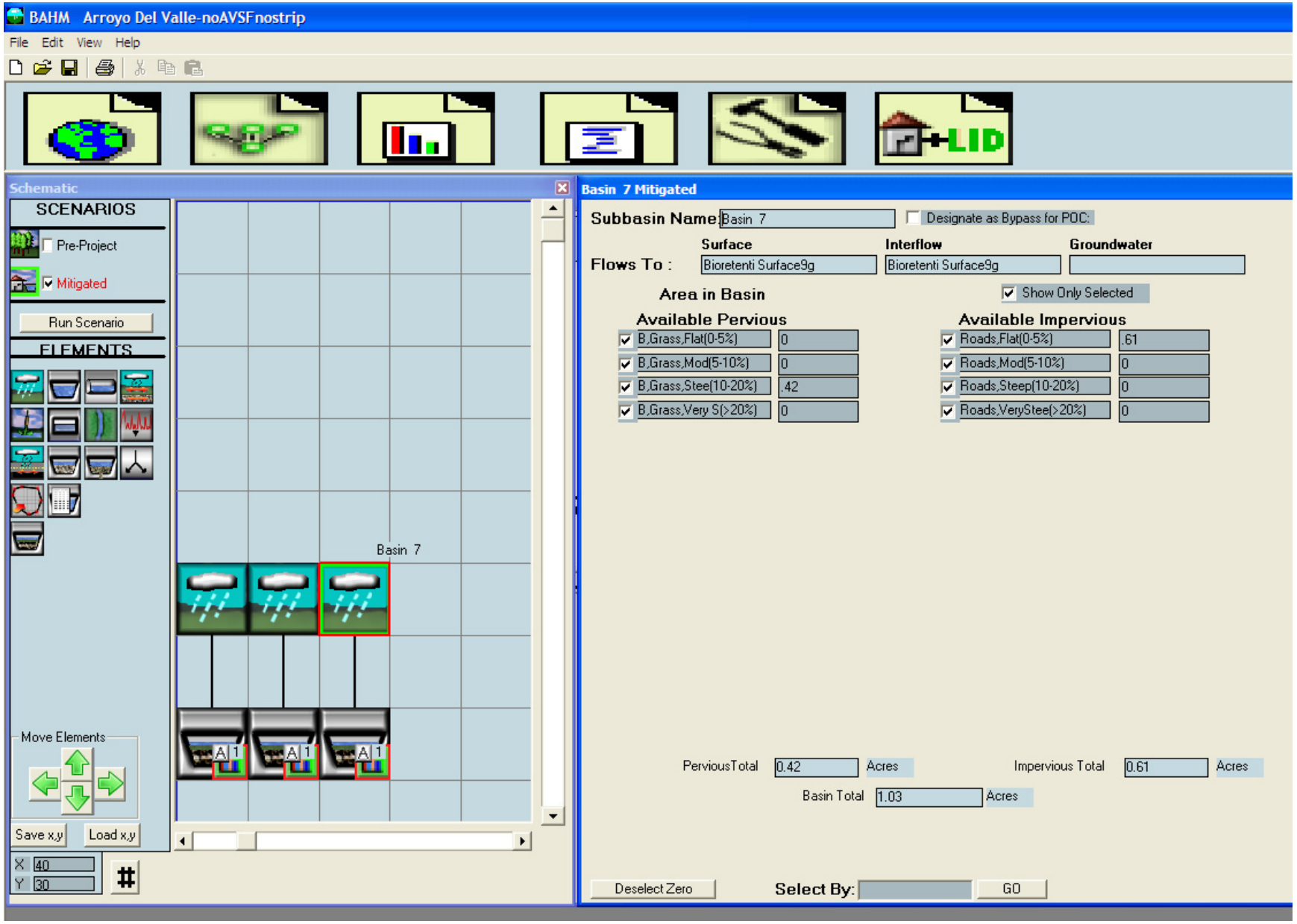
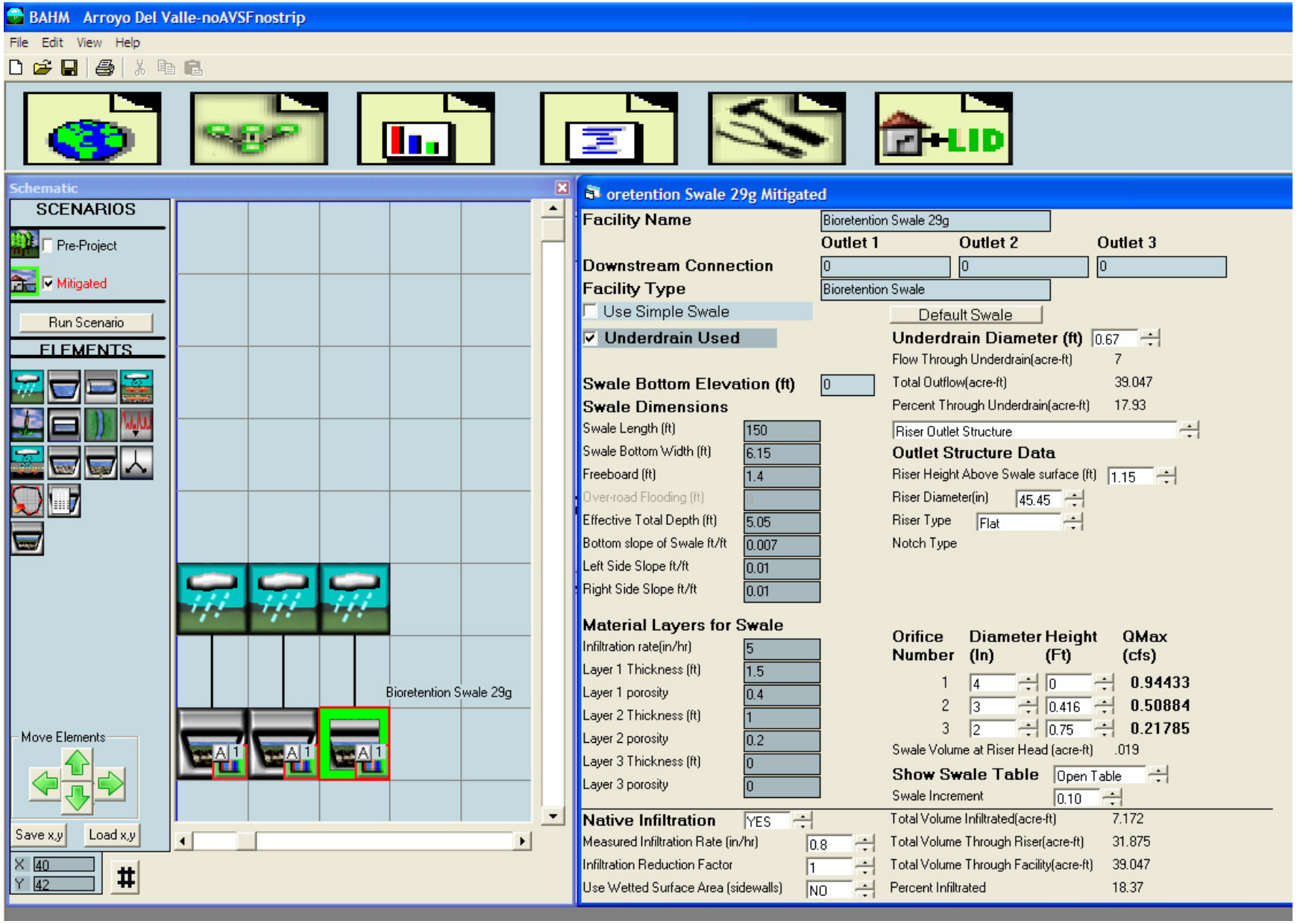
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Move Elements
Save x,y
Load x,y
X 20
Y 42
Bioretention Swale 25b
oretention Swale 25b Mitigated
Facility Name
Bioretention Swale 25b
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
0
0
0
Facility Type
Bioretention Swale
Use Simple Swale
Default Swale
Underdrain Used
Underdrain Diameter (ft) 0.67
Flow Through Underdrain(acre-ft) 51.439
Total Outflow(acre-ft) 268.517
Percent Through Underdrain(acre-ft) 19.16
Swale Bottom Elevation (ft) 0
Swale Dimensions
Swale Length (ft) 250
Swale Bottom Width (ft) 10.7
Freeboard (ft) 1.4
Over-road Flooding (ft)
Effective Total Depth (ft) 4.3
Bottom slope of Swale ft/ft 0.0115
Left Side Slope ft/ft 0.01
Right Side Slope ft/ft 0.01
Riser Outlet Structure
Outlet Structure Data
Riser Height Above Swale surface (ft) 0.4
Riser Diameter(in) 39.73
Riser Type Flat
Notch Type
Material Layers for Swale
Infiltration rate(in/hr) 5
Layer 1 Thickness (ft) 1.5
Layer 1 porosity 0.4
Layer 2 Thickness (ft) 1
Layer 2 porosity 0.2
Layer 3 Thickness (ft) 0
Layer 3 porosity 0
Orifice Number
Diameter (In)
Height (Ft)
QMax (cfs)
1 2 0 0.21785
2 1 0.25 0.05286
3 0 0 0
Swale Volume at Riser Head (acre-ft) .055
Show Swale Table Open Table
Swale Increment 0.10
Native Infiltration YES
Measured Infiltration Rate (in/hr) 0.8
Infiltration Reduction Factor 1
Use Wetted Surface Area (sidewalls) NO
Total Volume Infiltrated(acre-ft) 60.327
Total Volume Through Riser(acre-ft) 208.19
Total Volume Through Facility(acre-ft) 268.517
Percent Infiltrated 22.47


BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Basin 6
Move Elements
Save x,y
Load x,y
X 30
Y 30
Basin 6 Mitigated
Subbasin Name: Basin 6
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Bioretenti Surface6e
Bioretenti Surface6e
Area in Basin
Show Only Selected
Available Pervious
B,Grass,Flat(0-5%) 0
B,Grass,Mod(5-10%) 0
B,Grass,Stee(10-20%) .38
B,Grass,Very S(>20%) 0
Available Impervious
Roads,Flat(0-5%) .52
Roads,Mod(5-10%) 0
Roads,Steep(10-20%) 0
Roads,VeryStee(>20%) 0
PerviousTotal 0.38 Acres
Impervious Total 0.52 Acres
Basin Total 0.9 Acres
Deselect Zero
Select By:
GO


BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Zoom Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Move Elements
Save x,y
Load x,y
X 30
Y 42
Bioretention Swale 26e
oretention Swale 26e Mitigated
Facility Name
Bioretention Swale 26e
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
0
0
0
Facility Type
Bioretention Swale
Use Simple Swale
Default Swale
Underdrain Used
Underdrain Diameter (ft) 0.67
Flow Through Underdrain(acre-ft) 6.193
Total Outflow(acre-ft) 33.697
Percent Through Underdrain(acre-ft) 18.38
Swale Bottom Elevation (ft) 0
Swale Dimensions
Swale Length (ft) 150
Swale Bottom Width (ft) 6.06
Freeboard (ft) 1.4
Over-road Flooding (ft)
Effective Total Depth (ft) 5.1
Bottom slope of Swale ft/ft 0.007
Left Side Slope ft/ft 0.01
Right Side Slope ft/ft 0.01
Riser Outlet Structure
Outlet Structure Data
Riser Height Above Swale surface (ft) 1.2
Riser Diameter(in) 46.6
Riser Type Flat
Notch Type
Material Layers for Swale
Infiltration rate(in/hr) 5
Layer 1 Thickness (ft) 1.5
Layer 1 porosity 0.4
Layer 2 Thickness (ft) 1
Layer 2 porosity 0.2
Layer 3 Thickness (ft) 0
Layer 3 porosity 0
Orifice Number
Diameter (In)
Height (Ft)
QMax (cfs)
1 4 0 0.949
2 3 0.416 0.51158
3 2 0.75 0.21911
Swale Volume at Riser Head (acre-ft) .019
Show Swale Table Open Table
Swale Increment 0.10
Native Infiltration YES
Measured Infiltration Rate (in/hr) 0.8
Infiltration Reduction Factor 1
Use Wetted Surface Area (sidewalls) NO
Total Volume Infiltrated(acre-ft) 6.344
Total Volume Through Riser(acre-ft) 27.353
Total Volume Through Facility(acre-ft) 33.697
Percent Infiltrated 18.83

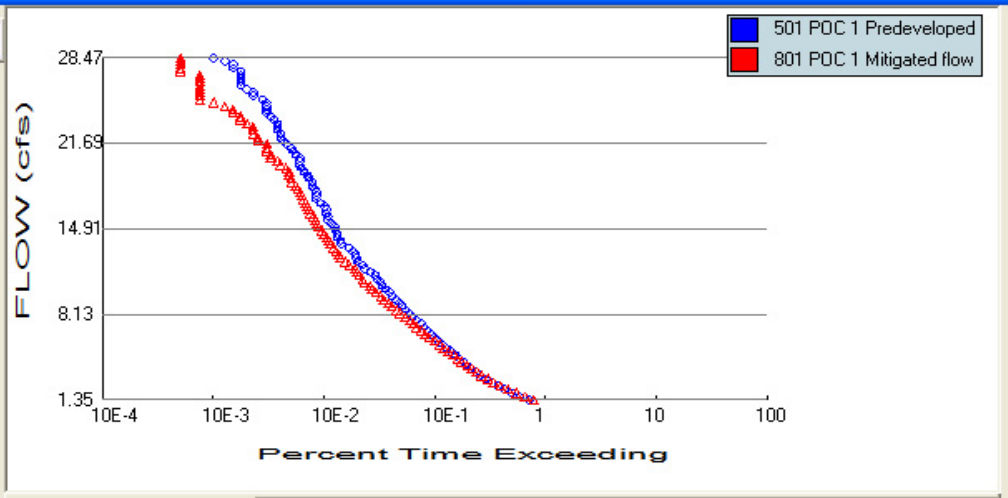

BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Basin 7
Move Elements
Save x,y
Load x,y
X 40
Y 30
Basin 7 Mitigated
Subbasin Name: Basin 7
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Bioretenti Surface9g
Bioretenti Surface9g
Area in Basin
Show Only Selected
Available Pervious
B,Grass,Flat(0-5%) 0
B,Grass,Mod(5-10%) 0
B,Grass,Stee(10-20%) .42
B,Grass,Very S(>20%) 0
Available Impervious
Roads,Flat(0-5%) .61
Roads,Mod(5-10%) 0
Roads,Steep(10-20%) 0
Roads,VeryStee(>20%) 0
PerviousTotal 0.42 Acres
Impervious Total 0.61 Acres
Basin Total 1.03 Acres
Deselect Zero
Select By:
GO


BAHM Arroyo Del Valle-noAVSFnostrip
File Edit View Help
LID
Schematic
SCENARIOS
Pre-Project
Mitigated
Run Scenario
ELEMENTS
Move Elements
Save x,y
Load x,y
X 40
Y 42
Bioretention Swale 29g
oretention Swale 29g Mitigated
Facility Name
Bioretention Swale 29g
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
0
0
0
Facility Type
Bioretention Swale
Use Simple Swale
Default Swale
Underdrain Used
Underdrain Diameter (ft) 0.67
Flow Through Underdrain(acre-ft) 7
Swale Bottom Elevation (ft) 0
Total Outflow(acre-ft) 39.047
Swale Dimensions
Percent Through Underdrain(acre-ft) 17.93
Swale Length (ft) 150
Riser Outlet Structure
Swale Bottom Width (ft) 6.15
Outlet Structure Data
Freeboard (ft) 1.4
Riser Height Above Swale surface (ft) 1.15
Over-road Flooding (ft)
Riser Diameter(in) 45.45
Effective Total Depth (ft) 5.05
Riser Type Flat
Bottom slope of Swale ft/ft 0.007
Notch Type
Left Side Slope ft/ft 0.01
Right Side Slope ft/ft 0.01
Material Layers for Swale
Orifice Number
Diameter (In)
Height (Ft)
QMax (cfs)
Infiltration rate(in/hr) 5
1 4 0 0.94433
Layer 1 Thickness (ft) 1.5
2 3 0.416 0.50884
Layer 1 porosity 0.4
3 2 0.75 0.21785
Layer 2 Thickness (ft) 1
Swale Volume at Riser Head (acre-ft) .019
Layer 2 porosity 0.2
Show Swale Table Open Table
Layer 3 Thickness (ft) 0
Swale Increment 0.10
Layer 3 porosity 0
Native Infiltration YES
Total Volume Infiltrated(acre-ft) 7.172
Measured Infiltration Rate (in/hr) 0.8
Total Volume Through Riser(acre-ft) 31.875
Infiltration Reduction Factor 1
Total Volume Through Facility(acre-ft) 39.047
Use Wetted Surface Area (sidewalls) NO
Percent Infiltrated 18.37

BAHM Arroyo Del Valle-noAVSFnostrip

File Edit View Help

Analysis



Durations | Flow Frequency | Drawdown | Hydrograph

Analyze datasets

501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow

All Datasets | Flow | Stage | Precip | Evap | POC 1

The Facility PASSED

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
1.3484	2787	3092	110	Pass
1.6223	2322	2571	110	Pass
1.8963	1945	2145	110	Pass
2.1703	1692	1810	106	Pass
2.4442	1483	1554	104	Pass
2.7182	1317	1343	101	Pass
2.9921	1143	1195	104	Pass
3.2661	1022	1053	103	Pass
3.5400	922	944	102	Pass
3.8140	847	853	100	Pass
4.0879	773	779	100	Pass
4.3619	719	693	96	Pass
4.6358	657	635	96	Pass
4.9098	601	585	97	Pass
5.1837	557	519	93	Pass
5.4577	508	476	93	Pass
5.7317	468	439	93	Pass
6.0056	423	394	93	Pass
6.2796	389	353	90	Pass
6.5535	367	320	87	Pass
6.8275	342	298	87	Pass
7.1014	318	270	84	Pass
7.3754	300	252	84	Pass
7.6493	270	235	87	Pass
7.9233	245	211	86	Pass
8.1972	231	194	83	Pass
8.4712	216	178	82	Pass
8.7451	200	161	80	Pass
9.0191	191	150	78	Pass
9.2931	178	137	76	Pass
9.5670	162	129	79	Pass

Appendix D Hydromodification Costs and Quantities

SR 84- Quantities and Costs: Hydromodification

ITEM	UNIT	UNIT PRICE	Tributary to Arroyo Del Valle		Arroyo Del Valle		Arroyo Mocho		48" HDPE to Arroyo Las Positas		Total	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
ditch excavation	yd3	$ 45.00	144.45	$ 6,500.07	740.13	$ 33,305.63		$ -		$ -	884.57	$ 39,805.70
Imported Soil Media	yd3	$ 65.00	93.12	$ 6,053.10	477.16	$ 31,015.42		$ -		$ -	570.28	$ 37,068.52
Class 3 Permeable Material	yd3	$ 70.00	51.32	$ 3,592.49	262.96	$ 18,407.54		$ -		$ -	314.29	$ 22,000.03
8 inch PPP	ft	$ 55.00	205.59	$ 11,307.45	1,053.42	$ 57,938.10		$ -		$ -	1,259.01	$ 69,245.55
8 inch PP	ft	$ 75.00	375.2	$ 28,140.00	1,406.50	$ 105,487.50		$ -		$ -	1,781.70	$ 133,627.50
Filter Fabric	yd2	$ 7.00	442.02	$ 3,094.13	2,264.85	$ 15,853.97		$ -		$ -	2,706.87	$ 18,948.10
RSP (Backing No.3)	cy	$ 200.00		$ -	17.00	$ 3,400.00		$ -		$ -	17.00	$ 3,400.00
RSP Fabric	sy	$ 10.00		$ -	90.00	$ 900.00		$ -		$ -	90.00	$ 900.00
1" PP	lf	$ 35.00		$ -	10.00	$ 350.00		$ -		$ -	10.00	$ 350.00
2" PP	lf	$ 35.00		$ -	35.00	$ 1,225.00		$ -		$ -	35.00	$ 1,225.00
3" PP	lf	$ 35.00		$ -	25.00	$ 875.00		$ -		$ -	25.00	$ 875.00
4" PP	lf	$ 35.00		$ -	56.00	$ 1,960.00		$ -		$ -	56.00	$ 1,960.00
											Contingency (15%)	$ 49,410.81
Totals				**$ 58,687.25**		**$ 270,718.16**		**$ -**		**$ -**		**$ 379,000.00**

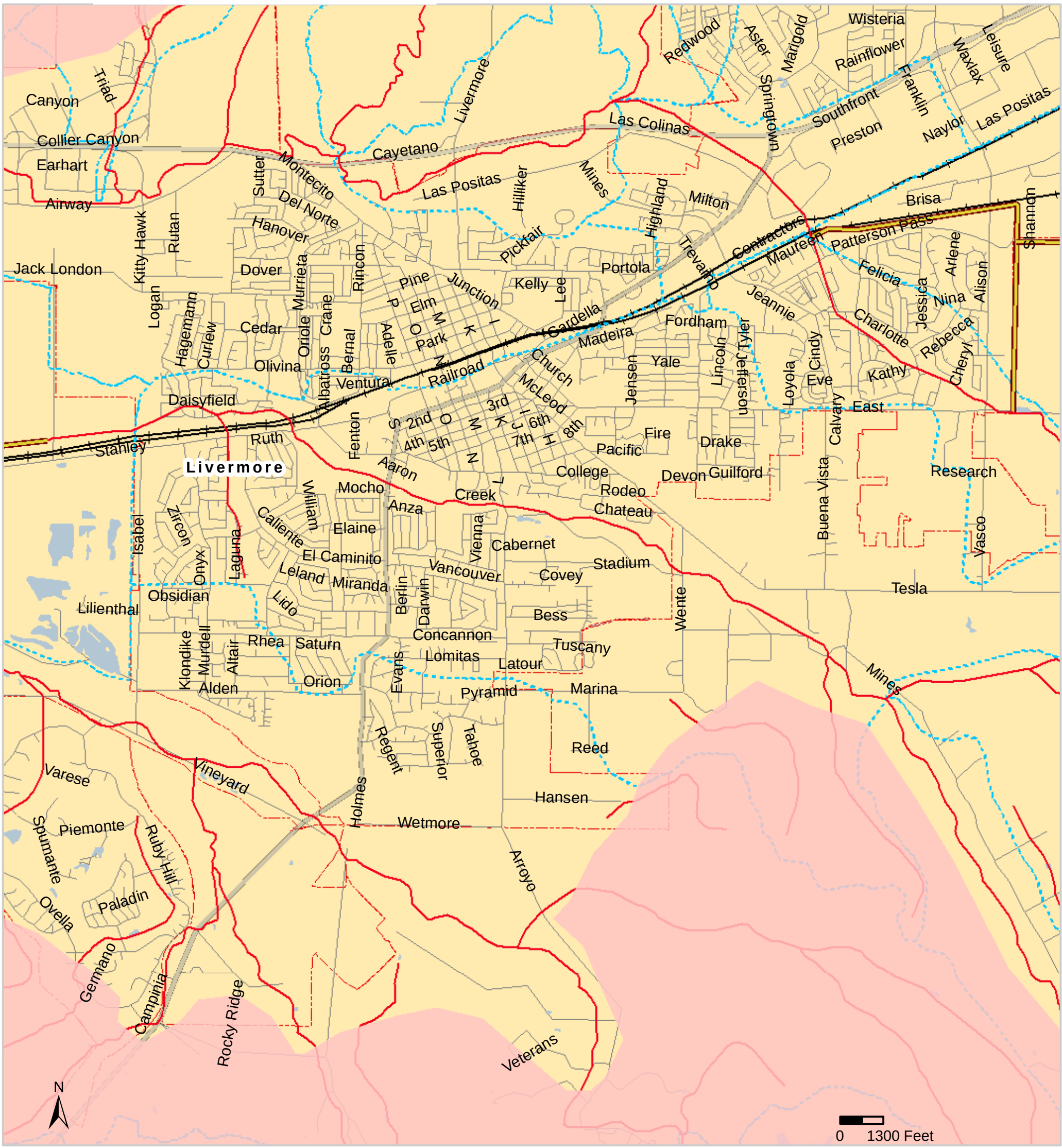
Appendix E Hydromodification Susceptibility References

Alameda Countywide Clean Water Program

A Consortium of Local Agencies

HYDROMODIFICATION SUSCEPTIBILITY MAP

Version: 1.0 Print date: _____



This map is intended for for preliminary determination of hydromodification requirements and is not intended for legal description. All drainage conditions should be verified in the field or from appropriate authorities.

LEGEND

- Hill or high slope region (susceptible)
- Tidally Influenced / depositional - exempt
- Not included in HMP
- Watersheds

Special Consideration Area

- San Lorenzo & Alameda Creeks
- Codornices Creek

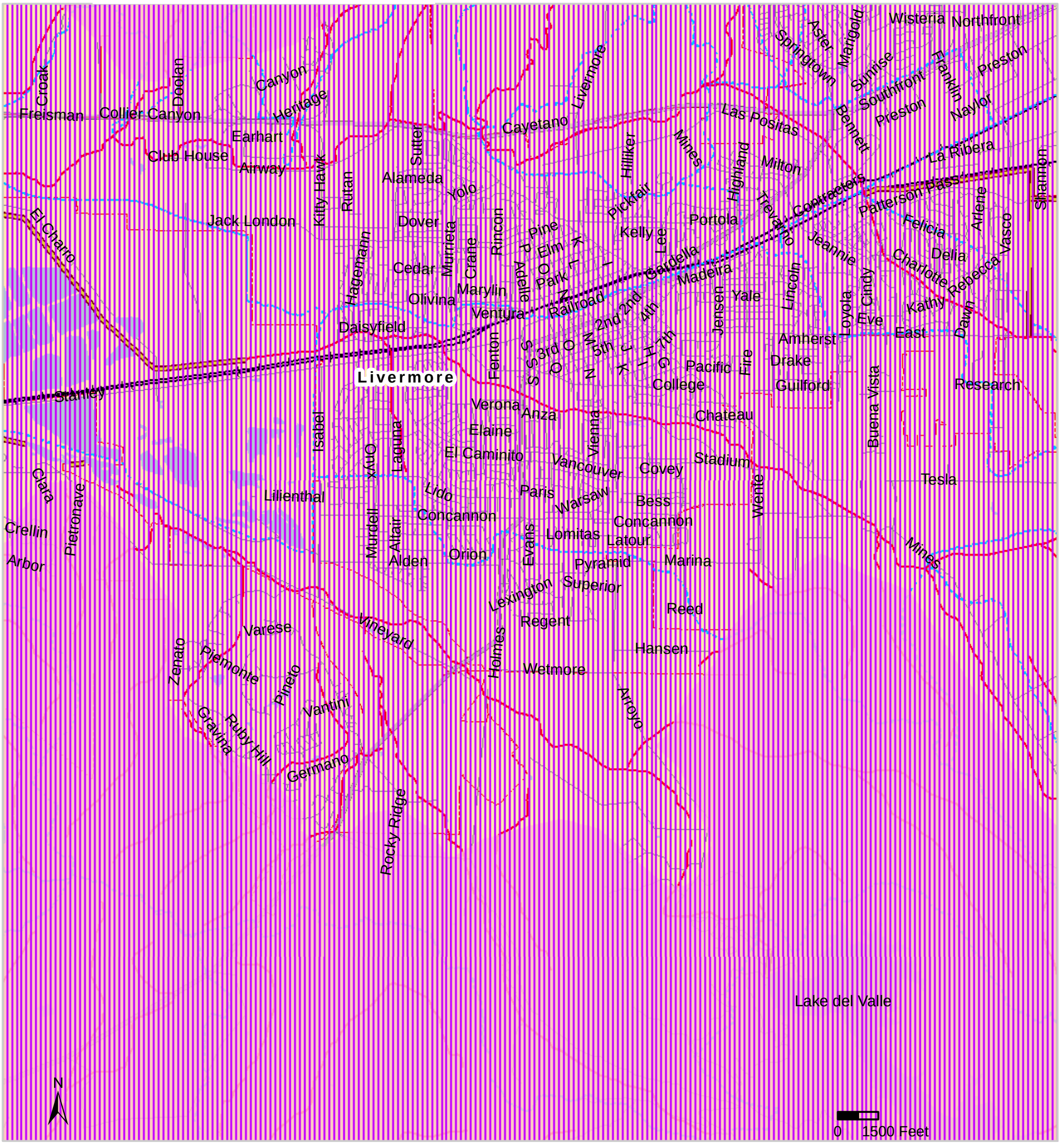
- Natural creek or stream (susceptible)
- Earthen channel or connector
- Engineered channel - materials unknown
- Engineered channel - concrete
- Enclosed pipe or culvert
- Parcels - Unincorporated

Alameda Countywide Clean Water Program

A Consortium of Local Agencies

HYDROMODIFICATION SUSCEPTIBILITY MAP

Version: 1.0 Print date: _____



This map is intended for for preliminary determination of hydromodification requirements and is not intended for legal description. All drainage conditions should be verified in the field or from appropriate authorities.

LEGEND

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- Earthen channel or connector
- Engineered channel - materials unknown
- Engineered channel - concrete
- Enclosed pipe or culvert
- Parcels - Unincorporated

Attachment A:

Hydrograph Modification Management Standard – HM Control Areas

The areas of HM applicability in Alameda County are shown on the map[14] below. To assist location and evaluation of project applicability, the susceptibility map depicts a number of features including:

- hardened channels and culverts at least 24 inches in diameter (green solid or dashed lines);
- natural channels (red lines);
- boundaries of major watersheds (light blue lines); and
- surface streets and highways (gray or black ~~pink~~ lines).

These data are of varying age, precision and accuracy and are not intended for legal description or engineering design. Watersheds extending beyond the County boundaries are shown for illustration purposes only. Project proponents are responsible for verifying and describing actual conditions of site location and drainage.

The map is color-coded as follows:

Solid pink areas: Solid pink designates hilly areas, where high slopes (greater than 25%) occur. The HM Standard and all associated requirements apply in areas shown in solid pink on the map. In this area, the HM Standard does *not* apply if a project proponent demonstrates that all project runoff will flow through enclosed storm drains, existing concrete culverts, or fully hardened (with bed and banks continuously concrete-lined) channels to the tidal area shown in light gray.

Purple/red hatched areas: These are upstream of areas where hydromodification impacts are of concern due to factors such as bank instability, sensitive habitat, or restoration projects. The HM Standard and all associated requirements apply in areas shown in purple/red (printer-dependant) hatch marking on the map. Projects in these areas may be subject to additional agency reviews related to hydrologic, habitat or other watershed-specific concerns.

Solid white areas: Solid white designates the land area between the hills and the tidal zone. This area may be susceptible to hydromodification unless the site is connected to storm drains that discharge to the tidal area. The HM Standard and all associated requirements apply to projects in solid white areas ***unless*** a project proponent demonstrates that all project runoff will flow through fully hardened channels[15]. Short segments of engineered earthen channels (length less than 10 times the maximum width of trapezoidal cross-section) can be considered resistant to erosion if located downstream of a concrete channel of similar or greater length and comparable cross-sectional dimensions. Plans to restore a hardened channel may affect the HM Standard applicability in this area.

Solid gray areas: Solid gray designates areas where streams or channels are tidally influenced or primarily depositional near their outfall in San Francisco Bay. The HM Standard does not apply to projects in this area. Plans to restore a hardened channel may affect the HM Standard applicability in this area.

Dark gray, Eastern County area: Dark gray designates the portion of eastern Alameda County that lies outside of the discharge area of this NPDES permit. This area is in the Central Valley Regional Water Quality Control Board's jurisdiction.

[14] The watercourses potentially susceptible to hydromodification impacts are identified based on an assessment approach developed by Balance Hydrologics (2003).

[15] In this paragraph, "fully hardened channels" include enclosed storm drains, existing concrete culverts, or channels whose bed and banks are continuously concrete-lined to the tidal area shown in light gray on the map.

Potential Exceptions to Map Designations

The Program may choose to prepare a User Guide[16] to be used for evaluating individual receiving waterbodies using detailed methods to assess channel stability and watercourse critical flow. This User Guide would reiterate and collate established stream stability assessment methods that have been presented in the Program's HMP.[17] After the Program has collated its methods into User Guide format, received approval of the User Guide from the Executive Officer,[18] and informed the public through such process as an email list-serve, the User Guide may be used to guide preparation of technical reports for: implementing the HM standard using in-stream or regional measures as described in C.3.f.viii above; determining whether certain projects are discharging to a watercourse that is less susceptible (from point of discharge to the Bay) to hydromodification (e.g., would have a lower potential for erosion than set forth in these requirements); and/or determining if a watercourse has a higher critical flow and project(s) discharging to it are eligible for an alternative Qcp for the purpose of designing onsite or regional measures to control flows draining to these channels (i.e., the actual threshold of erosion-causing critical flow is higher than 10% of the 2-year pre-project flow). In no case shall the design value of Qcp exceed 50% of the 2-year pre-project flow.

[16] The User Guide may be offered under a different title.
[17] The Program's HMP has undergone Water Board staff review and been subject to public notice and comment.
[18] The User Guide will not introduce a new concept, but rather reformat existing methods; therefore, Executive Officer approval is appropriate. See also Finding 6.

Attachment A:
HMP susceptibility map

Alameda Countywide
Clean Water Program
January 26, 2007

LEGEND (see text also)

- Major highways
- Major watersheds
- County boundary
- Streets

Channel type

- Natural creek or stream (susceptible)
- Earthen channel or connector
- Engineered channel - materials unknown
- Engineered channel - concrete
- Enclosed pipe or culvert

- Special consideration - San Lorenzo & Alameda Creeks
- Special consideration - Codornices Creek
- Hill or high slope region (susceptible)
- Tidally influenced / depositional - exempt
- Not included in HMP

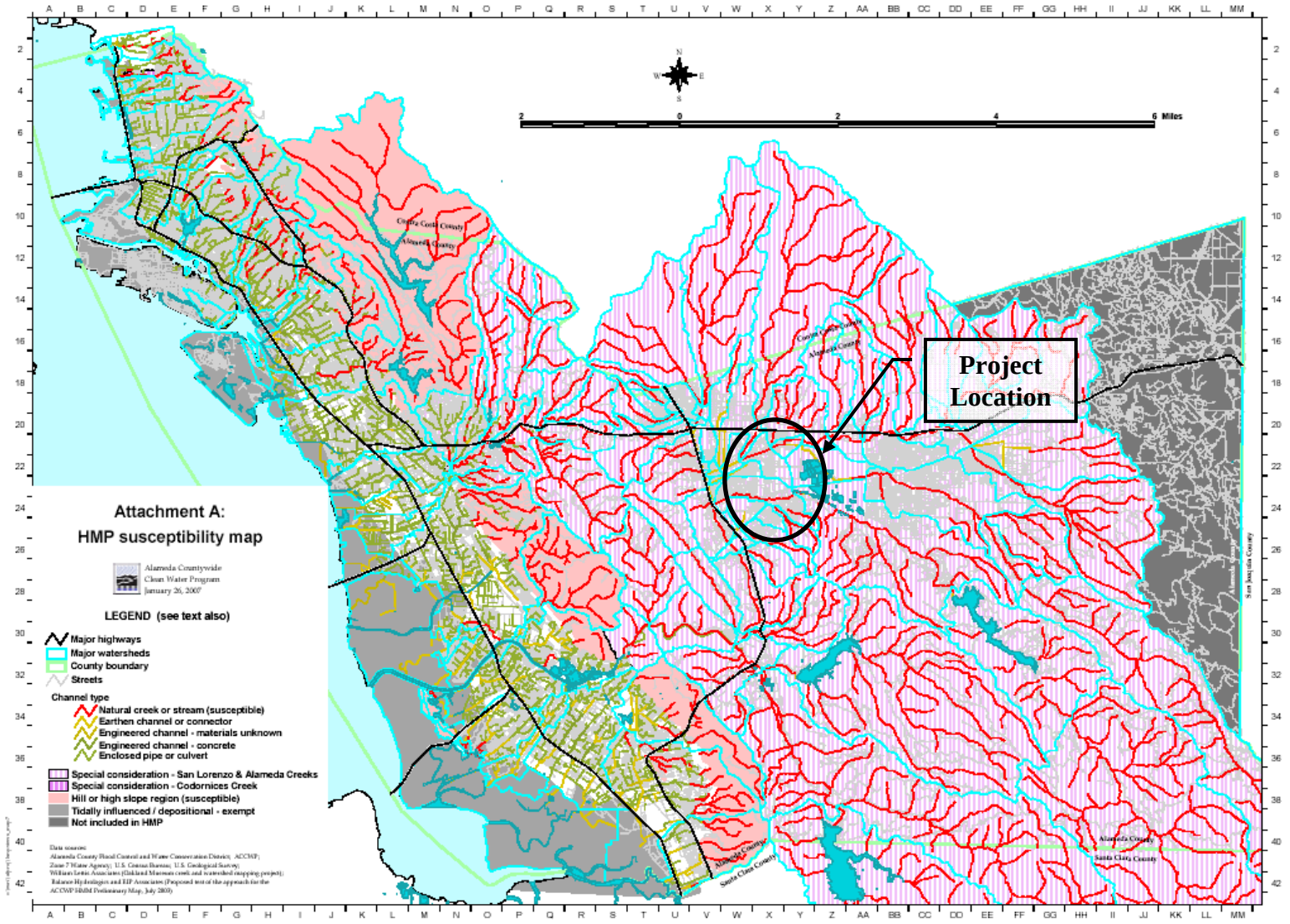
Data sources:
Alameda County Flood Control and Water Conservation District; ACCWP;
Zone 7 Water Agency; U.S. Census Bureau; U.S. Geological Survey;
William Lettis Associates (Oakland Museum creek and watershed mapping project);
Balance Hydrologics and EIP Associates (Proposed test of the approach for the ACCWP HMM Preliminary Map, July 2003)

c:\esri\aprj\hmp\slews_map7

N W E S

2 0 2 4 6 Miles

Contra Costa County
Alameda County
Contra Costa County
Alameda County
Alameda County
San Joaquin County
Alameda County
Santa Clara County
Alameda County
Santa Clara County


Project Location
Attachment A:
HMP susceptibility map
Alameda Countywide Clean Water Program
January 26, 2007
LEGEND (see text also)
Major highways
Major watersheds
County boundary
Streets
Channel type
Natural creek or stream (susceptible)
Earthen channel or connector
Engineered channel - materials unknown
Engineered channel - concrete
Enclosed pipe or culvert
Special consideration - San Lorenzo & Alameda Creeks
Special consideration - Codornices Creek
Hill or high slope region (susceptible)
Tidally influenced / depositional - exempt
Not included in HMP
Miles

FOR CONTRACT NO. 297614

DRAINAGE/HYDRAULIC INFORMATION

STORM WATER DATA REPORT

DATED 1/2011

Storm Water Data Report

Dist-County-Route: 04-Ala-84

Post Mile Limits: 22.9/27.1

Project Type: Expressway Widening

EA: 04-297601

RU: 04256

Program Identification: 20.10.400

Phase: ☐ **PID** ☐ **PA/ED** ☒ **PS&E**

Regional Water Quality Control Board(s): Region 2, San Francisco Bay

Is the project required to consider incorporating Treatment BMPs? ☒ Yes ☐ No

If yes, can Treatment BMPs be incorporated into the project? ☒ Yes ☐ No

If No, a Technical Data Report must be submitted to the RWQCB at least 60 days prior to PS&E Submittal. List submittal date: _____

Total Disturbed Soil Area: 83.19 acres (81.57 ac in Caltrans R/W; 1.62 ac in City/Zone 7 R/W)

Estimated Construction Start Date: October 2011 Construction Completion Date: August 2013 (without Landscaping)

Notification of Construction (NOC) Date to be submitted: September 2011

Notification of ADL reuse (if Yes, provide date) ☐ Yes Date: _____ ☒ No

Separate Dewatering Permit (if Yes, permit number) ☐ Yes Permit #: _____ ☒ No

This Report has been prepared under the direction of the following Licensed Person. The Licensed Person attests to the technical information contained herein and the data upon which recommendations, conclusions, and decisions are based. Professional Engineer or Landscape Architect stamp required at PS&E.

Analette Ochoa 1/18/11

Analette Ochoa, P.E. *Registered Project Engineer* Date

I have reviewed the storm water quality design issues and find this report to be complete, current, and accurate:

REGISTERED PROFESSIONAL ENGINEER
ANALETTE A. OCHOA
No. 55279
Exp. 12/31/12 STAMP
CIVIL
STATE OF CALIFORNIA
[Required for PS&E only]

Issa Bouri, *Project Manager* Date

Bob Braga, *Designated Maintenance Representative* Date

David Yam, *Designated Landscape Architect Representative* Date

Norman Gonsalves *District/Regional SW Coordinator or Designee* Date

STORM WATER DATA INFORMATION

1. Project Description

The Project, located in Livermore/Pleasanton in Alameda County, proposes to widen and upgrade State Route 84 (SR 84) from Ruby Hill Drive to Jack London Boulevard. The widening would: 1) improve the route as a regional connection between State Routes 680 (SR 680) and 580 (SR 580); 2) improve the local traffic circulation; 3) upgrade the route to expressway standards; and 4) improve pedestrian and bicycle access.

SR 84 would be widened to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would generally conform to the existing roadway alignment. Improvements would include: 1) the widening of the Arroyo del Valle and Arroyo Mocho Bridges; 2) the widening and upgrading of signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Discovery Drive and Jack London Boulevard; 3) relocating existing private driveway access to signalized intersections on SR 84; and 4) constructing new bridge crossings at Arroyo Mocho and Arroyo del Valle for private and recreational access.

The roadway cross section would consist of 12-ft wide traveled lanes and 10-ft wide shoulders, divided by a concrete median barrier. Where practical, side slopes would be 4:1 (H:V) or flatter to provide a Clear Recovery Zone (CRZ) for errant vehicles. Outside the CRZ, side slopes would be 2:1 (H:V) or flatter. The roadway median at intersections would be widened up to 36 ft to accommodate left-turn lanes.

The Project has been split into two segments for construction, as described in Table 1.

Most of the project lies within the Caltrans right-of-way (R/W). However, a portion of the project is in the City or Zone 7 Water Agency (Zone 7) R/W. Further discussion of Zone 7 is included in Section 2 of this report.

The total Disturbed Soil Area (DSA) would be 83.19 ac. Of this total, 81.57 ac are in the Caltrans R/W, and 1.62 ac are in the City or Zone 7 R/W. Of the DSA in the Caltrans R/W, 29.96 ac are in Segment A, and 51.61 ac are in Segment B. The DSA was calculated by identifying the area within the Project limits that would be impacted by construction activities including areas of cut and fill and staging areas. The program Microstation was used to measure these areas. A summary of existing, overlay, added, and removed impervious areas, divided by R/W, are described in Table 2.

The Project limits are within Alameda County, which is identified as a Phase I Municipal Separate Storm Sewer System (MS4).

Table 1. Project Segments

	Start Location		End Location	
	PM	**Description**	**PM**	**Description**
Segment A	25.5	0.4 mi. north of Concannon Blvd	27.1	Intersection with Jack London Blvd
Segment B	22.9	0.1 mi. south of Ruby Hill Drive	25.7	0.6 mi. north of Concannon Blvd

Table 2. Impervious Area Calculations

Impervious Areas Separated by R/W

R/W	Existing Impervious Area	Total Pavement Area	Overlay Impervious Area	Additional Impervious Area	Removed Impervious Area	Net Additional Impervious Area	Reworked Impervious Area	Disturbed Soil Area (DSA)
Caltrans	35.90	62.68	25.24	27.57	0.79	26.78	9.87	81.57
City/Zone 7	0.00	0.40	0.00	0.40	0.00	0.40	0.00	1.62
Total	**35.90**	**63.08**	**25.24**	**27.97**	**0.79**	**27.18**	**9.87**	**83.19**

Treatment Req	**37.05**

Impervious Areas in Caltrans R/W Separated by Segment

Segment	Existing Impervious Area	Total Pavement Area	Overlay Impervious Area	Additional Impervious Area	Removed Impervious Area	Net Additional Impervious Area	Reworked Impervious Area	Disturbed Soil Area (DSA)
A	15.65	24.78	11.77	9.14	0.00	9.14	3.87	29.96
B	20.25	37.90	13.47	18.43	0.79	17.64	6.00	51.61
Total	**35.90**	**62.68**	**25.24**	**27.57**	**0.79**	**26.78**	**9.87**	**81.57**

Notes:

1. All measurements are in acres (ac)
2. Additional Impervious Area = Total Pavement Area – Overlay Impervious Area – Reworked Area
3. Net Additional Impervious Area = Additional Impervious Area – Removed Impervious Area
4. Reworked Impervious Area = Existing Impervious Area – Overlay Impervious Area – Removed Impervious Area
5. Treatment requirement = Net Additional Impervious Area + Reworked Impervious Area (for both R/W areas)

2. Site Data and Storm Water Quality Design Issues

Hydrologic Area and Sub-area

The Project site is located in the Cities of Livermore and Pleasanton, in Alameda County. The Project falls under the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). It is located in the Alameda Creek Hydrologic Area (Sub-Area number 204.30) of the San Francisco Bay Region's South Bay Hydrologic Unit. The watershed size at the SR 84 Bridge at Arroyo del Valle is approximately 160 square miles. The watershed size at the SR 84 Bridge at Arroyo Mocho is approximately 50 square miles.

Receiving Water Bodies

Currently, most of the storm water within the Project area discharges to Arroyo Mocho and Arroyo Del Valle. A portion of the runoff discharges to Arroyo Las Positas, which is 0.3 mi away from the northern Project limit and is a tributary of Arroyo Mocho. Storm water flows from Arroyo Del Valle and Arroyo Mocho throughout the year, eventually discharging into Arroyo de la Laguna (which is approximately 9 mi from the Project limits).

303(d) List of Water Quality Limited Segments

The 2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments (303[d] List) (U.S. Environmental Protection Agency [EPA], 2007) lists Arroyo Mocho, Arroyo Del Valle, and Arroyo Las Positas as impaired water bodies due to Diazinon. However, Diazinon is not generated by the highway within the State's R/W.

Total Maximum Daily Loads

There are currently Total Maximum Daily Loads (TMDLs) for Diazinon and Pesticides for the Arroyo Mocho, Arroyo Del Valle, and Arroyo Las Positas. These TMDLs were approved by the U.S. EPA on May 16, 2007. The TMDLs can be found and referenced in the San Francisco Bay Area Urban Creeks TDML Report. However, Caltrans is not a listed stakeholder for this TMDL.

Current and Potential Beneficial Uses of Affected Waters

The State Water Resources Control Board's (SWRCB) *Water Quality Control Plan for the RWQCB Region 2* (SWRCB, 2007), also called the Basin Plan, lists the existing beneficial uses of the Arroyo Del Valle as follows:

- Cold Freshwater Habitat (COLD)
- Groundwater Recharge (GWR)
- Municipal and Domestic Supply (MUN)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Wildlife Habitat (WILD)

In addition, the potential beneficial uses for Arroyo Del Valle are:

- Fish Migration (MIGR)
- Water Contact Recreation (REC-1)
- Non-contact Water Reclamation (REC-2)

The existing beneficial uses for Arroyo de la Laguna are listed below, including uses that generally apply to its tributary streams:

- Groundwater Recharge (GWR)
- Migration of Aquatic Organisms (MIGR)
- Non-contact Water Recreation (REC-2)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Water Contact Recreation (REC-1)
- Wildlife Habitat (WILD)

The potentially beneficial uses of the Arroyo de la Laguna include:

- Cold Freshwater Habitat (COLD)
- Warm Freshwater Habitat (WARM)

The Basin Plan does not list any beneficial uses for Arroyo Mocho and Arroyo Las Positas.

High Risk Area

Caltrans defines a High Risk Area as municipal or domestic water supply reservoirs or groundwater percolation facilities discharging to aquifers designated as water supply sources (Caltrans, May 2007). According to the Basin Plan, there are presently no High Risk Areas within the Project limits (SWRCB, 2007). However the proposed Zone 7 Chain of Lakes project, planned adjacent to this Project (see Future Land Use section), could be designated as a high risk facility in the future.

Concerns and Requirements of Local Agencies

Local agencies that are stakeholders for this Project include: the Alameda County Transportation Improvement Agency (ACTIA), the City of Livermore, the City of Pleasanton, and Caltrans. The U.S. Army Corp of Engineers (USACE), the Federal Emergency Management Agency (FEMA), Zone 7, and the SFBRWQCB all have jurisdiction over flood control or water quality activities in the Project. The Project would implement temporary and permanent Best Management Practices (BMPs) to meet the requirements of Caltrans' Statewide National Pollutant Discharge Elimination System (NPDES) permit.

The following requirements and concerns related to local agencies requirements were expressed by the Project Team and addressed in the design:

- The proposed improvements should meet the requirements in accordance with the State's/Caltrans' statutes in order to bring the state route to expressway standards.

- The proposed drainage improvements should conform to the Pigeon Pass Safety Project and the I-580/Isabel Avenue Interchange Project.

- The proposed Project should not preclude the construction, maintenance, and operation of the Zone 7 facilities.

- Encroachment upon the Environmentally Sensitive Areas, between Ruby Hill Drive and Vallecitos Road, are to be avoided.

- No infiltration is allowed in areas adjacent to the future Chain of Lakes area in the Zone 7 R/W.

The Project would result in work that would impact an identified Water of the U.S.; therefore, a 401 Certification is required for the Project.

Climate

The geotechnical report prepared by URS provides climatic information for the Project. The area is defined as Mediterranean with dry summers and mild winters. The mean annual temperature is 59.4°F with temperatures ranging from an average daily maximum of 89.5°F in July to an average daily low of 36.4°F in January. Freeze-thaw conditions are not an issue for the area because freezing temperatures are only anticipated to occur and average of 30.8 days per year. The average annual precipitation for the City of Livermore is 14.53 inches and occurs mainly from October through May.

Land Use

In the Project vicinity, the land use is residential with some commercial use within the City of Livermore. Aerial photographs indicate that the east side of SR 84, from the northern project limits to Alden Lane, is residential. The Ruby Hill Development in the City of Pleasanton is located on the west side of SR 84, from Vineyard Road to the southern Project limits. The land use from Alden Lane to the southern end of the Project limits (on the west side of SR 84) is agricultural. There are two gravel mining facilities along Arroyo Del Valle on both sides of the freeway, operated by Cemex and Vulcan; these activities are located adjacent to the western side of SR 84, between Arroyo Del Valle and Stanley Boulevard.

Future Land Use

Planned expansion of the Cemex and Vulcan gravel mining operations are planned to occur on both sides of SR 84 between Vineyard Avenue and Stanley Boulevard. However, these operations are independent of the proposed highway improvements. Mining operations would take place within 50 ft of the existing R/W limits. Significant mining operations of up to depths of 240 ft are planned. After mining is completed in approximately 25 years, an adopted Zone 7 *Reclamation Plan* would be initiated. This plan specifies the formation of basins—collectively referred to as the Chain of Lakes—to create seasonal water storage, flood water detention, and conveyance of both local and imported waters (see Attachments for map). The Chain of Lakes will be located

between the Cities of Livermore and Pleasanton; when completed, it will consist of a series of reclaimed gravel quarry pits converted into nine linked lakes (Lakes A through I).

Zone 7 is the Tri-Valley water wholesaler serving Livermore, Pleasanton, and Dublin. Zone 7 would operate and maintain these facilities. The Chain of Lakes would be considered a future receiving water body within the Project area. At Lake I, the water levels would be maintained to allow the de-silted water to percolate through the lakes' sidewalls and into the groundwater basin; this should augment the current "artificial recharge" that Zone 7 already provides for its Main Basin aquifers. The artificial recharge intent for the Project would be a drinking water source.

As shown in the Attachments, Lakes A, B, C and D are planned to be constructed adjacent to the proposed Project. Lake A is located on the southeast side of SR 84, while Lakes B, C and D are on the west side of SR 84.

Topography

The geotechnical report identifies the topographic conditions throughout the Project. The elevation along the existing route ranges from 410 ft to 420 ft between Jack London Boulevard at "A3" Line Station (Sta.) 448+00 and the Arroyo Del Valle crossing at "A1" Line Sta. 320+00. South of Arroyo Del Valle, the roadway alignment climbs a gentle alluvial fan to 590 ft south of the Ruby Hills Drive at Sta. 227+00. South of the SR 84 intersection with Vallecitas Road, the alignment is surrounded by rolling hills as it enters the mouth of the canyon.

Soil and Geology

The general description of the subsurface soils within the Project is described by the geotechnical report as consisting of a few feet of fill overlying alluvium. The fill ranges from a minimum of 3 ft to as much as 25 ft along the hillside between SR 84 and East Ruby Hill Drive. The fill is made up of locally derived silt, sand and clay with gravel and occasionally contains asphalt-concrete fragments. The alluvium consists of complexly interbedded sand, silt and clay with gravel and extensive channel deposits of silty gravel, clayey gravel, and poorly graded sand/gravel mixtures (AGS, 2006).

South of Arroyo Del Valle, the fine grained soils (silts and clay) are generally medium stiff to hard in consistency with some occasional softness, while the coarse grained soils (sand and gravel) are typically medium to very dense, with some occasional softness. Certain boring identified fat clays, elastic silt and cobble. North of Arroyo Del Valle the fine grained soils were generally stiff to hard, with occasional softness, and the coarse grained soils were typically medium dense, to very dense. Cobble and boulders were also identified (AGS, 2006).

The *Web Soil Survey*, created by the National Resources Conservation Service, is an online program used to identify general soil information of a given area. Using this tool, the Hydrologic Soil Groups (HSG) for soils within the Project was identified as being within HSG A, B, or D (see Table 3). Soils classified as HSG A or HSG B have a higher chance of promoting infiltration. See the soil map in the attachments and the table below for more detailed information about soils.

Table 3. Soil Types

Location	Soil Symbol	Soil Type	Soil Group	Slope	Erosion Hazard
W Jack London Boulevard to Stanley Boulevard	Lg	Livermore gravelly loam	B	---	Moderate
	Lm	Livermore very gravelly coarse sandy loam	B	---	Moderate
	Rh	Riverwash	A	---	None
	YmA	Yolo loam	A	0 to 3%	Moderate
	Yr	Yolo gravelly loam	A	0 to 3%	Moderate
	Za	Zamora silt loam	A	0 to 4%	Very High
Stanley Boulevard to Lilienthal Road	Gp	Gravel Pits	A	---	Moderate
	Lg	Livermore gravelly loam	B	---	Moderate
	Lm	Livermore very gravelly coarse sandy loam	B	---	Moderate
	PtB2	Positas gravelly loam, thick surface	D	2 to 10%	High
	Rh	Riverwash	A	---	None
	Za	Zamora silt loam	A	0 to 4%	Very High
Lilienthal Road to Ruby Hill Drive	Gp	Gravel Pits	A	---	Moderate
	Lm	Livermore very gravely coarse sandy loam	B	---	Moderate
	PgA	Pleasanton gravelly loam	B	0 to 3%	Moderate-High
	PoC2	Positas gravelly loam	D	2 to 20%	High
	Rh	Riverwash	A	---	None
	YmA	Yolo loam	A	0 to 3%	Moderate
Ruby Hill Drive to Vallecitos Road	Lm	Livermore very gravelly coarse sandy loam	B	---	Moderate
	PgA	Pleasanton gravelly loam	B	0 to 3%	Moderate-High
	PgB	Pleasanton gravelly loam	A	3 to 12%	Moderate-High
	PoC2	Positas gravelly loam	D	2 to 20%	High
	PoE2	Positas gravelly loam	D	20 to 40%	
	Sa	San Ysidro Loam	D	---	

Groundwater

The geotechnical report provides information on groundwater depths that were encountered during drilling for the northbound (NB) borings; these results are summarized in Table 4.

Table 4. Groundwater Depths for NB borings

Boring Number	Water Depth (ft)	Total Boring Depth (ft)	Boring Number	Water Depth (ft)	Total Boring Depth (ft)
NB01	20.0	25.0	NB19	Dry	30.0
NB02	Dry	30.0	NB20	Dry	40.0
NB03	Not Measured	80.0	NB21	Dry	40.0
NB04	Dry	25.0	NB22	Dry	30.0
NB05	Not Measured	56.5	NB22A	24.7	30.0
NB05A	Dry	35.0	NB23	Not Measured	101.5
NB06	Not Measured	80.0	NB24	Not Measured	101.5
NB07	Dry	20.0	NB25	Dry	22.0
NB07A	Dry	20.0	NB25A	Dry	25.0
NB08	Dry	31.5	NB26	Dry	30.0
NB09	Dry	30.0	NB30	24	50.0
NB10	23.5	30.0	NB31	28	50.0
NB11	Not Measured	60.0	NB32	Dry	50.0
NB12	Not Measured	71.5	NB33	Dry	50.0
NB13	Not Measured	80.0	NB34	Dry	50.0
NB14	Not Measured	60.0	NB35	14.5	50.0
NB15	Dry	14.0	NB36	Dry	50.0
NB16	Dry	15.5	NB37	3.5	90.0
NB17	Dry	20.0	NB38	3	90.0
NB18	Dry	20.0			

Source: URS, 2009

Minimal dewatering is anticipated for this Project. Refer to Section 6 of this report for more details on dewatering.

Potential Hazardous Waste

The *Initial Site Assessment* (ISA), prepared for the Project by BASELINE Environmental Consulting in December 2005, identifies areas of potential concern due to the presence of hazardous materials. The potential sources of contamination included: agriculture, chemical residue, Aerially Deposited Lead (ADL) from vehicle exhaust, and the dumping of household refuse near the intersection of Isabel Avenue and Jack London Boulevard. The ISA states that, while there may be residue from a remediated site at 1901 Isabel Avenue, none of the other reported releases would be likely to affect Project development.

A soil and groundwater investigation was conducted in April 2008. The conclusion mentions that the soils in the Project area would be considered non-hazardous; in addition, the hazardous issues mentioned in the 2005 ISA are dated to have existed before completion of several recent projects in the area.

Aerially Deposited Lead

The ISA suggests excavation activities may uncover soils within the alignment that could be potentially classified as hazardous waste, depending on the total or soluble lead content in the soils. These contaminated lead soils within Caltrans' R/W are known as ADL. However, the soil and groundwater investigation conducted in April 2008 did not find any presence of ADL above the Total Threshold Limit Concentration (TTLC) and STLC threshold. In addition, most of the Project area has been reconstructed after 1993, and no ADL has been found in the Project area by earlier projects. Therefore, there are no special handling instructions for ADL, and the ADL variance would not be invoked for this Project.

Erosion Potential

Studies conducted for the geotechnical report found that there are two small existing landslides that extend into the Project R/W that are 150 ft wide and 220 to 240 ft long located east of SR 84 opposite Sta. 247+00 and 250+00. These landslide areas are now overgrown with vegetation and impact a small drainage channel that parallels the edge of the roadway. However, while these areas are within the Project R/W, there are no anticipated impacts to the Project, as the proposed improvements to SR 84 are not within the vicinity of these slide areas.

Areas within the Project are classified as being susceptible to liquefaction, where sediments temporarily lose shear strength and collapse. The alluvium from Jack London Boulevard and Stanley Boulevard is classified as having "high" liquefaction susceptibility. From Stanley Boulevard to Arroyo Del Valle, the liquefaction susceptibility of the alluvium is classified as being "moderate." From Arroyo Del Valle to approximately 1,500 ft south along the alignment, the susceptibility is "high," and from this pint to the end of the Project alignment, the liquefaction susceptibility is classified as "moderate." The historic channel deposits within the active channel of Arroyo Del Valle and Arroyo Mocho are identified as having "very high" liquefaction susceptibility.

To mitigate for any erosion potential, the geotechnical report provides recommendations for the placement of fill. Fill would consist of soil or soil/rock mixtures compacted to a minimum of 90 percent to 95 percent where required. The Project also proposes to install retaining walls and appropriate subsurface drainage (see attached Drainage Plans showing retaining wall locations). Newly created or disturbed slopes would be treated with appropriate temporary and/or permanent erosion control measures as discussed in Section 4 of this report.

Measures for Avoiding or Reducing Potential Storm Water Impacts

Bridge work would be scheduled only during the allowed construction window. To avoid storm water impacts, the Project should be phased to minimize soil-disturbing work during the rainy season. Permanent storm water pollution controls would be installed as early in the construction process as is feasible in order to provide protection from construction storm water impacts. The order of work as specified in the Project Specifications would be modified to reflect the installation of permanent and temporary storm water controls, especially prior to soil disturbing work during a rainy season.

To ensure slope stability, the Project would grade slopes to 4:1 (H:V) or flatter, except at locations with R/W limitations are present or when matching existing topography. In these cases slopes would be graded to a maximum of 2:1 (H:V). The Project includes the use of retaining walls to decrease the R/W and cut and fill requirements.

Existing Treatment Best Management Practices and R/W

There are currently no identified existing treatment BMPs within the Project limits. The treatment BMP strategy for the Project is currently designed within the proposed Project R/W, and no further R/W acquisition is anticipated for the purpose of treatment BMP design. However, there is one biofiltration swale that, while within the Project R/W, is located parallel to Vallecitos Road in the City of Pleasanton's R/W and is being used to treat storm water runoff from SR 84. The issue of maintenance of this biofiltration swale is anticipated to be part of a cooperative agreement between the City and Caltrans.

Environmentally Sensitive Areas

There are environmentally sensitive areas (ESAs) within the Project limits. These areas are designated on the Project plans attached in this report. The ESAs include areas of existing wetlands on the east side of SR 84, between Station "A1" Line 240+00 and "A2" Line 250+00 and at creek crossings.

3. Regional Water Quality Control Board Agreements

The SFBRWQCB's 2007 Water Quality Control Plan for the San Francisco Bay Basin includes regulation for discharges within this area.

Storm water discharges from the State's R/W, within the Project area, are regulated by the Department's Statewide NPDES Storm Water Permit issued by the SWRCB (Order No. 2009-0009-DWQ No. CAS000002).

In addition, discharges from construction activities within the Project area are regulated by the revised "NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities" (NPDES Number CAS000002), also called the Construction General Permit (CGP), which became effective on July 1, 2010.

Permit Requirements

Because the Project work limits are adjacent to water sensitive areas (e.g., wetlands, rivers, creeks, and other waterways), necessary permits for this Project include: a USACE 404 Permit, a 401 Water Quality Certification from the SFBRWQCB, and a 1602 Permit from the California Department of Fish and Game (CDFG).

Pursuant to the requirements for the 404 Permit, the Project team is working to prepare a draft wetland delineation to be approved by the USACE. The permit application to the USACE, as well as the 401 Water Quality Certification permit application to the SFBRWQCB and the 1602 Permit application to the CDFG, have been submitted. The anticipated approval date for all the Project permits is May 2011.

For the CGP, the Project has been determined to have medium sediment risk and low receiving water risk, which results in a Project Combined Risk Level 2 (see Attachments for Risk Assessment calculations). The Project must comply with the requirements set forth in the CGP. Additional information is included in Section 6 of this report. For a detailed description of the requirements, refer to the CGP.

Other requirements

Per the Caltrans District 4 Office of Water Quality, the Project is required to consider hydromodification mitigation because the Project increases impervious areas and is within a county that has a SFBRWQCB-approved Hydromodification Management Plan. Mitigation measures include site design and source control measures that support infiltration and minimize the change in the runoff rate of flow. The mitigation measures for this Project are discussed in the Project's *Hydromodification Report* (WRECO, 2010).

Project improvements would incorporate the use of temporary construction site and permanent BMPs to preserve floodplains and wetlands, and to maintain slope stability. Between Ruby Hill Drive and Vallecitos Road, SR 84 would be realigned to avoid encroachment onto an ESA on the east side. As described in the previous section, ESAs have been confirmed as the areas located

at creek crossings and on the east side of SR 84, between Station "A1" Line 240+00 and "A2" Line 250+00. Existing vegetation would be preserved in these locations.

4. Proposed Design Pollution Prevention BMPs to be used on the Project

Downstream Effects Related to Potentially Increased Flow

The widening of SR 84 for this Project would create a net increase of 27.63 ac impervious surface area within the Project area (27.23 ac in the Caltrans R/W and 0.40 in the City/Zone 7 R/W). This additional impervious area would increase the volume of the downstream flow of both Arroyo Del Valle and Arroyo Mocho.

There are proposed new cross culverts, drainage inlets, and longitudinal drainage systems (dikes, and relocated ditches) that are part of the drainage design for this Project. Existing drainage systems located within the Project limits, in the City of Livermore, would be modified to maintain the existing drainage pattern. Drainage from the widening of the proposed bridge and trail bridge over Arroyo del Valle and the proposed bridge and access bridge over Arroyo Mocho are addressed in the *Bridge Design Hydraulic Study Report* (WRECO, May 2009).

A new longitudinal drainage system consisting of 36-in. diameter pipes is proposed to convey the off-site flows from the City of Livermore to an outfall at Arroyo Del Valle. Detailed drainage design information on the new longitudinal drainage system and outfall at Arroyo Del Valle is referenced in the *Drainage Report* (WRECO, January 2011).

The incorporation of dissipation devices at culvert outfalls, such as flared end sections (FESs) and rock slope protection (RSP) are utilized as part of the drainage design to reduce velocities of storm water runoff.

Hydromodification measures are proposed for discharges to Arroyo Del Valle and Arroyo Las Positas in order to minimize impacts to water bodies from additional flow created by the Project. One biofiltration strip and seven biofiltration swales would provide sufficient infiltration for hydromodification mitigation. Further discussion of the dual function of strips and swales for treatment and for hydromodification can be found in the *Hydromodification Report* (WRECO, 2010). In addition to strips and swales, there is an existing pump station that would be maintained for this Project; the impacts to the pump station from the added impervious area created from the Project are minimal based on analysis of the capacity of the pump.

Slope/Surface Protection Systems

Disturbed areas would be re-stabilized with erosion control measures. The Project would incorporate landscaping under a separate contract. The Project would modify existing side slopes to accommodate the roadway widening. Where feasible, side slopes within Caltrans' R/W are 4:1 (H:V) in order to provide a Clear Recovery Zone (CRZ) for errant vehicles. Where R/W or existing topography does not allow for the ability to grade slopes 4:1 (H:V) or flatter, slopes are graded to a maximum of 2:1 (H:V).

The Project would incorporate slope protection measures such as permanent fiber rolls and erosion control (hydroseed). Erosion control (hydroseed) would be placed on slopes and disturbed soil areas to promote vegetation growth. Since the Project would involve soil disturbance more than 25 ac over multiple rainy seasons, Move-In/Move-Out (Erosion Control)

is included in the Project to ensure the establishment of vegetation within the Project. Outlet protection/velocity dissipation BMPs would be placed at all drainage system outfalls that flow into earth-lined ditches/basins (see Drainage Plans). Placing outlet protection/velocity dissipation systems promotes erosion control at drainage outlets.

Retaining walls would be utilized to minimize erosion or the steepness or shortness of slopes. According to the geotechnical report and plans, 13 retaining walls would be proposed for the Project. The specific locations for these retaining walls are shown on the Project Plans.

Vegetated Surfaces: Vegetation within the Project limits consists of the following: California annual grassland, valley oak woodland, purple needlegrass, grassland, coyote brush scrub, mixed willow, riparian forest mosaic, and restoration wetland and riparian.

The wetlands located along SR 84 within the Project limits are designated as ESAs and are identified on the Project plans. From the south side of the beginning of the Project limits, wetlands are scattered northward toward Vallecitos Road. After crossing this road, various wetland areas are identified in both the east and west direction of SR 84.

Hard Surfaces: RSP would be the primary energy dissipation system used throughout the Project. RSP would be placed at the discharge points into unlined ditches and at the stream banks of the proposed bridge and trail bridge over Arroyo del Valle and at the stream banks of the proposed train bridge over Arroyo Mocho. Arroyo Mocho is an existing concrete lined channel and, therefore, does not require RSP.

Concentrated Flow Conveyance Systems

The Project proposes to create and modify existing ditches, dikes, berms and swales. Existing slopes would be created and modified to satisfy drainage and erosion control needs. The existing roadway drainage design would either be modified to fit with new drainage systems, or be abandoned or removed and replaced by new systems. The proposed drainage is shown on the attached Drainage Plans, and detailed analyses of the Project drainage systems are discussed in the Project *Drainage Report* (WRECO, January 2011).

Preservation of Existing Vegetation

The goal of an effective erosion control strategy is to maintain the natural pre-construction condition. Existing vegetation would be preserved to the MEP, and areas disturbed by construction activities would be minimized through the use of ESA fencing. Preservation involves the identification and protection of desirable vegetation to provide erosion and sediment control benefits. All areas to be preserved are delineated and mapped on the Layout plans.

5. Proposed Permanent Treatment BMPs to be used on the Project

Treatment BMP Strategy

The direct receiving water bodies for this Project are Arroyo Mocho, Arroyo Del Valle, and Arroyo Las Positas. According to the 2006 Clean Water Act Section 303(d) list of Water Quality Limited Segments, these three water bodies are impaired due to high Diazinon concentrations. Diazinon, however, is not a targeted design constituent for Caltrans, so permanent Treatment BMPs are considered in the order of the following general pollutant removal criteria:

I. Infiltration Devices
II. Biofiltration Strips and Wet Basin
III. Biofiltration Swale and Austin Sand Filter
IV. Detention Device, Delaware Filter, and Multi-Chamber Treatment Trains (MCTTs)

The Project proposes to treat approximately 37.1 ac, which is slightly more than 100 percent of the total added and reworked impervious area (37.05 ac) within the Project limits. This calculation of required treated area includes the City R/W impervious areas because one swale (BMP-6) is in the City R/W and treats both CT and City impervious areas. Inclusion of this swale is required to meet treatment goals.

While infiltration devices are ranked first for general pollutant removal, they were determined to be infeasible for this Project, as discussed in the following subsections. The treatment BMP strategy for the Project consists of biofiltration strips, biofiltration swales, and two Austin Vault Sand Filters (AVSF). AVSF were selected for the Project in the areas adjacent to the Zone 7 R/W due to concerns about seepage of potential contaminants for the future Chain of Lakes.

The proposed treatment BMPs are listed in Table 5.

Table 5. Proposed Treatment BMPs for the Project

BMP ID No.	Segment	Treatment Type	Begin Station	End Station	Rt or Lt	Treated Area (sq ft)	Treated Area (ac)	WQV (ac-ft)
BMP-1	B	Biofiltration Strip	"A1" Line 231+00	"A1" Line 233+44	Rt	11,751	0.27	n/a
BMP-2	B	Biofiltration Strip	"A1" Line 235+25	"A1" Line 244+04	Rt	91,245	2.09	n/a
BMP-3	B	Biofiltration Swale	"VEx" Line 53+76	"VEx" Line 54+59	Lt	37,508	0.86	n/a
BMP-4	B	Biofiltration Strip	"VEx" Line 53+47	"VEx" Line 55+74	Lt	6,517	0.15	n/a
BMP-5	B	Biofiltration Strip	"V" Line 103+10	"V" Line 109+00	Lt	25,795	0.59	n/a
BMP-6	B	Biofiltration Swale	"V" Line 105+50	"V" Line 107+00	Lt	128,502	2.95	n/a
BMP-7	B	Biofiltration Swale	"A1" Line 299+00	"A1" Line 301+50	Lt	135,043	3.10	n/a
BMP-8	B	Biofiltration Swale	"A1" Line 285+14	"A1" Line 287+64	Rt	110,243	2.53	n/a
BMP-9	B	Biofiltration Strip	"A1" Line 285+10	"A1" Line 312+19	Rt	153,366	3.52	n/a
BMP-10	B	Biofiltration Swale	"A1" Line 296+04	"A1" Line 298+04	Rt	48,720	1.12	n/a
BMP-11	B	Biofiltration Swale	"A1" Line 301+04	"A1" Line 302+54	Rt	22,647	0.52	n/a
BMP-12	B	Biofiltration Swale	"A1" Line 306+75	"A1" Line 308+25	Rt	26,355	0.61	n/a
BMP-13	B	Austin Vault Sand Filter (Segment B)	"A1" Line 321+15*	"A1" Line 322+67*	Lt	451,148	10.36	0.49
BMP-14	A	Austin Vault Sand Filter (Segment A)	"A2" Line 390+14*	"A2" Line 391+15*	Rt	367,108	8.43	0.40
				Total Proposed Treatment:		**1,615,948**	**37.10**	**ac**
					Goal:		**37.05**	**ac**

Percent Treatment: **100 %**

* Note : AVSF stationing limits are measured from the two interior corners of the vaults that are closest to the stationing line.

Infiltration Devices

Infiltration devices are ranked first for consideration under the General Purpose Pollutant Removal Order. Infiltration devices store runoff and allow it to infiltrate the ground into the underlying soil. Infiltration prevents pollutants in the captured runoff from reaching surface waters. Infiltration basins are designed to remove solid and dissolved particles from storm water by providing a pond with a minimum capacity of 0.1 ac-ft Water Quality Volume (WQV). The effectiveness of an infiltration basin depends on the soil type and the depth to seasonally high groundwater, with a minimum 10 ft below grade to groundwater preferred. According to the *Final Geotechnical Impact Assessment* for this Project, the groundwater depth is from 21 to 40 ft below the groundwater below surface; therefore, infiltration basins would be feasible (AGS, Inc., April 2006). However, there is not adequate area within the R/W to accommodate a large device such as an infiltration basin.

Furthermore, infiltration devices are not allowed in areas adjacent to existing Zone 7 facilities or the future Chain of Lakes project.

Biofiltration Strips

Biofiltration strips, also known as vegetated buffer strips, are vegetated sections of land that receive storm water flows in the form of overland sheet flow. Pollutants are removed by filtration through the grass, sedimentation, adsorption to soil particles, and infiltration through the soil. Biofiltration devices are mainly effective for removing total suspended solids, particulate, metals, and litter, although some dissolved constituents are removed by infiltration into the soil. These devices should be considered wherever site conditions and climate allow vegetation to be established, and where flow velocities will not cause scour. Vegetative cover of about 70 percent would be required for treatment.

The proposed biofiltration strip locations are listed in Table 5. These strips would allow vegetation to be established because the sites are unpaved and are flat enough to allow sheet flow without scour to occur. To further promote infiltration and vegetation growth, compost, incorporate is incorporated to the design of all biofiltration strips within the Project.

Other locations for the placement biofiltration devices were evaluated and considered; however, these locations were determined to be infeasible due to: 1) the topography of the location (i.e., high velocities of storm water runoff traveling over steep slopes that could potentially erode the biofiltration strips and swales); 2) conflicts with underground utility facilities; 3) the close proximity of ESAs; 4) R/W constraints due to the development of proposed or active mining areas; or 5) the close proximity to the Zone 7 R/W, because infiltration is prohibited in areas adjacent to the future Chain of Lakes project.

Wet Basins

Wet basins were determined infeasible for the Project for the following reasons: 1) the volume of the wet basin above the permanent pool was not equal to at least the WQV using a 24 to 72 hour drawdown; and 2) a permanent source of water was not available, and there was not a sufficient amount of water to maintain a permanent pool for the wet basin. Furthermore, *The Alameda County Mosquito Abatement District Control Program* (1999) suggests that storm water facilities

where permanent standing water may be present (i.e. wet basins and Delaware filters) be designed to, "be kept clean of weeds with a water quality sufficient to support mosquito-eating fish."

Biofiltration Swales

Biofiltration swales are vegetated channels that can receive both overland and concentrated storm water flows. The consideration for the placement of biofiltration swales is similar to that of biofiltration strips; swales should be placed in areas where vegetation could be established and where scour from runoff would not occur. Further, biofiltration swales are not allowed in areas adjacent to Zone 7 areas. The proposed biofiltration swale locations are listed in Table 5.

Austin Sand Filters

Two AVSFs are being proposed for this Project. These devices primarily remove Total Suspended Solid (TSS) pollutants, such as sediments and metals, from storm water by means of sedimentation and filtering. They are also effective for removing dissolved metals and litter. Theses devices perform better where a drainage area has a relatively high percentage of impervious area, with low sediment loading. Austin sand filters also require sufficient hydraulic head, in order to operate the device (a minimum of 3 ft between the inflow and outflow chambers). There are two proposed locations within the Project limits that have enough head to operate the device effectively. AVSFs are the only type of treatment BMP that are allowed to be located adjacent to Zone 7 areas. The proposed locations for the two AVSF are listed in Table 5.

Detention Basins

A detention device is a permanent treatment BMP designed to reduce the sediment and particulate loading in runoff from the water quality design storm. Detention basins are best suited for areas with clayey soils where infiltration is not feasible. There was a detention basin proposed during the PA/ED Phase, but it did not have sufficient hydraulic head at that location to prevent the backwater effect onto the roadway. Furthermore, the treatment for this Project is achieved through the use of biofiltration strips, swales and AVSF, which are all ranked above detention basins for general pollutant removal.

Delaware Filters

Delaware filters remove fine sediment, particulate-associated pollutants and sometimes dissolved pollutants. Delaware filters meet the feasibility requirements for the Project, shown in Checklist T-1 in the attachments, and could be designed to effectively treat storm water runoff from the Project; however, there is a potential vector control issue presented with the implementation of this device. The design of a Delaware filter to meet the Alameda County Mosquito Abatement District requirements for storm water devices containing permanent pools of water would not be feasible or cost effective for the Project.

Multi-Chamber Treatment Train

The Multi-Chamber Treatment Train (MCTT) was developed for the treatment of storm water at "critical source areas" such as vehicle service facilities, parking areas, paved storage areas, and fueling stations. The Project site does not have "critical source areas"; thus, an MCTT was not

considered. In addition, MCTTs require permanent standing water or a permanent pool of water, which is not allowed by the local vector control agency.

6. Proposed Temporary Construction Site BMPs to be used on Project

Storm Water Pollution Prevention Plan

This Project involves disturbing more than 1 ac of soil; thus, a Storm Water Pollution Prevention Plan (SWPPP) will be prepared by the contractor that would identify BMPs to reduce water quality impacts during construction. The SWPPP should emphasize: 1) standard temporary erosion control measures to reduce sedimentation and turbidity of surface runoff from disturbed areas; 2) personnel training; 3) scheduling and implementation of BMPs throughout the various construction phases and during various seasons; 4) identification of BMPs for non-storm water discharge such as fuel spills; and 5) mitigation and monitoring throughout the construction period.

Construction Site BMP Strategy

The Project is within the jurisdiction of Caltrans District 4 and the SFBRWQCB. Elevations of the Project vary between 405 ft and 600 ft (123.4 m to 182.8 m). Based on the Project's location and elevation, the Project is within Rainfall Area 2, according to Caltrans' Construction Site BMPs Manual, Table 2-1 (Caltrans, March 2003). Temporary Construction Site BMPs considered are: soil stabilization, sediment barrier (or control), non-storm water management, and waste management.

Because this Project is expected to span two rainy seasons, the cost estimate is adjusted to reflect maintenance sharing.

Construction General Permit

This Project is subject to the Construction General Permit (CGP) as discussed in Section 3 of this report. Under this Permit, projects are required to complete a risk assessment to determine the combined sediment and receiving water risk. Based on these two risk factors, a project is given a risk level of 1, 2, or 3, with associated construction requirements increasing with the risk level number.

The sediment risk factor is determined from the product of the rainfall runoff erosivity factor (R), the soil erodibility factor (K), and the length-slope factor (LS). The R factor is determined from the United States Environmental Protection Agency "Rainfall Erosivity Factor Calculator". The K factor represents the susceptibility of soil to erosion and is a weighted average, by area, for all site soils. Data for K factor calculation is from the Natural Resources Conservation Service's (NRCS) Web Soil Survey. Hillslope length and gradient has an effect on erosion; generally speaking, as hillslope length and/or gradient increases, soil loss also increases. The LS factor is a weighted average, by area, for all slopes. The product of these three values is the Watershed Erosion Estimate, expressed in tons per acre.

The table below lists the values of each of these factors, which result in a Medium Sediment Risk Factor. See the Supplemental Attachments for greater detail of the sediment risk factor input values.

Table 6. Sediment Risk Factor

R Factor	Rainfall runoff erosivity	**79.68**
K Factor	Soil erodibility	**0.2**
LS Factor	Length-slope	**1.51**
RxKxLS	Watershed Erosion Estimate	**24.06 tons/acre**
Site Sediment Risk Factor	Low Sediment Risk: < 15 tons/acre Medium Sediment Risk: >=15 and <75 High Sediment Risk: >= 75	**MEDIUM**

The receiving water risk is classified as **Low** because none of the receiving water bodies is on the 303(d) List as impaired for sediment; additionally, none of the receiving water bodies has the beneficial uses of SPWN, COLD and MIGR.

The combined Medium sediment risk and Low receiving water risk, results in the Project being classified as Risk Level 2. Detailed requirements for Risk Level 2 projects are presented in Attachment D of the CGP.

Monitoring and Reporting

All sites regardless of risk level must conduct visual site monitoring, including routine weekly BMP inspections, rain event triggered inspections, and quarterly non-storm water monitoring. In addition, Risk Level 2 sites must perform non-visible pollutant sampling at all storm water runoff and non-storm water pollutant discharge points.

Risk Level 2 sites also have Numeric Action Level (NALs) on pH and turbidity of storm water effluent. Samples with pH greater than 8.5 or less than 6.5 or with turbidity greater than 250 NTU would require a NAL exceedance report. For more detailed description of Risk Level 2 BMP, monitoring, sampling, and reporting requirements, refer to Attachment D of the CGP. Monitoring costs are included in the BEES.

Soil Stabilization Measures

The following soil stabilization measures are considered for this Project and are included as separate bid line items in the Basic Engineering Estimating System (BEES) of this Project:

- Move In/Move Out (Temporary Erosion Control)
- Temporary Cover
- Hydraulic Mulch (Bonded Fiber Matrix)
- Temporary Fence (Type ESA)
- Check Dams

Sediment Control Measures

The following sediment control measures are considered for this Project and are included as separate bid line items:

- Temporary Fiber Rolls
- Temporary Silt Fence
- Temporary Drainage Inlet Protection

Desilting Basins

Desilting basins are not proposed for the Project. As stated in the Caltrans *Storm Water Quality Handbooks: Construction Site Best Management Practices (BMPs) Manual*, Table 2-2 and Table 2-3, the location of the Project would require desilting basins for only active areas, during a rainy season, with greater than 2:1 (H:V) slopes; slopes greater than 2:1 (H:V) are not anticipated for this Project.

Sediment Traps

Sediment traps are not proposed for this Project as there is not adequate space within the Project's R/W to construct and maintain this type of device.

Tracking Control

Because of the large footprint of the Project, the Project Team anticipates that several areas would need temporary construction entrances to avoid off-site tracking of sediment. The following tracking control measures are considered for this Project and are included as separate bid line items:

- Temporary Construction Entrance
- Street Sweeping

Non-Storm Water Management

Concrete work is proposed for this Project; therefore, temporary concrete washouts (portable) are included as a separate line item. All other anticipated no-storm water management measures would be covered under the Construction Site Management lump sum.

- Temporary Concrete Washout (Portable)

Dewatering

The Project includes bridge widening or replacement over the creeks at Arroyo Mocho and Arroyo Del Valle. Dewatering is anticipated for this Project and is included as a separate bid line item, as temporary active treatment system. However, a separate dewatering permit is not anticipated.

Most bridge excavations are anticipated to be made in the dry (i.e., groundwater below bottom of excavation), with the exception of the following locations:

1. Arroyo Del Valle Trail Bridge
   Bent 2; water head of 3.5 ft; clayey sand (SC)
2. Arroyo Del Valle Widen
   Bent 2; water head of 2 ft; clayey sand (SC) and clayey gravel (GC)

Water head is defined as the difference of elevation of water level in boring at time of drilling minus elevation of bottom of excavation. Because neither laboratory nor field tests were within the scope of work, it is difficult to estimate construction pumping rates. However, it appears that where heads are small (less than 5 feet) and SC, GC and CL soils were encountered, pumping rates might be relatively small. Based on the site soil conditions and the empirical relationships between grain sizes and permeability, URS estimates order of magnitude pumping rates ranging from 30 to 200 gallons per minutes (gpm). Further discussion of dewatering can be found in an internal URS memorandum dated August 5, 2010, which is included in the appendices.

- Temporary Active Treatment System

Construction Site Management

It is also anticipated that the following "housekeeping" BMPs would be implemented for this Project, designated under the lump sum "Construction Site Management" item.

- Spill prevention and control
- Materials management
- Stockpile management
- Waste management
- Concrete waste
- Water control and conservation
- Vehicle and equipment cleaning
- Vehicle and equipment fueling and maintenance
- Paving
- Saw cutting
- Grinding operations
- Thermoplastic striping and pavement markers
- Concrete curing
- Concrete finishing

Additionally, the following miscellaneous items are included as separate bid line items:

- Water Sampling and Analysis
- Water Pollution Control Maintenance Sharing
- Additional Water Pollution Control

The quantities and costs for construction site BMPs proposed for this Project are included in the attachments.

7. Maintenance BMPs (Drain Inlet Stenciling)

Inlet stenciling is proposed for all inlets within the Project where pedestrians or bicyclists are permitted. Caltrans-approved stenciling would be specified for drainage inlets within the State's R/W. The City of Pleasanton and the City of Livermore also have specific drainage inlet stenciling details that would be used for inlets located with each City's R/W. Specific locations, Plans, Special Provisions, and costs associated with stenciling drainage inlets would be provided in the Contract Documents.

REQUIRED ATTACHMENTS

- ⇒ **Location Map**
- ⇒ **Vicinity Map**
- ⇒ **Evaluation Documentation Form (EDF)**
- ⇒ **Construction Site BMP Consideration Form**
- ⇒ **Treatment BMP Summary Spreadsheets**
- ⇒ **Quantities for BMPs**

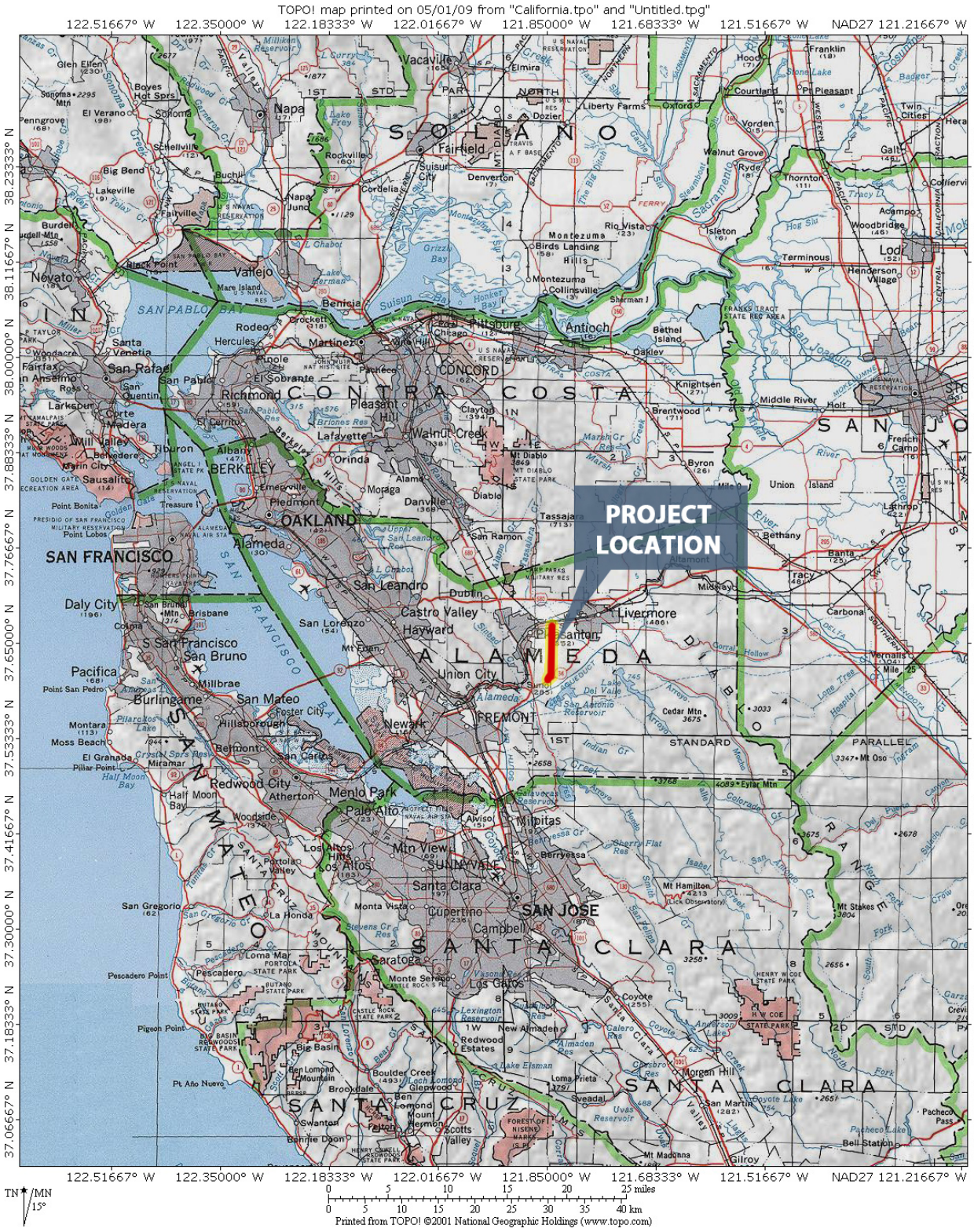


Figure 1. Location Map

Source: USGS

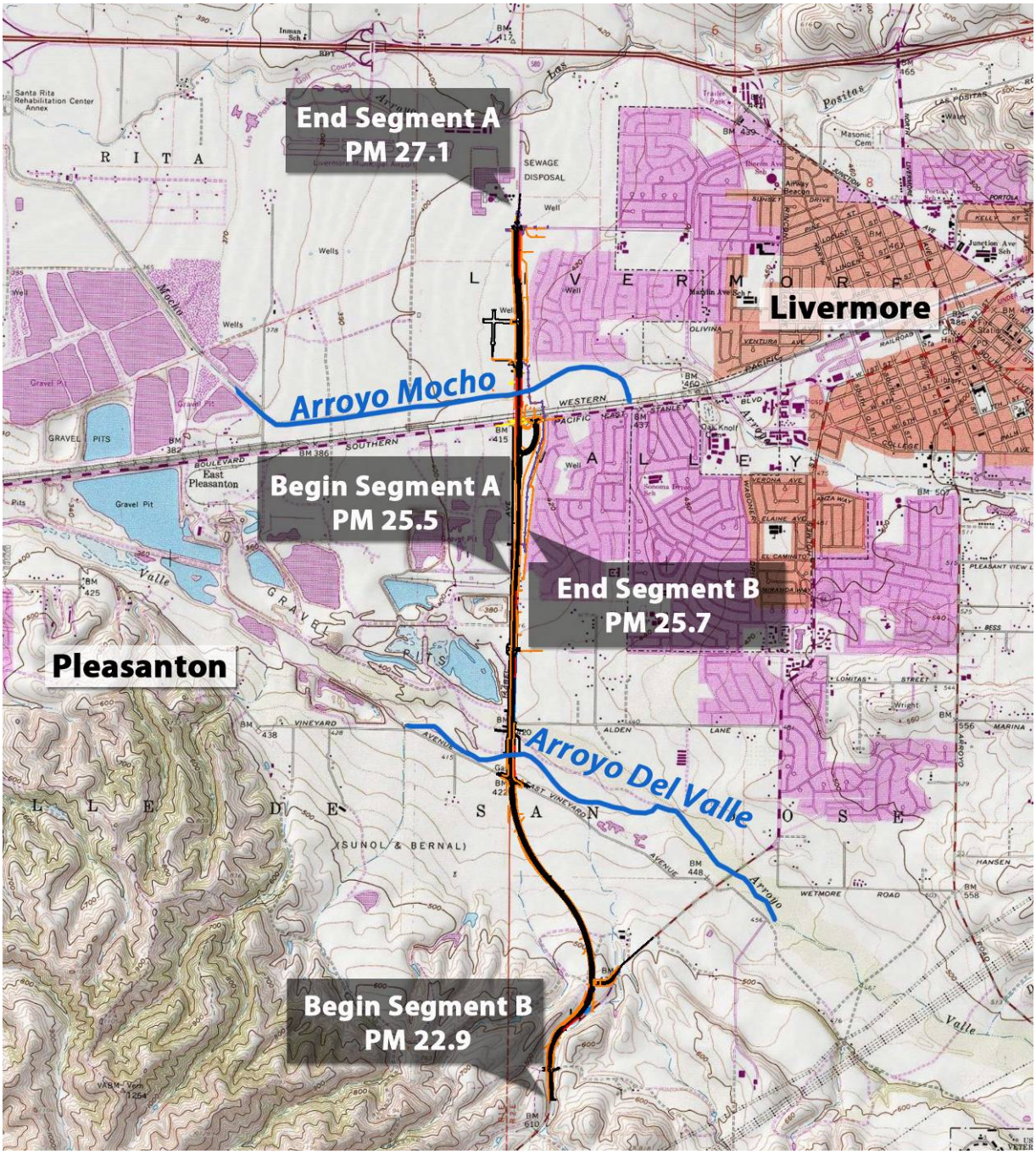


Figure 2. Vicinity Map

Source: USGS

DATE: Oct 2010

See Figure 4-1, Project Evaluation Process for Consideration of Permanent Treatment BMPS EA: 04-297601

NO.	CRITERIA	YES	NO	SUPPLEMENTAL INFORMATION FOR EVALUATION
1.	Begin Project Evaluation regarding requirement for consideration of Treatment BMPs	☒		Go to 2
2.	Is this an emergency project?	☐	☒	If **Yes**, go to 11. If **No**, continue to 3.
3.	Have TMDLs or other Pollution Control Requirements been established for surface waters within the project limits? Information provided in the water quality assessment or equivalent document.	☒	☐	If **Yes**, contact the District/Regional NPDES Coordinator to discuss the Department's obligations under the TMDL (if Applicable) or Pollution Control Requirements, go to 10 or 4. _____ (*Dist./Reg. SW Coordinator initials*) If **No**, continue to 4.
4.	Is the project located within an area of a local MS4 Permittee?	☒	☐	If **Yes**. (*Alameda County*), go to 5. If **No**, document in SWDR go to 5.
5.	Is the project directly or indirectly discharging to surface waters?	☒	☐	If **Yes**, continue to 6. If **No**, go to 11.
6.	Is this a new facility or major reconstruction?	☒	☐	If **Yes**, continue to 8. If **No**, go to 7.
7.	Will there be a change in line/grade or hydraulic capacity?	☐	☐	If **Yes**, continue to 8. If **No**, go to 11.
8.	Does the project result in a net increase or does the project rework one acre or more of impervious surface?	☒	☐	If **Yes**, continue to 10. If **No**, go to 9. *27.63 ac (Net Increase total = 27.23 ac in Caltrans R/W and 0.40 ac in City/Zone 7 R/W)* *8.7 ac (Reworked, all in Caltrans R/W)*
9.	Is the project part of a Common Plan of Development?	☐	☐	If **Yes**, continue to 10. If **No**, go to 11.
10.	Project is required to consider approved Treatment BMPs.	☒	See Sections 2.4 and either Section 5.5 or 6.5 for BMP Evaluation and Selection Process. Complete Checklist T-1 in this Appendix E.	
11.	Project is not required to consider Treatment BMPs. _____*(Dist./Reg. SW Coord. Initials)* _____*(Project Engineer Initials)* _____ *(Date)*	☐	Document for Project Files by completing this form, and attaching it to the SWDR.	

See Figure 4-1, Project Evaluation Process for Consideration of Permanent Treatment BMPs

DATE: Oct 2010

Project Evaluation Process for the Consideration of Construction Site BMPs EA: 04-297601

NO.	CRITERIA	YES	NO	SUPPLEMENTAL INFORMATION
1.	Will construction of the project result in areas of disturbed soil as defined by the Project Planning and Design Guide (PPDG)?	☒	☐	If **Yes**, Construction Site BMPs for Soil Stabilization (SS) will be required. Complete CS-1, Part 1. Continue to 2. If **No**, Continue to 3.
2.	Is there a potential for disturbed soil areas within the project to discharge to storm drain inlets, drainage ditches, areas outside the right of way, etc?	☒	☐	If **Yes**, Construction Site BMPs for Sediment Control (SC) will be required. Complete CS-1, Part 2. Continue to 3.
3.	Is there a potential for sediment or construction related materials and wastes to be tracked offsite and deposited on private or public paved roads by construction vehicles and equipment?	☒	☐	If **Yes**, Construction Site BMPs for Tracking Control (TC) will be required. Complete CS-1, Part 3. Continue to 4.
4.	Is there a potential for wind to transport soil and dust offsite during the period of construction?	☒	☐	If **Yes**, Construction Site BMPs for Wind Erosion Control (WE) will be required. Complete CS-1, Part 4. Continue to 5.
5.	Is dewatering anticipated or will construction activities occur within or adjacent to a live channel or stream?	☒	☐	If **Yes**, Construction Site BMPs for Non-Storm Water Management (NS) will be required. Complete CS-1, Part 5. Continue to 6.
6.	Will construction include saw-cutting, grinding, drilling, concrete or mortar mixing, hydro-demolition, blasting, sandblasting, painting, paving, or other activities that produce residues?	☒	☐	If **Yes**, Construction Site BMPs for Non-Storm Water Management (NS) will be required. Complete CS-1, Part 5. Continue to 7.
7.	Are stockpiles of soil, construction related materials, and/or wastes anticipated?	☒	☐	If **Yes**, Construction Site BMPs for Waste Management and Materials Pollution Control (WM) will be required. Complete CS-1, Part 6. Continue to 8.
8.	Is there a potential for construction related materials and wastes to have direct contact with precipitation; storm water run-on, or stormwater runoff; be dispersed by wind; be dumped and/or spilled into storm drain systems?	☒	☐	If **Yes**, Construction Site BMPs for Waste Management and Materials Pollution Control (WM) will be required. Complete CS-1, Part 6. Continue to 9.
9.	End of checklist.	☒	Document for Project Files by completing this form, and attaching it to the SWDR.	

AAO 1/12/11

PE to initialize after concurrence with Construction (PS&E only) *Date*

Treatment BMP Summary Spreadsheet

Dist-County-Route:	**04-Ala-84**
Post Mile Limits:	**22.9/27.1**
Project Type:	**Expressway Widening**
EA:	**04-297601**
RU:	**04256**
Program Identification:	**20.10.400**
Phase:	**PS&E**
Date:	**03/15/10**
Construction Start:	**October 2011**
Construction End:	**August 2013**

BMP ID No.	Treatment Type	Begin Station	End Station	Rt or Lt	Treated Area (sq ft)	Treated Area (ac)	WQV (ac-ft)	WQF (ft3/s)	Design Storm Flow (25-year) (ft3/s)	Velocity for the Design Storm (ft/s)	Depth of Flow for Design Storm (ft)
BMP-1	Biofiltration Strip	"A1" Line 231+00	"A1" Line 233+44	Rt	11,751	0.27	n/a	0.05	n/a	n/a	n/a
BMP-2	Biofiltration Strip	"A1" Line 235+25	"A1" Line 244+04	Rt	91,245	2.09	n/a	0.42	n/a	n/a	n/a
BMP-3	Biofiltration Swale	"VEx" Line 53+76	"VEx" Line 54+59	Lt	37,508	0.86	n/a	0.35	4.37	1.41	0.45
BMP-4	Biofiltration Strip	"VEx" Line 53+47	"VEx" Line 55+74	Lt	6,517	0.15	n/a	0.03	n/a	n/a	n/a
BMP-5	Biofiltration Strip	"V" Line 103+10	"V" Line 109+00	Lt	25,795	0.59	n/a	0.12	n/a	n/a	n/a
BMP-6	Biofiltration Swale	"V" Line 105+50	"V" Line 107+00	Lt	128,502	2.95	n/a	1.03	16.78	2.68	0.77
BMP-7	Biofiltration Swale	"A1" Line 299+00	"A1" Line 301+50	Lt	135,043	3.10	n/a	1.87	30.38	2.96	1.20
BMP-8	Biofiltration Swale	"A1" Line 285+14	"A1" Line 287+64	Rt	110,243	2.53	n/a	0.80	12.92	2.60	0.67
BMP-9	Biofiltration Strip	"A1" Line 285+10	"A1" Line 312+19	Rt	153,366	3.52	n/a	0.70	n/a	n/a	n/a
BMP-10	Biofiltration Swale	"A1" Line 296+04	"A1" Line 298+04	Rt	48,720	1.12	n/a	0.29	2.55	1.38	0.53
BMP-11	Biofiltration Swale	"A1" Line 301+04	"A1" Line 302+54	Rt	22,647	0.52	n/a	0.15	2.43	1.11	0.36
BMP-12	Biofiltration Swale	"A1" Line 306+75	"A1" Line 308+25	Rt	26,355	0.61	n/a	0.18	2.88	1.39	0.33
BMP-13	Austin Vault Sand Filter (Segment B)	"A1" Line 321+15*	"A1" Line 322+67*	Lt	451,148	10.36	0.49	n/a	n/a	n/a	n/a
BMP-14	Austin Vault Sand Filter (Segment A)	"A2" Line 390+14*	"A2" Line 391+15*	Rt	367,108	8.43	0.40	n/a	n/a	n/a	n/a
			Total Proposed Treatment:		**1,615,948**	**37.10**	**ac**				
				Goal:		**37.05**	**ac**				

Percent Treatment: 100 %

* Note : AVSF stationing limits are measured from the two interior corners of the vaults that are closest to the stationing line.

SEGMENT A

Temporary Construction Site BMPs

ID	BEES	Temporary BMPs - PPDG Appendix C	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
		Temporary Soil Stabilization				
SS-1	074037	Move-In/Move-out (Temporary Erosion Control)	07-485	No	4	EA
SS-2	071325	Temporary Fence (Type ESA)	07-446	Yes	2,200	LF
SS-3	074040	Temp. Hydraulic Mulch (Bonded Fiber Matrix)	07-381	No	17,500	SQYD
	074035	Temporary Check Dam			1000	LF
SS-7	074034	Temporary Cover	07-395	Yes	10,000	SQYD

Subtotal Soil Stabilization BMPs

ID	BEES	***Temporary Sediment Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
SC-1	074029	Temporary Silt Fence	07-430	Yes	20,000	LF
SC-5	074028	Temporary Fiber Rolls	07-420	Yes	6,710	LF
SC-10	074038	Temporary Drainage Inlet Protection	07-490	Yes	110	EA

Subtotal Sediment Control BMPs

ID	BEES	***Temporary Tracking Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
TC-1	074033	Temporary Construction Entrance	07-480	Yes	7	EA
SC-7	074041	Street Sweeping	07-360	No	1	LS

Subtotal Tracking Control BMPs

ID	BEES	***Temporary Waste Management Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
WM-1	CSM*	Material Delivery and Storage	07-346	No		LS
WM-2	CSM*	Material Use	07-346	No		LS
WM-3	CSM*	Stockpile Management	07-346	No		LS
SS-7	074034	Plastic Covers	07-395	Yes		m^2
WM-4	CSM*	Spill Prevention and Control	07-346	No		LS
WM-5	CSM*	Solid Waste Management	07-346	No		LS
WM-6	CSM*	Hazardous Waste Management	07-346	No		LS
WM-7	CSM*	Contaminated Soil Management	07-346	No		LS
WM-8		Concrete Waste Management	07-346	No		LS
WM-8	074032	Temporary Concrete Washout (Portable)	07-405	Yes	7	EA
		Grinding PCC (Displ of PCC Pavemt Grooving & Grinding Residues)	42-600	No		LS
WM-9	CSM*	Sanitary/Septic Waste Managemt	07-346	No		LS
WM-10	CSM*	Liquid Waste Management	07-346	No		LS

Subtotal Waste Management & Materials Handling BMPs

ID	BEES	***Temporary Non-Storm Water Management***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
NS-1	CSM*	Water Conservation Practices	07-346	No		LS
NS-2	074015	Temporary Active Treatment System (Dewatering Operations)	07-347	No	1	LS
NS-6	CSM*	Detection and Reporting	07-346	No		LS
NS-7	CSM*	Potable Water/Irrigation	07-346	No		LS
NS-8	CSM*	Vehicle and Equipment Cleaning	07-346	No		LS
NS-9	CSM*	Vehicle and Equipment Fueling	07-346	No		LS
NS-10	CSM*	Vehicle and Equipmt Maintenance	07-346	No		LS
NS-11	CSM*	Pile Driving Operations	07-346	No		LS
NS-12	CSM*	Concrete Curing	07-346	No		LS
NS-13	CSM*	Material & Equipmt use over water	07-346	No		LS
NS-14	CSM*	Concrete Finishing	07-346	No		LS
NS-17		Streambank Stabilization				LS
	074016	***Construction Site Management**	07-346	No	1	LS

Subtotal Non-Storm Water Management

ID	BEES	***Miscellaneous Items***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
	074019	Prepare Storm Water Pollution Prevention Plan	07-345	No	1	LS
	074056	Rain Event Action Plan	07-345	No	75	EA
	074057	Storm Water Annual Report	07-345	No	2	EA
	074058	Storm Water Sampling and Analysis Day	07-345	No	50	EA
	066596	Additional Water Pollution Control		No	1	LS
	066597	Storm Water Sampling and Analysis	07-345	No	1	LS
	66595	Water Pollution Control Maintenance Sharing	05-020	No	1	LS

Subtotal Miscellaneous Items

SEGMENT B

Temporary Construction Site BMPs

ID	BEES	Temporary BMPs - PPDG Appendix C	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
		Temporary Soil Stabilization				
SS-1	074037	Move-In/Move-out (Temporary Erosion Control)	07-485	No	5	EA
SS-2	071325	Temporary Fence (Type ESA)	07-446	Yes	3,400	LF
SS-3	074040	Temp. Hydraulic Mulch (Bonded Fiber Matrix)	07-381	No	38,000	SQYD
	071324	Temporary Check Dam			3000	LF
SS-7	074034	Temporary Cover	07-395	Yes	20,000	SQYD

Subtotal Soil Stabilization BMPs

ID	BEES	***Temporary Sediment Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
SC-1	074029	Temporary Silt Fence	07-430	Yes	40,000	LF
SC-5	074028	Temporary Fiber Rolls	07-420	Yes	5,800	LF
SC-10	074038	Temporary Drainage Inlet Protection	07-490	Yes	200	EA

Subtotal Sediment Control BMPs

ID	BEES	***Temporary Tracking Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
TC-1	074033	Temporary Construction Entrance	07-480	Yes	10	EA
SC-7	074041	Street Sweeping	07-360	No	1	LS

Subtotal Tracking Control BMPs

ID	BEES	***Temporary Waste Management Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
WM-1	CSM*	Material Delivery and Storage	07-346	No		LS
WM-2	CSM*	Material Use	07-346	No		LS
WM-3	CSM*	Stockpile Management	07-346	No		LS
SS-7	074034	Plastic Covers	07-395	Yes		m^2
WM-4	CSM*	Spill Prevention and Control	07-346	No		LS
WM-5	CSM*	Solid Waste Management	07-346	No		LS
WM-6	CSM*	Hazardous Waste Management	07-346	No		LS
WM-7	CSM*	Contaminated Soil Management	07-346	No		LS
WM-8		Concrete Waste Management	07-346	No		LS
WM-8	074042	Temporary Concrete Washout (Portable)	07-405	Yes	10	EA
		Grinding PCC (Displ of PCC Pavemt Grooving & Grinding Residues)	42-600	No		LS
WM-9	CSM*	Sanitary/Septic Waste Managemt	07-346	No		LS
WM-10	CSM*	Liquid Waste Management	07-346	No		LS

Subtotal Waste Management & Materials Handling BMPs

ID	BEES	***Temporary Non-Storm Water Management***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
NS-1	CSM*	Water Conservation Practices	07-346	No		LS
NS-2	074015	Temporary Active Treatment System	07-347	No	1	LS
NS-6	CSM*	Detection and Reporting	07-346	No		LS
NS-7	CSM*	Potable Water/Irrigation	07-346	No		LS
NS-8	CSM*	Vehicle and Equipment Cleaning	07-346	No		LS
NS-9	CSM*	Vehicle and Equipment Fueling	07-346	No		LS
NS-10	CSM*	Vehicle and Equipmt Maintenance	07-346	No		LS
NS-11	CSM*	Pile Driving Operations	07-346	No		LS
NS-12	CSM*	Concrete Curing	07-346	No		LS
NS-13	CSM*	Material & Equipmt use over water	07-346	No		LS
NS-14	CSM*	Concrete Finishing	07-346	No		LS
NS-17		Streambank Stabilization				LS
	074016	***Construction Site Management**	07-346	No	1	LS

Subtotal Non-Storm Water Management

ID	BEES	***Miscellaneous Items***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit
	074019	Prepare Storm Water Pollution Prevention Plan	07-345	No	1	LS
	074056	Rain Event Action Plan	07-345	No	75	EA
	074057	Storm Water Annual Report	07-345	No	2	EA
	074058	Storm Water Sampling and Analysis Day	07-345	No	50	EA
	066596	Additional Water Pollution Control		No	1	LS
	066597	Storm Water Sampling and Analysis	07-345	No	1	LS
	66595	Water Pollution Control Maintenance Sharing	05-020	No	1	LS

Subtotal Miscellaneous Items

SUPPLEMENTAL ATTACHMENTS

- ⇒ Storm Water BMP Cost Summary
- ⇒ Austin Vault Sand Filter Cost Estimate
- ⇒ Checklist SW-1, Site Data Sources
- ⇒ Checklist SW-2, Storm Water Quality Issues Summary
- ⇒ Checklist SW-3, Measures for Avoiding or Reducing Potential Storm Water BMPs
- ⇒ Checklists DPP-1, Parts 1–5 (Design Pollution Prevention BMPs)
- ⇒ Checklists T-1, Parts 1, 2 and 8 (Treatment BMPs)
- ⇒ Checklists CS-1, Parts 1–6 (Construction Site BMPs)
- ⇒ Chain of Lakes Map
- ⇒ Soils Map
- ⇒ Construction General Permit Risk Assessment Calculations
- ⇒ Layout Sheets
- ⇒ Temporary Water Pollution Control Plans
- ⇒ Erosion Control Plans
- ⇒ Drainage Plans
- ⇒ Drainage Profiles and Details (AVSF Only)
- ⇒ Treatment BMP Watershed Maps
- ⇒ Treatment BMPs Calculations
- ⇒ Dewatering Memorandum

SEGMENT A

Project Name:	**State Route 84 Expressway Widening SEGMENT A**
District:	**04**
EA:	**04-297601**
County:	**Ala**
Route:	**84**
Postmile:	**22.9**
End Postmile:	**27.1**

Total Treatment BMP Costs	$ 1,565,000
Total Design Pollution Prevention BMP Costs	$ 297,063
Total Permanent Storm Water BMP Costs	$ 1,862,063
Subtotal Soil Stabilization BMPs	$ 69,600
Subtotal Sediment Control BMPs	$ 91,091
Subtotal Wind Erosion Control BMPs	$ -
Subtotal Tracking Control BMPs	$ 45,000
Subtotal Waste Management & Materials Handling BMPs	$ 11,200
Subtotal Non-Storm Water Management	$ 130,000
Subtotal Miscellaneous Items	$ 133,900
Total Construction Site BMP Costs	$ 480,791
TOTAL COST FOR STORM WATER BMPs	$ 2,342,854

SEGMENT B

Project Name:	**State Route 84 Expressway Widening SEGMENT B**
District:	**04**
EA:	**04-297601**
County:	**Ala**
Route:	**84**
Postmile:	**22.9**
End Postmile:	**27.1**

Total Treatment BMP Costs	$ 2,186,351
Total Design Pollution Prevention BMP Costs	$ 608,721
Total Permanent Storm Water BMP Costs	$ 2,795,072
Subtotal Soil Stabilization BMPs	$ 149,500
Subtotal Sediment Control BMPs	$ 160,180
Subtotal Wind Erosion Control BMPs	$ -
Subtotal Tracking Control BMPs	$ 50,000
Subtotal Waste Management & Materials Handling BMPs	$ 16,000
Subtotal Non-Storm Water Management	$ 330,000
Subtotal Miscellaneous Items	$ 210,250
Total Construction Site BMP Costs	$ 915,930
TOTAL COST FOR STORM WATER BMPs	$ 3,711,002

SEGMENT A

Treatment BMPs

BEES	Pollution Prevention BMPs PPDG Appendix A	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
034731	Austin Vault Sand Filter			1	LS	1,565,000.00	$ 1,565,000
				Total Treatment BMP Costs			$ 1,565,000

Design Pollution Prevention BMPs

BEES	Pollution Prevention BMPs PPDG Appendix A	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
	Slope/Surface Protection Systems-Vegetated Surfaces						
203026	Move-in/Move-Out (Erosion Control)	20-020	N	4	EA	1,500.00	$ 6,000
203016	Erosion Control (Hydroseed)	20-040	N	222,000	SQFT	0.10	$ 22,200
203025	Compost (Incorporate)	20-056	N	23,900	SQYD	10.00	$ 239,000
203021	Fiber Rolls	20-060	Y	6,710	LF	1.80	$ 12,078
203018	Rolled Erosion Control Product (Netting)	20-015	N	12,800	SQFT	0.95	$ 12,160
	Concentrated Flow Conveyance Systems						
194001	Ditch Excavation	N	N	125	CY	45.00	$ 5,625
				Total Design Pollution Prevention BMP Costs			$ 297,063

Total Permanent Storm Water BMP Costs	**$ 1,862,063**

SEGMENT B

Treatment BMPs

BEES	Pollution Prevention BMPs PPDG Appendix A	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
203025	Compost, Incorporate	20-056	N	13,954	SQYD	10.00	$ 139,540
203021	Fiber Rolls	20-060	Y	546	LF		
203016	Erosion Control (Hydroseed)	20-040	N	125,541	SQFT	0.10	$ 12,554
203018	Rolled Erosion Control Product (Netting)	20-015	N	17,702	SQFT	0.95	$ 16,817
204013	Plant (Group M)	20-502	N	6,380	EA	15.00	$ 95,700
038110	Imported Soil Media			570	CY	65.00	$ 37,068
682045	Class 3 Permeable Material			555	CY	70.00	$ 38,850
681990	Filter Fabric			2,707	SQYD	7.00	$ 18,949
680905	8" Perforated Plastic Pipe Underdrain			1,259	LF	55.00	$ 69,245
681030	8" Plastic Pipe			1,782	LF	75.00	$ 133,628
034731	Austin Vault Sand Filter			1	LS	1,624,000.00	$ 1,624,000
					Total Treatment BMP Costs		$ 2,186,351

Design Pollution Prevention BMPs

BEES	Pollution Prevention BMPs PPDG Appendix A	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
	Slope/Surface Protection Systems- Hard Surfaces						
705309	15" Alternative Flared End Section	N	Y	1	EA	600.00	$ 600
705311	18" Alternative Flared End Section	N	Y	10	EA	550.00	$ 5,500
705319	30" Alternative Flared End Section	N	Y	1	EA	1000.00	$ 1,000
721008	Rock Slope Protection (Light, Method B)	72-010	N	99	CY	200.00	$ 19,800
721011	Rock Slope Protection (Backing No. 2, Method B)			52	CY	200.00	$ 10,400
729010	Rock Slope Protection Fabric	72-150	N	1129	SQYD	10.00	$ 11,290
	Slope/Surface Protection Systems- Vegetated Surfaces						
203026	Move-in/Move-out (Erosion Control)	20-020	N	5	EA	1,500.00	$ 7,500
203016	Erosion Control (Hydroseed)	20-040	N	395,459	SQFT	0.10	$ 39,546
203025	Compost, Incorporate	20-056	N	35,746	SQYD	10.00	$ 357,460
203021	Fiber Rolls	20-060	Y	5,254	LF	1.80	$ 9,457
203018	Rolled Erosion Control Product (Netting)	20-015	N	89,298	SQFT	0.95	$ 84,833
	Concentrated Flow Conveyance Systems						
194001	Ditch Excavation	N	N	1,363	CY	45.00	$ 61,335
					Total Design Pollution Prevention BMP Costs		$ 608,721

Total Permanent Storm Water BMP Costs	**$ 2,795,072**

SEGMENT A

Temporary Construction Site BMPs

ID	BEES	Temporary BMPs - PPDG Appendix C	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
		Temporary Soil Stabilization						
SS-1	074037	Move-In/Move-out (Temporary Erosion Control)	07-485	No	4	EA	900	$ 3,600
SS-2	071325	Temporary Fence (Type ESA)	07-446	Yes	2,200	LF	5.00	$ 11,000
SS-3	074040	Temp. Hydraulic Mulch (Bonded Fiber Matrix)	07-381	No	17,500	SQYD	1.00	$ 17,500
	074035	Temporary Check Dam			1000	LF	15	$ 15,000
SS-7	074034	Temporary Cover	07-395	Yes	10,000	SQYD	2.25	$ 22,500
							Subtotal Soil Stabilization BMPs	**$ 69,600**

ID	BEES	***Temporary Sediment Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
SC-1	074029	Temporary Silt Fence	07-430	Yes	20,000	LF	2.20	$ 44,000
SC-5	074028	Temporary Fiber Rolls	07-420	Yes	6,710	LF	2.10	$ 14,091
SC-10	074038	Temporary Drainage Inlet Protection	07-490	Yes	110	EA	300	$ 33,000
							Subtotal Sediment Control BMPs	**$ 91,091**

ID	BEES	***Temporary Tracking Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
TC-1	074033	Temporary Construction Entrance	07-480	Yes	7	EA	3,100	$ 21,700
SC-7	074041	Street Sweeping	07-360	No	1	LS	10,000	$ 10,000
							Subtotal Tracking Control BMPs	**$ 45,000**

ID	BEES	***Temporary Waste Management Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
WM-1	CSM*	Material Delivery and Storage	07-346	No		LS		$ -
WM-2	CSM*	Material Use	07-346	No		LS		$ -
WM-3	CSM*	Stockpile Management	07-346	No		LS		$ -
SS-7	074034	Plastic Covers	07-395	Yes		m^2		$ -
WM-4	CSM*	Spill Prevention and Control	07-346	No		LS		$ -
WM-5	CSM*	Solid Waste Management	07-346	No		LS		$ -
WM-6	CSM*	Hazardous Waste Management	07-346	No		LS		$ -
WM-7	CSM*	Contaminated Soil Management	07-346	No		LS		$ -
WM-8		Concrete Waste Management	07-346	No		LS		$ -
WM-8	074032	Temporary Concrete Washout (Portable)	07-405	Yes	7	EA	1,600	$ 11,200
		Grinding PCC (Displ of PCC Pavemt Grooving & Grinding Residues)	42-600	No		LS		$ -
WM-9	CSM*	Sanitary/Septic Waste Managemt	07-346	No		LS		$ -
WM-10	CSM*	Liquid Waste Management	07-346	No		LS		$ -
							Subtotal Waste Management & Materials Handling BMPs	$ 11,200

ID	BEES	***Temporary Non-Storm Water Management***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
NS-1	CSM*	Water Conservation Practices	07-346	No		LS		$ -
NS-2	074015	Temporary Active Treatment System (Dewatering Operations)	07-347	No	1	LS	30,000	$ 30,000
NS-6	CSM*	Detection and Reporting	07-346	No		LS		$ -
NS-7	CSM*	Potable Water/Irrigation	07-346	No		LS		$ -
NS-8	CSM*	Vehicle and Equipment Cleaning	07-346	No		LS		$ -
NS-9	CSM*	Vehicle and Equipment Fueling	07-346	No		LS		$ -
NS-10	CSM*	Vehicle and Equipmt Maintenance	07-346	No		LS		$ -
NS-11	CSM*	Pile Driving Operations	07-346	No		LS		$ -
NS-12	CSM*	Concrete Curing	07-346	No		LS		$ -
NS-13	CSM*	Material & Equipmt use over water	07-346	No		LS		$ -
NS-14	CSM*	Concrete Finishing	07-346	No		LS		$ -
NS-17		Streambank Stabilization				LS		$ -
	074016	***Construction Site Management**	07-346	No	1	LS	100,000	$ 100,000
							Subtotal Non-Storm Water Management	$ 130,000

ID	BEES	***Miscellaneous Items***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
	074019	Prepare Storm Water Pollution Prevention Plan	07-345	No	1	LS	7,000	$ 7,000
	074056	Rain Event Action Plan	07-345	No	75	EA	500	$ 37,500
	074057	Storm Water Annual Report	07-345	No	2	EA	2,000	$ 4,000
	074058	Storm Water Sampling and Analysis Day	07-345	No	50	EA	1,048	$ 52,400
	066596	Additional Water Pollution Control		No	1	LS	10,000	$ 10,000
	066597	Storm Water Sampling and Analysis	07-345	No	1	LS	6,000	$ 6,000
	66595	Water Pollution Control Maintenance Sharing	05-020	No	1	LS	10,000	$ 10,000
							Subtotal Miscellaneous Items	**$ 133,900**

Total Construction Site BMP Costs	**$ 480,791**

SEGMENT B

Temporary Construction Site BMPs

ID	BEES	Temporary BMPs - PPDG Appendix C	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost ($)
		Temporary Soil Stabilization						
SS-1	074037	Move-In/Move-out (Temporary Erosion Control)	07-485	No	5	EA	900	$ 4,500
SS-2	071325	Temporary Fence (Type ESA)	07-446	Yes	3,400	LF	5.00	$ 17,000
SS-3	074040	Temp. Hydraulic Mulch (Bonded Fiber Matrix)	07-381	No	38,000	SQYD	1.00	$ 38,000
	071324	Temporary Check Dam			3000	LF	15	$ 45,000
SS-7	074034	Temporary Cover	07-395	Yes	20,000	SQYD	2.25	$ 45,000
							Subtotal Soil Stabilization BMPs	**$ 149,500**

ID	BEES	***Temporary Sediment Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
SC-1	074029	Temporary Silt Fence	07-430	Yes	40,000	LF	2.20	$ 88,000
SC-5	074028	Temporary Fiber Rolls	07-420	Yes	5,800	LF	2.10	$ 12,180
SC-10	074038	Temporary Drainage Inlet Protection	07-490	Yes	200	EA	300	$ 60,000
							Subtotal Sediment Control BMPs	**$ 160,180**

ID	BEES	***Temporary Tracking Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
TC-1	074033	Temporary Construction Entrance	07-480	Yes	10	EA	3,100	$ 31,000
SC-7	074041	Street Sweeping	07-360	No	1	LS	15,000	$ 15,000
							Subtotal Tracking Control BMPs	**$ 50,000**

ID	BEES	***Temporary Waste Management Control***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
WM-1	CSM*	Material Delivery and Storage	07-346	No		LS		$ -
WM-2	CSM*	Material Use	07-346	No		LS		$ -
WM-3	CSM*	Stockpile Management	07-346	No		LS		$ -
SS-7	074034	Plastic Covers	07-395	Yes		m^2		$ -
WM-4	CSM*	Spill Prevention and Control	07-346	No		LS		$ -
WM-5	CSM*	Solid Waste Management	07-346	No		LS		$ -
WM-6	CSM*	Hazardous Waste Management	07-346	No		LS		$ -
WM-7	CSM*	Contaminated Soil Management	07-346	No		LS		$ -
WM-8		Concrete Waste Management	07-346	No		LS		$ -
WM-8	074042	Temporary Concrete Washout (Portable)	07-405	Yes	10	EA	1,600	$ 16,000
		Grinding PCC (Displ of PCC Pavemt Grooving & Grinding Residues)	42-600	No		LS		$ -
WM-9	CSM*	Sanitary/Septic Waste Managemt	07-346	No		LS		$ -
WM-10	CSM*	Liquid Waste Management	07-346	No		LS		$ -
							Subtotal Waste Management & Materials Handling BMPs	$ 16,000

ID	BEES	***Temporary Non-Storm Water Management***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
NS-1	CSM*	Water Conservation Practices	07-346	No		LS		$ -
NS-2	074015	Temporary Active Treatment System	07-347	No	1	LS	30,000	$ 30,000
NS-6	CSM*	Detection and Reporting	07-346	No		LS		$ -
NS-7	CSM*	Potable Water/Irrigation	07-346	No		LS		$ -
NS-8	CSM*	Vehicle and Equipment Cleaning	07-346	No		LS		$ -
NS-9	CSM*	Vehicle and Equipment Fueling	07-346	No		LS		$ -
NS-10	CSM*	Vehicle and Equipmt Maintenance	07-346	No		LS		$ -
NS-11	CSM*	Pile Driving Operations	07-346	No		LS		$ -
NS-12	CSM*	Concrete Curing	07-346	No		LS		$ -
NS-13	CSM*	Material & Equipmt use over water	07-346	No		LS		$ -
NS-14	CSM*	Concrete Finishing	07-346	No		LS		$ -
NS-17		Streambank Stabilization				LS		$ -
	074016	***Construction Site Management**	07-346	No	1	LS	300,000	$ 300,000
							Subtotal Non-Storm Water Management	$ 330,000

ID	BEES	***Miscellaneous Items***	SSP/nSSP (#, Y or N)	STD. Det. (Y or N)	Quantity	Unit	Unit Cost ($/Unit)	Cost
	074019	Prepare Storm Water Pollution Prevention Plan	07-345	No	1	LS	7,000	$ 7,000
	074056	Rain Event Action Plan	07-345	No	75	EA	500	$ 37,500
	074057	Storm Water Annual Report	07-345	No	2	EA	2,000	$ 4,000
	074058	Storm Water Sampling and Analysis Day	07-345	No	50	EA	2,095	$ 104,750
	066596	Additional Water Pollution Control		No	1	LS	20,000	$ 20,000
	066597	Storm Water Sampling and Analysis	07-345	No	1	LS	10,000	$ 10,000
	66595	Water Pollution Control Maintenance Sharing	05-020	No	1	LS	20,000	$ 20,000
							Subtotal Miscellaneous Items	**$ 210,250**

Total Construction Site BMP Costs	**$ 915,930**

Austin Vault Sand Filter Cost Estimate – Segment A

Austin Vault Sand Filter

Quantity Calculations
CREATED BY: Doug Dunrud, J&P Peterson
DATE: 10/12/2010

DESIGN INPUT

Note: Input cells are highlighted yellow

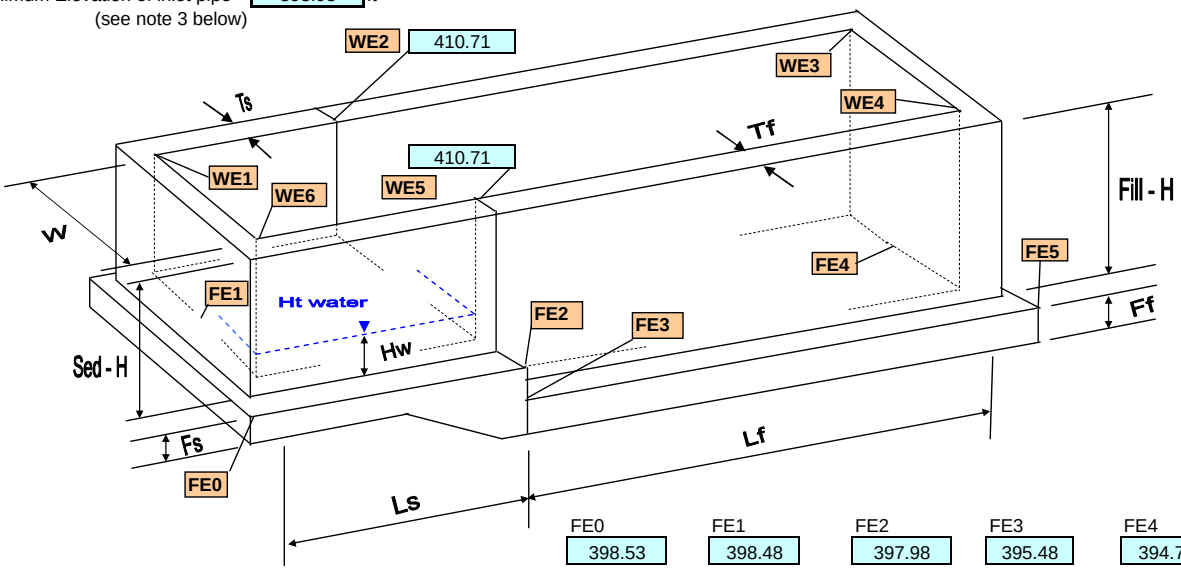
Vault Type	WQV (ft^3)	W (ft)	Ls (ft)	Lf (ft)	Hw (ft)
S-15000-6	22,500	45	25	76	6

	E	Top of Wall Elevation			
		WE1	WE3	WE4	WE6
Elevation of outlet pipe =	394.89 ft				
Filtration Basin Floor Elev. at FE4 = (see note 2 below)	394.72 ft	410.71 ft	410.71	410.71 ft	410.71 ft

Sediment Basin: Actual H = 12.7 ft Ts = 14 inches Fs = 21 inches D = 12 ft
Design H = 14

Filtration Basin: H = 16.0 ft Tf = 14 inches Ff = 21 inches D = 12 ft
Design H = 16 **(Do not exceed 16')**

Minimum Elevation of inlet pipe = 398.98 ft
(see note 3 below)



	FE0	FE1	FE2	FE3	FE4	FE5
	398.53	398.48	397.98	395.48	394.72	394.70

	1	2	3	4	5	6
Top of Wall	410.71	410.71	410.71	410.71	410.71	410.71
FG	410.21	410.21	410.21	410.21	410.21	410.21
Difference	0.50	0.50	0.50	0.50	0.50	0.50

AUSTIN SAND VAULT

Notes:
1) Ls and Lf are measured from the inside of the inlet and outlet wall.
2) FE4 is calculated at 2-inches below pipe outlet invert
3) Verify there is 6-inches minimum clearance between FE1 elevation and pipe inlet invert elevation.
4) Verify difference between Top of Wall and Finished Grade (FG) elevations are a minimum of 0.5 feet.
5) Verify difference between FE1and outer diameter of inlet pipe is at least 6 inches.
6) Provide minimum ground cover above the crown of the inlet pipe per HDM, Table 854.9.

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

Date: 10/12/2010

ESTIMATED QUANTITES

STRUCTURE				EA	DISTRICT						COUNTY	ROUTE	CALCULATED BY	CHECKED BY
Austin Vault Sand Filter Type: S-15000-6														
Description Estimated Quantities		Unit (CY)	Unit (LB)	Unit (CY)	Unit (CY)	Unit (CY)	Unit (LF)	Unit (CY)	Unit (CY)	Unit (SQYD)	Unit (LB)			
Concrete		544												
Bar Reinforcement			135,683											
Structure Excavation				3,346										
Structure Backfill					364									
Gabion Wall						30								
Cable Railing							289							
Sand Bedding								190						
Permeable Material									175					
Filter Fabric										420				
Misc Metal and Steel											115			

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

Date: 10/12/2010

CONCRETE SUMMARY

Estimating Section to Forward to RE Pending File

STRUCTURE	EA	DISTRICT	COUNTY	ROUTE	CALCULATED B	CHECKED BY
Austin Vault Sand Filter Type: *S-15000-6*						

Description	Concrete (CY)
----- Walls ------	
Sedimentation Chamber Wall - Longitudinal	36
Sedimentation Chamber Wall - Transverse	31
Filtration Chamber Walls - Longitudinal	107
Filtration Chamber Wall - Transverse	32
----- Slabs ------	
Sedimentation Chamber Slab	87
Filtration Chamber Slab	250
Slab Wedge	1

BREAKDOWN BY CONCRETE TYPES	
	ESTIMATE
Walls	206.00
Slab	338.00
TOTAL CY	544

Project: Austin Vault Sand Filter By: D. Dunrud Date: 10/12/2010

BAR REINFORCING STEEL QUANTITY P & J Peterson

BAR REINFORCING STEEL

ID #	ID, BAR SIZE & DESCRIPTION		QTY (ea)	SIZE #	LENG ft	TOTAL ft	LENGTH OF REBAR (Ft.)										
							#3	#4	#5	#6	#7	#8	#9	#10	#11	#14	#18
							0.367	0.668	1.043	1.502	2.044	2.670	3.400	4.303	5.313	7.650	13.600
SEDIMENT BASIN																	
	WALL REINFORCEMENT																
	"a"bars A Jt	#8 @ 8	39	#8	18.4	716						716					
	"a"bars C Jt	#8 @ 8	39	#8	18.4	716						716					
	"a"bars AC	#8 @ 8	69	#8	18.4	1,267						1,267					
	"b"bars A Jt	#8 @ 8	39	#8	18.4	716						716					
	"b"bars C Jt	#8 @ 8	39	#8	18.4	716						716					
	"b"bars AC	#8 @ 8	69	#8	18.4	1,267						1,267					
	Hor. A Jt	#5 @ 12 Ea face	33	#5	27.0	881			881								
	Hor. C Jt	#5 @ 12 Ea face	33	#5	27.0	881			881								
	Hor. AC	#5 @ 12 Ea face	33	#5	49.0	1,599			1,599								
	Corner A	#4 @ 12 Hor	17	#4	4.0	67		67									
	Corner C	#4 @ 12 Hor	17	#4	4.0	67		67									
	Corner A	#4 vertical	1	#4	17.2	17		17									
	Corner C	#4 vertical	1	#4	17.2	17		17									
	SLAB REINFORCEMENT																
	"c"bars (S)	#7 @ 8	147	#7	6.5	962					962						
	"d"bars (S)	#7 @ 8	148	#7	14.0	2,078					2,078						
	long T&B (S)	#7 @ 12	99	#7	26.9	2,656					2,656						
	trans T&B (S)	#7 @ 12	54	#7	49.0	2,638					2,638						
	slab @ wall (Long)	#5 tot 8	8	#5	27.0	216			216								
	slab @ wall (Trans)	#5 tot 4	4	#5	49.0	196			196								
	Restraint Blk (vert)	#4 tot 12	12	#4	4.5	54		54									
	Restraint Blk (Hor)	#4 tot 3	3	#4	0.7	2		2									
	WEDGE REINFORCEMENT																
	#5 L	#5 @ 16	37	#5	5.0	185			185								
	#5 Z	#4 @ 16	37	#4	7.0	259		259									
	trans	#4 tot 4	10	#4	49.0	490		490									
	dowel	#7 Eq Bar (Smooth)	33	#7	2.5	82					82						
FILTRATION BASIN																	
	WALL REINFORCEMENT																
	"a"bars B Jt	#9 @ 6	153	#9	18.7	2,860							2,860				
	"a"bars D Jt	#9 @ 6	153	#9	18.7	2,860							2,860				
	"a"bars BD	#9 @ 6	91	#9	18.7	1,701							1,701				
	"b"bars B Jt	#8 @ 6	153	#8	18.5	2,835						2,835					
	"b"bars D Jt	#8 @ 6	153	#8	18.5	2,835						2,835					
	"b"bars BD	#8 @ 6	91	#8	18.5	1,686						1,686					
	Hor. B Jt	#5 @ 12	33	#5	78.0	2,572			2,572								
	Hor. D Jt	#5 @ 12	33	#5	78.0	2,572			2,572								
	Hor. BD	#5 @ 12	33	#5	49.0	1,616			1,616								
	Corner B	#4 @ 12	25	#4	4.0	100		100									
	Corner D	#4 @ 12	25	#4	4.0	100		100									
	Corner B	#4 vertical	1	#4	17.2	17		17									
	Corner D	#4 vertical	1	#4	17.2	17		17									
	SLAB REINFORCEMENT																
	"c"bars (F)	#7 @ 6	397	#7	6.5	2,597					2,597						
	"d"bars (F)	#7 @ 6	201	#7	14.0	2,822					2,822						
	long T&B	#7 @ 12	99	#7	77.9	7,688					7,688						
	trans T&B	#7 @ 12	156	#7	49.0	7,636					7,636						
	slab @ wall (Long)	#5 tot 8	8	#5	78.0	624			624								
	slab @ wall (Trans)	#5 tot 4	4	#5	49.0	196			196								

SUMMARY

	SIZE	#3	#4	#5	#6	#7	#8	#9)	#10	#11	#14	#18
	LB/FT	0.376	0.668	1.043	1.502	2.044	2.670	3.400	4.303	5.313	7.650	13.600
TOTAL WEIGHT (LB) =	135,683		807	12,035		59,602	34,053	25,235				

NOTES:

ALWAYS TYPE 0 (ZERO) FOR NO INPUT. (TO AVOID ERROR MESSAGE)

TOTALS ARE AUTOMATICALLY TRASFERRED TO THE SUMMARY SHEET.

SIMILAR TO FORM DS-D-0110 (REV. 5/93)

Spreadsheet does not include miscellaneous additional reinforcement around openings

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

SUMMARY-STRUCTURE EXCAVATION AND STRUCTURE BACKFILL

DS-D-0022 (REV. 3/00)

Estimating Section to forward to RE Pending File

STRUCTURE	BRIDGE NO	CALCULATED BY	Date
Sand Vault (End-to-End)			10/12/2010

DISTRICT	COUNTY	ROUTE	EA	CHECKED BY	

LOCATION	STRUCTURE EXCAVATION		STRUCTURE BACKFILL			
	ESTIMATE	CHECK	ESTIMATE	CHECK		
Sedimentation Basin	749		109			
Filtration Basin	2597		255			
TOTAL (CY)	**3346.00**	**0.00**	**364.00**	**0.00**		

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

Date: 10/12/2010

MISCELLANEOUS ITEMS SUMMARY

Estimating Section to Forward to RE Pending File

STRUCTURE		EA	DISTRICT	COUNTY	ROUTE	CALCULATED	CHECKED
Austin Vault Sand Filter Type: S-15000-6						By	BY

Description Misc Items		Unit (CY)	Unit (LF)	Unit (CY)	Unit (CY)	Unit (SQYD)	Unit (LB)		
Gabion Wall		30							
Concrete Railing			289						
Sand Bedding				190					
Permeable Material					175				
Filter Fabric						420			
Misc Metal and Steel							115		

Note: Misc metal & steel is the same for all vault confurations. This item includes trash screen onlu and is based on a 24" dia. Overflow outlet pipe.

[ ] PA&ED [ ] PS&E

Revised By MM - October 5, 2009

RCVD BY: **IN EST:** **OUT EST:**

BRIDGE: NA **BR. No.:** NA **DISTRICT:**
TYPE: AVSF **RTE:**
CU: **CO:**
EA: **PM:**
LENGTH: **WIDTH:** **AREA (SF)=**

DESIGN SECTION:
 # OF STRUCTURES IN PROJECT : **EST. NO.**
PRICES BY : **COST INDEX:**
PRICES CHECKED BY : **DATE:**
QUANTITIES BY: **DATE:**

	CONTRACT ITEMS	TYPE	UNIT	QUANTITY	PRICE	AMOUNT
1	Concrete		CY	544	$500.00	$272,000.00
2	Bar Reinforcement		LB	135,683	$2.00	$271,366.67
3	Structure Excavation		CY	3,346	$105.00	$351,330.00
4	Structure Backfill		CY	364	$115.00	$41,860.00
5	Gabion Wall		CY	30	$500.00	$15,000.00
6	Cable Railing		LF	289	$22.00	$6,358.00
7	Sand Bedding		CY	190	$105.00	$19,950.00
8	Permeable Material		CY	175	$85.00	$14,875.00
9	Filter Fabric		SQYD	420	$7.00	$2,940.00
10	Misc Metal and Steel		LB	115	$2.50	$287.50
11	6" PP		LF	7	$65.00	$422.50
12	6" PPP		LF	627	$45.00	$28,215.00
13						$0.00
14						$0.00
15						$0.00
25						$0.00
26						$0.00
27						$0.00
28						$0.00
29						$0.00
30						$0.00

SUBTOTAL	$1,024,605
TIME RELATED OVERHEAD	$102,460
MOBILIZATION (@ 10 %)	$125,229
SUBTOTAL BRIDGE ITEMS	$1,252,295
CONTINGENCIES (@ 25%)	$313,074
STRUCTURE TOTAL COST	$1,565,368
GRAND TOTAL	$1,565,368
BUDGET ESTIMATE AS OF 1/0/00	**$1,565,000**

ROUTING
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COMMENTS:

Austin Vault Sand Filter Cost Estimate – Segment B

Austin Vault Sand Filter

Quantity Calculations
CREATED BY: Doug Dunrud, J&P Peterson
DATE: 10/12/2010

DESIGN INPUT

Note: Input cells are highlighted yellow

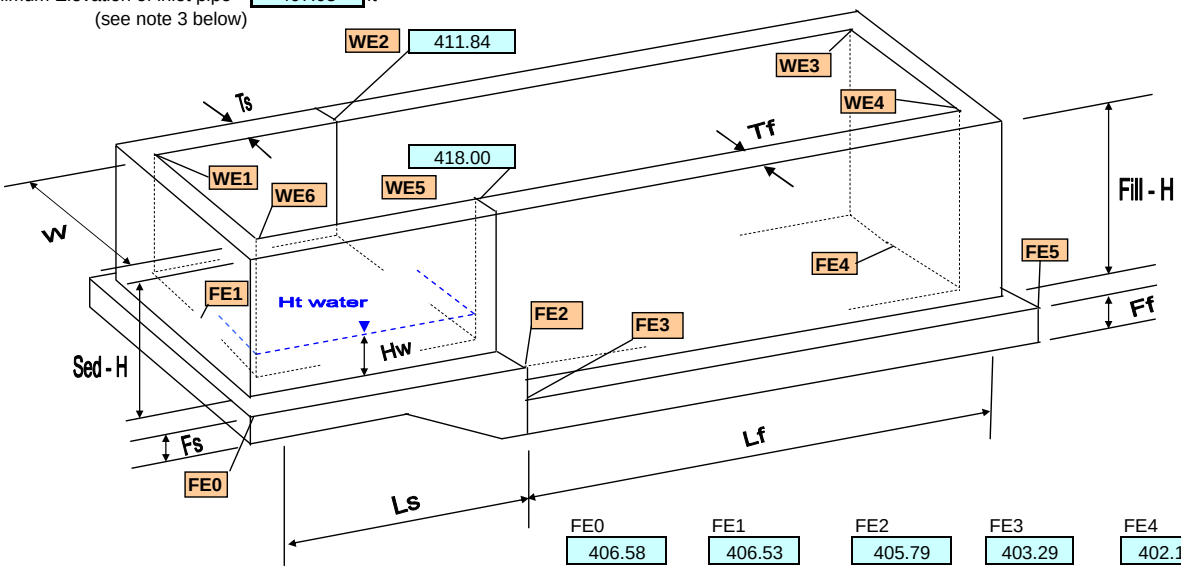
Vault Type	WQV (ft^3)	W (ft)	Ls (ft)	Lf (ft)	Hw (ft)
L-15000-6	22,500	30	37	115	6

	E	Top of Wall Elevation			
		WE1	WE3	WE4	WE6
Elevation of outlet pipe =	402.31 ft				
Filtration Basin Floor Elev. at FE4 = (see note 2 below)	402.14 ft	411.67 ft	412.38	418.00 ft	418.00 ft

Sediment Basin: Actual H = 12.2 ft Ts = 14 inches Fs = 21 inches D = 8 ft
Design H = 14

Filtration Basin: H = 15.9 ft Tf = 14 inches Ff = 21 inches D = 8 ft
Design H = 16 **(Do not exceed 16')**

Minimum Elevation of inlet pipe = 407.03 ft
(see note 3 below)



	FE0	FE1	FE2	FE3	FE4	FE5
	406.58	406.53	405.79	403.29	402.14	402.12

	1	2	3	4	5	6
Top of Wall	411.67	411.84	412.38	418.00	418.00	418.00
FG	1510.00	1510.00	1510.00	1511.00	1511.19	1511.25
Difference	-1098.33	-1098.16	-1097.62	-1093.00	-1093.19	-1093.25

AUSTIN SAND VAULT

Notes:
1) Ls and Lf are measured from the inside of the inlet and outlet wall.
2) FE4 is calculated at 2-inches below pipe outlet invert
3) Verify there is 6-inches minimum clearance between FE1 elevation and pipe inlet invert elevation.
4) Verify difference between Top of Wall and Finished Grade (FG) elevations are a minimum of 0.5 feet.
5) Verify difference between FE1and outer diameter of inlet pipe is at least 6 inches.
6) Provide minimum ground cover above the crown of the inlet pipe per HDM, Table 854.9.

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

Date: 10/12/2010

ESTIMATED QUANTITES

STRUCTURE				EA	DISTRICT						COUNTY	ROUTE	CALCULATED BY	CHECKED BY
Austin Vault Sand Filter Type: *L-15000-6*														
Description Estimated Quantities		Unit (CY)	Unit (LB)	Unit (CY)	Unit (CY)	Unit (CY)	Unit (LF)	Unit (CY)	Unit (CY)	Unit (SQYD)	Unit (LB)			
Concrete		556												
Bar Reinforcement			141,309											
Structure Excavation				3,456										
Structure Backfill					450									
Gabion Wall						20								
Cable Railing							361							
Sand Bedding								192						
Permeable Material									201					
Filter Fabric										432				
Misc Metal and Steel											115			

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

Date: 10/12/2010

CONCRETE SUMMARY

Estimating Section to Forward to RE Pending File

STRUCTURE	EA	DISTRICT	COUNTY	ROUTE	CALCULATED B	CHECKED BY
Austin Vault Sand Filter Type: *L-15000-6*						

Description	Concrete (CY)
----- Walls ------	
Sedimentation Chamber Wall - Longitudinal	42
Sedimentation Chamber Wall - Transverse	17
Filtration Chamber Walls - Longitudinal	130
Filtration Chamber Wall - Transverse	17
----- Slabs ------	
Sedimentation Chamber Slab	88
Filtration Chamber Slab	261
Slab Wedge	1

BREAKDOWN BY CONCRETE TYPES	
	ESTIMATE
Walls	206.00
Slab	350.00
TOTAL CY	556

Project: Austin Vault Sand Filter

By: D. Dunrud Date: 10/12/2010

BAR REINFORCING STEEL QUANTITY

P & J Peterson

BAR REINFORCING STEEL

ID #	ID, BAR SIZE & DESCRIPTION		QTY (ea)	SIZE #	LENG ft	TOTAL ft	LENGTH OF REBAR (Ft.)										
							#3	#4	#5	#6	#7	#8	#9	#10	#11	#14	#18
							0.367	0.668	1.043	1.502	2.044	2.670	3.400	4.303	5.313	7.650	13.600
SEDIMENT BASIN																	
	WALL REINFORCEMENT																
	"a"bars A Jt	#8 @ 8	57	#8	12.0	683						683					
	"a"bars C Jt	#8 @ 8	57	#8	18.2	1,039						1,039					
	"a"bars AC	#8 @ 8	46	#8	15.1	693						693					
	"b"bars A Jt	#8 @ 8	57	#8	12.0	683						683					
	"b"bars C Jt	#8 @ 8	57	#8	18.2	1,039						1,039					
	"b"bars AC	#8 @ 8	46	#8	15.1	693						693					
	Hor. A Jt	#5 @ 12 Ea face	20	#5	39.0	783			783								
	Hor. C Jt	#5 @ 12 Ea face	32	#5	39.0	1,263			1,263								
	Hor. AC	#5 @ 12 Ea face	32	#5	34.0	1,101			1,101								
	Corner A	#4 @ 12 Hor	10	#4	4.0	41		41									
	Corner C	#4 @ 12 Hor	17	#4	4.0	67		67									
	Corner A	#4 vertical	1	#4	10.7	11		11									
	Corner C	#4 vertical	1	#4	17.1	17		17									
	SLAB REINFORCEMENT																
	"c"bars (S)	#7 @ 8	160	#7	6.5	1,047					1,047						
	"d"bars (S)	#7 @ 8	161	#7	10.0	1,617					1,617						
	long T&B (S)	#7 @ 12	69	#7	38.9	2,672					2,672						
	trans T&B (S)	#7 @ 12	78	#7	34.0	2,647					2,647						
	slab @ wall (Long)	#5 tot 8	8	#5	39.0	312			312								
	slab @ wall (Trans)	#5 tot 4	4	#5	34.0	136			136								
	Restraint Blk (vert)	#4 tot 12	12	#4	4.5	54		54									
	Restraint Blk (Hor)	#4 tot 3	3	#4	0.7	2		2									
	WEDGE REINFORCEMENT																
	#5 L	#5 @ 16	26	#5	5.0	129			129								
	#5 Z	#4 @ 16	26	#4	7.0	180		180									
	trans	#4 tot 4	10	#4	34.0	340		340									
	dowel	#7 Eq Bar (Smooth)	23	#7	2.5	57					57						
FILTRATION BASIN																	
	WALL REINFORCEMENT																
	"a"bars B Jt	#9 @ 6	231	#9	12.7	2,928							2,928				
	"a"bars D Jt	#9 @ 6	231	#9	18.6	4,289							4,289				
	"a"bars BD	#9 @ 6	61	#9	15.8	961							961				
	"b"bars B Jt	#8 @ 6	231	#8	12.5	2,890						2,890					
	"b"bars D Jt	#8 @ 6	231	#8	18.4	4,250						4,250					
	"b"bars BD	#8 @ 6	61	#8	15.6	951						951					
	Hor. B Jt	#5 @ 12	21	#5	117.0	2,512			2,512								
	Hor. D Jt	#5 @ 12	33	#5	117.0	3,827			3,827								
	Hor. BD	#5 @ 12	33	#5	34.0	1,112			1,112								
	Corner B	#4 @ 12	17	#4	4.0	68		68									
	Corner D	#4 @ 12	25	#4	4.0	100		100									
	Corner B	#4 vertical	1	#4	11.4	11		11									
	Corner D	#4 vertical	1	#4	17.1	17		17									
	SLAB REINFORCEMENT																
	"c"bars (F)	#7 @ 6	523	#7	6.5	3,421					3,421						
	"d"bars (F)	#7 @ 6	264	#7	10.0	2,651					2,651						
	long T&B	#7 @ 12	69	#7	116.9	8,028					8,028						
	trans T&B	#7 @ 12	234	#7	34.0	7,951					7,951						
	slab @ wall (Long)	#5 tot 8	8	#5	117.0	936			936								
	slab @ wall (Trans)	#5 tot 4	4	#5	34.0	136			136								

SUMMARY

	SIZE	#3	#4	#5	#6	#7	#8	#9)	#10	#11	#14	#18
	LB/FT	0.376	0.668	1.043	1.502	2.044	2.670	3.400	4.303	5.313	7.650	13.600
TOTAL WEIGHT (LB) =	141,309		607	12,774		61,506	34,501	27,805				

NOTES:

ALWAYS TYPE 0 (ZERO) FOR NO INPUT. (TO AVOID ERROR MESSAGE)

TOTALS ARE AUTOMATICALLY TRASFERRED TO THE SUMMARY SHEET.

SIMILAR TO FORM DS-D-0110 (REV. 5/93)

Spreadsheet does not include miscellaneous additional reinforcement around openings

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

SUMMARY-STRUCTURE EXCAVATION AND STRUCTURE BACKFILL

DS-D-0022 (REV. 3/00)

Estimating Section to forward to RE Pending File

STRUCTURE	BRIDGE NO	CALCULATED BY	Date
Sand Vault (End-to-End)			10/12/2010

DISTRICT	COUNTY	ROUTE	EA	CHECKED BY	

LOCATION	STRUCTURE EXCAVATION		STRUCTURE BACKFILL			
	ESTIMATE	CHECK	ESTIMATE	CHECK		
Sedimentation Basin	728		118			
Filtration Basin	2728		332			
TOTAL (CY)	**3456.00**	**0.00**	**450.00**	**0.00**		

STATE OF CALIFORNIA-DEPARTMENT OF TRANSPORTATION

Date: 10/12/2010

MISCELLANEOUS ITEMS SUMMARY

Estimating Section to Forward to RE Pending File

STRUCTURE		EA	DISTRICT	COUNTY	ROUTE	CALCULATED	CHECKED
Austin Vault Sand Filter Type: *L-15000-6*						By	BY

Description Misc Items		Unit (CY)	Unit (LF)	Unit (CY)	Unit (CY)	Unit (SQYD)	Unit (LB)		
Gabion Wall		20							
Concrete Railing			361						
Sand Bedding				192					
Permeable Material					201				
Filter Fabric						432			
Misc Metal and Steel							115		

Note: Misc metal & steel is the same for all vault confurations. This item includes trash screen onlu and is based on a 24" dia. Overflow outlet pipe.

[ ] PA&ED [ ] PS&E

Revised By MM - October 5, 2009

RCVD BY: **IN EST:** **OUT EST:**

BRIDGE: NA **BR. No.:** NA **DISTRICT:**
TYPE: AVSF 36 n **RTE:**
CU: **CO:**
EA: **PM:**
LENGTH: **WIDTH:** **AREA (SF)=**

DESIGN SECTION:
 # OF STRUCTURES IN PROJECT : **EST. NO.**
PRICES BY : **COST INDEX:**
PRICES CHECKED BY : **DATE:**
QUANTITIES BY: **DATE:**

	CONTRACT ITEMS	TYPE	UNIT	QUANTITY	PRICE	AMOUNT
1	Concrete		CY	556	$500.00	$278,000.00
2	Bar Reinforcement		LB	141,309	$2.00	$282,617.66
3	Structure Excavation		CY	3,456	$105.00	$362,880.00
4	Structure Backfill		CY	450	$115.00	$51,750.00
5	Gabion Wall		CY	20	$500.00	$10,000.00
6	Cable Railing		LF	361	$22.00	$7,942.00
7	Sand Bedding		CY	192	$105.00	$20,160.00
8	Permeable Material		CY	201	$85.00	$17,085.00
9	Filter Fabric		SQYD	432	$7.00	$3,024.00
10	Misc Metal and Steel		LB	115	$2.50	$287.50
11	6" PP		LF	38	$65.00	$2,470.00
12	6" PPP		LF	589	$45.00	$26,505.00
13						$0.00
14						$0.00
15						$0.00
25						$0.00
26						$0.00
27						$0.00
28						$0.00
29						$0.00
30						$0.00

SUBTOTAL		$1,062,721
TIME RELATED OVERHEAD		$106,272
MOBILIZATION (@ 10 %)		$129,888
SUBTOTAL BRIDGE ITEMS		$1,298,881
CONTINGENCIES	(@ 25%)	$324,720
STRUCTURE TOTAL COST		$1,623,602
GRAND TOTAL		$1,623,602
BUDGET ESTIMATE AS OF	1/0/00	**$1,624,000**

ROUTING
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COMMENTS:

Checklist SW-1, Site Data Sources

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Information for the following data categories should be obtained, reviewed and referenced as necessary throughout the project planning phase. Collect any available documents pertaining to the category and list them and reference your data source. For specific examples of documents within these categories, refer to Section 5.5 of this document. Example categories have been listed below; add additional categories, as needed. Summarize pertinent information in Section 2 of the SWDR.

DATA CATEGORY/SOURCES	Date
Topographic	
• *Ecological Subregions of California*: Section M262A.	Access Date: April 23, 2008.
• USGS Topo! Livermore, CA. Contour Interval: 20 ft. Elevation Data: USGS 1 arc-second NED, 1 meter vertical precision.	Map Version 1978. Map Current as of: 1980.
Hydraulic	
• WRECO. *Bridge Design Hydraulic Study Report*, State Route 84 Expressway Widening Project, Cities of Livermore and Pleasanton, Alameda County, California. 04-ALA-84, EA 297601, 33C0710/33C0713. Prepared for Alameda County Transportation Improvement Authority Oakland, CA	May 2009
• WRECO. *Drainage Report*, State Route 84 Expressway Widening Project, Cities of Livermore and Pleasanton, Alameda County, California. 04-ALA-84, EA 297601. Prepared for Alameda County Transportation Improvement Authority.	January 2011
• WRECO. *Hydromodification Report,* State Route 84 Expressway Widening Project, Cities of Livermore and Pleasanton, Alameda County, California. 04-ALA-84, EA 297601. Prepared for Alameda County Transportation Improvement Authority.	January 2011
Soils	
• URS. V*olumes I of II Geotechnical Design Report and Materials Report*, Route 84 Expressway Widening, Livermore, California. Prepared for Alameda Transportation Improvement Authority. 04-ALA-84-PM 22.5/27.1, EA 297601	March 13, 2009
• BASELINE Environmental Consulting. *Initial Site Assessment* SR 84 Expressway Widening Project, Ruby Hill Drive to Jack London Boulevard, City of Livermore, Alameda County, California, (PM 22.5/27.3) EA 04-297600, Prepared for Alameda County Transportation Improvement Authority Oakland, CA	December 2005
• AGS, Inc. *Final Geotechnical Impact Assessment*, Route 84 Expressway Widening Project, Alameda California. Prepared for Alameda Transportation Improvement Authority. 04-ALA-84-PM 22.5/27.3, EA 297600	April 2006
Climatic	
• Federal Emergency Management Agency (FEMA). *Flood*	Revised: September 30, 1997

Insurance Study, City of Pleasanton, California. Alameda County. Community Number – 060012	
Water Quality	
• WRECO and URS Corp. *PA/ED Phase Storm Water Data Report*, Route 84 Expressway Widening Project, City of Livermore, Alameda County, California. Prepared for Alameda County Transportation Improvement Authority.	April 2007
• State Water Resources Control Board. *2006 CWA Section 303(d) List of Water Quality Limited Segments*.	Approval Date: June 28, 2007
• SWRCB. *San Francisco Bay Region Water Quality Control Plan (Basin Plan).*	January 18, 2007
• U.S. Environmental Protection Agency (EPA). *Total Maximum Daily Loads, Detailed TMDL Report*. Available on website at: http://oaspub.epa.gov/waters/waters_list.tmdl_report?p_tmdl_id=32396	Access Date: July 28, 2008
• SWRCB. National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit). Order No. 2009-0009-DWQ. NPDES Number CAS000002.	September 2, 2009
Other Data Categories	
• San Francisco Bay Regional Water Quality Control Board-Total Maximum Daily Loads (TMDLs) and the 303(d) List of Impaired Water Bodies http://www.waterboards.ca.gov/sanfranciscobay/tmdlmain.htm	Access Date: December 26, 2007
• Caltrans. *Project Planning and Design Guide*	May 2007
• Caltrans. *Construction Site BMP Manual*	March 2003
• Caltrans. *SWPPP/WPCP Preparation Manual*	March 2007
• Caltrans. *Statewide Storm Water Management Plan*. CTSW-RT-02-008	May 2003
• Matthew W. Katen, RG, CHg, Carol D. Mahoney, RG, James F. Reilly, PE. *Case Study: Chain-of-Lakes Project*, Alameda County, California.	
• URS. Response to Questions from WRECO. Personal Communication.	November 16, 2007.
• Alameda County Mosquito Abatement District. *The Alameda County Mosquito Abatement District Control Program*.	1999

Checklist SW-2, Storm Water Quality Issues Summary

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

The following questions provide a guide to collecting critical information relevant to project stormwater quality issues. Complete responses to applicable questions, consulting other Caltrans functional units (Environmental, Landscape Architecture, Maintenance, etc.) and the District/Regional Storm Water Coordinator as necessary. Summarize pertinent responses in Section 2 of the SWDR.

1. Determine the receiving waters that may be affected by the project throughout the project life cycle (i.e., construction, maintenance and operation).	☒Complete	☐NA
2. For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.	☒Complete	☐NA
3. Determine if there are any municipal or domestic water supply reservoirs or groundwater percolation facilities within the project limits. Consider appropriate spill contamination and spill prevention control measures for these new areas.	☒Complete	☐NA
4. Determine the RWQCB special requirements, including TMDLs, effluent limits, etc.	☒Complete	☐NA
5. Determine regulatory agencies seasonal construction and construction exclusion dates or restrictions required by federal, state, or local agencies.	☒Complete	☐NA
6. Determine if a 401 certification will be required.	☒Complete	☐NA
7. List rainy season dates.	☒Complete	☐NA
8. Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.	☒Complete	☐NA
9. If considering Treatment BMPs, determine the soil classification, permeability, erodibility, and depth to groundwater.	☒Complete	☐NA
10. Determine contaminated or hazardous soils within the project area.	☒Complete	☐NA
11. Determine the total disturbed soil area of the project.	☒Complete	☐NA
12. Describe the topography of the project site.	☒Complete	☐NA
13. List any areas outside of the Caltrans right-of-way that will be included in the project (e.g. contractor's staging yard, work from barges, easements for staging, etc.).	☒Complete	☐NA
14. Determine if additional right-of-way acquisition or easements and right-of-entry will be required for design, construction and maintenance of BMPs. If so, how much?	☐Complete	☒NA
15. Determine if a right-of-way certification is required.	☐Complete	☒NA
16. Determine the estimated unit costs for right-of-way should it be needed for Treatment BMPs, stabilized conveyance systems, lay-back slopes, or interception ditches.	☐Complete	☒NA
17. Determine if project area has any slope stabilization concerns.	☒Complete	☐NA
18. Describe the local land use within the project area and adjacent areas.	☒Complete	☐NA
19. Evaluate the presence of dry weather flow.	☒Complete	☐NA

Checklist SW-3, Measures for Avoiding or Reducing Potential Storm Water Impacts

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

The PE must confer with other functional units, such as Landscape Architecture, Hydraulics, Environmental, Materials, Construction and Maintenance, as needed to assess these issues. Summarize pertinent responses in Section 2 of the SWDR.

Options for avoiding or reducing potential impacts during project planning include the following:

1.	Can the project be relocated or realigned to avoid/reduce impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?	☐Yes	☒No	☐NA
2.	Can structures and bridges be designed or located to reduce work in live streams and minimize construction impacts?	☐Yes	☒No	☐NA
3.	Can any of the following methods be utilized to minimize erosion from slopes:			
	a. Disturbing existing slopes only when necessary?	☒Yes	☐No	☐NA
	b. Minimizing cut and fill areas to reduce slope lengths?	☒Yes	☐No	☐NA
	c. Incorporating retaining walls to reduce steepness of slopes or to shorten slopes?	☒Yes	☐No	☐NA
	d. Acquiring right-of-way easements (such as grading easements) to reduce steepness of slopes?	☐Yes	☒No	☐NA
	e. Avoiding soils or formations that will be particularly difficult to re-stabilize?	☐Yes	☐No	☒NA
	f. Providing cut and fill slopes flat enough to allow re-vegetation and limit erosion to pre-construction rates?	☒Yes	☐No	☐NA
	g. Providing benches or terraces on high cut and fill slopes to reduce concentration of flows?	☐Yes	☒No	☐NA
	h. Rounding and shaping slopes to reduce concentrated flow?	☒Yes	☐No	☐NA
	i. Collecting concentrated flows in stabilized drains and channels?	☒Yes	☐No	☐NA
4.	Does the project design allow for the ease of maintaining all BMPs?	☒Yes	☐No	
5.	Can the project be scheduled or phased to minimize soil-disturbing work during the rainy season?	☒Yes	☐No	
6.	Can permanent storm water pollution controls such as paved slopes, vegetated slopes, basins, and conveyance systems be installed early in the construction process to provide additional protection and to possibly utilize them in addressing construction storm water impacts?	☒Yes	☐No	☐NA

Design Pollution Prevention BMPs
Checklist DPP-1, Part 1

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84

PM : 22.9/27.1 EA: 04-297601

RWQCB: Region 2, San Francisco Bay

Consideration of Design Pollution Prevention BMPs

1. Consideration of Downstream Effects Related to Potentially Increased Flow [to streams or channels]?

(a) Will project increase velocity or volume of downstream flow?	☒Yes	☐No	☐NA
(b) Will the project discharge to unlined channels?	☒Yes	☐No	☐NA
(c) Will project increase potential sediment load of downstream flow?	☒Yes	☐No	☐NA
(d) Will project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect downstream channel stability?	☒Yes	☐No	☐NA

If Yes was answered to any of the above questions, consider ***Downstream Effects Related to Potentially Increased Flow***, complete the DPP-1, Part 2 checklist.

2. Slope/Surface Protection Systems

(a) Will project create new slopes or modify existing slopes?	☒Yes	☐No	☐NA

If Yes was answered to the above question, consider ***Slope/Surface Protection Systems***, complete the DPP-1, Part 3 checklist.

3. Concentrated Flow Conveyance Systems

(a) Will the project create or modify ditches, dikes, berms, or swales?	☒Yes	☐No	☐NA
(b) Will project create new slopes or modify existing slopes?	☒Yes	☐No	☐NA
(c) Will it be necessary to direct or intercept surface runoff?	☒Yes	☐No	☐NA
(d) Will cross drains be modified?	☒Yes	☐No	☐NA

If Yes was answered to any of the above questions, consider ***Concentrated Flow Conveyance Systems***; complete the DPP-1, Part 4 checklist.

4. Preservation of Existing Vegetation

a) It is the goal of the Storm Water Program to maximize the protection of desirable existing vegetation to provide erosion and sediment control benefits on all projects. ☒Complete

Consider ***Preservation of Existing Vegetation***, complete the DPP-1, Part 5 checklist.

Design Pollution Prevention BMPs
Checklist DPP-1, Part 2

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Downstream Effects Related to Potentially Increased Flow

1.	Review total paved area and reduce to the maximum extent practicable.	☒Complete
2.	Review channel lining materials and design for stream bank erosion control.	☒Complete
	(a) See Chapters 860 and 870 of the HDM.	☒Complete
	(b) Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.	☒Complete
3.	Include, where appropriate, energy dissipation devices at culvert outlets.	☒Complete
4.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.	☒Complete
5.	Include, if appropriate, peak flow attenuation basins to reduce peak discharges.	☒Complete

Design Pollution Prevention BMPs
Checklist DPP-1, Part 3

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM (KP): 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Slope / Surface Protection Systems

1. What are the proposed areas of cut and fill? (attach plan or map)	☒Complete
2. Were benches or terraces provided on high cut and fill slopes to reduce concentration of flows?	☐Yes ☒No
3. Were slopes rounded and/or shaped to reduce concentrated flow?	☒Yes ☐No
4. Were concentrated flows collected in stabilized drains or channels?	☒Yes ☐No
5. Are slopes > 1:4 vertical: horizontal (V:H))?	☒Yes ☐No
If Yes, District Landscape Architecture must prepare or approve an erosion control plan.	
6. Are slopes > 1:2 (V:H)?	☐Yes ☒No
If Yes, Geotechnical Services must prepare a Geotechnical Design Report, and the District Landscape Architect should prepare or approve an erosion control plan. Concurrence must be obtained from the District Maintenance Storm Water Coordinator for slopes steeper than 1:2 (V:H).	
7. Estimate the change to the impervious areas that will result from this project. Net additional impervious area (in both Caltrans and City R/W)27.63 ac	☒Complete

VEGETATED SURFACES

1. Identify existing vegetation.	☒Complete
2. Evaluate site to determine soil types, appropriate vegetation and planting strategies.	☒Complete
3. How long will it take for permanent vegetation to establish?	☒Complete
4. Minimize overland and concentrated flow depths and velocities.	☒Complete

HARD SURFACES

1. Are hard surfaces required?	☒Yes ☐No
If Yes, document purpose (safety, maintenance, soil stabilization, etc.), types, and general locations of the installations.	☒Complete
Review appropriate SSPs for Vegetated Surface and Hard Surface Protection Systems.	☒Complete

Design Pollution Prevention BMPs
Checklist DPP-1, Part 4

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84

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RWQCB: Region 2, San Francisco Bay

Concentrated Flow Conveyance Systems

Ditches, Berms, Dikes and Swales

1. Consider Ditches, Berms, Dikes, and Swales as per Chapters 813, 836, and 860 of the HDM. ☒Complete
2. Evaluate risks due to erosion, overtopping, flow backups or washout. ☒Complete
3. Consider outlet protection where localized scour is anticipated. ☒Complete
4. Examine the site for run-on from off-site sources. ☒Complete
5. Consider channel lining when velocities exceed scour velocity for soil. ☒Complete

Overside Drains

1. Consider downdrains, as per Index 834.4 of the HDM. ☒Complete
2. Consider paved spillways for side slopes flatter than 1:4 V:H. ☒Complete

Flared Culvert End Sections

1. Consider flared end sections on culvert inlets and outlets as per Chapter 827 of the HDM. ☒Complete

Outlet Protection/Velocity Dissipation Devices

1. Consider outlet protection/velocity dissipation devices at outlets, including cross drains, as per Chapters 827 and 870 of the HDM. ☒Complete

Review appropriate SSPs for Concentrated Flow Conveyance Systems. ☒Complete

Design Pollution Prevention BMPs
Checklist DPP-1, Part 5

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84

PM : 22.9/27.1 EA: 04-297601

RWQCB: Region 2, San Francisco Bay

Preservation of Existing Vegetation

1.	Review Preservation of Property, Standard Specifications 16.1.01 and 16-1.02 (Clearing and Grubbing) to reduce clearing and grubbing and maximize preservation of existing vegetation.	☒Complete
2.	Has all vegetation to be retained been coordinated with Environmental, and identified and defined in the contract plans?	☒Yes ☐No
3.	Have steps been taken to minimize disturbed areas, such as locating temporary roadways to avoid stands of trees and shrubs and to follow existing contours to reduce cutting and filling?	☒Complete
4.	Have impacts to preserved vegetation been considered while work is occurring in disturbed areas?	☒Yes ☐No
5.	Are all areas to be preserved delineated on the plans?	☒Yes ☐No

Treatment BMPs

Checklist T-1, Part 1

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84

PM : 22.9/27.1 EA: 04-297601

RWQCB: Region 2, San Francisco Bay

Consideration of Treatment BMPs

This checklist is used for projects that require the consideration of Approved Treatment BMPs, as determined from the process described in Section 4 (Project Treatment Consideration) and the Evaluation Documentation Form (EDF). This checklist will be used to determine which Treatment BMPs should be considered for each watershed and sub-watersheds within the project. Supplemental data will be needed to verify sitting and design applicability for final incorporation into a project.

Complete this checklist for each phase of the project, when considering Treatment BMPs. Use the responses to the questions as the basis when developing the narrative in Section 5 of the Storm Water Data Report to document that Treatment BMPs have been appropriately considered.

Answer all questions, unless otherwise directed.

1. Dry Weather Flow Diversion

   (a) Are dry weather flows generated by Caltrans anticipated to be persistent? ☐Yes ☒No

   (b) Is a sanitary sewer located on or near the site? ☒Yes ☐No

   (c) Is the connection to the sanitary sewer possible without extraordinary plumbing, features or construction practices? ☐Yes ☒No

   (d) Is the domestic wastewater treatment authority willing to accept flow? ☐Yes ☒No

   If Yes was answered to <u>all</u> of these questions consider Dry Weather Flow Diversion, complete and attach Part 3 of this checklist

2. Is the receiving water on the 303(d) list for litter/trash or has a TMDL been issued for litter/trash? ☐Yes ☒No

   If Yes, consider Gross Solids Removal Devices (GSRDs), complete and attach Part 6 of this checklist. Note: Biofiltration Systems, Infiltration Devices, Detention Devices, Media Filters, MCTTs, and Wet Basins also can capture litter – consult with District/Regional NPDES if these devices should be considered to meet litter/trash TMDL.

3. Is project located in an area (e.g., mountain regions) where traction sand is applied more than twice a year?
   If Yes, consider ***Traction Sand Traps***, complete and attach **Part 7** of this checklist. ☐Yes ☒No

4. (a) Are there local influent limits for infiltration or Basin Plan restrictions or other local agency prohibitions that would restrict the use of the infiltration devices? ☐Yes ☒No

(b) Would infiltration pose a threat to local groundwater quality as determined by the District/Regional Storm Water Coordinator? ☐Yes ☒No

If the answer to either part of Question 4 is Yes, then Infiltration Devices are infeasible and the consideration of Infiltration Devices should not be made when completing Questions 5 through 17.

5. (a) Does the project discharge to any 303(d) listed water body? ☒Yes ☐No
   If No, go to Question 17, General Purpose Pollutant Removal

   (b) If Yes, is the identified pollutant(s) considered a Targeted Design Constituent (TDC) (check all that apply):

   ___phosphorus, ___nitrogen, ___total copper, ___dissolved copper,

   ___total lead ___dissolved lead, ___total zinc, ___dissolved zinc,

   ___sediments, ___general metals [unspecified metals].

   (c) If only one TDC is checked above, continue to Question 6. ☐Complete

   (d) If more than one TDC is checked, contact your District/Regional NPDES Coordinator to determine priority before continuing with this checklist. ☐Complete

6. Consult with the District/Regional Storm Water Coordinator to determine whether Treatment BMP selection will be affected by any existing or future TMDL requirements. ☒Complete

The following questions show the approved Treatment BMPs in order of preference based on load reduction (performance) for the listed constituent and lifetime costs for the device, excluding right-of-way. Note that a line separates Treatment BMPs into groups of approximately equal effectiveness and within each grouping, any of the Treatment BMPs may be selected for placement if meeting site conditions. In the space provided next to the BMP, use Yes or a check mark to indicate a positive response.

If none of the listed Treatment BMPs for a specific constituent of concern (TDC) can be sited, go to Step #17 (General Purpose Pollutant Removal) to determine whether another Treatment BMP can be incorporated into the project.

For the SWDRs developed for the PID and PA/ED phases of a project: **Consider all approved Treatment BMPs listed that can be reasonably incorporated into the project for each TDC.**

For the SWDR developed for the PS&E phase: **Indicate (Yes or check mark) only those BMPs that will be incorporated into the project.**

7. Is phosphorus the TDC? [Use this constituent if "eutrophic" or "nutrients" is the TDC for the water body.] If Yes, consider: ☐Yes ☒No

   _____Infiltration Devices
   _____Austin Sand Filters

8. Is nitrogen the TDC? If Yes, consider: ☐Yes ☒No

_____Infiltration Devices
_____Austin Sand Filters
_____Delaware Filter
_____Detention Device
_____MCTT

9. Is copper (total) the TDC? If Yes for total Copper, consider: ☐Yes ☒No

_____Infiltration Devices
_____Wet Basins
_____Biofiltration Strips
_____Detention Device
_____Biofiltration Swales
_____Austin Sand Filter
_____Delaware Filter
_____MCTT

10. Is copper (dissolved) the TDC? If Yes for dissolved Copper, consider: ☐Yes ☒No

_____Infiltration Devices
_____Biofiltration Strips
_____Wet Basin
_____Biofiltration Swale

11. Is lead (total) the TDC? If Yes for total Lead, consider: ☐Yes ☒No

_____Infiltration Devices
_____Wet Basin
_____Biofiltration Strips
_____Austin Sand Filter
_____**Delaware Filter**
_____Detention Device
_____Biofiltration Swales
_____MCTT

12. Is lead (dissolved) the TDC? If Yes for dissolved Lead, consider: ☐Yes ☒No

_____Infiltration Devices
_____Biofiltration Strips
_____Wet Basin
_____Detention Device
_____Biofiltration Swales
_____Austin Sand Filter

13. Is zinc (total) the TDC? If Yes for total Zinc, consider: ☐Yes ☒No

_____Infiltration Devices
_____Delaware Filter
_____Wet Basin
_____Biofiltration Strips
_____Biofiltration Swales
_____Austin Sand Filter
_____MCTT
_____Detention Devices

14. Is zinc (dissolved) the TDC? If Yes for dissolved Zinc, consider: ☐Yes ☒No

    ____ Infiltration Devices
    ____ Delaware Filter
    ____ Biofiltration Strip
    ____ Biofiltration Swale
    ____ Austin Sand Filter
    ____ MCTT

15. Is sediment (total suspended solids [TSS]) the TDC? If Yes for TSS, consider: ☐Yes ☒No

    ____ Infiltration Devices
    ____ Austin Sand Filter
    ____ Delaware Filter
    ____ Wet Basin
    ____ Detention Device
    ____ Biofiltration Strip
    ____ MCTT
    ____ Biofiltration Swale

16. Are "General Metals" or (unspecified) "Metals" the TDC? If Yes for General Metals, consider: ☐Yes ☒No

    ____ Infiltration Devices
    ____ Biofiltration Strips
    ____ Wet Basin
    ____ Biofiltration Swale
    ____ Austin Sand Filter
    ____ Delaware Filter
    ____ MCTT

17. General Purpose Pollutant Removal.: When it is determined that there are no TDCs, consider the Treatment BMPs in the order listed below. ☒Yes ☐No

    ____ Infiltration Devices
    X Biofiltration Strips
    ____ Wet Basin
    X Biofiltration Swale
    X Austin Sand Filter
    ____ Detention Device
    ____ Delaware Filter
    ____ MCTT

18. Biofiltration
    (a) Are site conditions and climate favorable to allow suitable vegetation to be established? ☒Yes ☐No

    (b) Have Biofiltration strips and swales been considered to the extent practicable? Note: Biofiltration BMPs should be considered for all projects, even if other Treatment BMPs are placed. ☒Yes ☐No

    If No to (a) or (b), document justification in Section 5 of the SWDR.

19. After completing the above, complete and attach the checklists shown below for every Treatment BMP under consideration ☒Complete

- **X** Biofiltration Strips and Biofiltration Swales: Checklist T-1, Part 2
- ____ Dry Weather Diversion: Checklist T-1, Part 3
- ____ Infiltration Devices: Checklist T-1, Part 4
- ____ Detention Devices: Checklist T-1, Part 5
- ____ GSRDs: Checklist T-1, Part 6
- ____ Traction Sand Traps: Checklist T-1, Part 7
- **X** Media Filter [Austin Sand Filter and Delaware Filter]: Checklist T-1, Part 8
- ____ Multi-Chambered Treatment Train: Checklist T-1, Part 9
- ____ Wet Basins: Checklist T-1, Part 10

20. (a) Estimate what percentage of WQV/WQF will be treated by the preferred Treatment BMP(s): 100% ☒Complete

(b) Have Treatment BMPs been considered for use in parallel or series to increase this percentage? ☐Yes ☒No

21. Prepare cost estimate, including right-of-way, for selected Treatment BMPs and include as supplemental information for SWDR approval. ☒Complete

Treatment BMPs

Checklist T-1, Part 2

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84

PM : 22.9/27.1 EA: 04-297601

RWQCB: Region 2, San Francisco Bay

Biofiltration Swales / Biofiltration Strips

Feasibility

1. Do the climate and site conditions allow vegetation to be established? ☒Yes ☐No

2. Are flow velocities < 4 fps (i.e. low enough to prevent scour of the vegetated bioswale as per HDM Table 873.3E)? ☒Yes ☐No

   If No to either question above, Biofiltration Swales and Biofiltration Strips are not feasible.

3. Are Biofiltration Swales proposed at sites where known hazardous soils or contaminated groundwater plumes exist? ☐Yes ☒No
   If Yes, consult with District/Regional NPDES Coordinator about how to proceed.

4. Does adequate area exist within the right-of-way to place biofiltration device(s)? ☒Yes ☐No
   If Yes, continue to the Design Elements section. If No, continue to Question 5.

5. If adequate area does not exist within right-of-way, can suitable, additional right-of-way be acquired to site Biofiltration Devices and how much right-of way would be needed to treat WQF? _____ acres ☐Yes ☐No
   If Yes, continue to Design Elements section. If No, continue to Question 6.

6. If adequate area cannot be obtained, document in Section 5 of the SWDR that the inability to obtain adequate area prevents the incorporation of these Treatment BMPs into the project. ☐Complete

Design Elements

* **Required** Design Element – A "Yes" response to these questions is required to further the consideration of this BMP into the project design. Document a "No" response in Section 5 of the SWDR to describe why this Treatment BMP cannot be included into the project design.

** **Recommended** Design Element – A "Yes" response is preferred for these questions, but not required for incorporation into a project design.

1. Has the District Landscape Architect provided vegetation mixes appropriate for climate and location? * ☒Yes ☐No

2.	Can the bioswale be designed as a conveyance system under any expected flows > the WQF event, as per HDM Chapter 800? * (e.g. freeboard, minimum slope, etc.)	☒Yes	☐No
3.	Can the bioswale be designed as a water quality treatment device under the WQF while meeting the required HRT, depth, and velocity criteria? (Reference Appendix B, Section B.2.3.1)*	☒Yes	☐No
4.	Is the maximum length of a biostrip ≤ 300 ft? At one location only, station 231+00 to 233+50 (maximum length is 250 feet)..	☒Yes	☐No
5.	Has the minimum width (in the direction of flow) of the invert of the bioswale received the concurrence of Maintenance? *	☒Yes	☐No
6.	Can bioswales be located in natural or low cut sections to reduce maintenance problems caused by animals burrowing through the berm of the swale? **	☐Yes	☐No
7.	Is the biostrip sized as long as possible in the direction of flow? **	☒Yes	☐No
8.	Have Biofiltration Systems been considered for locations upstream of other Treatment BMPs, as part of a treatment train? **	☒Yes	☐No

Treatment BMPs
Checklist T-1, Part 8

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
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RWQCB: Region 2, San Francisco Bay

Media Filters

Caltrans has approved two types of Media Filter: Austin Sand Filters and Delaware Filters. Austin Sand filters are typically designed for larger drainage areas, while Delaware Filters are typically designed for smaller drainage areas. The Austin Sand Filter is constructed with an open top and may have a concrete or earthen invert, while the Delaware is always constructed as a vault. See Appendix B, Media Filters, for a further description of Media Filters.

Feasibility – Austin Sand Filter

1. Is the volume of the Austin Sand Filter equal to at least the WQV using a 40 to 48 hour drawdown? (Note: the WQV must be ≥ 4,356 ft^3 [0.1 acre-feet]) ☒Yes ☐No

2. Is there sufficient hydraulic head to operate the device (minimum 3 ft between the inflow and outflow chambers)? ☒Yes ☐No

3. If initial chamber has an earthen bottom, is initial chamber invert ≥ 3 ft above seasonally high groundwater? ☒Yes ☐No

4. If a vault is used for either chamber, is the level of the concrete base of the vault above seasonally high groundwater or is a special design provided? ☒Yes ☐No

   If No to any question above, then an Austin Sand Filter is not feasible.

5. Does adequate area exist within the right-of-way to place an Austin Sand Filter(s)? ☒Yes ☐No
   If Yes, continue to Design Elements sections. If No, continue to Question 6.

6. If adequate area does not exist within right-of-way, can suitable, additional right-of-way be acquired to site the device and how much right-of way would be needed to treat WQV? _____ acres ☐Yes ☐No
   If Yes, continue to the Design Elements section.

   If No, continue to Question 7.

7. If adequate area cannot be obtained, document in Section 5 of the SWDR that the inability to obtain adequate area prevents the incorporation of this Treatment BMP into the project. ☐ Complete

If an Austin Sand Filter meets these feasibility requirements, continue to the Design Elements – Austin Sand Filter below.

Feasibility- Delaware Filter

1. Is the volume of the Delaware Filter equal to at least the WQV using a 40 to 48 hour drawdown? (Note: the WQV must be ≥ 4,356 ft^3 [0.1 acre-feet], consult with District/Regional NPDES if a lesser volume is under consideration.) ☒Yes ☐No

2. Is there sufficient hydraulic head to operate the device (minimum 3 ft between the inflow and outflow chambers)? ☒Yes ☐No

3. Would a permanent pool of water be allowed by the local vector control agency?

Design of Delaware filter to meet Alameda County Mosquito Abatement District requirements for storm water devices containing permanent pools of water would not be feasible or cost effective for the Project. ☐Yes ☒No

If No to any question, then a Delaware Filter is not feasible

4. Does adequate area exist within the right-of-way to place a Delaware Filter (s)? If Yes, continue to Design Elements sections. If No, continue to Question 5. ☐Yes ☐No

5. If adequate area does not exist within right-of-way, can suitable, additional right-of-way be acquired to site the device and how much right-of way would be needed to treat WQV? _____ acres If Yes, continue to the Design Elements section. If No, continue to Question 6. ☐Yes ☐No

6. If adequate area cannot be obtained, document in Section 5 of the SWDR that the inability to obtain adequate area prevents the incorporation of this Treatment BMP into the project. ☐ Complete

If a Delaware Filter is still under consideration, continue to the Design Elements – Delaware Filter section.

Design Elements – Austin Sand Filter

* **Required** Design Element – A "Yes" response to these questions is required to further the consideration of this BMP into the project design. Document a "No" response in Section 5 of the SWDR to describe why this Treatment BMP cannot be included into the project design.

** **Recommended** Design Element – A "Yes" response is preferred for these questions, but not required for incorporation into a project design.

1. Is the drawdown time of the 2nd chamber 24 hours? * ☐Yes ☒No

48 hours was used as the drawdown time.

2. Is access for Maintenance vehicles provided to the Austin Sand Filter? * ☒Yes ☐No

3.	Is a bypass/overflow provided for storms > WQV? *	☒Yes	☐No
4.	Is the flow path length to width ratio for the sedimentation chamber of the "full" Austin Sand Filter ≥ 2:1? **	☐Yes	☒No
5.	Can pretreatment be provided to capture sediment and litter in the runoff (such as using biofiltration)? **	☐Yes	☒No
6.	Can the Austin Sand Filter be placed using an earthen configuration? ** If No, go to Question 9.	☐Yes	☒No
7.	Is the Austin Sand Filter invert separated from the seasonally high groundwater table by ≥ 10 ft? * If No, design with an impermeable liner.	☐Yes	☐No
8.	Are side slopes of the earthen chamber 1:3 (V:H) or flatter? *	☐Yes	☐No
9.	Is maximum depth ≤ 13 ft below ground surface? *	☒Yes	☐No
10.	Can the Austin Sand Filter be placed in an offline configuration? **	☐Yes	☒No

Construction Site BMPs
Checklist CS-1, Part 1

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Soil Stabilization

General Parameters

1. How many rainy seasons are anticipated between beginning and end of construction?	2
2. What is the total disturbed soil area for the project? (ac)	83.19
(a) How much of the project DSA consists of slopes 1V:4H or flatter? (ac)	77.61
(b) How much of the project DSA consists of 1V:4H < slopes < 1V:2H? (ac)	5.2
(c) How much of the project DSA consists of slopes 1V:2H and steeper? (ac)	0
(d) How much of the project DSA consists of slopes with slope lengths longer then 20 ft? (ac)	3.73
3. What rainfall area does the project lie within? (Refer to Table 2-1 of the Construction Site Best Management Practices Manual)	2
4. Review the required combination of temporary soil stabilization and temporary sediment controls and barriers for area, slope inclinations, rainy and non-rainy season, and active and non-active disturbed soil areas. (Refer to Tables 2-2, and 2-3 of the Construction Site Best Management Practices Manual for Rainfall Area requirements.)	☒ Complete

Scheduling (SS-1)

5. Does the project have a duration of more then one rainy season and have disturbed soil area in excess of 25 acres?	☒Yes ☐No
(a) Include multiple mobilizations (Move-in/Move-out) as a separate contract bid line item to implement permanent erosion control or revegetation work on slopes that are substantially complete. (Estimate at least 6 mobilizations for each additional rainy season. Designated Construction Representative may suggest an alternate number of mobilizations.)	☒ Complete
(b) Edit Order of Work specifications for permanent erosion control or revegetation work to be implemented on slopes that are substantially complete.	☒ Complete

(c) Edit permanent erosion control or revegetation specifications to require seeding and planting work to be performed when optimal. ☒ Complete

Preservation of Existing Vegetation (SS-2)

6. Do Environmentally Sensitive Areas (ESAs) exist within or adjacent to the project limits? (Verify the completion of DPP-1, Part 5) ☒ Yes ☐ No

   (a) Verify the protection of ESAs through delineation on all project plans. ☒ Complete

   (b) Protect from clearing and grubbing and other construction disturbance by enclosing the ESA perimeter with high visibility plastic fence or other BMP. ☒ Complete

7. Are there areas of existing vegetation (mature trees, native vegetation, landscape planting, etc.) that need not be disturbed by project construction? Will areas designated for proposed treatment BMPs need protection (infiltration characteristics, vegetative cover, etc.)? (Coordinate with District Environmental and Construction to determine limits of work necessary to preserve existing vegetation to the maximum extent practicable.) ☒ Yes ☐ No

   (a) Designate as outside of limits of work (or designate as ESAs) and show on all project plans. ☒ Complete

   (b) Protect with high visibility plastic fence or other BMP. ☒ Complete

8. If yes for 6, 7, or both, then designate ESA fencing as a separate contract bid line item, *if not already incorporated as part of design pollution prevention work (See DPP-1, Part 5).* ☒ Complete

Slope Protection

9. Provide a soil stabilization BMP(s) appropriate for the DSA, slope steepness, slope length, and soil erodibility. (Consult with District/Regional Landscape Architect.)

   (a) Select SS-3 (Hydraulic Mulch), SS-4 (Hydroseeding), SS-5 (Soil Binders), SS-6 (Straw Mulch), SS-7 (Geotextiles, RECPs, Etc.), SS-8 (Wood Mulching), other BMPs or a combination to cover the DSA throughout the project's rainy season. ☒ Complete

   (b) Increase the quantities by 25% for each additional rainy season. (Designated Construction Representative may suggest an alternate increase.) ☒ Complete

   (c) Designate as a separate contract bid line item. ☒ Complete

Slope Interrupter Devices

10. Provide slope interrupter devices for all slopes with slope lengths equal to or greater than of 20 ft in length. (Consult with District/Regional Landscape Architect and Designated Construction Representative.)

    (a) Select SC-5 (Fiber Rolls) or other BMPs to protect slopes throughout the project's rainy season. ☒ Complete

    (b) For slope inclination of 1V:4H and flatter, SC-5 (Fiber Rolls) or other BMPs shall be placed along the contour and spaced 20 ft on center. ☒ Complete

    (c) For slope inclination between 1V:4H and 1V:2H, SC-5 (Fiber Rolls) or other BMPs shall be placed along the contour and spaced 15 ft on center. ☒ Complete

    (d) For slope inclination of 1V:2H and greater, SC-5 (Fiber Rolls) or other BMPs shall be placed along the contour and spaced 10 ft on center. ☒ Complete

    (e) Increase the quantities by 25% for each additional rainy season. (Designated Construction Representative may suggest alternate increase.) ☒ Complete

    (f) Designate as a separate contract bid line item. ☒ Complete

Channelized Flow

11. Identify locations within the project site where concentrated flow from stormwater runoff can erode areas of soil disturbance. Identify locations of concentrated flow that enters the site from outside of the right-of-way (off-site run-on). ☒ Complete

    (a) Utilize SS-7 (Geotextiles, RECPs, etc.), SS-9 (Earth Dikes/Swales, Ditches), SS-10 (Outlet Protection/Velocity Dissipation), SS-11 (Slope Drains), SC-4 (Check Dams), or other BMPs to convey concentrated flows in a non-erosive manner. ☒ Complete

    (b) Designate as a separate contract bid line item. ☒ Complete

Construction Site BMPs
Checklist CS-1, Part 2

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Sediment Control

Perimeter Controls - Run-off Control

1. Is there a potential for sediment laden sheet and concentrated flows to discharge offsite from runoff cleared and grubbed areas, below cut slopes, embankment slopes, etc.? ☒Yes ☐No

   (a) Select linear sediment barrier such as SC-1 (Silt Fence), SC-5 (Fiber Rolls), SC-6 (Gravel Bag Berm), SC-8 (Sand Bag Barrier), SC-9 (Straw Bale Barrier), or a combination to protect wetlands, water courses, roads (paved and unpaved), construction activities, and adjacent properties. (Coordinate with District Construction for selection and preference of linear sediment barrier BMPs.) ☒ Complete

   (b) Increase the quantities by 25% for each additional rainy season. (Designated Construction Representative may suggest an alternate increase.) ☒ Complete

   (c) Designate as a separate contract bid line item. ☒ Complete

Perimeter Controls - Run-on Control

2. Do locations exist where sheet flow upslope of the project site and where concentrated flow upstream of the project site may contact DSA and construction activities? ☒Yes ☐No

   (a) Utilize linear sediment barriers such as SS-9 (Earth Dike/Drainage Swales and Lined Ditches), SC-5 (Fiber Rolls), SC-6 (Gravel Bag Berm), SC-8 (Sand Bag Barrier), SC-9 (Straw Bale Barrier), or other BMPs to convey flows through and/or around the project site. (Coordinate with District Construction for selection and preference of perimeter control BMPs.) ☒ Complete

   (b) Designate as a separate contract bid line item. ☒ Complete

Storm Drain Inlets

3. Do existing or proposed drainage inlets exist within the project limits? ☒Yes ☐No

   (a) Select SC-10 (Storm Drain Inlet Protection) to protect municipal storm drain systems or receiving waters wetlands at each drainage inlet. (Coordinate with District Construction for selection and preference of inlet protection BMPs.) ☒ Complete

   (b) Designate as a separate contract bid line item. ☒ Complete

4. Can existing or proposed drainage inlets utilize an excavated sediment trap as described in SC-10 (Storm Drain Inlet Protection- Type 2)? ☒Yes ☐No

   (a) Include with other types of SC-10 (Storm Drain Inlet Protection). ☒ Complete

Sediment/Desilting Basin (SC-2)

5. Does the project lie within a Rainfall Area where the required combination of temporary soil stabilization and sediment control BMPs includes desilting basins? (Refer to Tables 2-1, 2-2, and 2-3 of the Construction Site Best Management Practices Manual for Rainfall Area requirements.) Desilting basin only required on active DSAs with slopes greater than 2:1. There are no slopes in the Project with slopes greater than 2:1. ☐Yes ☒No

   (a) Consider feasibility for desilting basin allowing for available right-of-way within the project limits, topography, soil type, disturbed soil area within the watershed, and climate conditions. Document if the inclusion of sediment/desilting basins is infeasible. ☐ Complete

   (b) If feasible, design desilting basin(s) per the guidance in SC-2 Sediment/ Desilting Basins of the Construction Site BMP Manual to maximize capture of sediment-laden runoff. ☐ Complete

   Designate as a separate contract bid item. ☐ Complete

6. Will the project benefit from the early implementation of proposed permanent Treatment BMPs? (Coordinate with District Construction.) ☒Yes ☐No

   (a) Edit Order of Work specifications for permanent treatment BMP work to be implemented in a manner that will allow its use as a construction site BMP. ☒ Complete

Sediment Trap (SC-3)

7. Can sediment traps be located to collect channelized runoff from disturbed soil areas prior to discharge? ☐Yes ☒No

   (a) Design sediment traps in accordance with the Construction Site BMP Manual. ☐ Complete

   (b) Designate as a separate contract bid line item. ☐ Complete

Construction Site BMPs
Checklist CS-1, Part 3

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Tracking Controls

Stabilized Construction Entrance/Exit (TC-1)

1. Are there points of entrance and exit from the project site to paved roads where mud and dirt could be transported offsite by construction equipment? (Coordinate with District Construction for selection and preference of tracking control BMPs.) ☒Yes ☐No

   (a) Identify and designate these entrance/exit points as stabilized construction entrances (TC-1). ☒ Complete

   (b) Designate as a separate contract bid line item. ☒ Complete

Tire/Wheel Wash (TC-3)

1. Are site conditions anticipated that would require additional or modified tracking controls such as entrance/outlet tire wash? (Coordinate with District Construction.) ☒Yes ☐No

   Designate as a separate contract bid line item. ☒ Complete

Stabilized Construction Roadway (TC-2)

3. Are temporary access roads necessary to access remote construction activity locations or to transport materials and equipment? (In addition to controlling dust and sediment tracking, access roads limit impact to sensitive areas by limiting ingress, and provide enhanced bearing capacity.) (Coordinate with District Construction.) ☐Yes ☒No

   (a) Designate these temporary access roads as stabilized construction roadways (TC-2). ☐ Complete

   (b) Designate as a separate contract bid line item. ☐ Complete

Street Sweeping and Vacuuming (SC-7)

1. Is there a potential for tracked sediment or construction related residues to be transported offsite and deposited on public or private roads? (Coordinate with District Construction for preference of including street sweeping and vacuuming with tracking control BMPs.) ☒Yes ☐No

   Designate as a separate contract bid line item. ☒ Complete

Construction Site BMPs
Checklist CS-1, Part 4

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Wind Erosion Controls

Wind Erosion Control (WE-1)

1. Is the project located in an area where standard dust control practices in accordance with Standard Specifications, Section 10: Dust Control, are anticipated to be inadequate during construction to prevent the transport of dust offsite by wind? *(Note: Dust control by water truck application is paid for through the various items of work. Dust palliative, if it is included, is paid for as a separate item.)* ☒ Yes ☐ No

   (a) Select SS-3 (Hydraulic Mulch), SS-4 (Hydroseeding), SS-5 (Soil Binders), SS-7 (Geotextiles, Plastic Covers, & Erosion Control Blankets/Mats), SS-8 (Wood Mulching) or a combination to cover the DSA subject to wind erosion year-round, especially when significant wind and dry conditions are anticipated during project construction. (Coordinate with District Construction for selection and preference of wind erosion control BMPs.) ☒ Complete

   (b) Designate as a separate contract bid line item. ☒ Complete

Construction Site BMPs
Checklist CS-1, Part 5

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Non-Storm Water Management

Temporary Stream Crossing (NS-4) & *Clear Water Diversion* (NS-5)

1. Will construction activities occur within a waterbody or watercourse such as a lake, wetland, or stream? (Coordinate with District Construction for selection and preference for stream crossing and clear water diversion BMPs.) ☒Yes ☐No

   (a) Select from types offered in NS-4 (Temporary Stream Crossing) to provide access through watercourses consistent with permits and agreements.[1] **N/A** Complete

   (b) Select from types offered in NS-5 (Clear Water Diversion) to divert watercourse consistent with permits and agreements.[1] Temporary Creek Diversion is not proposed for this project. Structural confirmed that proposed bridge work would require coffer dam around proposed footing only. ☒ Complete

   (c) Designate as a separate contract bid line item(s). ☒ Complete

Other Non-Storm Water Management BMPs

2. Are construction activities anticipated that will generate wastes or residues with the potential to discharge pollutants? ☒Yes ☐No

   (a) Identify potential pollutants associated with the anticipated construction activity and select the corresponding BMP such as NS-1 (Water Conservation Practices), NS-2 (Dewatering Operations), NS-3 (Paving and Grinding Operations), NS-7 (Potable Water/Irrigation), NS-8 (Vehicle and Equipment Cleaning), NS-9 (Vehicle and Equipment Fueling), NS-10 (Vehicle and Equipment Maintenance), NS-11 (Pile Driving Operations), NS-12 (Concrete Curing), NS-13 (Material and Equipment Use Over Water), NS-14 (Concrete Finishing), and NS-15 (Structure Demolition/Removal Over or Adjacent to Water).[1] ☒ Complete

   (b) Verify that costs for non-storm water management BMPs are identified in the contract documents. Designate BMP as a separate contract bid line item if the requirements in Construction Site Management (SSP 07-346) are anticipated to be inadequate or if requested by Construction. ☒ Complete

1. Coordinate with District Environmental for consistency with US Army Corps of Engineers 404 permit and Dept. of Fish and Game 1601 Streambed alteration Agreements.

Construction Site BMPs
Checklist CS-1, Part 6

Prepared by: WRECO Date: January 2011 District-Co-Route: 04-Ala-84
PM : 22.9/27.1 EA: 04-297601
RWQCB: Region 2, San Francisco Bay

Waste Management & Materials Pollution Control

Concrete Waste Management (WM-8)

1. Does the project include concrete pours or mortar mixing? ☒Yes ☐No

   (a) Select from types offered in WM-8 (Concrete Waste Management) to provide concrete washout facilities. In addition, consider portable concrete washouts and vendor supplied concrete waste management services. (Coordinate with District Construction for selection and preference of waste management and materials pollution control BMPs.) ☒ Complete

   (b) Designate as a separate contract bid line item if the quantity of concrete waste and washout are anticipated to exceed 5.2 yd^3 or if requested by Construction. ☒ Complete

Other Waste Management and Materials Pollution Controls

2. Are construction activities anticipated that will generate wastes or residues with the potential to discharge pollutants? ☒Yes ☐No

   (a) Identify potential pollutants associated with the anticipated construction activity and select the corresponding BMP such as WM-1 (Material Delivery and Storage), WM-2 (Material Use), WM-4 (Spill Prevention and Control), WM-5 (Solid Waste Management), WM-6 (Hazardous Waste Management), WM-7 (Contaminated Soil Management), WM-9 (Sanitary/Septic Waste Management) and WM-10 (Liquid Waste Management) ☒ Complete

   (b) Verify that costs for waste management and materials pollution control BMPs are identified in the contract documents. Designate BMP as a separate contract bid line item if the requirements in Construction Site Management (SSP 07-346) are anticipated to be inadequate or if requested by Construction. ☒ Complete

Temporary Stockpiles (Soil, Materials, and Wastes)

3. Are stockpiles of soil, etc. anticipated during construction? ☒Yes ☐No

   (a) Select WM-3 (Stockpile Management), SS-3 (Hydraulic Mulch), SS-4 (Hydroseeding), SS-5 (Soil Binders), SS-7 (Geotextiles, RECPs etc.), or a combination as appropriate to cover temporary stockpiles of soil, etc. ☒ Complete

(b) Select linear sediment barrier such as SC-1 (Silt Fence), SC-5 (Fiber Rolls), SC-6 (Gravel Bag Berm), SC-8 (Sand Bag Barrier), SC-9 (Straw Bale Barrier), or a combination to encircle temporary stockpiles of soil, etc. (Coordinate with District Construction for selection and preference of BMPs related to stockpiles.) ☒ Complete

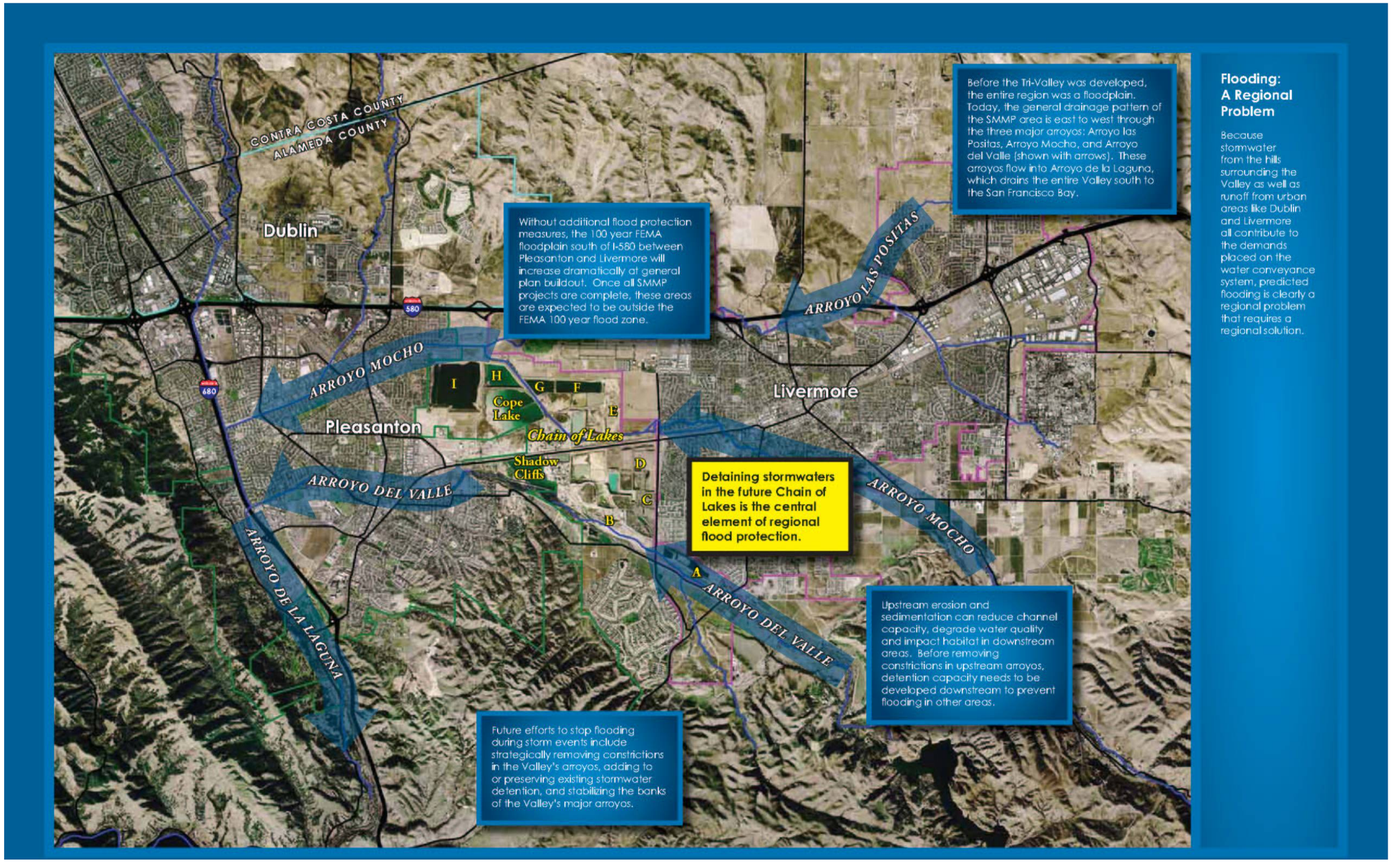
(c) Designate as a separate contract bid line item if the requirements in Construction Site management (SSP 07-346) are anticipated to be inadequate or if requested by Construction. ☒ Complete

4. Is there a potential for dust and debris from construction material (fill material, etc.) and waste (concrete, contaminated soil, etc.) stockpiles to be transported offsite by wind? ☒Yes ☐No

(a) Select SS-7, temporary cover, plastic sheeting or other BMP to cover stockpiles subject to wind erosion year-round, especially when significant wind and dry conditions are anticipated during project construction. (Coordinate with District Construction for selection and preference of wind erosion control BMPs.) ☒ Complete

(b) Designate as a separate contract bid line item. ☒ Complete

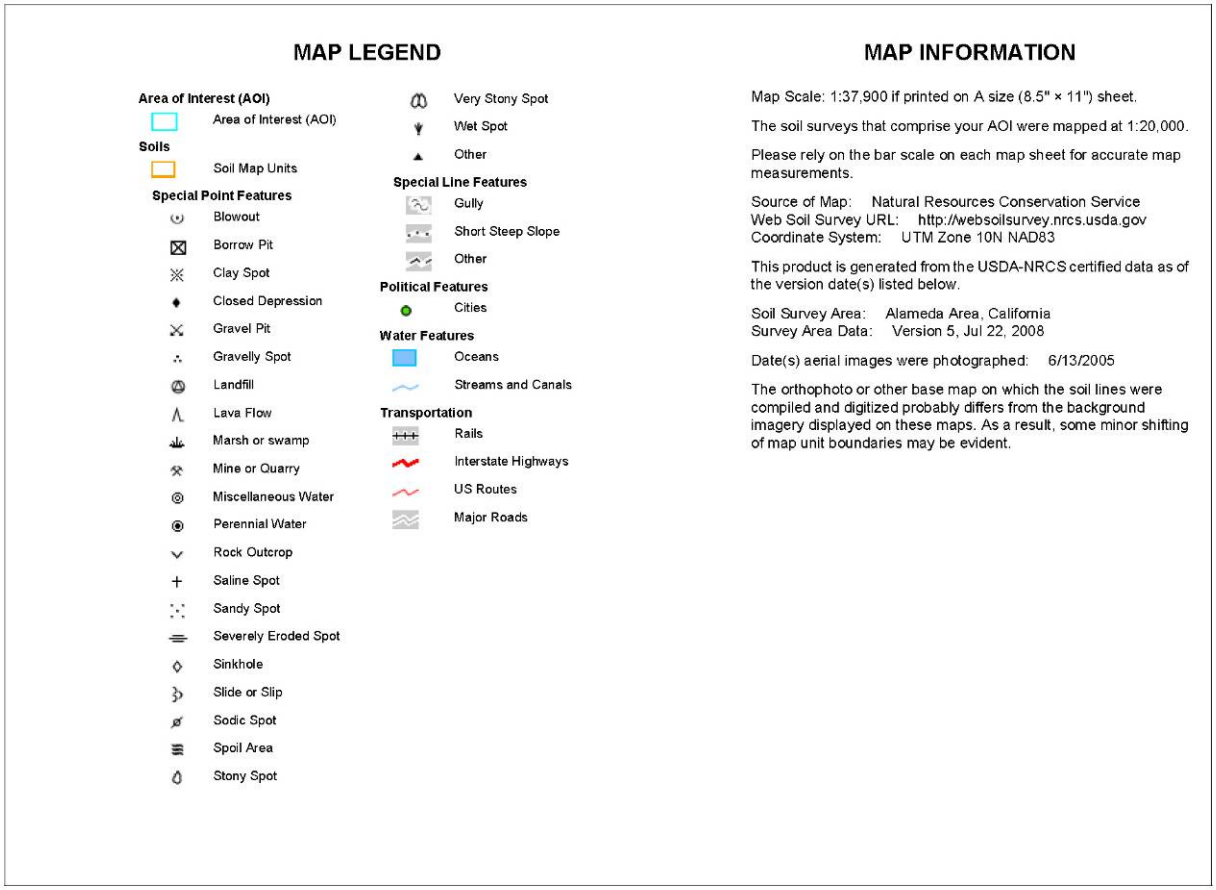
Chain of Lakes Map


CONTRA COSTA COUNTY
ALAMEDA COUNTY
Dublin
Pleasanton
Livermore
580
680
ARROYO MOCHO
ARROYO LAS POSITAS
ARROYO DEL VALLE
ARROYO DE LA LAGUNA
Cope Lake
Chain of Lakes
Shadow Cliffs
I
H
G
F
E
D
C
B
A
Before the Tri-Valley was developed, the entire region was a floodplain. Today, the general drainage pattern of the SMMP area is east to west through the three major arroyos: Arroyo las Positas, Arroyo Mocho, and Arroyo del Valle (shown with arrows). These arroyos flow into Arroyo de la Laguna, which drains the entire Valley south to the San Francisco Bay.
Without additional flood protection measures, the 100 year FEMA floodplain south of I-580 between Pleasanton and Livermore will increase dramatically at general plan buildout. Once all SMMP projects are complete, these areas are expected to be outside the FEMA 100 year flood zone.
Detaining stormwaters in the future Chain of Lakes is the central element of regional flood protection.
Upstream erosion and sedimentation can reduce channel capacity, degrade water quality and impact habitat in downstream areas. Before removing constrictions in upstream arroyos, detention capacity needs to be developed downstream to prevent flooding in other areas.
Future efforts to stop flooding during storm events include strategically removing constrictions in the Valley's arroyos, adding to or preserving existing stormwater detention, and stabilizing the banks of the Valley's major arroyos.
Flooding: A Regional Problem
Because stormwater from the hills surrounding the Valley as well as runoff from urban areas like Dublin and Livermore all contribute to the demands placed on the water conveyance system, predicted flooding is clearly a regional problem that requires a regional solution.

Soils Map

Soil Map—Alameda Area, California
(SR 84 Expressway Widening)
121° 50' 3"
121° 46' 2"
37° 41' 56"
37° 41' 54"
603300
604200
605100
606000
606900
607800
4173000
4172100
4171200
4170300
4169400
4168500
4167600
4166700
4165800
Arroyo Las Positas
E Airway Blvd
County Hwy J2
Portola Ave
N Murrieta Blvd
Livermore
1st St
Arroyo Mocho Canal
Arroyo Mocho
4th St
Stanley Blvd
E Stanley Blvd
College Ave
Granada Channel
Holmes St
Arroyo del Valle
State Hwy 84
Arroyo Rd
Vineyard Ave
E Vineyard Ave
Wetmore Rd
Vallecitos Rd
RdA
YmA
Ze
Lm
Rh
Cp
Ca
FgB
PoE2
37° 37' 39"
37° 37' 36"
121° 50' 7"
121° 46' 7"
Map Scale: 1:37,900 if printed on A size (8.5" x 11") sheet.
N
Meters
0 350 700 1,400 2,100
Feet
0 1,000 2,000 4,000 6,000
USDA Natural Resources Conservation Service
Web Soil Survey
National Cooperative Soil Survey
3/2/2010
Page 1 of 3

Soil Map–Alameda Area, California
(SR 84 Expressway Widening)



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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Alameda Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Gp	Gravel pit	A	15.5	3.9%
Lg	Livermore gravelly loam	B	49.6	12.4%
Lm	Livermore very gravelly coarse sandy loam	B	69.1	17.2%
PgA	Pleasanton gravelly loam, 0 to 3 percent slopes	B	60.5	15.1%
PgB	Pleasanton gravelly loam, 3 to 12 percent slopes	B	26.3	6.6%
PoC2	Positas gravelly loam, 2 to 20 percent slopes, eroded	D	19.7	4.9%
PoE2	Positas gravelly loam, 20 to 40 percent slopes, eroded	D	32.1	8.0%
PtB2	Positas gravelly loam, thick surface, 2 to 10 percent slopes, eroded	D	0.0	0.0%
Rh	Riverwash	A	36.5	9.1%
Sa	San Ysidro loam	D	3.3	0.8%
W	Water		0.1	0.0%
YmA	Yolo loam, 0 to 3 percent slopes	A	61.9	15.4%
Yr	Yolo gravelly loam, 0 to 3 percent slopes	A	14.6	3.6%
Za	Zamora silt loam, 0 to 4 percent slopes	A	12.0	3.0%
Totals for Area of Interest			**401.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**
2	**A) R Factor**		
3	Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site.		
4	http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm		
5	**R Factor Value**		79.68
6	**B) K Factor (weighted average, by area, for all site soils)**		
7	The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because of high infiltration resulting in low runoff even though these particles are easily detached. Medium-textured soils, such as a silt loam, have moderate K values (about 0.25 to 0.45) because they are moderately susceptible to particle detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted.		
8	Site-specific K factor guidance		
9	**K Factor Value**		0.2
10	**C) LS Factor (weighted average, by area, for all slopes)**		
11	The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.		
12	LS Table		
13	**LS Factor Value**		1.51
14			
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**		24.06336
16	**Site Sediment Risk Factor**		**Medium**
17	Low Sediment Risk: < 15 tons/acre		
18	Medium Sediment Risk: >=15 and <75 tons/acre		
19	High Sediment Risk: >= 75 tons/acre		
20			

Receiving Water (RW) Risk Factor Worksheet	Entry	Score
A. Watershed Characteristics	**yes/no**	
A.1. Does the disturbed area discharge (either directly or indirectly) to a **303(d)-listed waterbody impaired by sediment**? For help with impaired waterbodies please check the attached worksheet or visit the link below:	**No**	**Low**
2006 Approved Sediment-impared WBs Worksheet		
http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml		
OR		
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY?		
http://www.ice.ucdavis.edu/geowbs/asp/wbquse.asp		

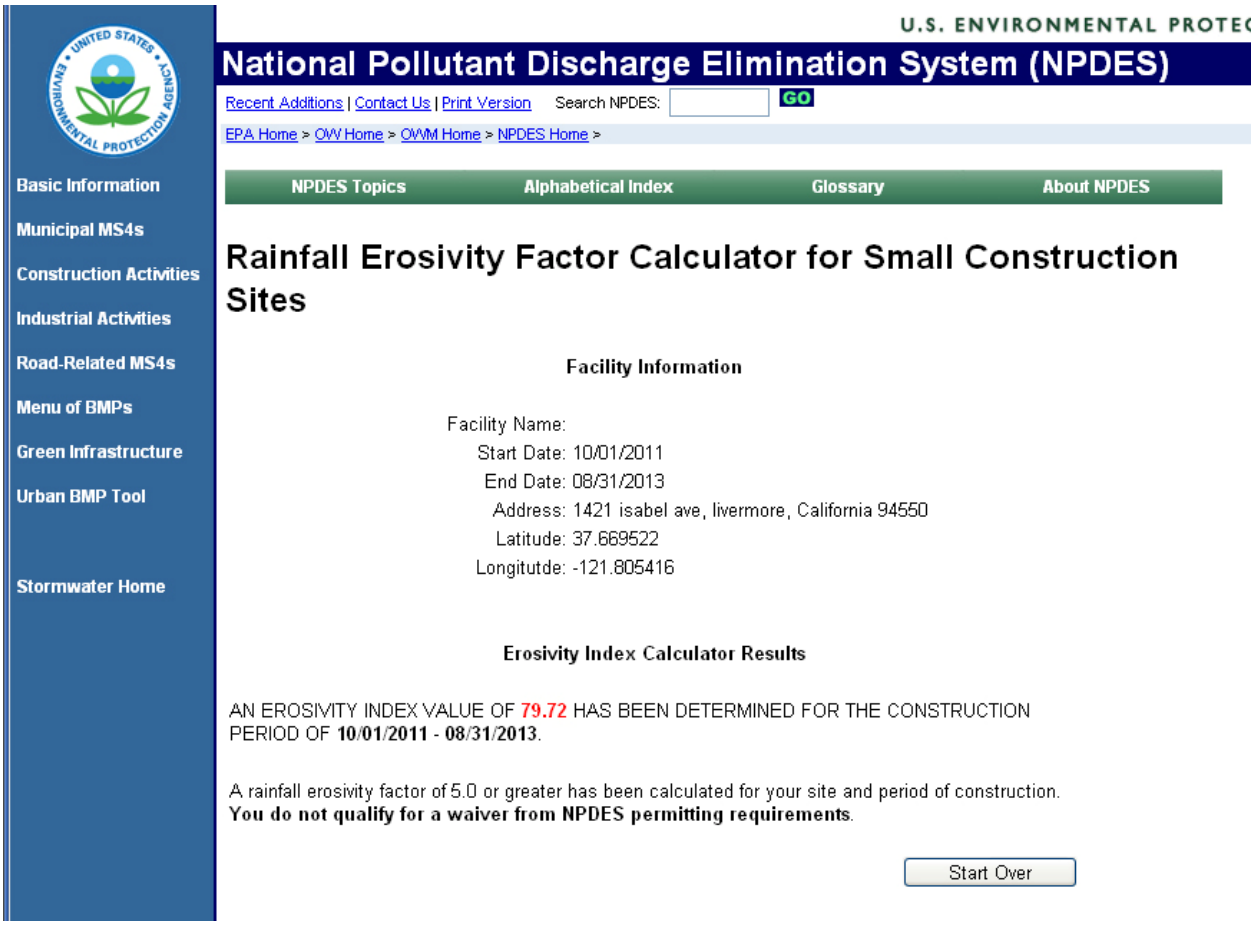
Combined Risk Level Matrix

Receiving Water Risk \ Sediment Risk	Low	Medium	High
Low	Level 1	Level 2	
High	Level 2		Level 3

Project Sediment Risk: Medium

Project RW Risk: Low

Project Combined Risk: Level 2



U.S. ENVIRONMENTAL PROTEC

National Pollutant Discharge Elimination System (NPDES)

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Basic Information
Municipal MS4s
Construction Activities
Industrial Activities
Road-Related MS4s
Menu of BMPs
Green Infrastructure
Urban BMP Tool
Stormwater Home

Rainfall Erosivity Factor Calculator for Small Construction Sites

Facility Information

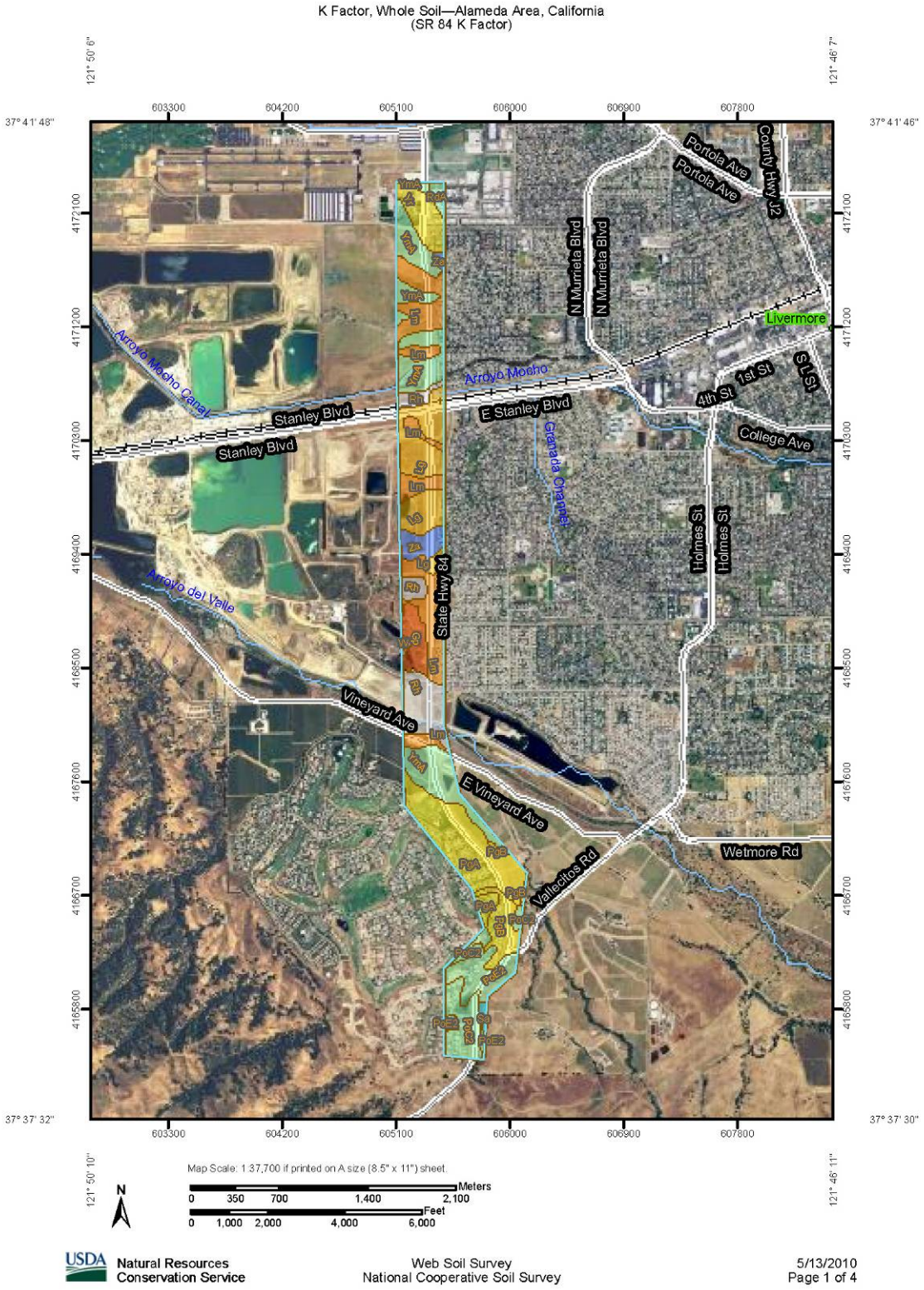
Facility Name:
Start Date: 10/01/2011
End Date: 08/31/2013
Address: 1421 isabel ave, livermore, California 94550
Latitude: 37.669522
Longitutde: -121.805416

Erosivity Index Calculator Results

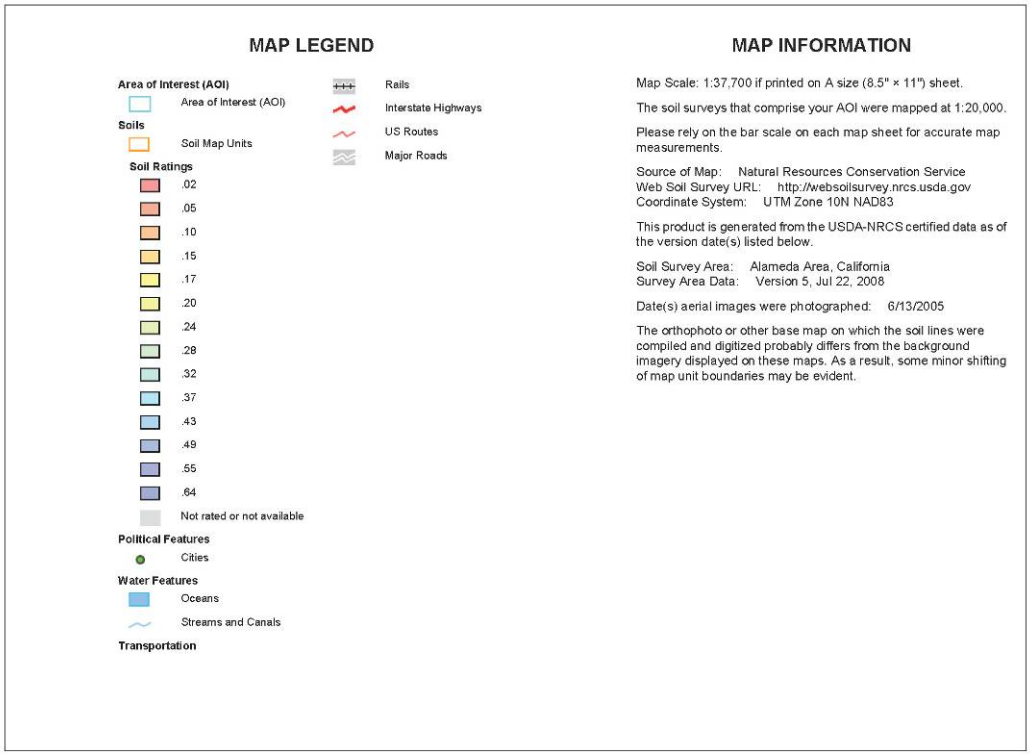
AN EROSIVITY INDEX VALUE OF **79.72** HAS BEEN DETERMINED FOR THE CONSTRUCTION PERIOD OF **10/01/2011 - 08/31/2013**.

A rainfall erosivity factor of 5.0 or greater has been calculated for your site and period of construction.
You do not qualify for a waiver from NPDES permitting requirements.

Start Over


K Factor, Whole Soil—Alameda Area, California
(SR 84 K Factor)
121° 50' 6"
121° 46' 7"
37° 41' 48"
37° 41' 46"
603300
604200
605100
606000
606900
607800
4172100
4171200
4170300
4169400
4168500
4167600
4166700
4165800
37° 37' 32"
37° 37' 30"
121° 50' 10"
121° 46' 11"
Portola Ave
County Hwy J2
N Murrieta Blvd
Livermore
Arroyo Mocho Canal
Arroyo Mocho
Stanley Blvd
E Stanley Blvd
1st St
4th St
S L St
College Ave
Granada Channel
Holmes St
Arroyo del Valle
State Hwy 84
Vineyard Ave
E Vineyard Ave
Wetmore Rd
Vallecitos Rd
Map Scale: 1:37,700 if printed on A size (8.5" x 11") sheet.
N
Meters
0 350 700 1,400 2,100
Feet
0 1,000 2,000 4,000 6,000
USDA Natural Resources Conservation Service
Web Soil Survey
National Cooperative Soil Survey
5/13/2010
Page 1 of 4

K Factor, Whole Soil–Alameda Area, California
(SR 84 K Factor)



K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Alameda Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Gp	Gravel pit	.05	21.2	3.2%
Lg	Livermore gravelly loam	.15	79.0	12.1%
Lm	Livermore very gravelly coarse sandy loam	.10	110.9	16.9%
PgA	Pleasanton gravelly loam, 0 to 3 percent slopes	.17	97.9	15.0%
PgB	Pleasanton gravelly loam, 3 to 12 percent slopes	.17	30.3	4.6%
PoC2	Positas gravelly loam, 2 to 20 percent slopes, eroded	.28	40.8	6.2%
PoE2	Positas gravelly loam, 20 to 40 percent slopes, eroded	.28	44.3	6.8%
PtB2	Positas gravelly loam, thick surface, 2 to 10 percent slopes, eroded	.28	1.1	0.2%
RdA	Rincon clay loam, 0 to 3 percent slopes	.28	6.1	0.9%
Rh	Riverwash		56.3	8.6%
Sa	San Ysidro loam	.37	3.5	0.5%
W	Water		1.2	0.2%
YmA	Yolo loam, 0 to 3 percent slopes	.28	112.5	17.2%
Yr	Yolo gravelly loam, 0 to 3 percent slopes	.17	29.1	4.4%
Za	Zamora silt loam, 0 to 4 percent slopes	.49	20.5	3.1%
Totals for Area of Interest			**654.8**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Table 7. LS Factor Calculation

Station	Line	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Total L (ft)	Avg S
227+00	A1	4.24	0.16	0.67	2.45	0.06	0.14	1.58	0.57	0.91	4.86	0.41	2.00	9.60	0.21	2.00							22.73	0.25
237+00	A1	24.85	0.07	1.62	30.04	0.45	13.50	13.87	0.04	0.62	14.24	0.08	1.08										83.00	0.20
247+00	A1	46.79	0.32	14.88	10.06	0.03	0.27	40.85	0.07	2.95													97.70	0.19
257+00	A1	25.56	0.39	10.00	14.25	0.10	1.43	56.50	0.02	1.30	9.70	0.03	0.33	34.14	0.39	13.20	14.05	0.04	0.50				154.19	0.17
267+00	A1	8.80	0.23	2.04	12.83	0.02	0.25	22.85	0.04	1.01													44.47	0.07
277+00	A1	3.98	0.00	0.01	33.17	0.04	1.44	4.54	0.33	1.51													41.69	0.07
287+00	A1	4.46	0.04	0.19	4.59	0.30	1.38	4.22	0.28	1.18	16.65	0.01	0.09	21.51	0.01	0.24	4.34	0.04	0.17	3.17	0.19	0.60	58.94	0.07
297+00	A1	3.83	0.01	0.03	6.09	0.08	0.46	11.00	0.01	0.13	30.02	0.02	0.69										50.94	0.03
307+00	A1	7.56	0.02	0.14	12.23	0.09	1.12	4.24	0.07	0.28	8.46	0.18	1.51	31.05	0.02	0.65							63.54	0.06
317+00	A1	10.19	0.37	3.80	18.80	0.21	3.89	8.20	0.47	3.87	18.39	0.03	0.60										55.58	0.22
327+00	A1	28.59	0.00	0.00	14.12	0.23	3.19	15.41	0.25	3.86	41.33	0.00	0.14										99.45	0.07
337+00	A1	30.54	0.01	0.32	13.03	0.16	2.10	17.31	0.60	10.33	16.44	0.02	0.25	4.43	0.09	0.40	6.15	0.27	1.64	6.75	0.08	0.51	94.65	0.16
345+00	A1	49.26	0.08	3.75	33.33	0.02	0.60																82.59	0.05
364+00	A2_A	7.65	0.00	0.00	11.21	0.03	0.33			0.00			0.00										18.86	0.02
374+00	A2_A	13.40	0.00	0.00	2.89	0.17	0.49	1.75	0.00	0.00	2.77	0.24	0.66										20.81	0.06
384+00	A2_A	17.61	0.03	0.61																			17.61	0.03
392+00	A2_A	36.30	0.20	7.26	18.31	-0.01	-0.22																54.61	0.13
393+00	A2_A	5.75	0.02	0.12	4.15	0.21	0.89																9.90	0.10
346+00	A2_B	8.51	0.00	0.01	4.16	0.06	0.25																12.67	0.02
356+00	A2_B	6.52	0.02	0.10	6.79	0.20	1.39	8.96	0.08	0.69													22.27	0.10
366+00	A2_B	4.40	0.09	0.40	14.20	0.01	0.08																18.60	0.03
395+00	A3_A	6.58	0.60	3.97	23.55	0.42	9.87	24.41	0.11	2.74	33.05	0.02	0.69										87.59	0.20
405+00	A3_A	13.82	0.03	0.47	10.39	0.04	0.46			0.00			0.00										24.21	0.04
413+50	A3_A	29.10	0.00	0.03	12.73	0.21	2.70	40.48	0.01	0.25	3.06	0.04	0.12	8.14	0.03	0.25							93.51	0.04
423+00	A3_A	5.29	0.06	0.32	13.25	0.01	0.11																18.54	0.02
433+00	A3_A	21.89	0.01	0.13																			21.89	0.01
443+00	A3_A	20.80	0.02	0.48																			20.80	0.02
122+00	AC1_A	15.69	0.00	0.07																			15.69	0.00
133+00	AC1_A	3.99	0.03	0.13	24.49	0.12	3.06	5.43	0.29	1.57	11.55	0.46	5.31										45.46	0.22
143+00	AC1_A	29.75	0.02	0.48	10.36	0.30	3.15	6.39	0.55	3.53													46.50	0.15
153+00	AC1_A	9.24	0.02	0.16	16.71	0.32	5.35	17.56	0.65	11.49	26.56	0.49	12.99	14.39	0.02	0.27							84.46	0.36
162+00	AC1_A	10.87	0.02	0.17	7.15	0.23	1.68	16.12	0.47	7.58			0.00										34.14	0.28
95+00	ST_A	50.51	0.01	0.41	16.48	0.08	1.35	7.95	0.33	2.62	14.57	0.49	7.14	10.62	0.48	5.05	4.51	0.22	1.00	40.41	0.02	0.64	145.05	0.13
103+00	V_B	18.64	0.22	4.06	8.28	0.27	2.24																26.92	0.23
113+00	V_B	4.10	0.40	1.64	9.75	0.07	0.64																13.85	0.16
53+30	VEX_B	72.36	0.04	2.72	66.76	0.07	4.73																139.12	0.05
18+70	VIN_B	34.70	0.00	0.09	3.08	0.06	0.17	1.85	0.06	0.12			0.00										39.63	0.01
																						AVERAGE	73.04	0.12

Layout Sheets – Segment A

By URS Corporation

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi — 10/21/10
REGISTERED CIVIL ENGINEER — DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

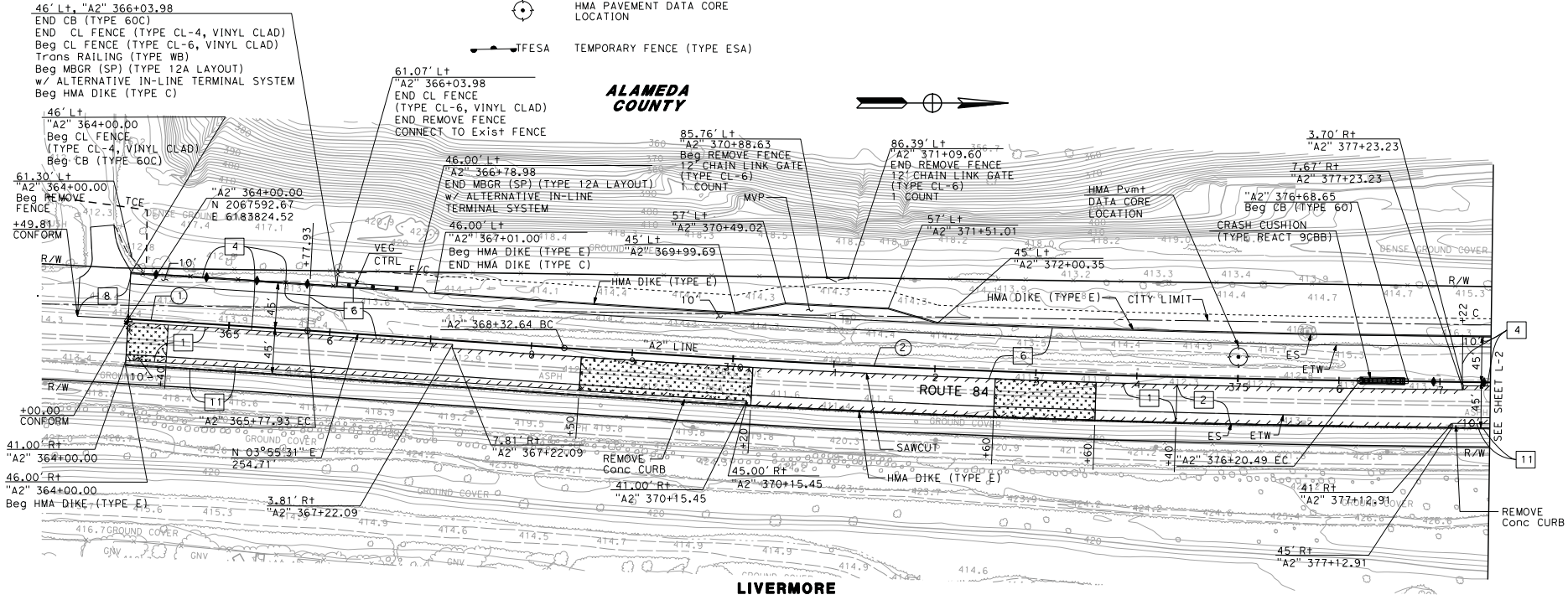
1. COORDINATES, DISTANCES AND BEARINGS SHOWN ARE BASED ON CALIFORNIA COORDINATE SYSTEM ZONE 3. THE HORIZONTAL DATUM IS NAD 83 (1991.35). THE VERTICAL DATUM IS NAVD 1988.
2. FOR LIMITS OF MBGR AND Conc REMOVAL ITEMS, SEE SUMMARY OF QUANTITY SHEETS.
3. FOR LIMITS OF CONTRACT ITEMS AND OTHER INFORMATION NOT SHOWN ON LAYOUT SHEETS, SEE CONSTRUCTION DETAILS.
4. FOR QUANTITY OF TFESA, SEE TEMPORARY WATER POLLUTION CONTROL TABLE OF QUANTITIES.

LEGEND:

- OVERLAY
- 0.15' COLD PLANE AC Pvmt
- IRRIGATION CROSSOVER
- No. — Prop Pvmt STRUCTURAL SECTION (SEE SHEET X-1)
- HMA PAVEMENT DATA CORE LOCATION
- TFESA — TEMPORARY FENCE (TYPE ESA)

ABBREVIATIONS:

MBGR (SP)	METAL BEAM GUARD RAILING (STEEL POST)
MVP	MAINTAINANCE VEHICLE PULLOUT
VEG CTRL	VEGETATION CONTROL (MINOR Conc)
w/	WITH
TCE	TEMPORARY CONSTRUCTION EASEMENT
SSE	SANITARY SEWER EASEMENT
UPRR	UNION PACIFIC RAILROAD
LSE	LANDSCAPE EASEMENT



CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
①	17,450.00'	02°35'00"	393.46'	786.78'	2066575.677	6201244.854
②	14,280.00'	03°09'40"	394.03'	787.85'	2069001.915	6169606.726

LAYOUT

SCALE: 1" = 50'

L-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: AB
DATE REVISED: 10/18/10

LAST REVISION — DATE PLOTTED => 1/14/2011 — TIME PLOTTED => 12:19:39 PM
10-21-10

BORDER LAST REVISED 7/2/2010
USERNAME => amber_grant
DGN FILE => 040002058Oea001.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi
No. 68606
Exp. 09-30-11
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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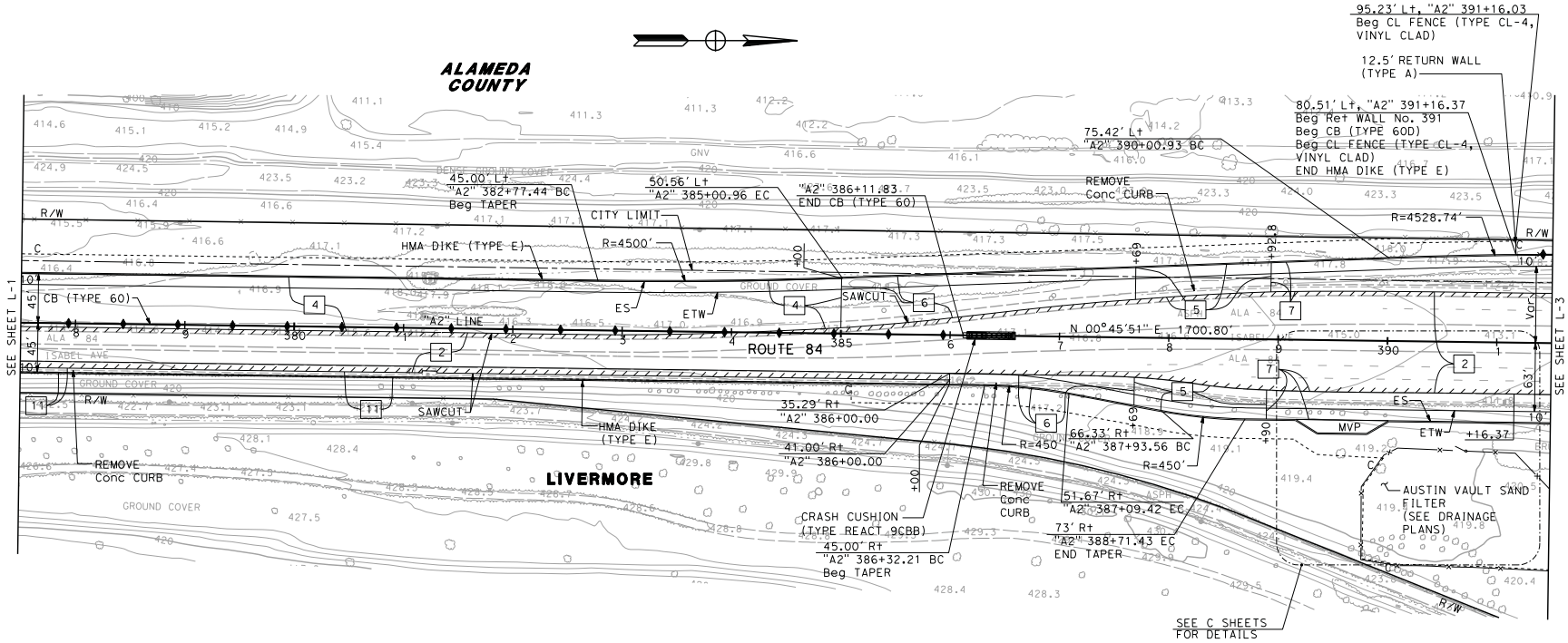
Oakland, CA 94612



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50'

L-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

LAST REVISION | DATE PLOTTED => 1/14/2011
10-21-10 | TIME PLOTTED => 12:19:51 PM

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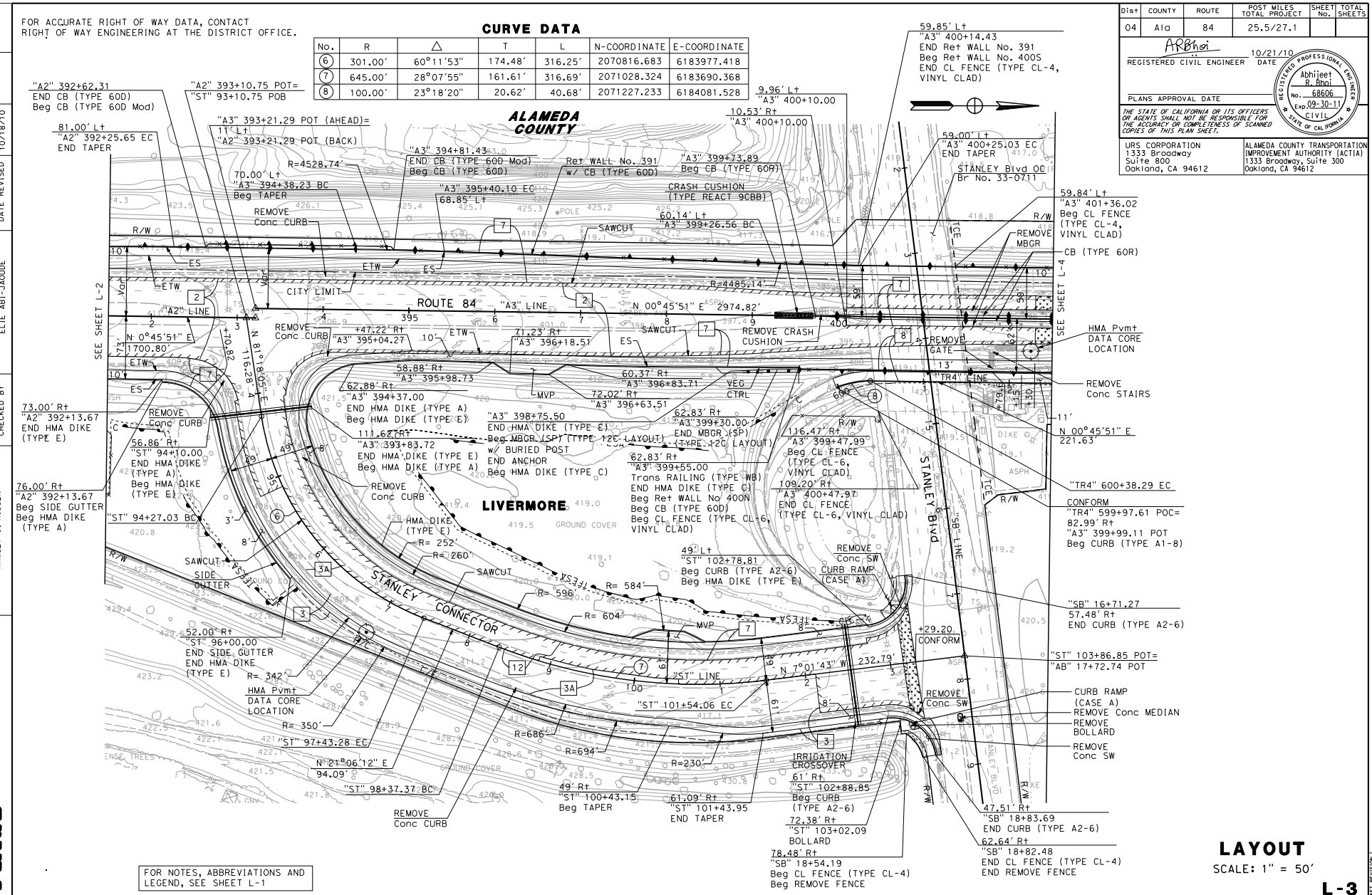

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY	CHECKED BY
ABHIJEET BHOI	ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION DATE PLOTTED => 1/14/2011
10-21-10 TIME PLOTTED => 12:20:10 PM

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(9)	21.00′	23°33′21"	4.38′	8.63′	2071450.454	6183963.494
(10)	15.00′	23°33′20"	3.13′	6.17′	2071464.400	6183996.684
(11)	289.00′	08°11′28"	20.69′	41.32′	2071549.016	6184271.837
(12)	508.94′	08°13′26"	36.59′	73.05′	2071709.213	6183489.299

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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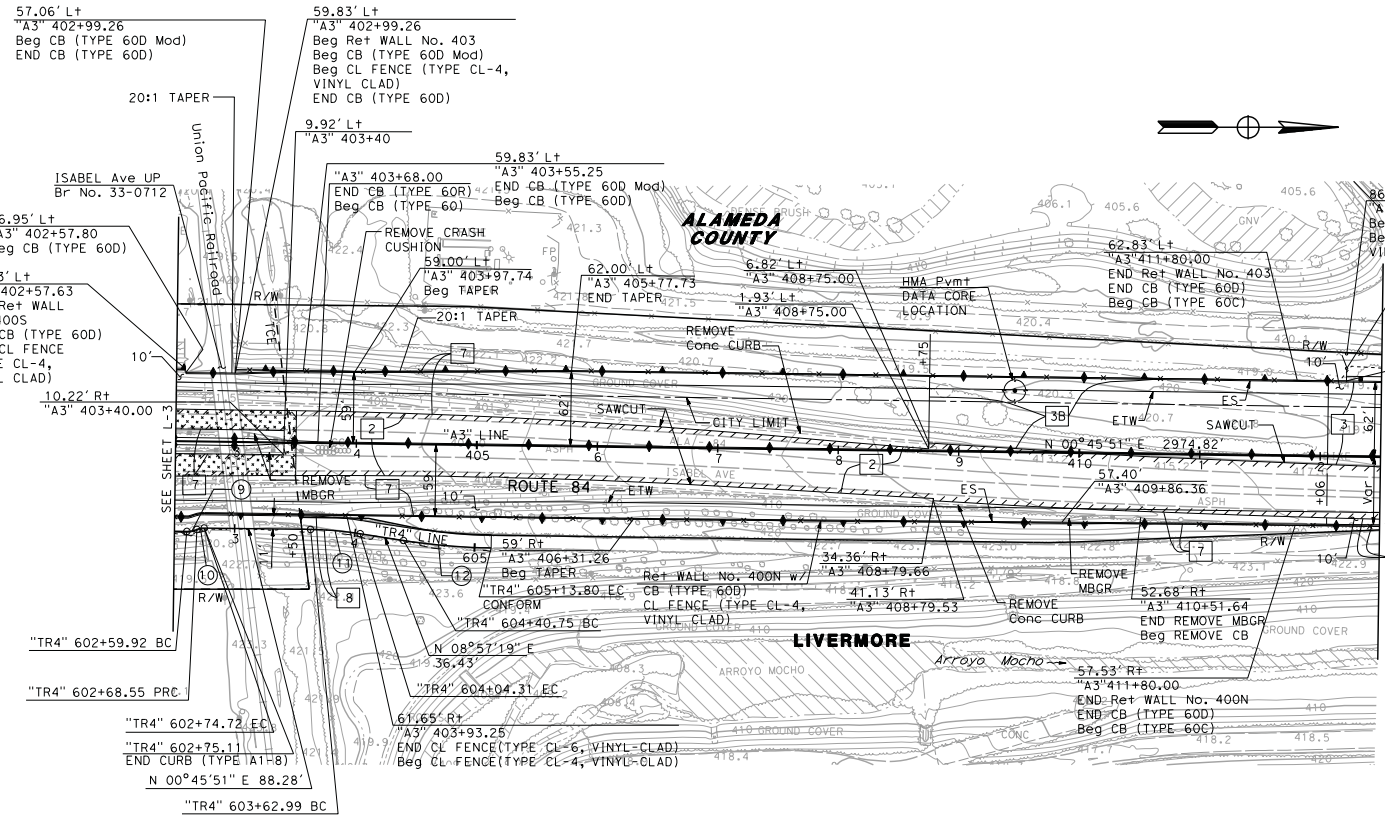


FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

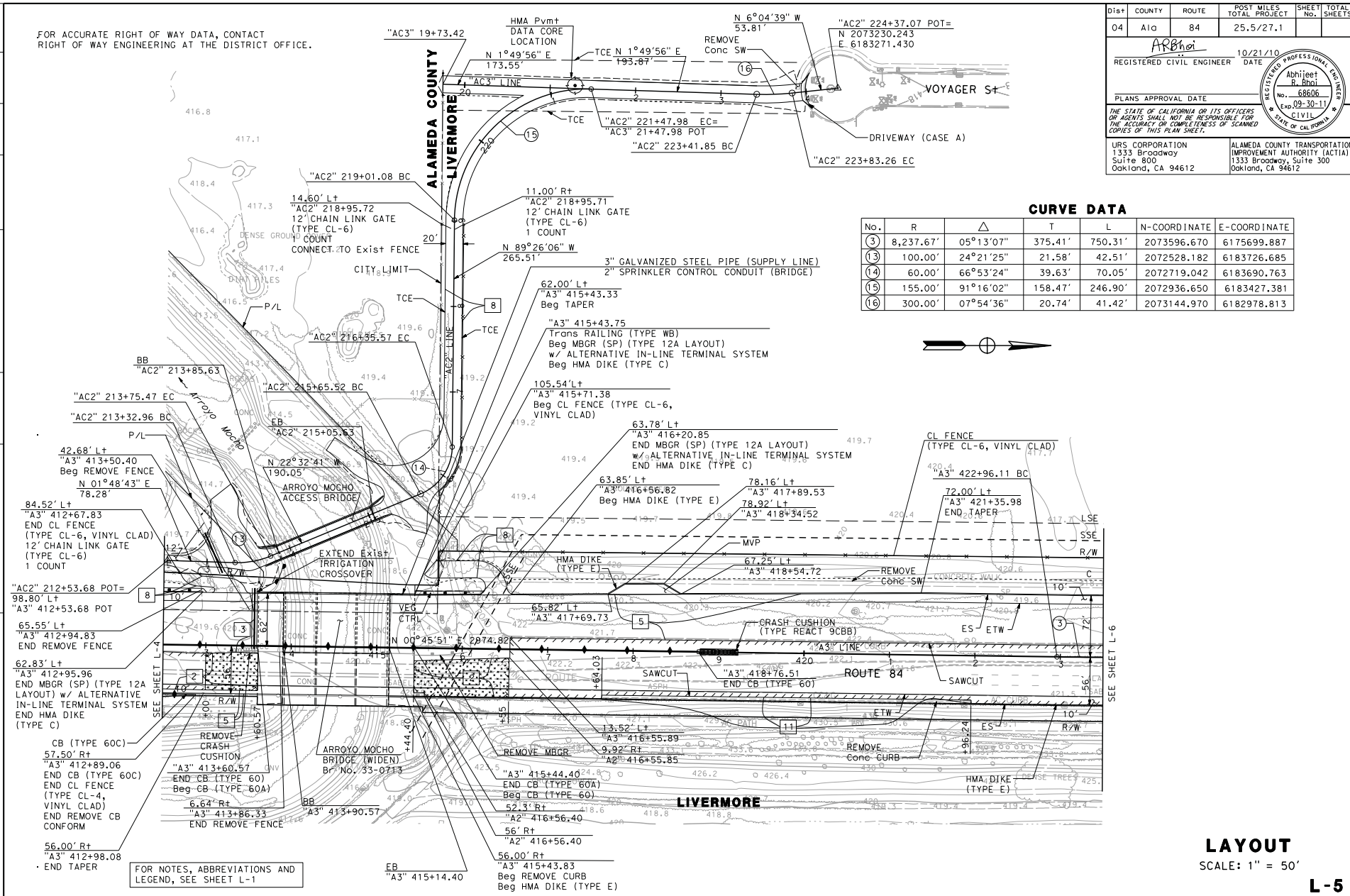
SCALE: 1" = 50′

L-4

LAST REVISION 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 12:20:28 PM

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN | CALCULATED-DESIGNED BY: ABHIJEET BHOI | CHECKED BY: ELIE ABI-JAOUDE | REVISED BY: AB | DATE REVISED: 10/18/10

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 040002058Oea004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801



CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
3	8,237.67'	05°13'07"	375.41'	750.31'	2073596.670	6175699.887
13	100.00'	24°21'25"	21.58'	42.51'	2072528.182	6183726.685
14	60.00'	66°53'24"	39.63'	70.05'	2072719.042	6183690.763
15	155.00'	91°16'02"	158.47'	246.90'	2072936.650	6183427.381
16	300.00'	07°54'36"	20.74'	41.42'	2073144.970	6182978.813

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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1333 Broadway, Suite 300
Oakland, CA 94612

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAYOUT

SCALE: 1" = 50'

L-5

LAST REVISION: DATE PLOTTED => 1/14/2011
10-21-10 TIME PLOTTED => 12:20:43 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 0400020580ea005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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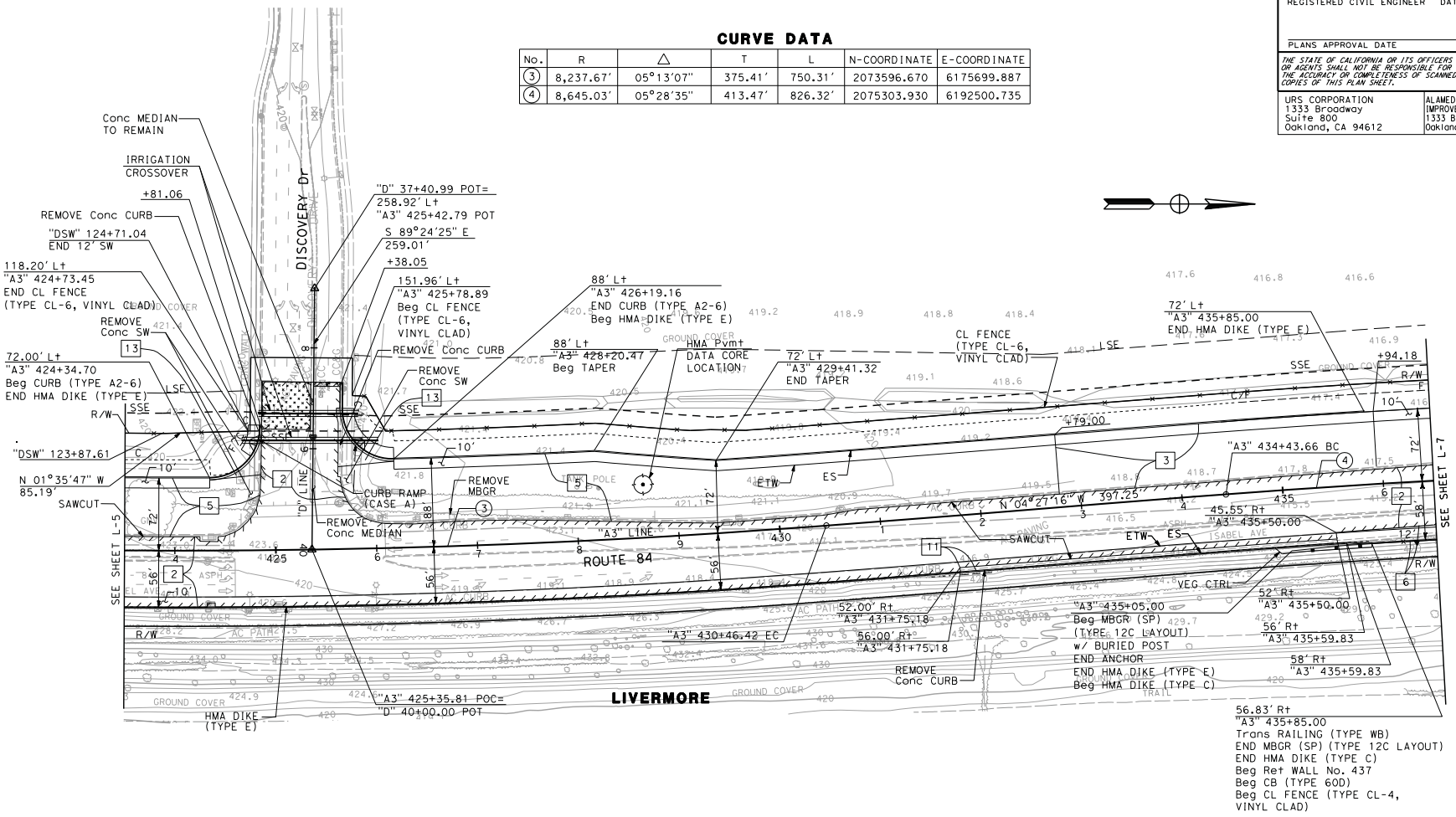
1333 Broadway, Suite 300
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
③	8,237.67′	05°13′07"	375.41′	750.31′	2073596.670	6175699.887
④	8,645.03′	05°28′35"	413.47′	826.32′	2075303.930	6192500.735



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN | CALCULATED-DESIGNED BY: ABHIJEET BHOI | CHECKED BY: ELIE ABI-JAOUDE | REVISED BY: AB | DATE REVISED: 10/18/10

LAST REVISION DATE PLOTTED => 1/14/2011
10-21-10 TIME PLOTTED => 12:20:59 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 040002058Oea006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

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1333 Broadway
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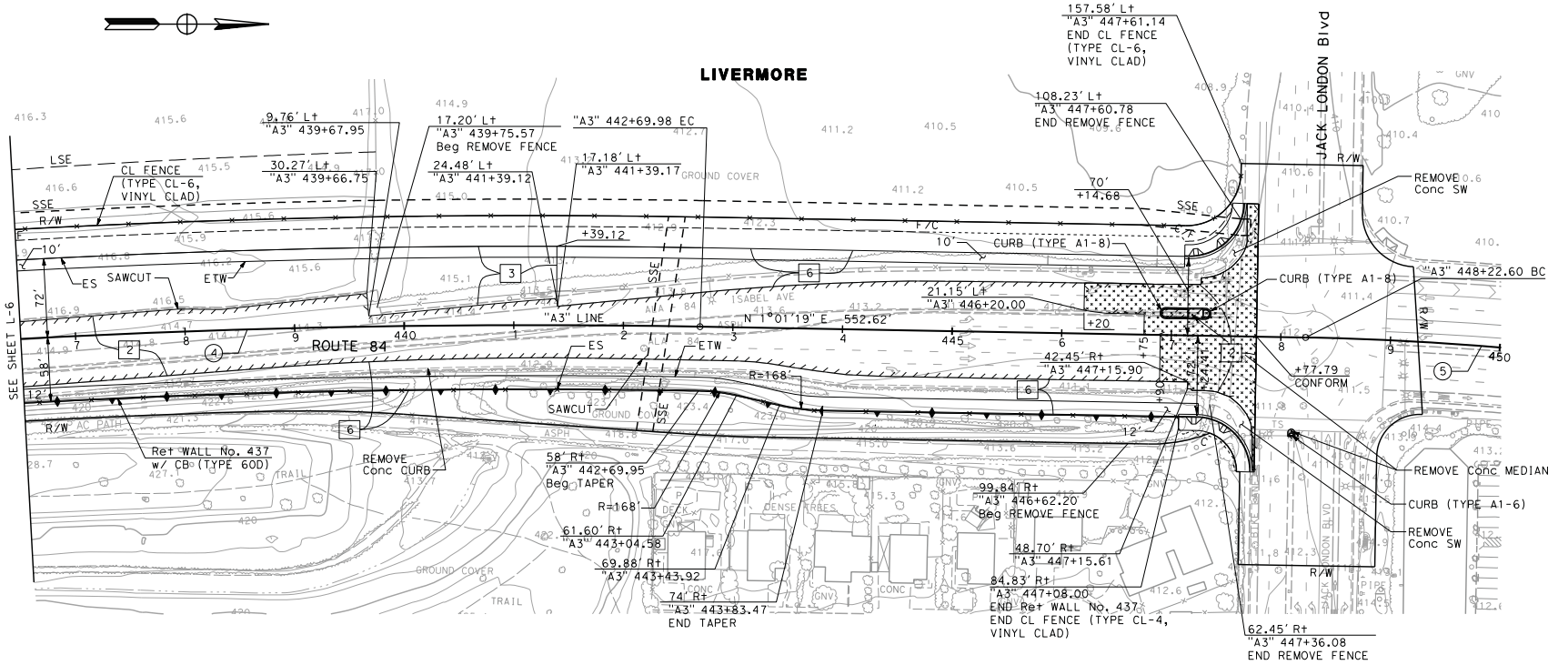
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(4)	8,645.03′	05°28′35"	413.47′	826.32′	2075303.930	6192500.735
(5)	2,624.67′	08°32′31"	196.01′	391.30′	2075963.855	6186491.187



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET L-1.

LAYOUT

SCALE: 1" = 50′

L-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

LAST REVISION 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 12:21:11 PM

BORDER LAST REVISED 7/2/2010	USERNAME => amber_grant DGN FILE => 0400020580ea007.dgn	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	UNIT 0733	PROJECT NUMBER & PHASE	04000205801

Layout Sheets – Segment B

By URS Corporation

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. COORDINATES, DISTANCES AND BEARINGS SHOWN ARE BASED ON CALIFORNIA COORDINATE SYSTEM ZONE 3. THE HORIZONTAL DATUM IS NAD 83 (1991.35). THE VERTICAL DATUM IS NAVD 1988.
2. FOR LIMITS OF METAL BEAM GUARD RAIL, CHAIN LINK FENCE, CONCRETE BARRIERS AND REMOVAL ITEMS, SEE SUMMARY OF QUANTITY SHEETS.
3. FOR LIMITS OF CONTRACT ITEMS NOT SHOWN ON LAYOUT SHEETS, SEE CONSTRUCTION DETAILS.

LEGEND:

- OVERLAY
- GRIND AND OVERLAY
- REMOVE BASE AND SURFACING
- MINOR CONCRETE (STAMPED CONCRETE)
- COLD PLANE AC Pvmt
- IRRIGATION CROSSOVER
- No. STRUCTURAL SECTION
- HMA PAVEMENT DATA CORE LOCATION

ABBREVIATIONS:

MVP	MAINTAINANCE VEHICLE PULLOUT
TFESA	TEMPORARY FENCE ENVIRONMENTALLY SENSITIVE AREA
VEG CTRL	VEGETATION CONTROL (MINOR CONCRETE)
WICF	WOOD IMITATION CONCRETE FENCE
w/	WITH

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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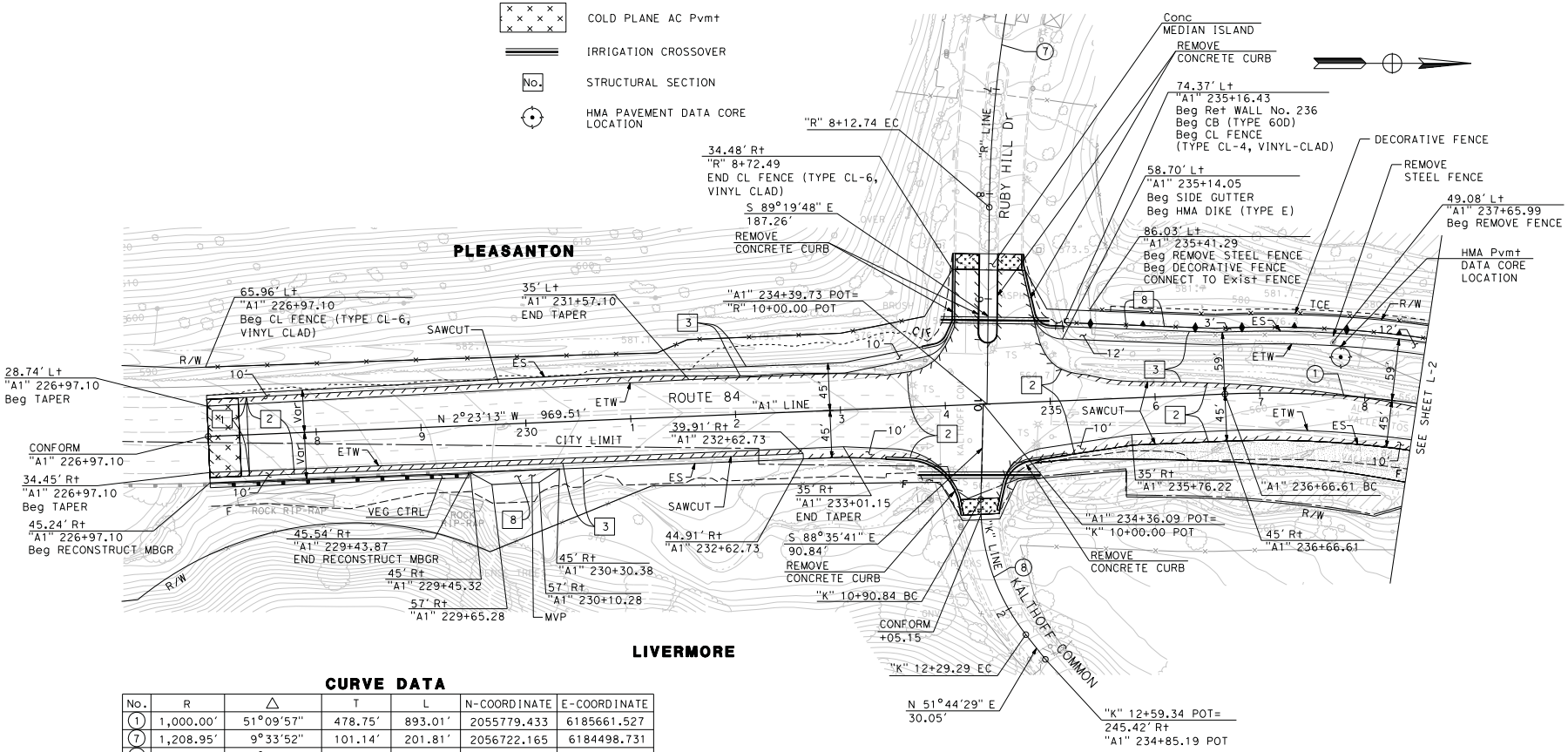

CURVE DATA

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(1)	1,000.00'	51°09'57"	478.75'	893.01'	2055779.433	6185661.527
(7)	1,208.95'	9°33'52"	101.14'	201.81'	2056722.165	6184498.731
(8)	200.00'	39°39'49"	72.13'	138.45'	2055705.182	6184767.715

LAYOUT

SCALE: 1" = 50'

L-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:25:54 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi
No. 68606
Exp. 09-30-11
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
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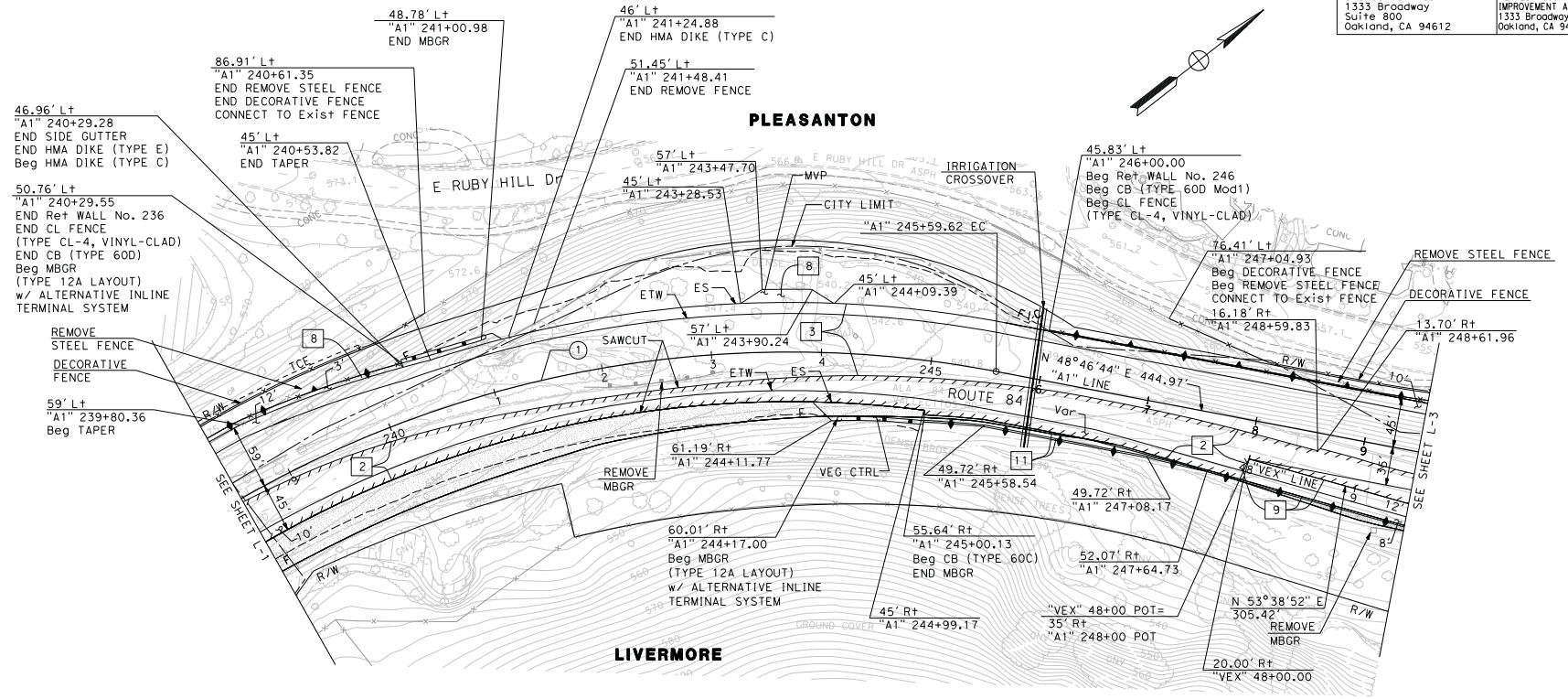

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN | CALCULATED-DESIGNED BY: ABHIJEET BHOI | CHECKED BY: ELIE ABI-JAOUDE | REVISED BY: AB | DATE REVISED: 10/18/10

LAST REVISION DATE PLOTTED => 10/21/2010
10-21-10 TIME PLOTTED => 9:26:53 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea002.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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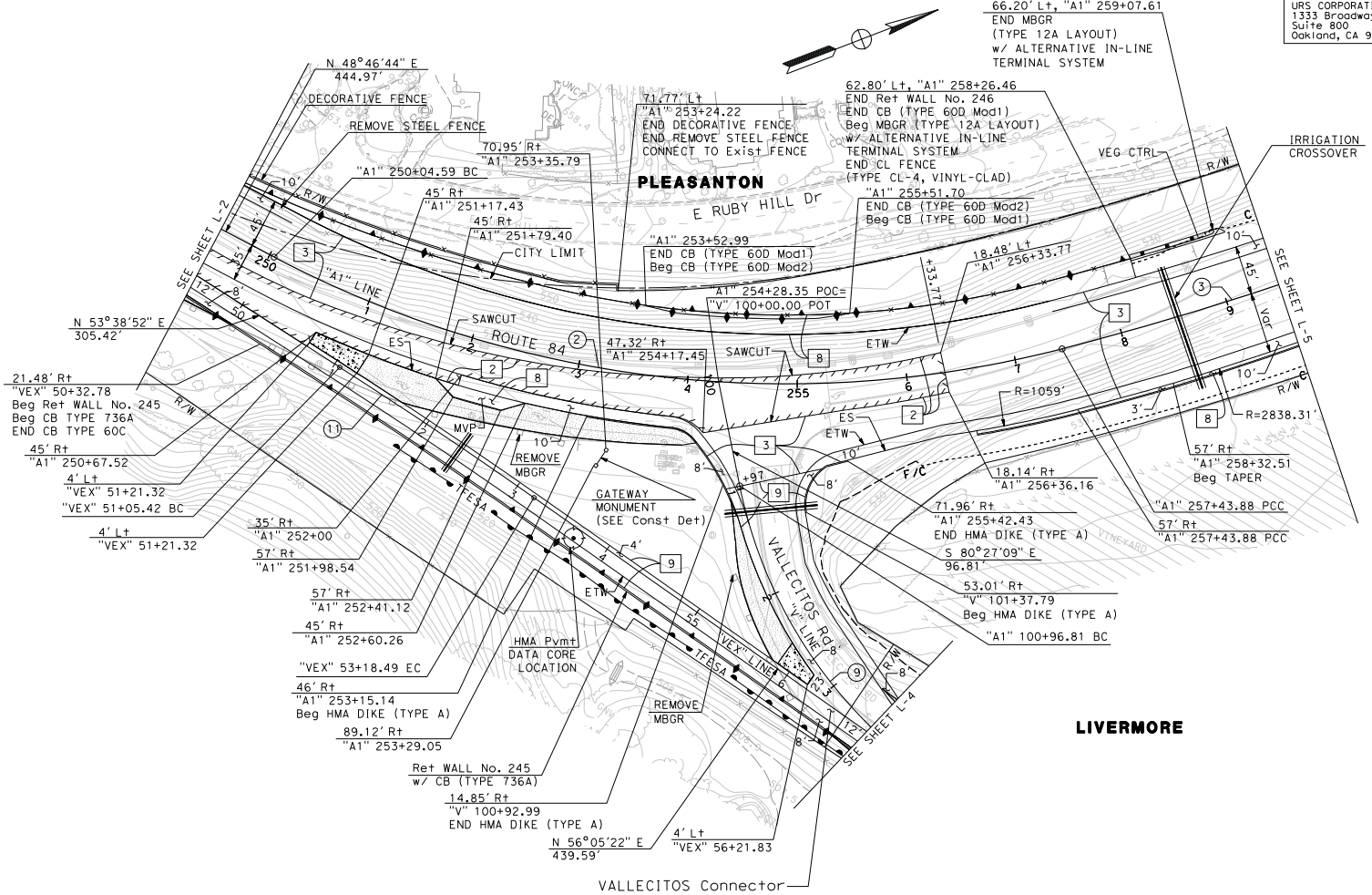
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(2)	1,002.00′	42°16′25"	387.38′	739.29′	2057578.500	6184676.967
(3)	3,016.00′	48°06′16"	1,346.11′	2,532.18′	2057806.674	6182675.934
(9)	425.00′	81°50′03"	368.37′	607.02′	2057565.279	6185754.369
(11)	5,000.00′	2°26′30"	106.55′	213.07′	2052817.773	6188416.145



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

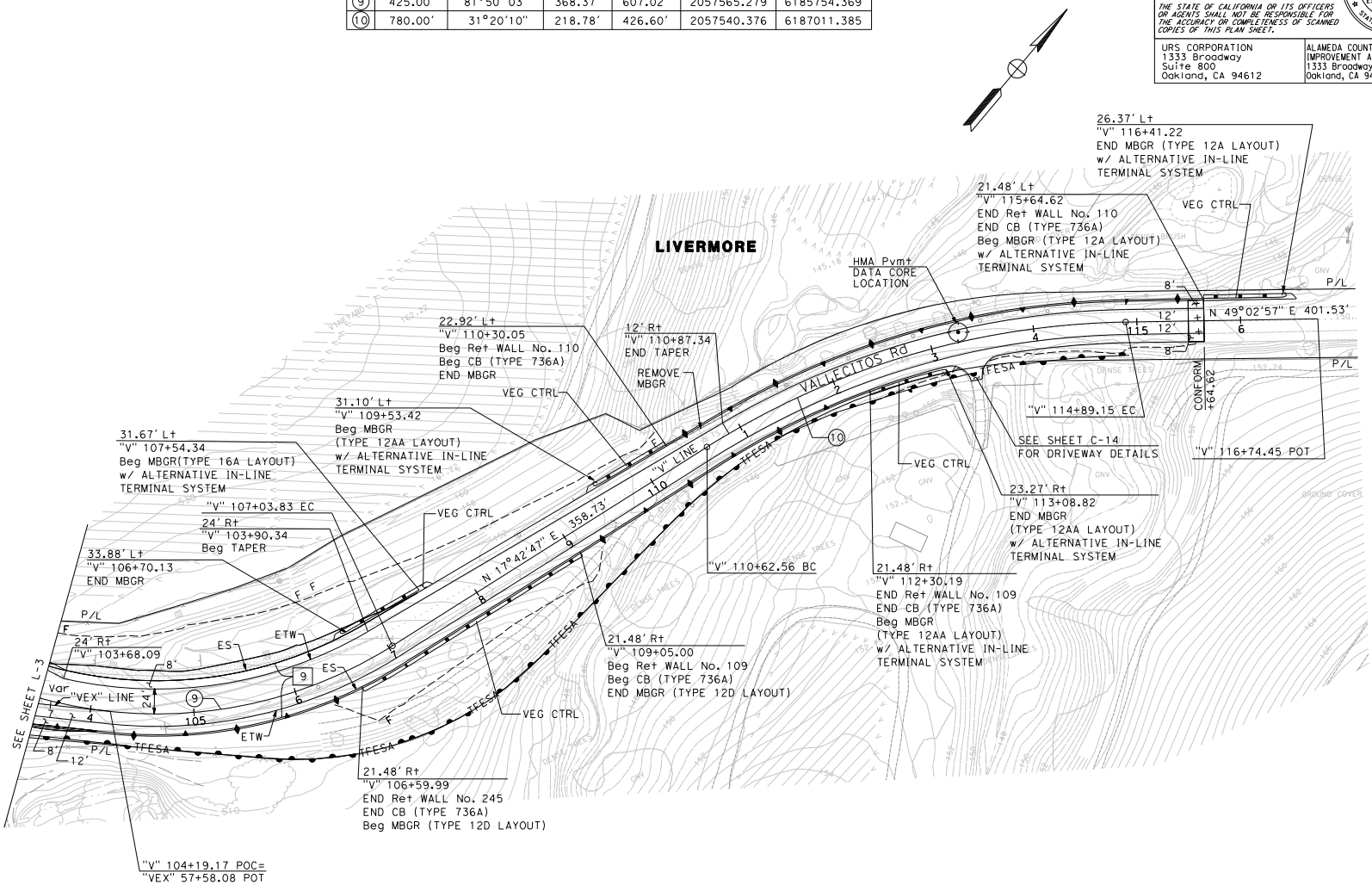
LAST REVISION
DATE PLOTTED => 10/21/2010
TIME PLOTTED => 9:26:10 AM

BORDER LAST REVISED 7/2/2010	USERNAME => minyoung_kim DGN FILE => ...\EA-Layout\429762ea003.dgn	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	UNIT 0733	PROJECT NUMBER & PHASE	04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(9)	425.00′	81°50′03"	368.37′	607.02′	2057565.279	6185754.369
(10)	780.00′	31°20′10"	218.78′	426.60′	2057540.376	6187011.385



FOR NOTES, ABBREVIATIONS AND
LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-4

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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1333 Broadway, Suite 300
Oakland, CA 94612

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY	CHECKED BY
ABHIJEET BHOI	ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:26:18 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
③	3,016.00′	48°06′16″	1,346.11′	2,532.18′	2057806.674	6182675.934

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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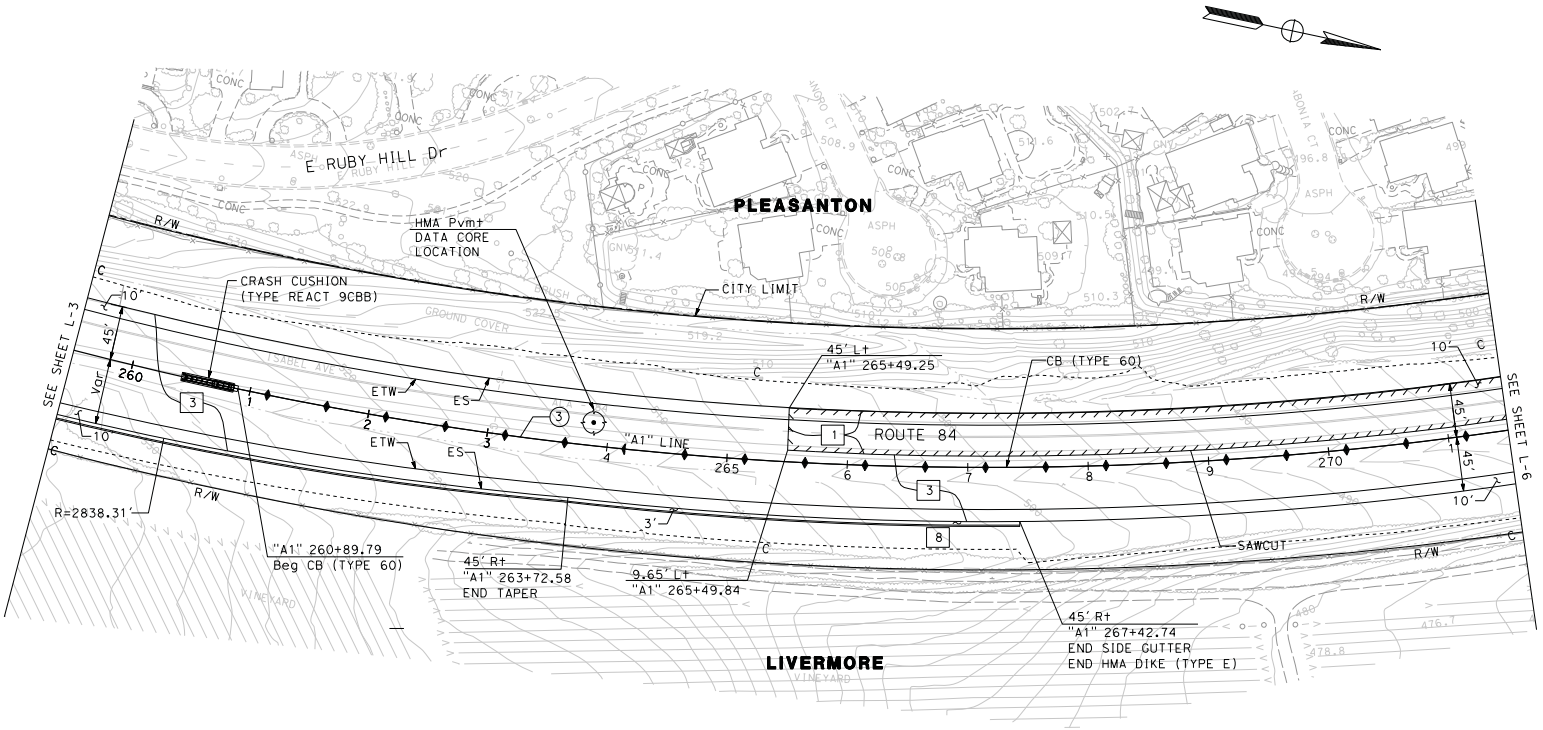
Oakland, CA 94612



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	AB	10/18/10
		CHECKED BY	ELIE ABI-JAOUDE	

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:28:27 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
③	3,016.00′	48°06′16"	1,346.10′	2,532.18′	2057806.674	6182675.934

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
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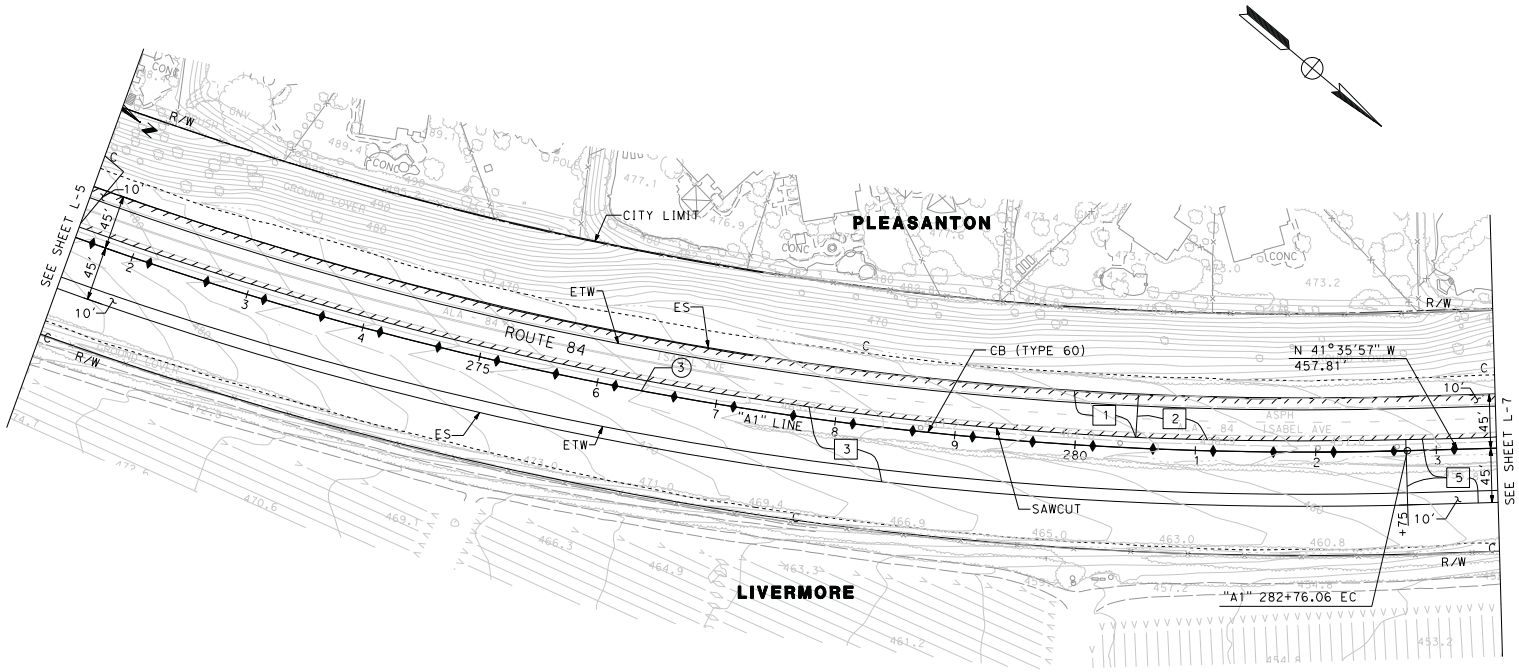
Oakland, CA 94612



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-6

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 10-21-10
DATE PLOTTED => 10/21/2010
TIME PLOTTED => 9:26:46 AM

BORDER LAST REVISED 7/2/2010
USERNAME => minyoung_kim
DGN FILE => ...\EA-Layout\429762ea006.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
④	3,600.00′	42°15′ 20"	1,391.13′	2,655.00′	2062541.499	6187319.476

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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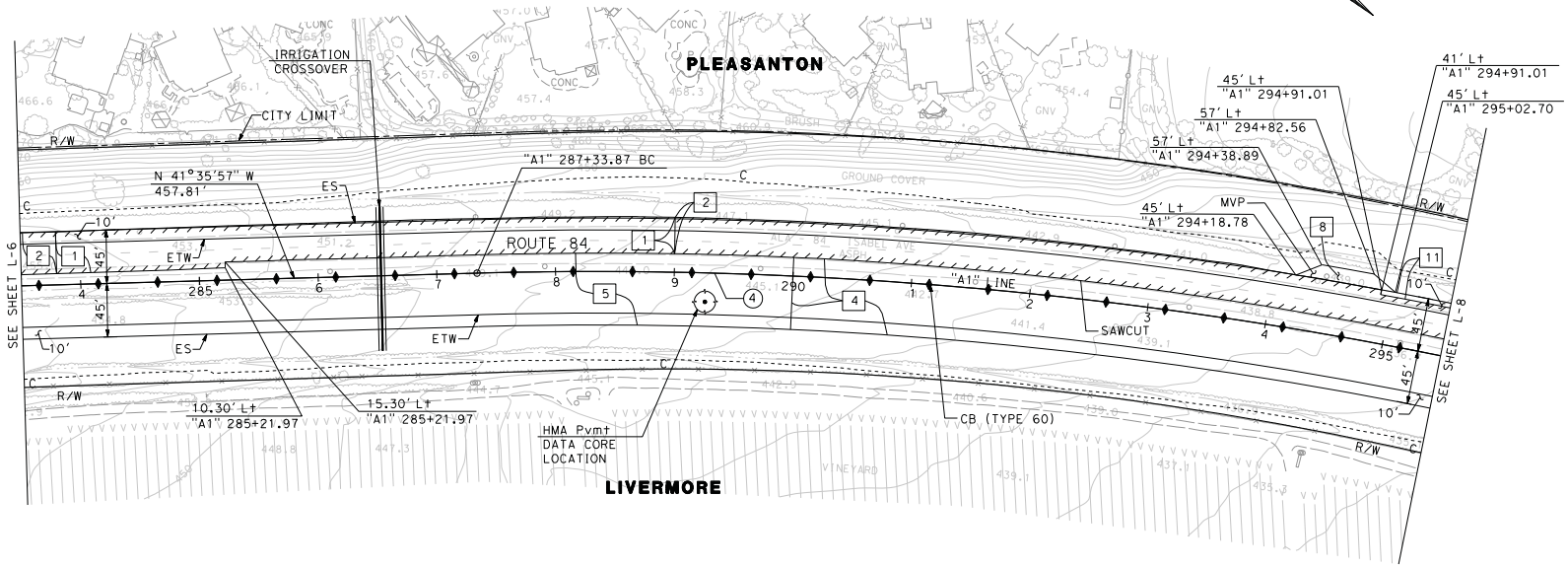

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN | CALCULATED-DESIGNED BY: ABHIJEET BHOI | CHECKED BY: ELIE ABI-JAOUDE | REVISED BY: AB | DATE REVISED: 10/18/10

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:26:53 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea007.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi
No. 68606
Exp. 09-30-11
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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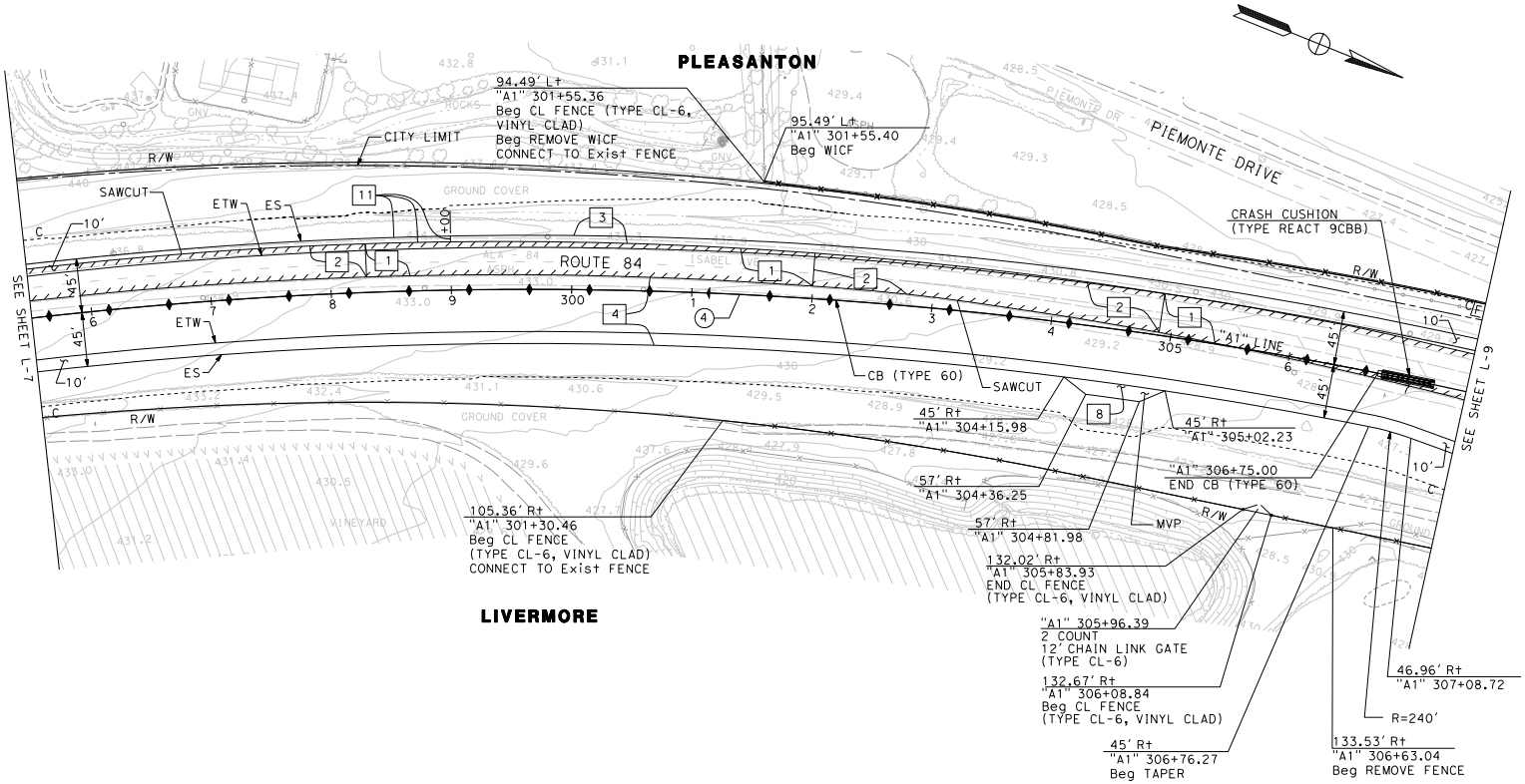
Oakland, CA 94612

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(4)	3,600.00′	42°15′20″	1,391.13′	2,655.00′	2062541.499	6187319.476



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-8

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

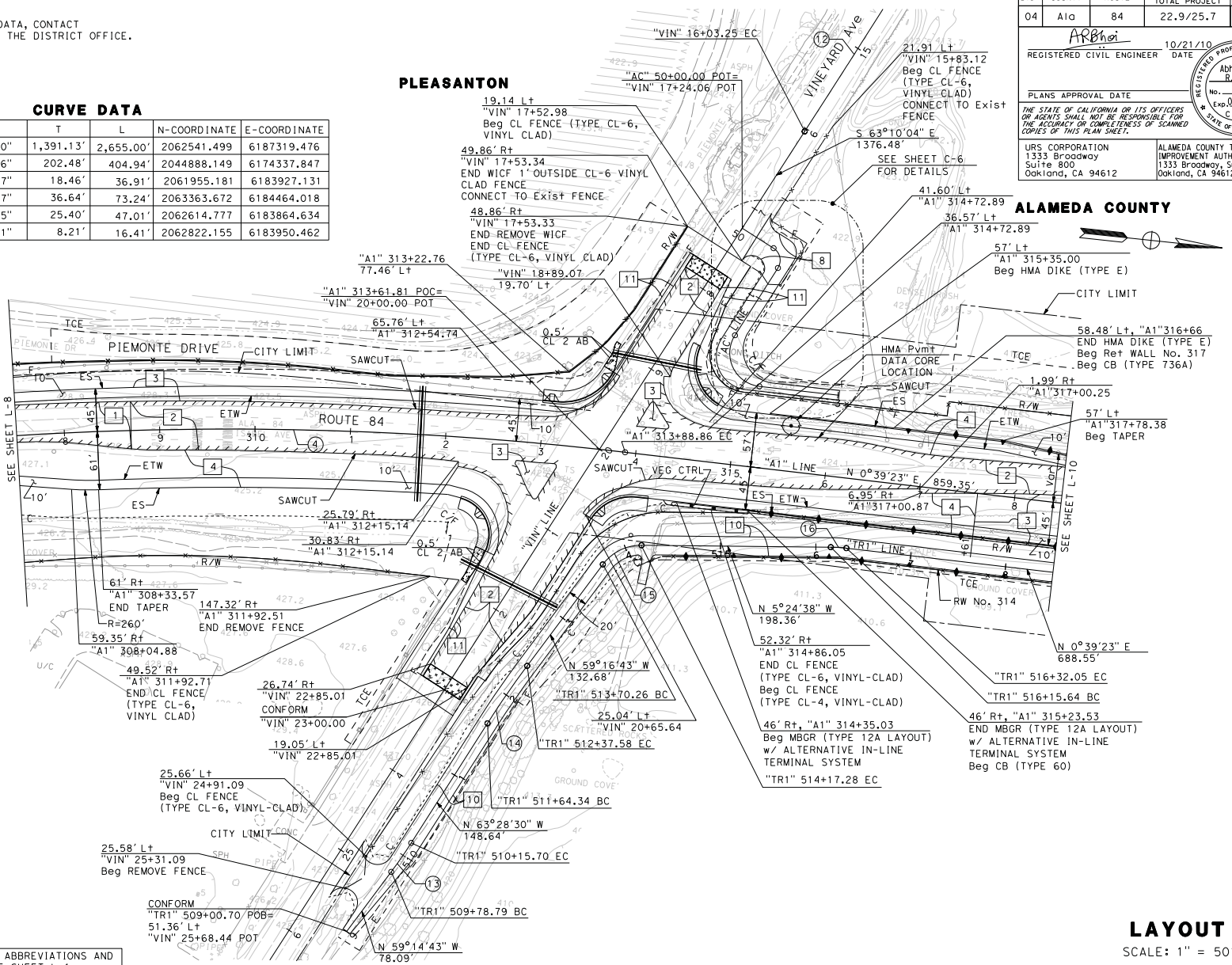
LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:26:58 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea008.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
4	3,600.00′	42°15′ 20"	1,391.13′	2,655.00′	2062541.499	6187319.476
12	20,000.00′	1°09′36"	202.48′	404.94′	2044888.149	6174337.847
13	500.00′	4°13′47"	18.46′	36.91′	2061955.181	6183927.131
14	1,000.00′	4°11′47"	36.64′	73.24′	2063363.672	6184464.018
15	50.00′	53°52′05"	25.40′	47.01′	2062614.777	6183864.634
16	155.00′	6°04′01"	8.21′	16.41′	2062822.155	6183950.462



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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Oakland, CA 94612

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1333 Broadway, Suite 300
Oakland, CA 94612

LAYOUT

SCALE: 1" = 50′

L-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:27:29 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea009.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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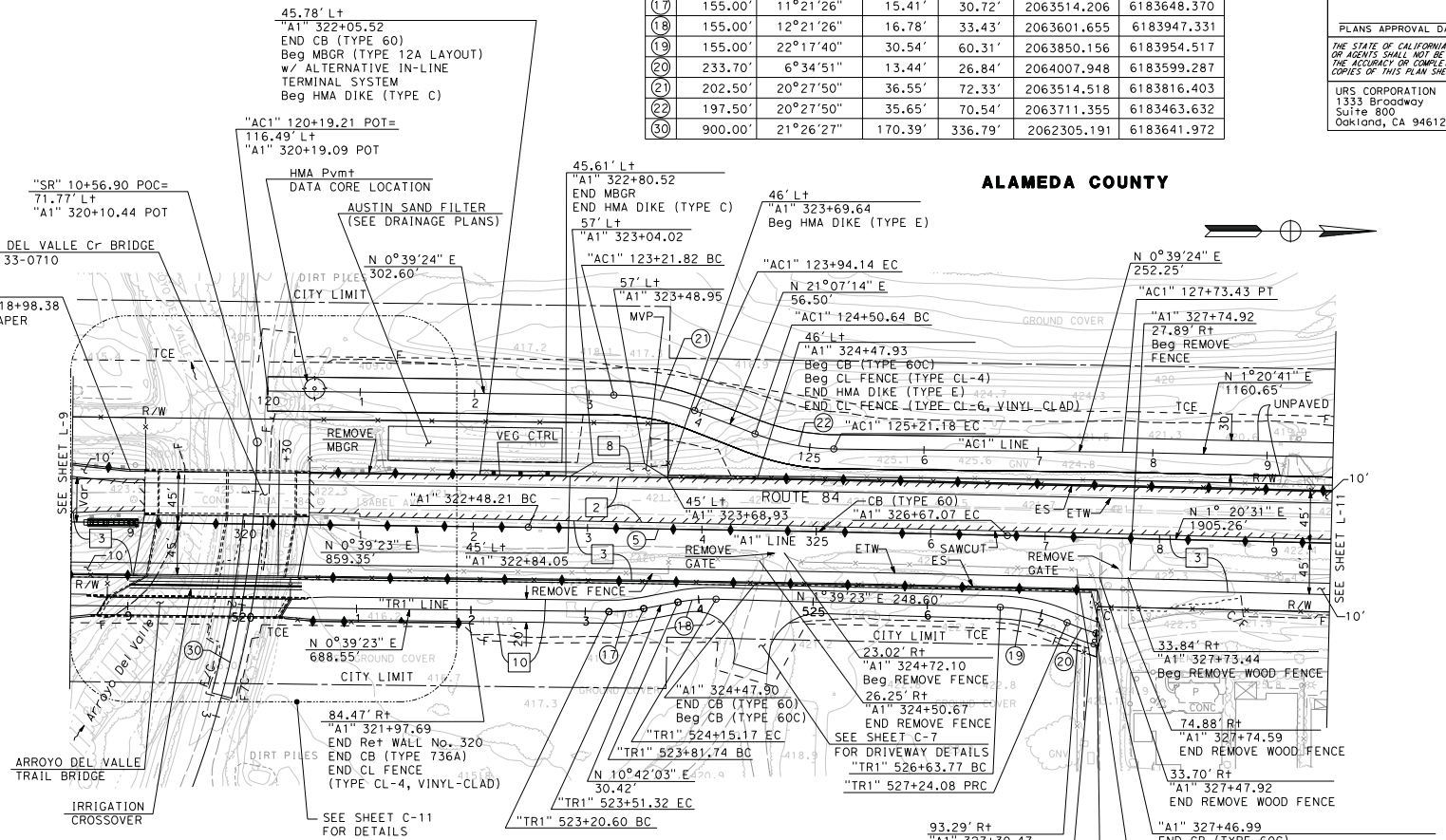
1333 Broadway, Suite 300
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(5)	35,000.00′	0°41′08"	209.44′	418.86′	2063041.113	6218727.259
(17)	155.00′	11°21′26"	15.41′	30.72′	2063514.206	6183648.370
(18)	155.00′	12°21′26"	16.78′	33.43′	2063601.655	6183947.331
(19)	155.00′	22°17′40"	30.54′	60.31′	2063850.156	6183954.517
(20)	233.70′	6°34′51"	13.44′	26.84′	2064007.948	6183599.287
(21)	202.50′	20°27′50"	36.55′	72.33′	2063514.518	6183816.403
(22)	197.50′	20°27′50"	35.65′	70.54′	2063711.355	6183463.632
(30)	900.00′	21°26′27"	170.39′	336.79′	2062305.191	6183641.972



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

BORDER LAST REVISED 7/2/2010	USERNAME => minyoung_kim DGN FILE => ...\EA-Layout\429762ea010.dgn	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	UNIT 0733	PROJECT NUMBER & PHASE	04000205811

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:27:37 AM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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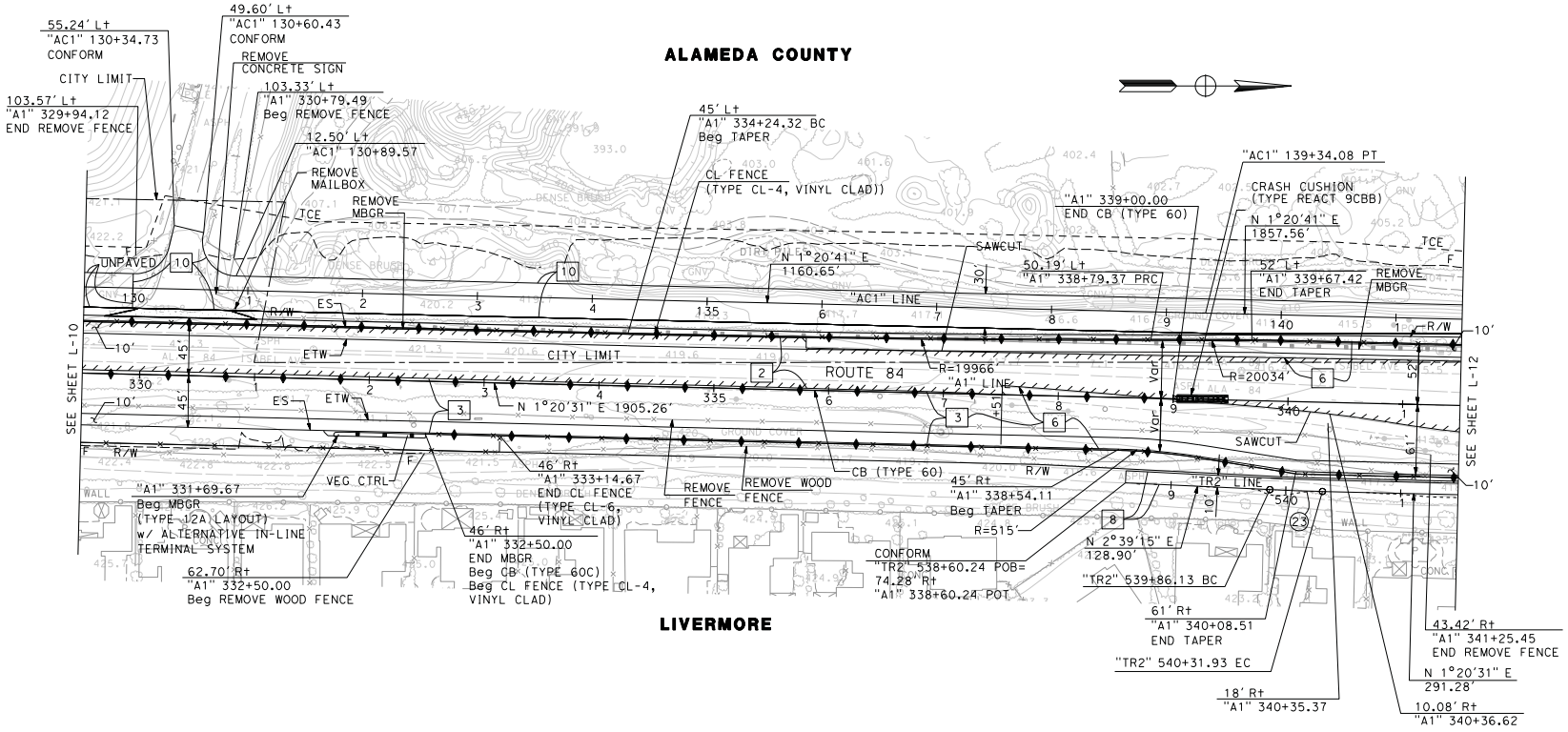
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
23	2,000.00′	1°18′ 44"	22.90′	45.80′	2065270.290	6181847.034



FOR NOTES, ABBREVIATIONS AND
LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-11

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:27:45 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea011.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
23	500.00′	3°25′28"	14.95′	29.88′	2065526.356	6183353.445
24	500.00′	4°02′31"	17.64′	35.27′	2065591.668	6184351.731
25	500.00′	1°54′40"	8.34′	16.68′	2066485.836	6183373.916

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi — 10/21/10
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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1333 Broadway, Suite 300
Oakland, CA 94612

ALAMEDA COUNTY

LIVERMORE

53′ Lt
"A1" 343+67.41
END CB (TYPE 60C)
END CL FENCE (TYPE CL-4)
Beg HMA DIKE (TYPE C)
Beg MBGR (TYPE 12A LAYOUT)
w/ ALTERNATIVE IN-LINE
TERMINAL SYSTEM

101.80′ Lt
"A1" 343+62.40
END REMOVE FENCE

53′ Lt
"A1" 344+42.41
END MBGR
(TYPE 12A LAYOUT)

73.21′ Lt
"A1" 344+71.34
Beg REMOVE FENCE

56.39′ Lt
"A1" 344+76.20
END HMA DIKE (TYPE C)

SAWCUT

94.02′ Lt
"A1" 343+84.22
Beg REMOVE FENCE

"CON" 29+25.01 POE=
"AC1" 145+49.21 POT

82.96′ Lt
"A1" 343+47.13
Beg REMOVE FENCE

129.11′ Lt
"A1" 343+92.51
END REMOVE FENCE

"CON" 30+00.11 POT=
"A1" 345+41.07 POT

"A2" 345+72.33 POT (AHEAD)=
10.40′ Lt
"A1" 345+72.33 POT (BACK)

87.06′ Lt
"A1" 344+07.55
Beg REMOVE FENCE

68.02′ Lt
"A2" 346+18.10
END REMOVE FENCE

13.50′ Lt
"AC1" 143+39.18
END CL FENCE
(TYPE CL-6, VINYL CLAD)

153.77′ Lt
"A1" 344+17.48
END REMOVE
FENCE

"AC1" 148+45.00
MAILBOX

"AC1" 142+41.58
2 COUNT
12′ CHAIN LINK GATE
(TYPE CL-6)

REMOVE
MBGR

TCE

VEG CTRL

49′ Lt
"A2" 346+42.33
Beg CB (TYPE 60C)
Beg CL FENCE (TYPE CL-4)

90.38′ Lt
"A2" 351+16.40
END REMOVE FENCE

"AC1" 148+93.22
2 COUNT
12′ CHAIN LINK GATE
(TYPE CL-6)

47′ Lt
"A2" 351+19.28
Beg TAPER

REMOVE
GATE

89.14′ Lt
"A2" 351+37.53
Beg REMOVE FENCE

CRASH CUSHION
(TYPE REACT 9CBB)

32.50′ Lt
"A2" 352+02.16

27.50′ Lt
"A2" 352+02.16

45′ Lt
"A2" 352+18.94
END TAPER

"A2" 352+39.56
Beg CB (TYPE 60)

REMOVE
MBGR

TCE

UNPAVED

SAWCUT

N 1°20′41" E 1857.56′

"AC1" LINE

N 1°20′31"E 1905.26′ "A1" LINE

ROUTE 84

REMOVE FENCE

CITY LIMIT

N 1°20′31" E 1218.82′

"A2" LINE

SEE SHEET L-11

SEE SHEET L-13

"A1" 344+40.32 56.83′ Rt
END REMOVE WOOD FENCE

REMOVE
CONCRETE
SIDEWALK

CURB RAMP
(CASE C)

47′ Lt
"A1" 348+14.55
Beg TAPER

N 1°20′31" E
674.77′

SAWCUT

63′ Rt
"A1" 350+33.02

ETW

ES

HMA Pvmt
DATA CORE
LOCATION

SAWCUT

"TR2" 543+23.21 BC

"A1" 343+38.11
63.00′ Rt
END CB (TYPE 60C)

N 1°20′31" E
291.28′

"TR3" LINE

LOT B

REMOVE
CONCRETE
SIDEWALK

REMOVE
BOLLARD

81.07′ Rt
"A2" 346+14.76
BOLLARD

90.07′ Rt
"A2" 349+79.95
Beg REMOVE FENCE

REMOVE
CONCRETE
ISLAND

2.78′ Lt
"CON" 31+11.15
END CURB
(TYPE A1-6)
CONFORM

REMOVE
CONCRETE CURB

"TR3" 546+08.02 POB=
86.07′ Rt
"A2" 346+08.02 POT

0′ Rt
"TR3" 552+39.56
END CURB (TYPE A1-8)

"TR3" 552+82.79 BC

"TR3" 552+99.47 EC

48.89′ Rt
"A2" 353+39.82
Beg REMOVE FENCE

64.21′ Rt
"A2" 353+27.27
Beg REMOVE FENCE

N 2°01′03" E
64.67′

"TR2" 543+09 EC

N 2°04′57" W 28.99′

"TR2" 543+82.08 BC

"TR2" 544+17.35 EC

N 1°57′34" E
66.60′

69.59′ Rt
"A1" 344+53.98
BOLLARD

REMOVE
CONCRETE CURB

REMOVE BOLLARD

63.40′ Rt
"A2" 350+03.98
Beg REMOVE FENCE

63.46′ Rt
"A2" 349+84.26
END REMOVE FENCE

73′ Rt
"A1" 350+33.19
Beg TAPER

REMOVE GATE

70.55′ Rt
"A2" 353+07.97
END REMOVE FENCE

63.59′ Rt
"A1" 344+53.87
END CL FENCE (TYPE CL-4,
VINYL CLAD)

S 89°14′36"E 767.67′
"CON" LINE 2
CONCANNON Blvd

1.83′ Rt
"CON" 31+11.15
Beg CURB
(TYPE A1-6)

"TR2" 544+83.96 POT=
75.44′ Rt
"A1" 344+84.68

74.93′ Rt
"A1" 344+85.53
Beg CURB (TYPE A1-6)

40.64′ Rt, "CON" +11.33
END CURB (TYPE A1-6)

FOR NOTES, ABBREVIATIONS AND
LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-12

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:28:00 AM

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN | CALCULATED-DESIGNED BY: ELIE ABI-JAOUDE | CHECKED BY: ABHIJEET BHOI | REVISED BY: AB | DATE REVISED: 10/18/10

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea012.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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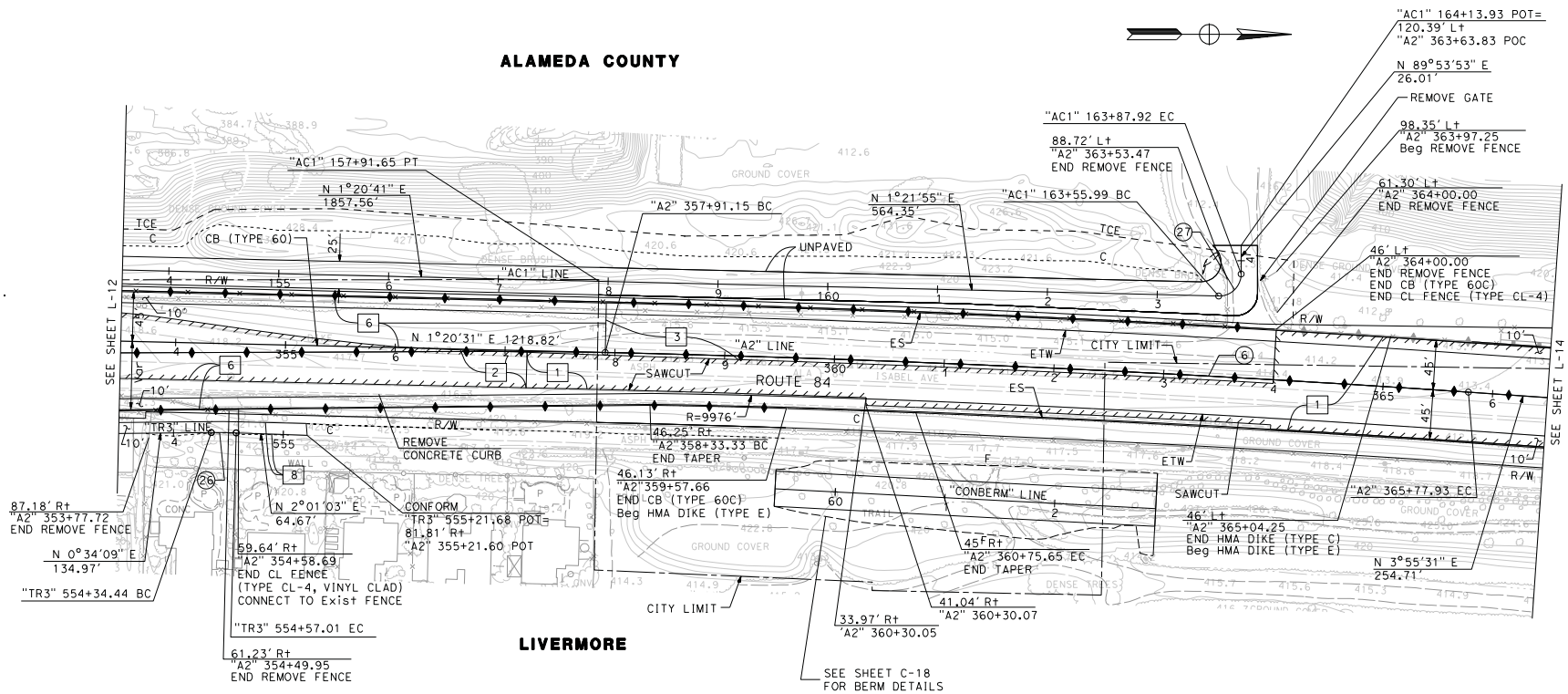
1333 Broadway, Suite 300
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(6)	17,450.00′	2°35′00"	393.46′	786.78′	2066575.677	6201244.854
(26)	500.00′	2°35′12"	11.29′	22.57′	2066630.734	6184372.526
(27)	20.00′	91°28′01"	20.52′	31.93′	2067543.371	6183728.291



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-13

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN | CALCULATED-DESIGNED BY: ABHIJEET BHOI | CHECKED BY: ELIE ABI-JAOUDE | REVISED BY: AB | DATE REVISED: 10/18/10

LAST REVISION DATE PLOTTED => 10/21/2010
TIME PLOTTED => 9:28:09 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea013.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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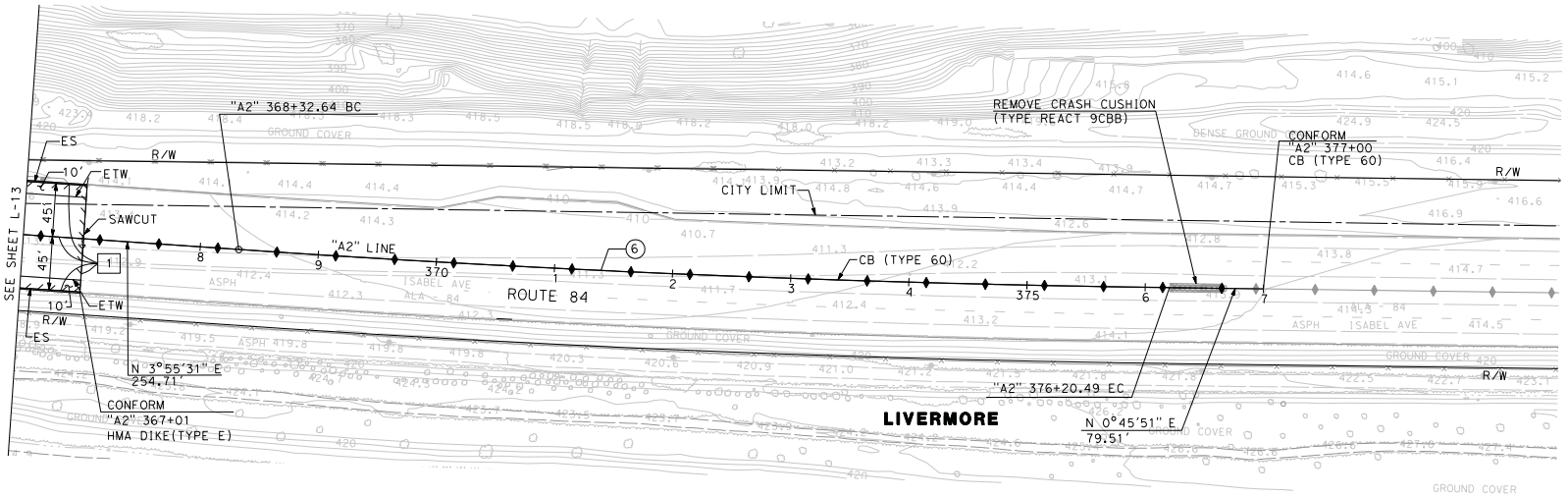
Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
⑥	14,280.00′	3°09′40″	394.03′	787.85′	2069001.915	6169606.726

ALAMEDA COUNTY



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT
SCALE: 1" = 50′

L-14

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:28:23 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\429762ea014.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Temporary Water Pollution Control Plans – Segment A

By URS Corporation

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. THESE PLANS PROVIDE MINIMUM LEVELS OF TEMPORARY WATER POLLUTION CONTROL DURING THE CONSTRUCTION OF PROJECT. ADJUSTMENT/MODIFICATIONS SHALL BE MADE IN REGARD TO ADDRESS ACTUAL SITE CONDITIONS OR AS DIRECTED BY THE ENGINEER.
2. SEE DRAINAGE PLANS FOR INLET TYPES AND SIZE OF DRAINAGE PIPES.

LEGEND:

- TEMPORARY DRAINAGE INLET PROTECTION
- DIRECTION OF FLOW
- STORM DRAIN INLET AND PIPE SYSTEM
- xx——xx——TSF—— TEMPORARY SILT FENCE
- ////////////////TFR/// TEMPORARY FIBER ROLL

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Maria Sedghi — No. 74619 — Exp. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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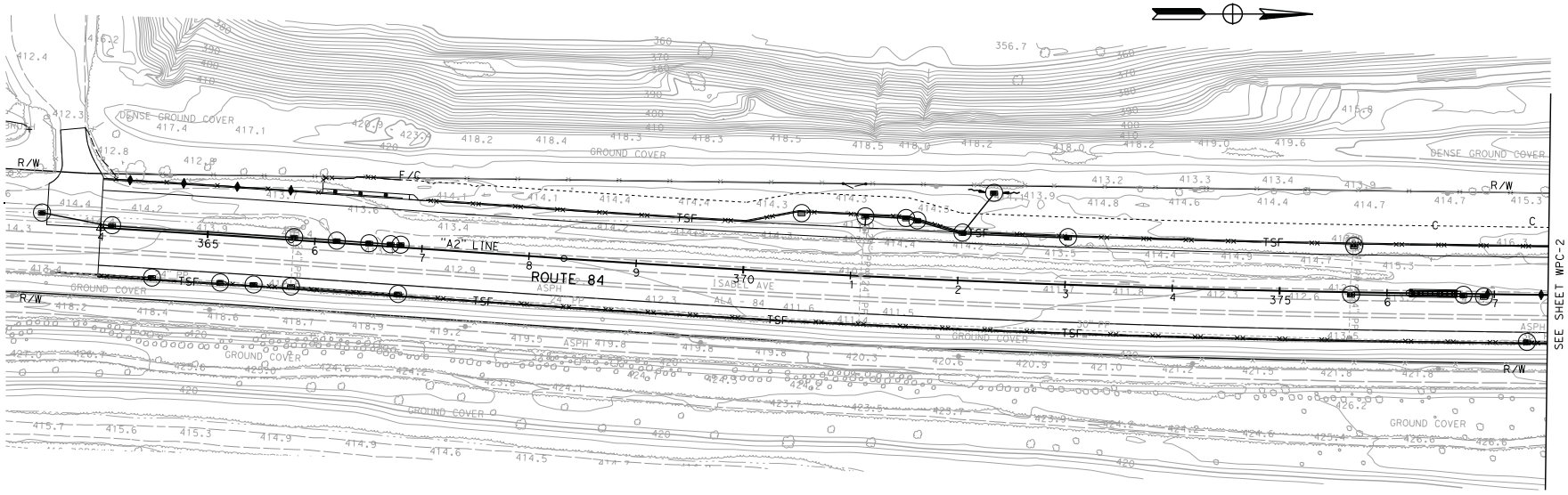

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 11:58:28 AM

BORDER LAST REVISED 7/2/2010	USERNAME => amber_grant DGN FILE => 04000205801gb001.dgn	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	UNIT 0733	PROJECT NUMBER & PHASE	04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
STATE OF CALIFORNIA

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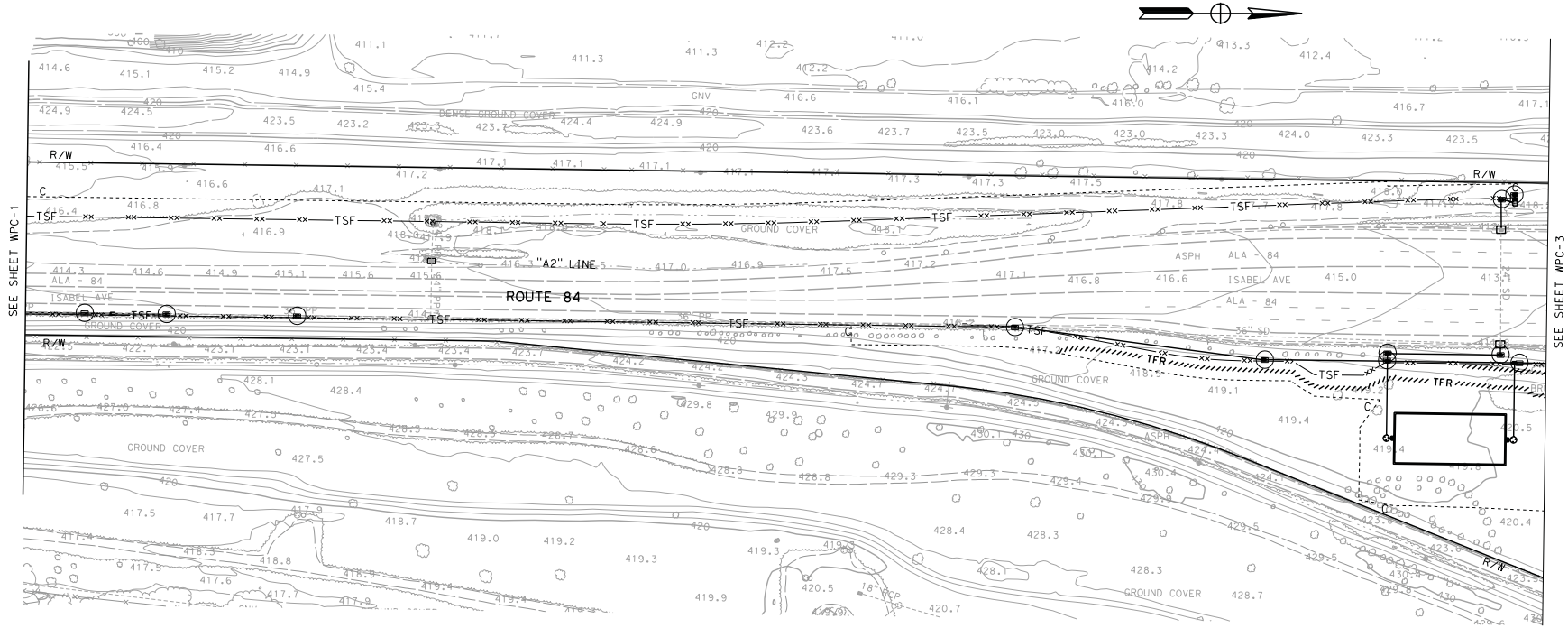

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-2

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: MARIA SEDGHI
CHECKED BY: ABHIJEET BHOI
REVISED BY: MS
DATE REVISED: 10/19/10

LAST REVISION
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 11:58:43 AM
10-21-10

BORDER LAST REVISED 7/2/2010
USERNAME => amber_grant
DGN FILE => 04000020580gb002.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
STATE OF CALIFORNIA

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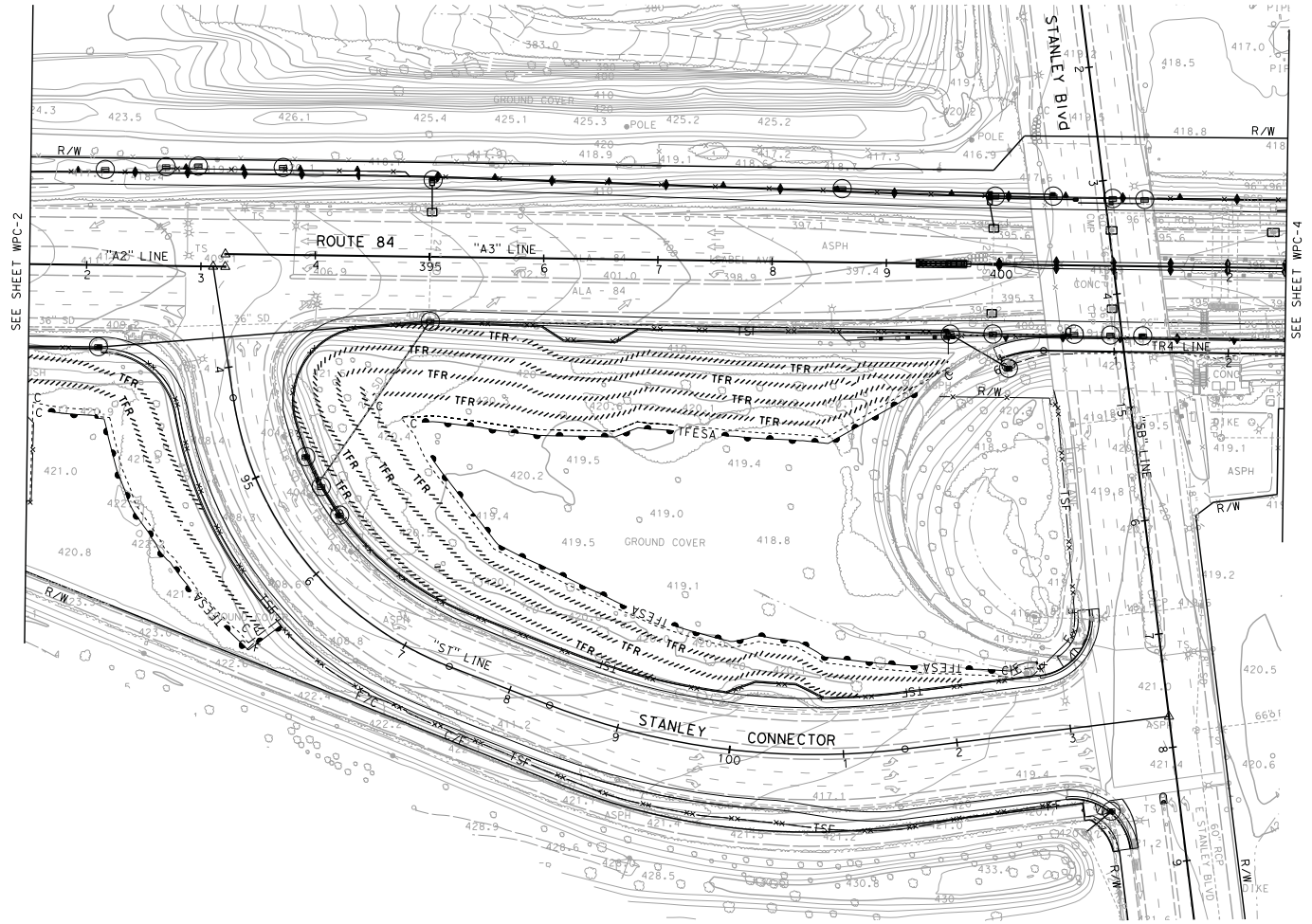
Oakland, CA 94612



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET WPC-1.

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 11:58:54 AM

BORDER LAST REVISED 7/2/2010	USERNAME => amber_grant DGN FILE => 040002058Ogb003.dgn	RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3	UNIT 0733	PROJECT NUMBER & PHASE	04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
STATE OF CALIFORNIA

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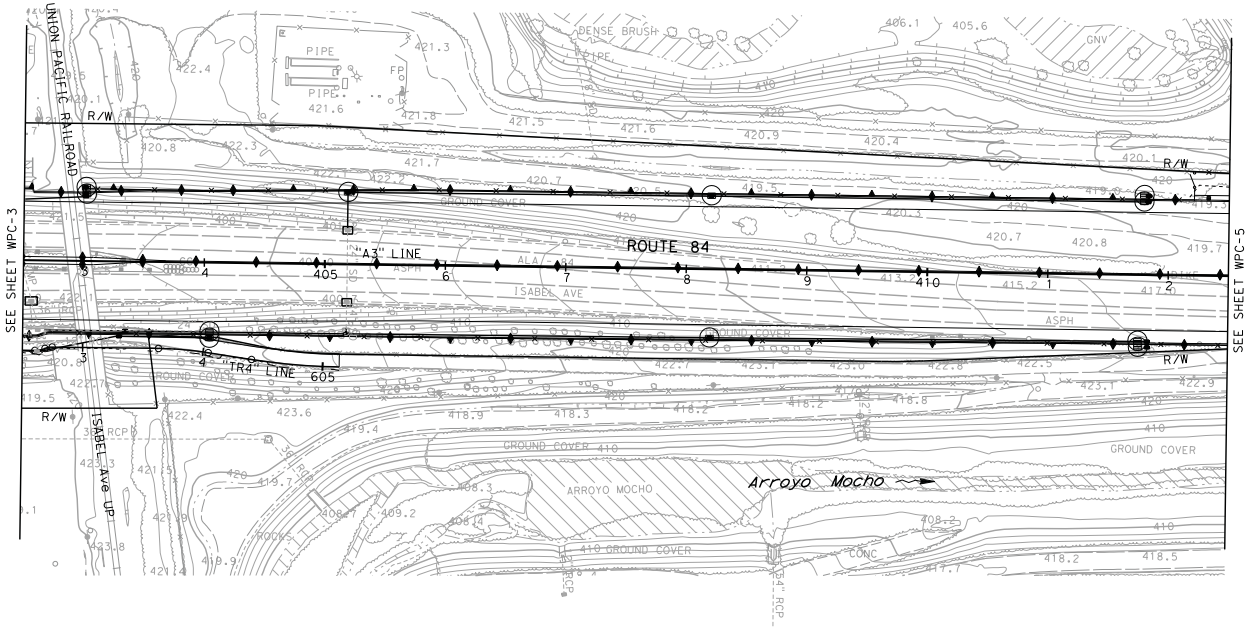

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET WPC-1.

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-4

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 11:49:07 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 04000205801gb004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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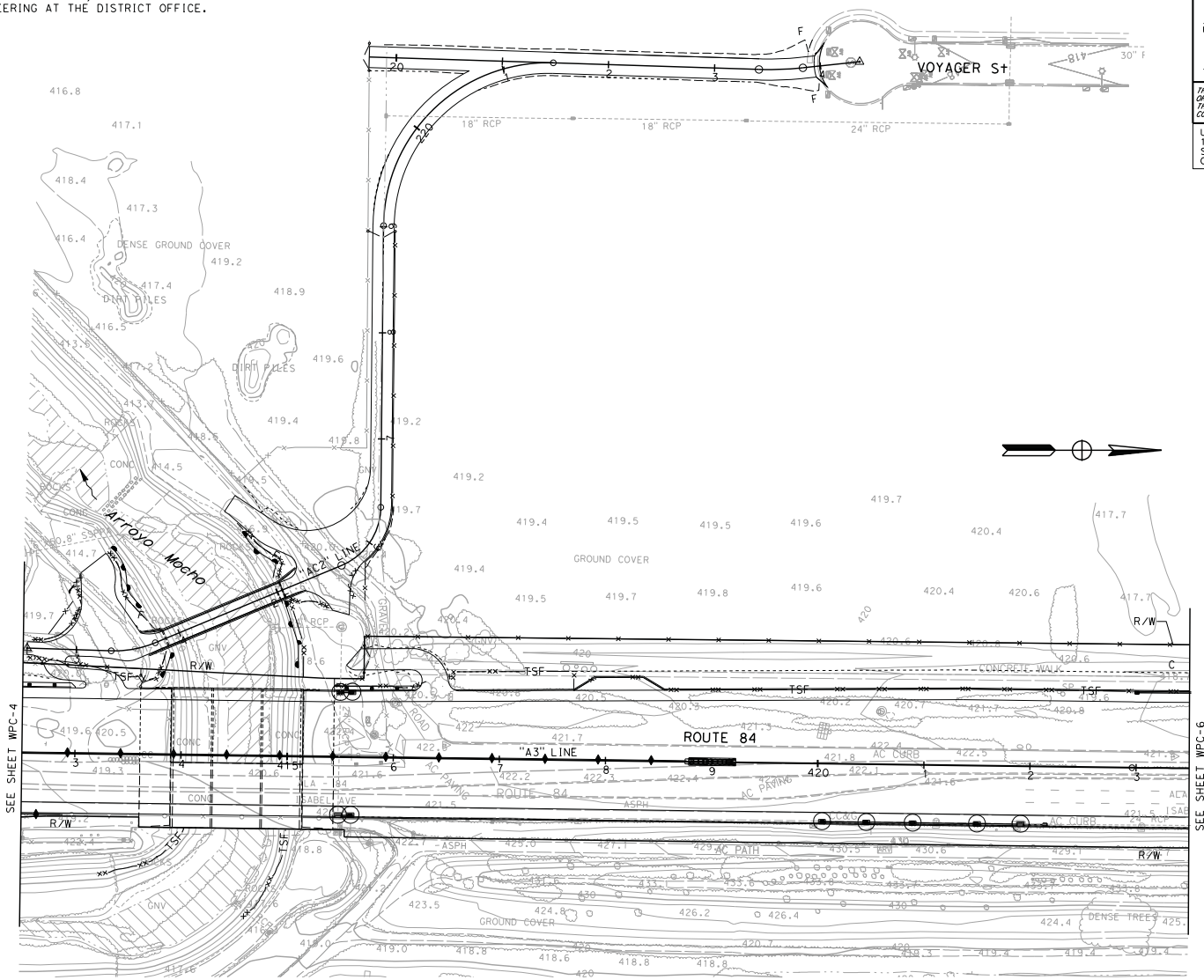

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET WPC-1.

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY.

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-5

REVISED BY	DATE REVISED
MS	10/19/10

CALCULATED-DESIGNED BY: MARIA SEDGHI
CHECKED BY: ABHIJEET BHOI

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 11:49:17 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 04000205801gb005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
STATE OF CALIFORNIA

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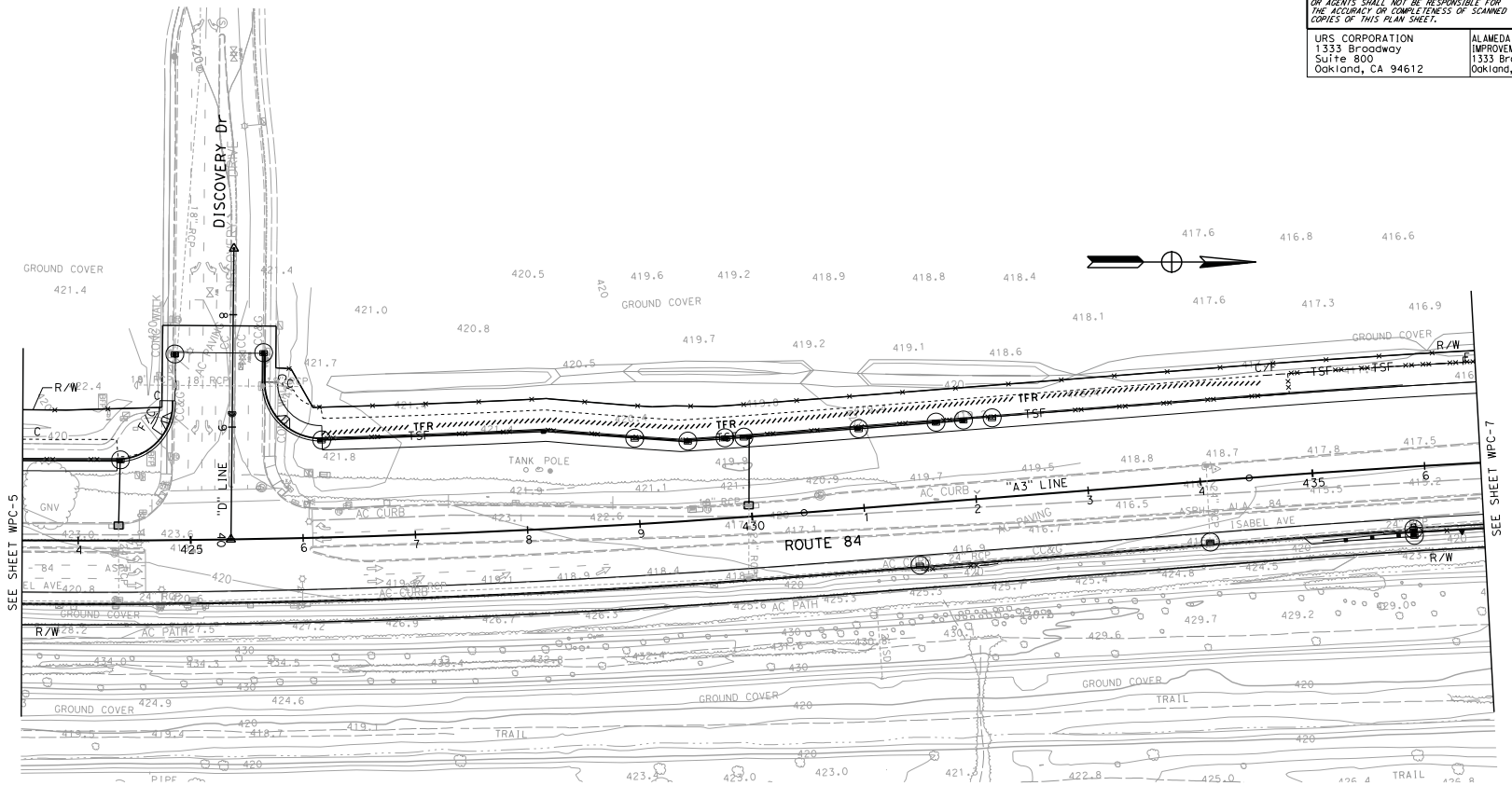

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET WPC-1.

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: MARIA SEDGHI
CHECKED BY: ABHIJEET BHOI
REVISED BY: MS
DATE REVISED: 10/19/10

LAST REVISION
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 11:59:23 AM

BORDER LAST REVISED 7/2/2010
USERNAME => amber_grant
DGN FILE => 04000205801gb006.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
STATE OF CALIFORNIA

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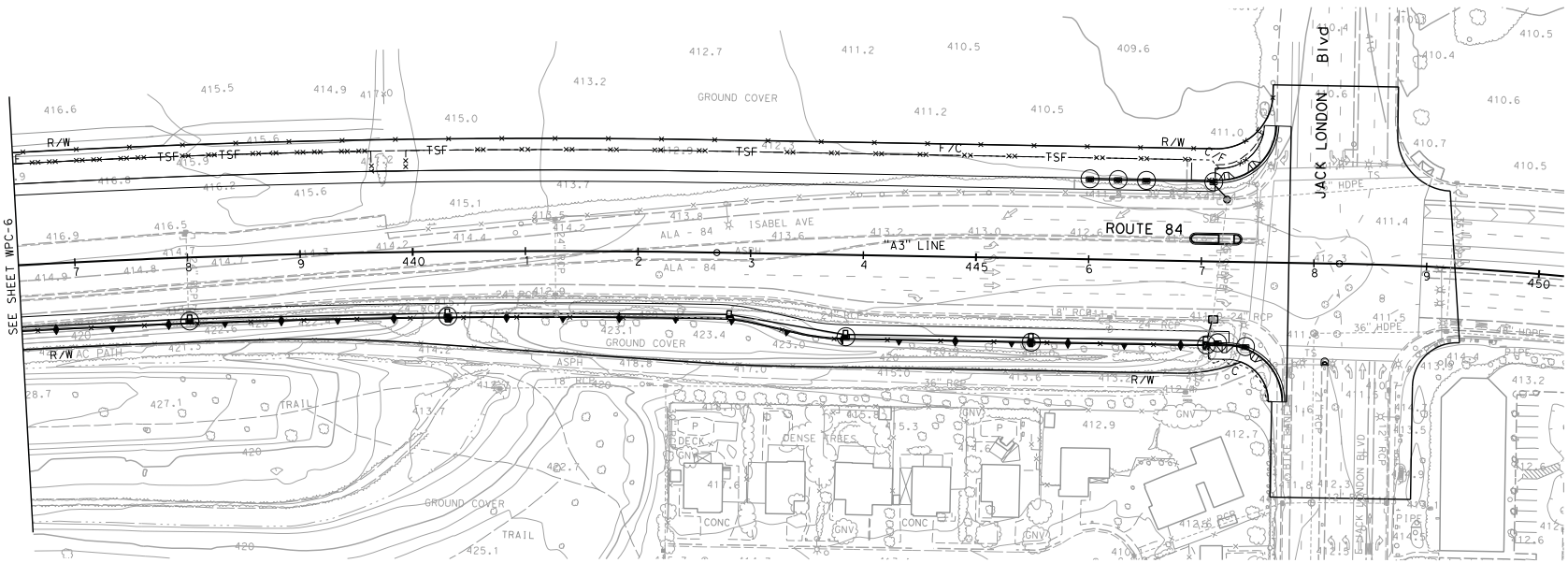

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET WPC-1.

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: MARIA SEDGHI
CHECKED BY: ABHIJEET BHOI
REVISED BY: MS
DATE REVISED: 10/19/10

LAST REVISION
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 11:59:38 AM

BORDER LAST REVISED 7/2/2010
USERNAME => amber_grant
DGN FILE => 040002058Ogb007.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Temporary Water Pollution Control Plans – Segment B

By URS Corporation

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Alo	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Maria Sedghi — No. 74619 — EXP. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

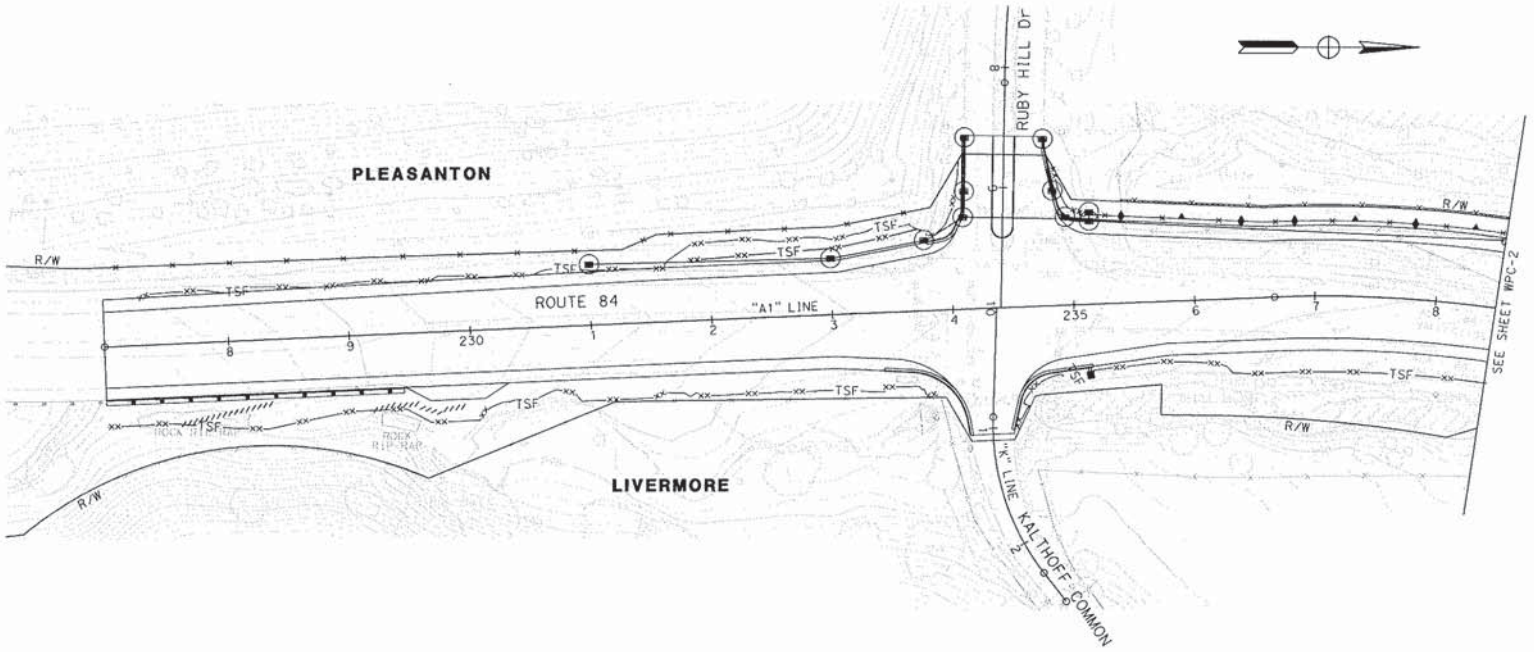
FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. THESE PLANS PROVIDE MINIMUM LEVELS OF TEMPORARY WATER POLLUTION CONTROL DURING THE CONSTRUCTION OF PROJECT. ADJUSTMENT/MODIFICATIONS SHALL BE MADE IN REGARD TO ADDRESS ACTUAL SITE CONDITIONS OR AS DIRECTED BY THE ENGINEER.
2. SEE DRAINAGE PLANS FOR INLET TYPES AND SIZE OF DRAINAGE PIPES.

LEGEND:

- TEMPORARY DRAINAGE INLET PROTECTION
- DIRECTION OF FLOW
- STORM DRAIN INLET AND PIPE SYSTEM
- xx—xx—TSF— TEMPORARY SILT FENCE
- ////////////// TFR /// TEMPORARY FIBER ROLL
- TEMPORARY COVER



TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN | CALCULATED-DESIGNED BY: MARIA SEDGHI | CHECKED BY: ABHIJEET BHOI | REVISED BY: MS | DATE REVISED: 10/19/10

ARE REVISIONS | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 11:06:12 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760gb001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Maria Sedghi — No. 74619 — Exp. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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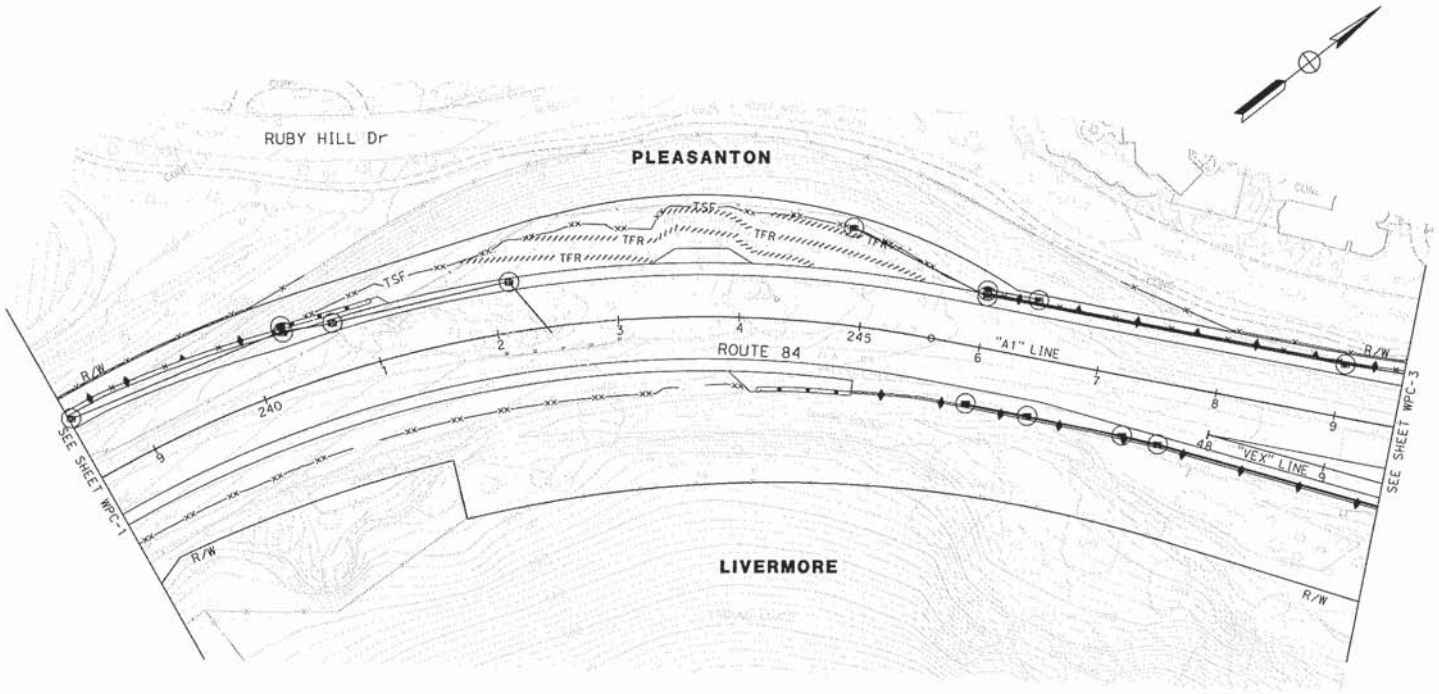

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-2

REVISED BY	MS
DATE REVISED	10/19/10

CALCULATED-DESIGNED BY: MARIA SEDGHI
CHECKED BY: ABHIJEET BHOI

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

AS-BUILT REVISIONS
DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:15 PM

BORDER LAST REVISED 7/2/2010

USERNAME => maria_sedghi
DGN FILE => ...\429760go002.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA REGISTERED PROFESSIONAL ENGINEER

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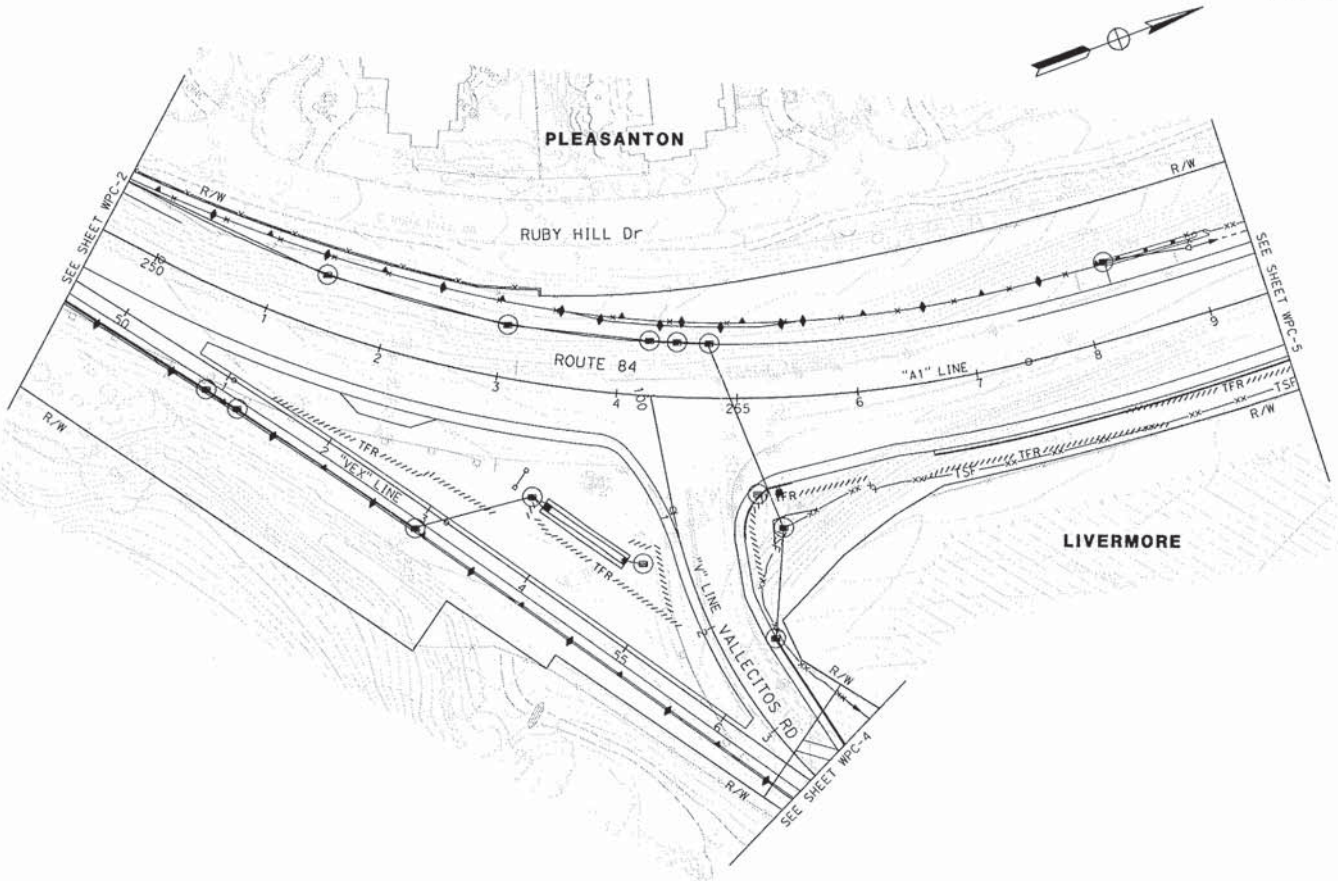

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	MS	10/19/10
		ABHIJEET BHOI		
		CHECKED BY		

LAST REVISION 10-21-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:06:16 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760g0003.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Maria Sedghi — No. 74619 — Exp. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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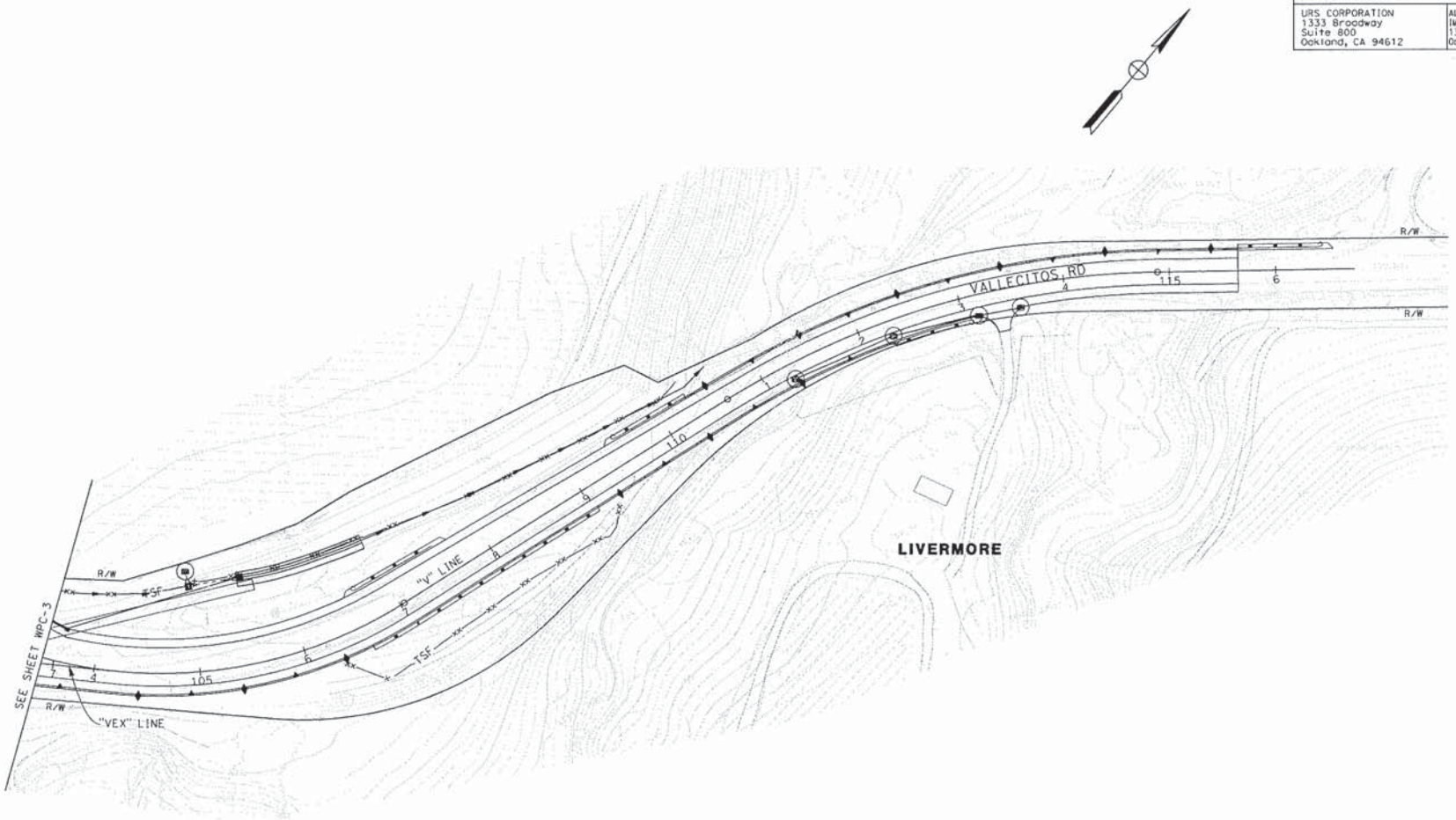

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-4

LAST REVISED: DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1106:17 PM

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: MARIA SEDGHI
CHECKED BY: ABHIJEET BHOI
REVISED BY: MS
DATE REVISED: 10/19/10

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760gb004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Alo	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Mario Sedghi — No. 74619 — Exp. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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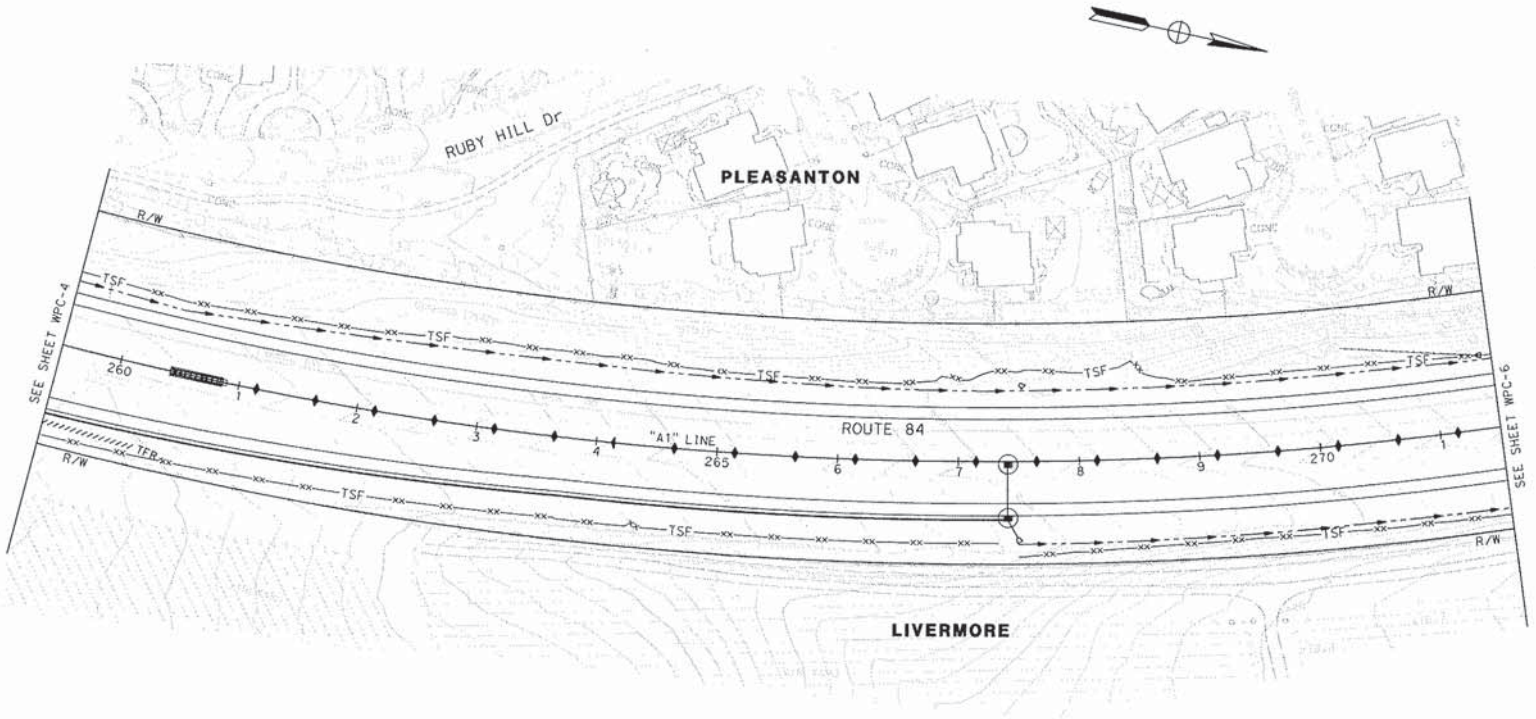

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:06:18 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => mario_sedghi | DGN FILE => ...\429760gb005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA
REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

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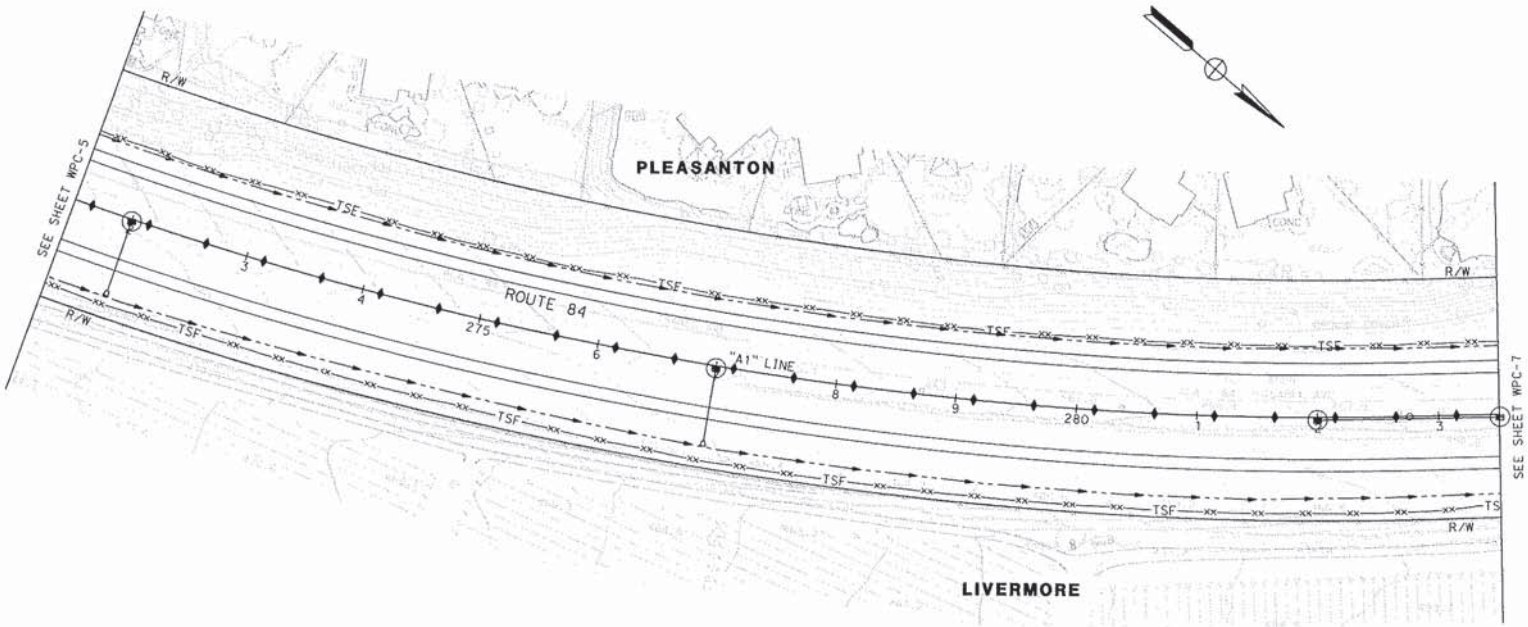

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:06:19 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi DGN FILE => ...\429760gb006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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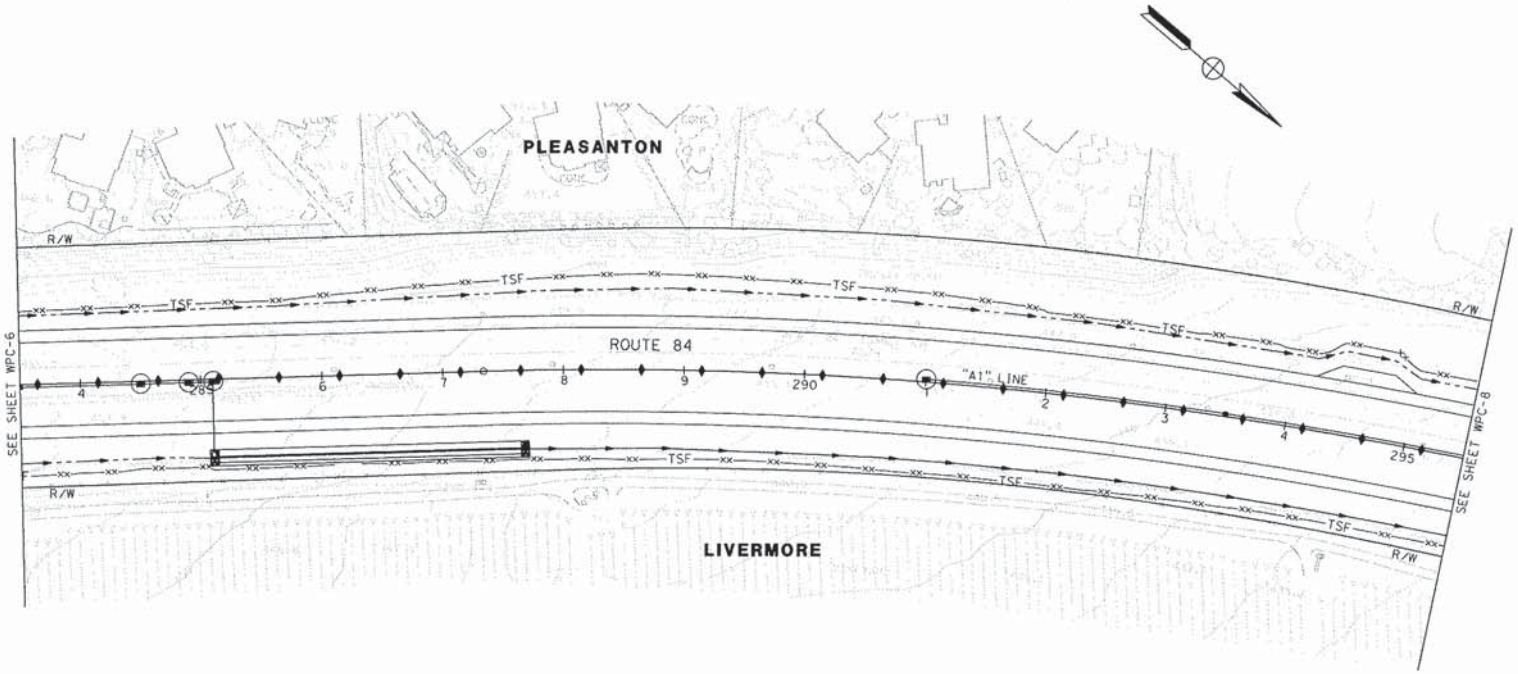

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-7

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:21 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi DGN FILE => ...\429760gb007.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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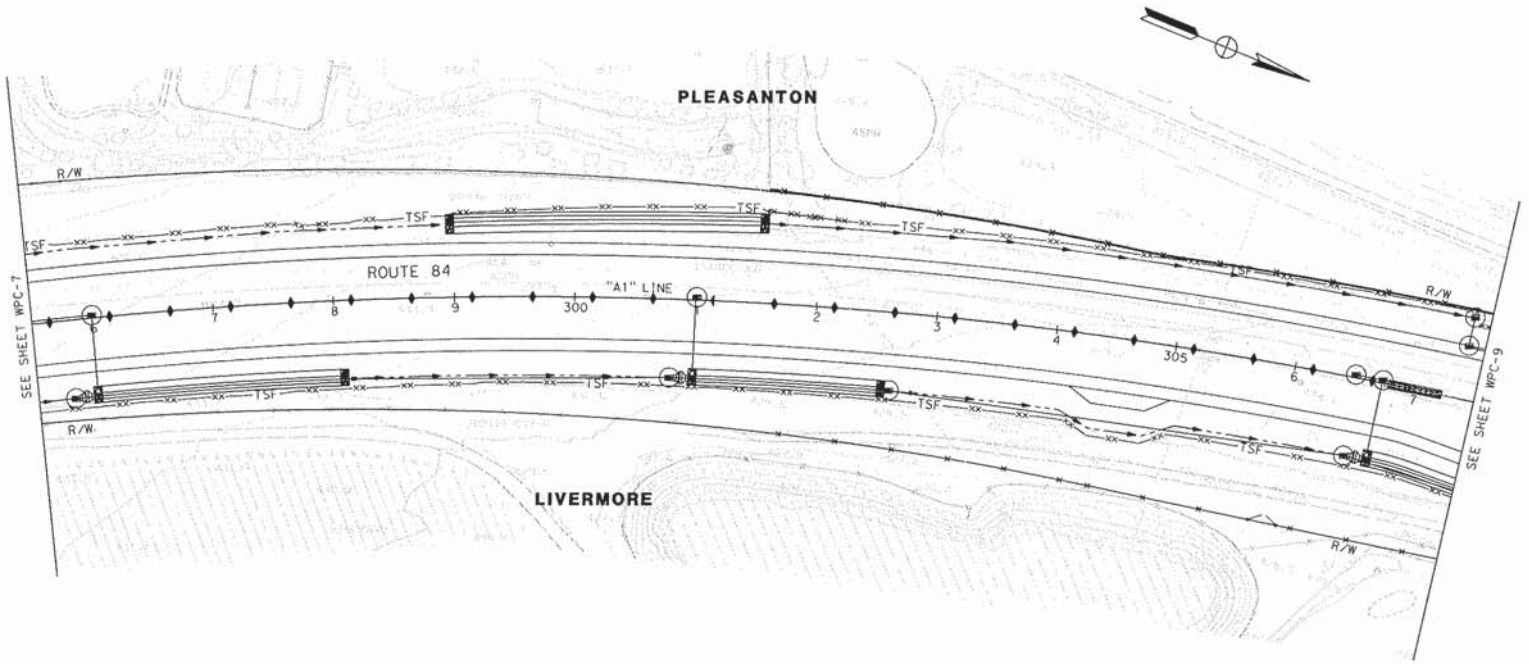

FOR NOTES AND LEGEND, SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-8

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
10-21-10 TIME PLOTTED => 1:06:22 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760gb008.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Alo	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
STATE OF CALIFORNIA

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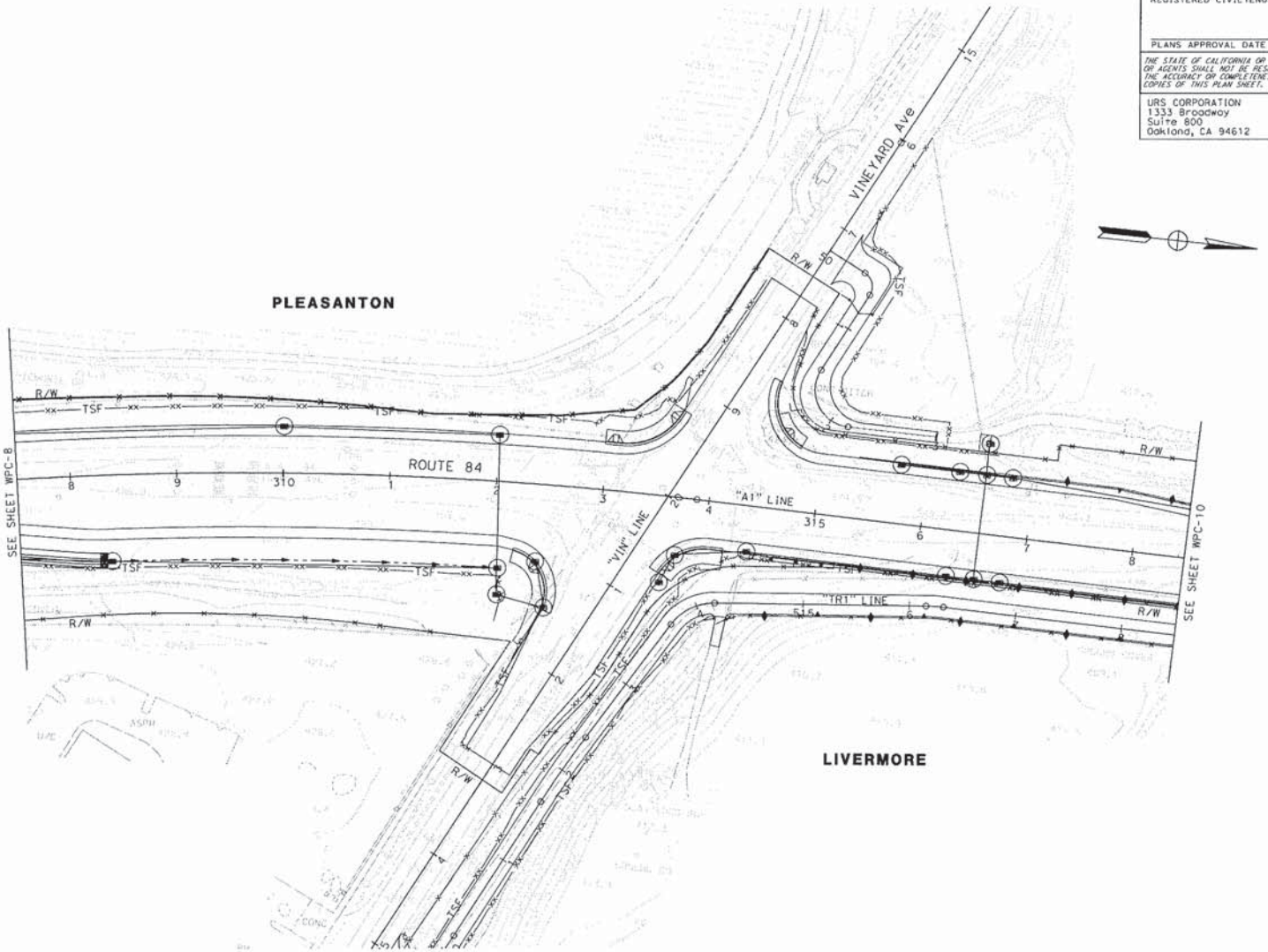

FOR NOTES AND LEGEND, SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-9

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760gb009.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1106:23 PM

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Alo	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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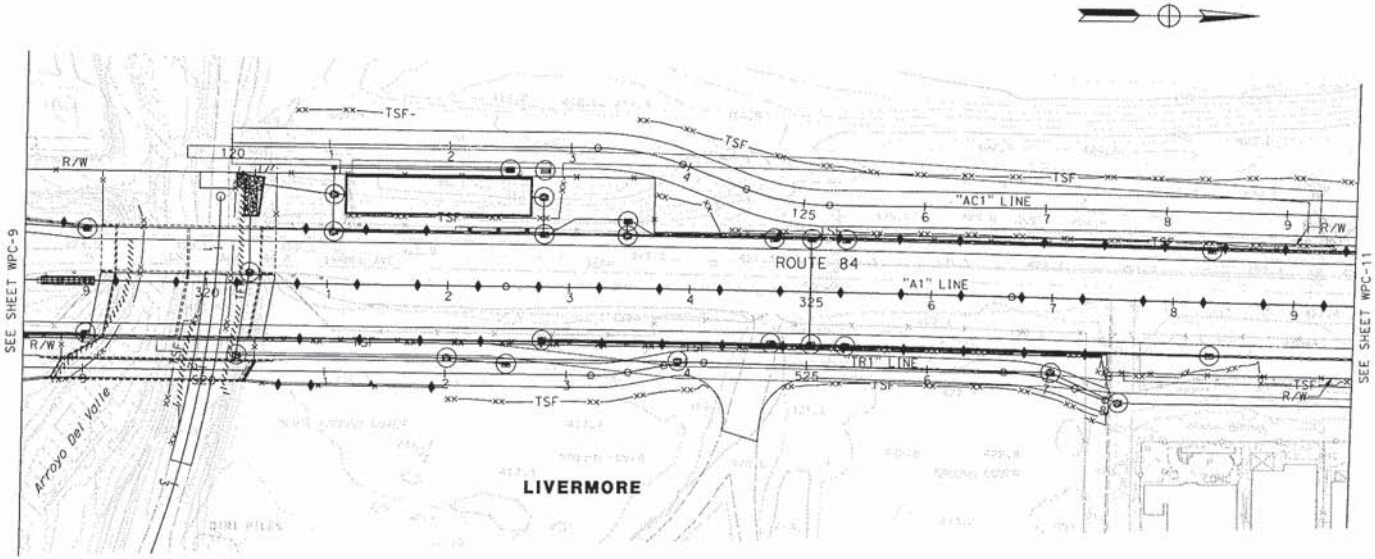

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	MS
Caltrans	RAMSEY J. HISSEN	CHECKED BY	DATE REVISED	10/19/10
		ABHIJEET BHOI		
		MARIA SEDGHI		

LAST REVISION 10-21-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:06:24 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760gb010.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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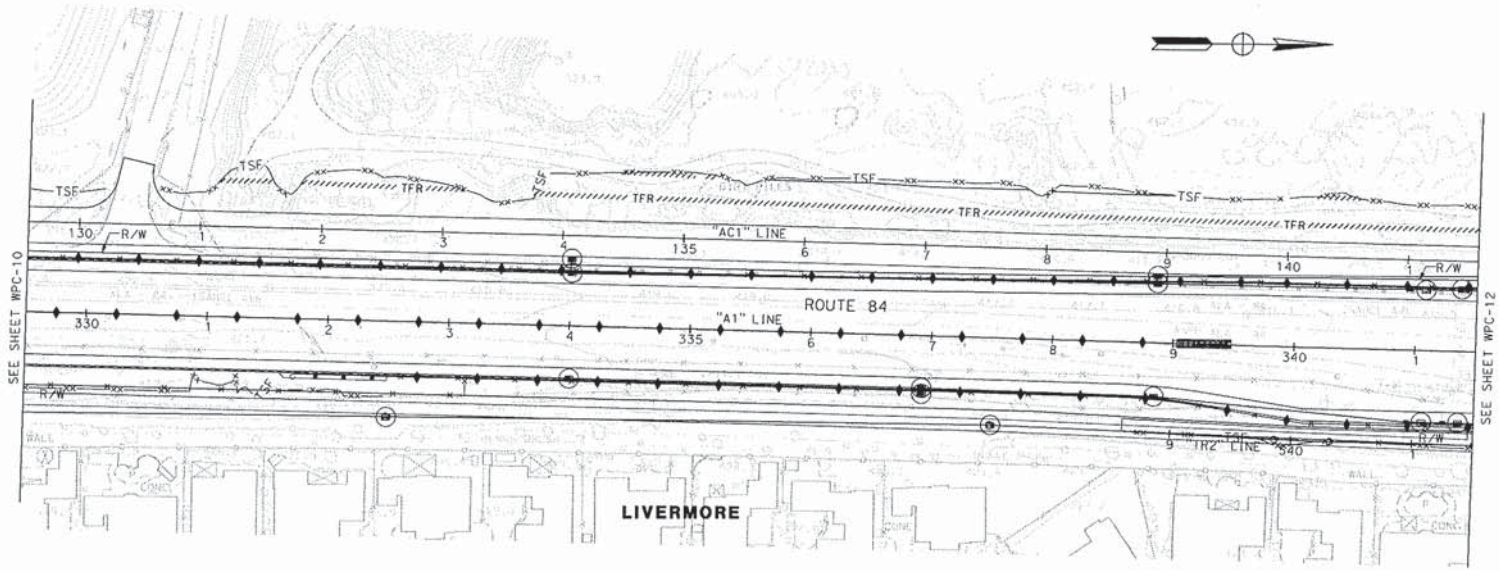

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-11

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION 10-21-10 DATE PLOTTED => 10/20/2010 TIME PLOTTED => 11:06:25 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi DGN FILE => ...\429760gb011.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

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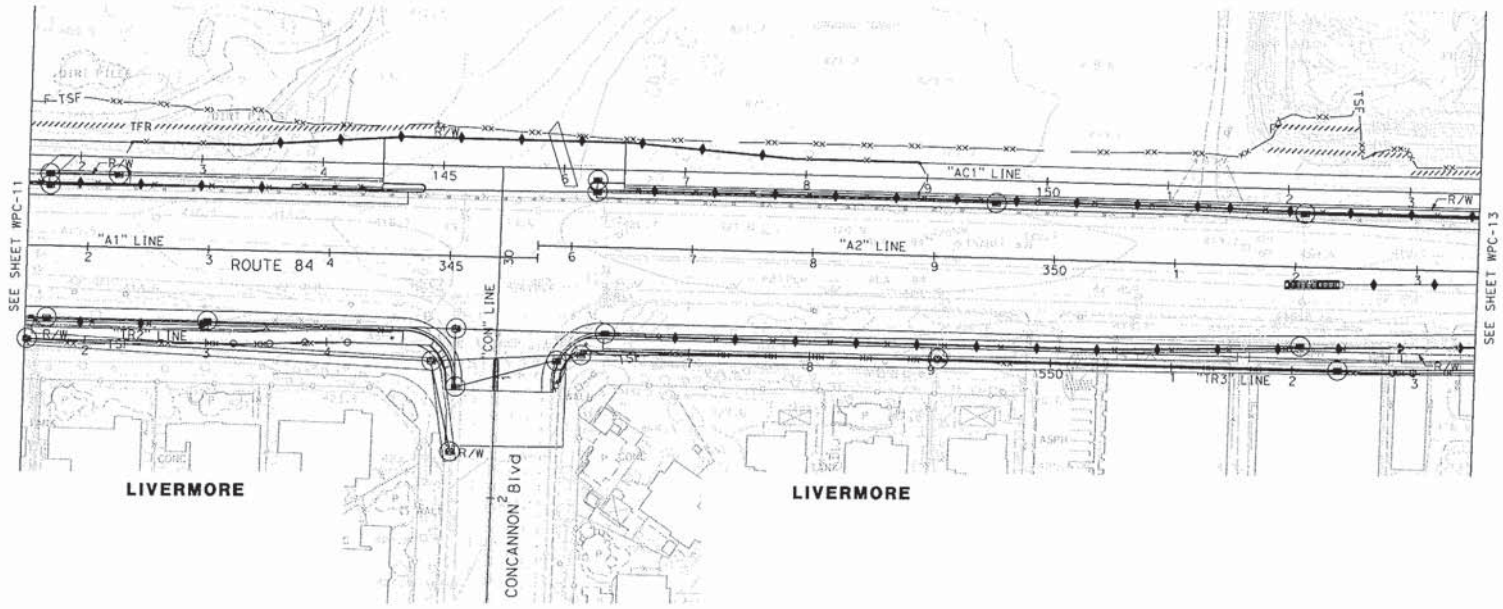

FOR NOTES AND LEGEND, SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-12

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION 10-21-10 DATE PLOTTED => 10/20/2010 TIME PLOTTED => 11:06:27 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi DGN FILE => ...\429760gb012.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Alo	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Mario Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

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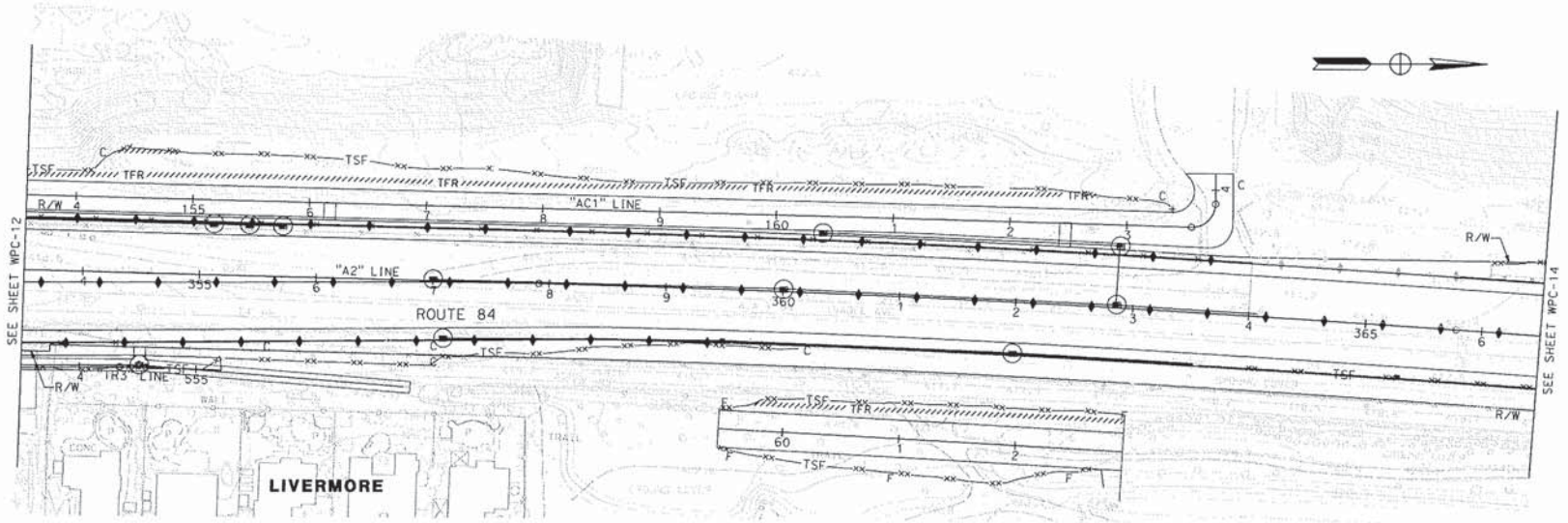

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-13

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	WS	10/19/10

LAST REVISION 10-21-10 DATE PLOTTED => 10/20/2010 TIME PLOTTED => 1106:28 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi DGN FILE => ...\429760gb013.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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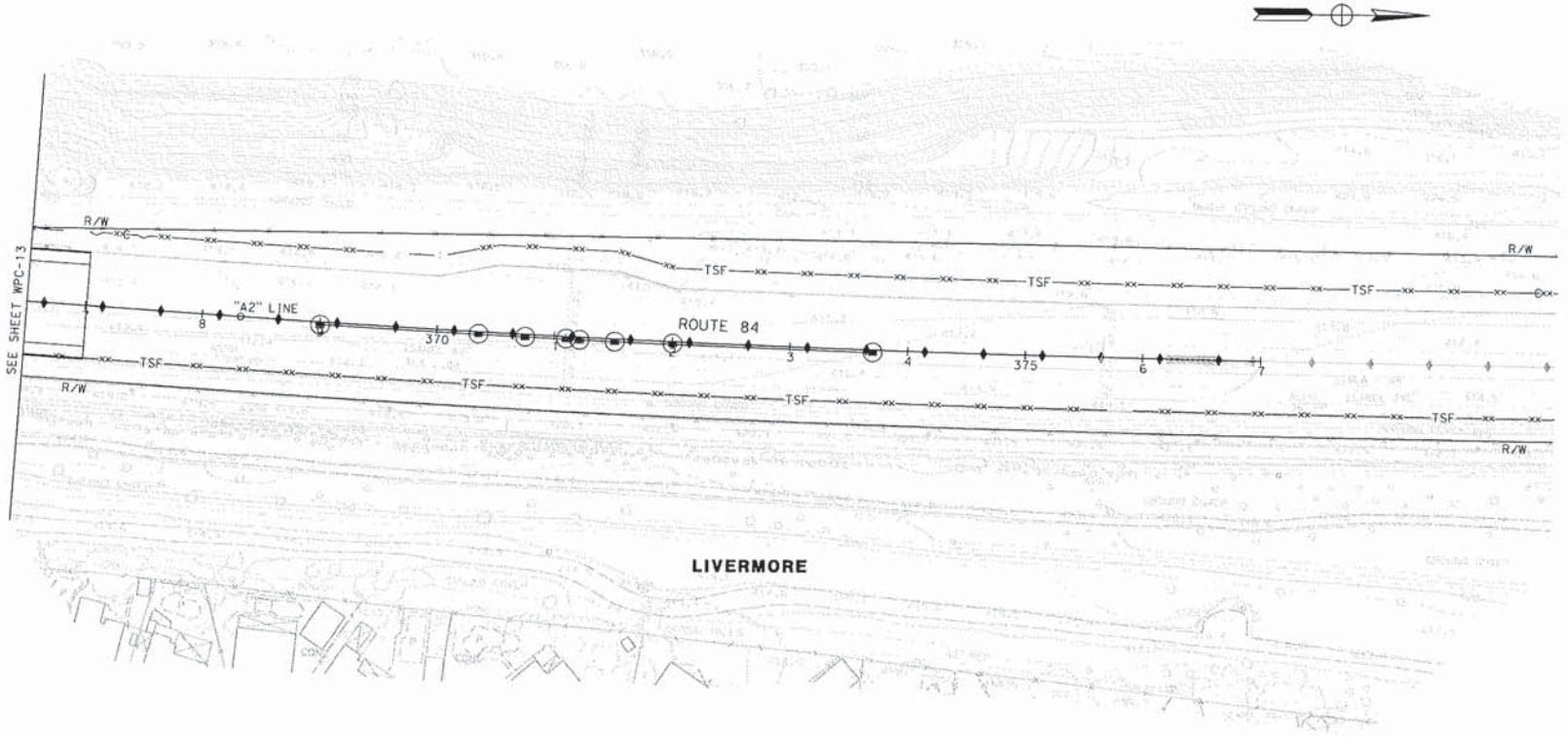

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

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BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760gb014.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Erosion Control Plans – Segment A

By URS Corporation

Erosion Control Plans – Segment B

By URS Corporation

Drainage Plans – Segment A

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — 1/17/11
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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NOTES:

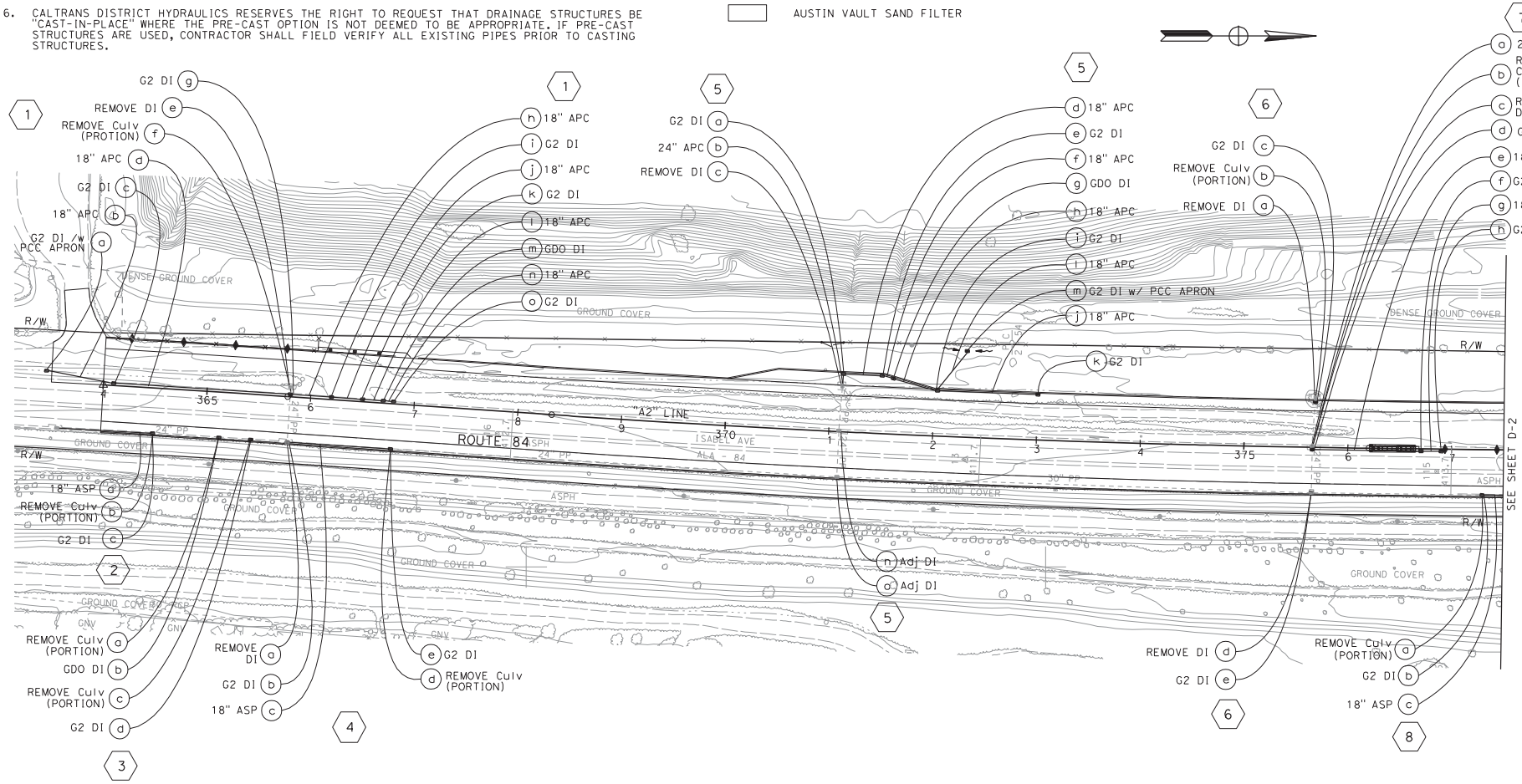
1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
3. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.
4. CONTRACTOR IS RESPONSIBLE TO PROVIDE POSITIVE DRAINAGE FROM ALL ROADWAY AREA AT ALL TIMES.
5. LOCATIONS OF EXISTING DRAINAGE FACILITIES ARE APPROXIMATE. VERIFY LOCATION AND ELEVATION OF EXISTING DRAINAGE FACILITIES PRIOR TO MODIFYING.
6. CALTRANS DISTRICT HYDRAULICS RESERVES THE RIGHT TO REQUEST THAT DRAINAGE STRUCTURES BE "CAST-IN-PLACE" WHERE THE PRE-CAST OPTION IS NOT DEEMED TO BE APPROPRIATE. IF PRE-CAST STRUCTURES ARE USED, CONTRACTOR SHALL FIELD VERIFY ALL EXISTING PIPES PRIOR TO CASTING STRUCTURES.

LEGEND:

- Exist STORM DRAIN
- PROPOSED STORM DRAIN
- GUTTER/DITCH FLOW LINE
- (No.) DRAINAGE SYSTEM No.
- (h) DRAINAGE UNIT
- GRADE TO DRAIN
- INLET
- Exist DI
- CAP DI
- AUSTIN VAULT SAND FILTER

ABBREVIATIONS:

COL	CITY OF LIVERMORE
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA
ASP	ALTERNATIVE SLOTTED PIPE
TC	TOP OF COVER



DRAINAGE PLAN

SCALE: 1'' = 50'

D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED	LAST REVISION
Caltrans	HAN-BIN LIANG	IRENE LIU / ANALETTE OCHOA	JP	1/11/11	10-19-10

DATE PLOTTED => 11/14/2011
TIME PLOTTED => 5:43:43 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801a001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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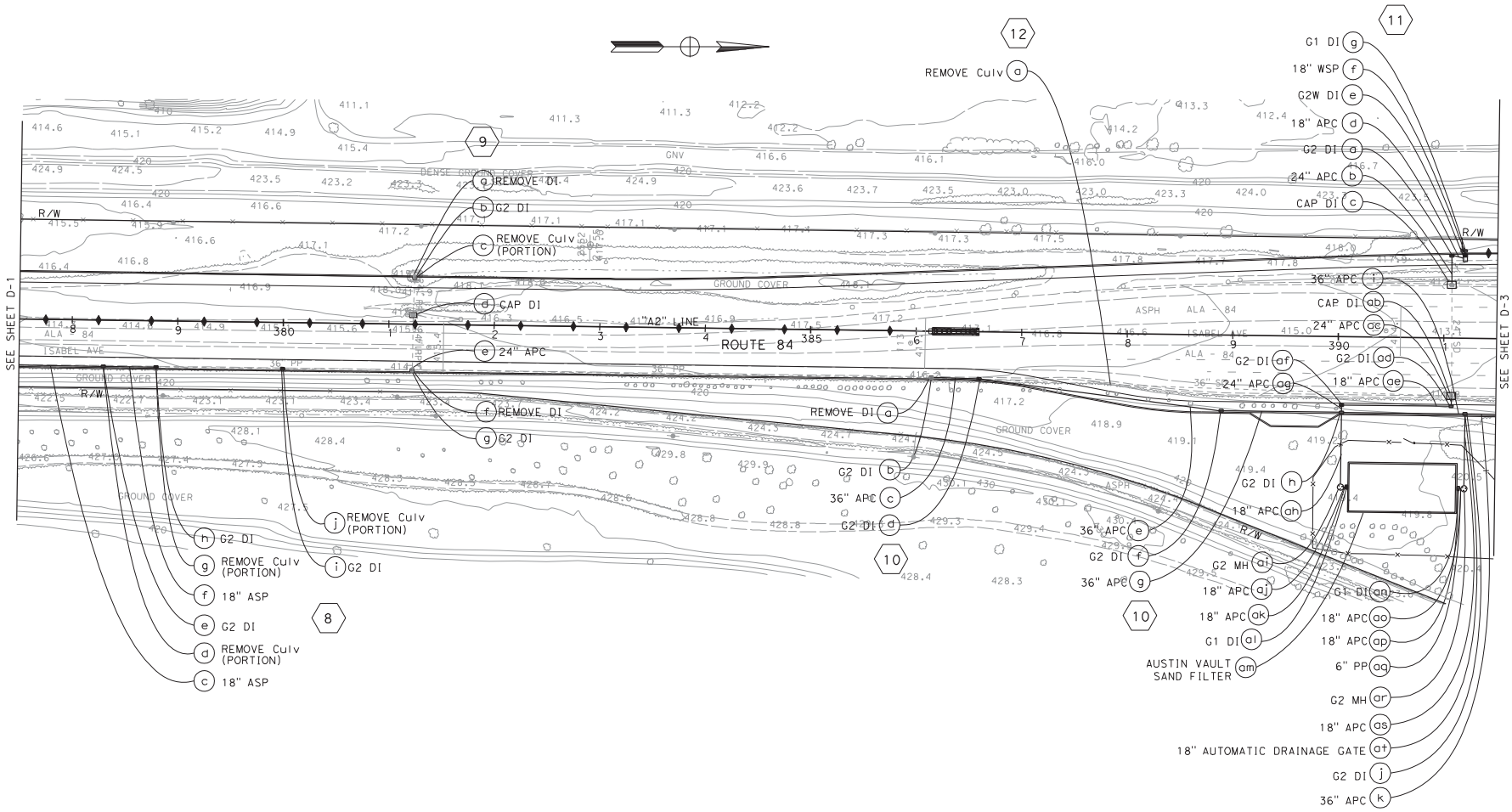

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

LAST REVISION 10-19-10
DATE PLOTTED => 11/14/2011
TIME PLOTTED => 5:43:46 PM

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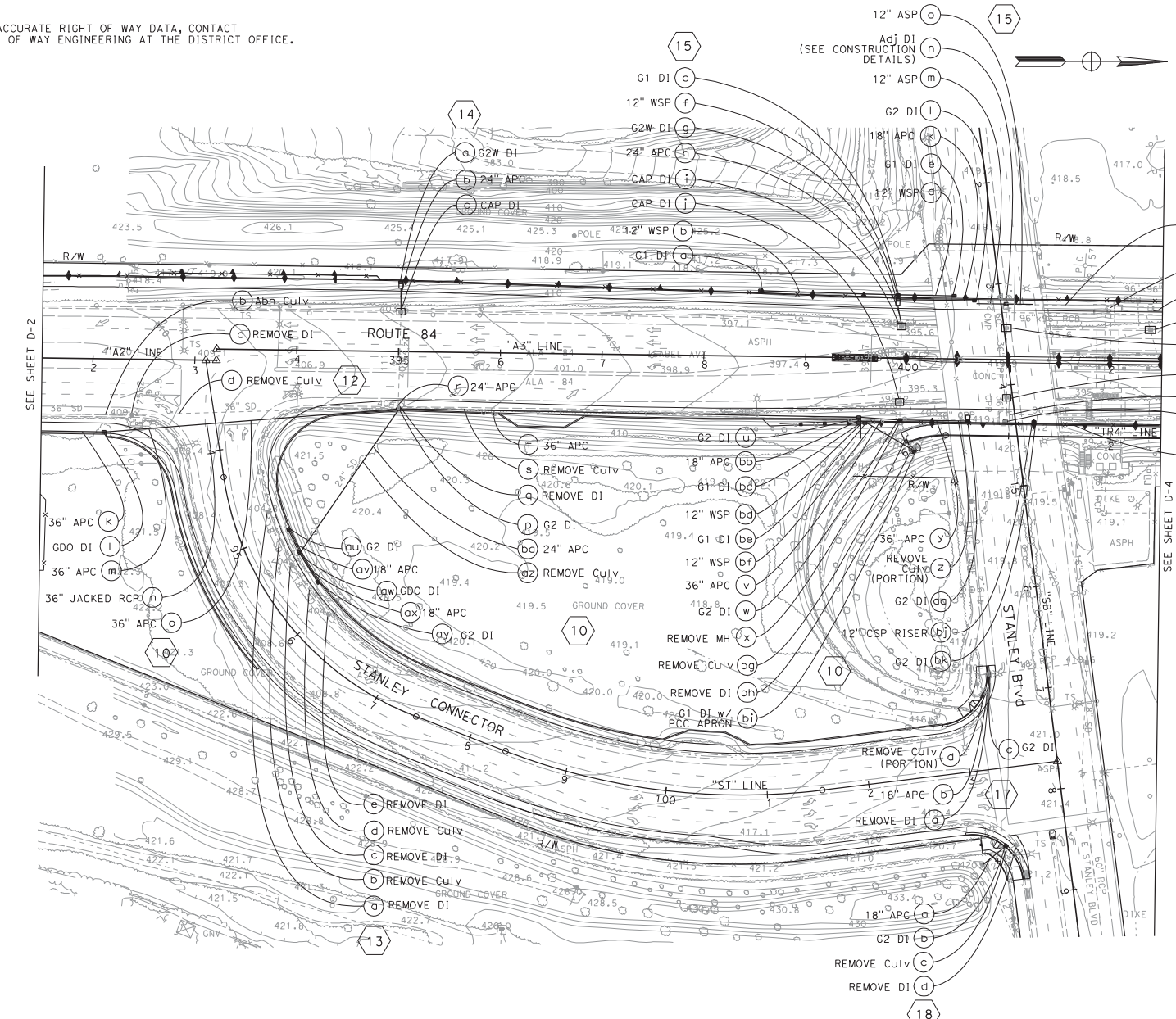

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
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LAST REVISION 10-19-10 DATE PLOTTED => 1/14/2011 TIME PLOTTED => 5:43:50 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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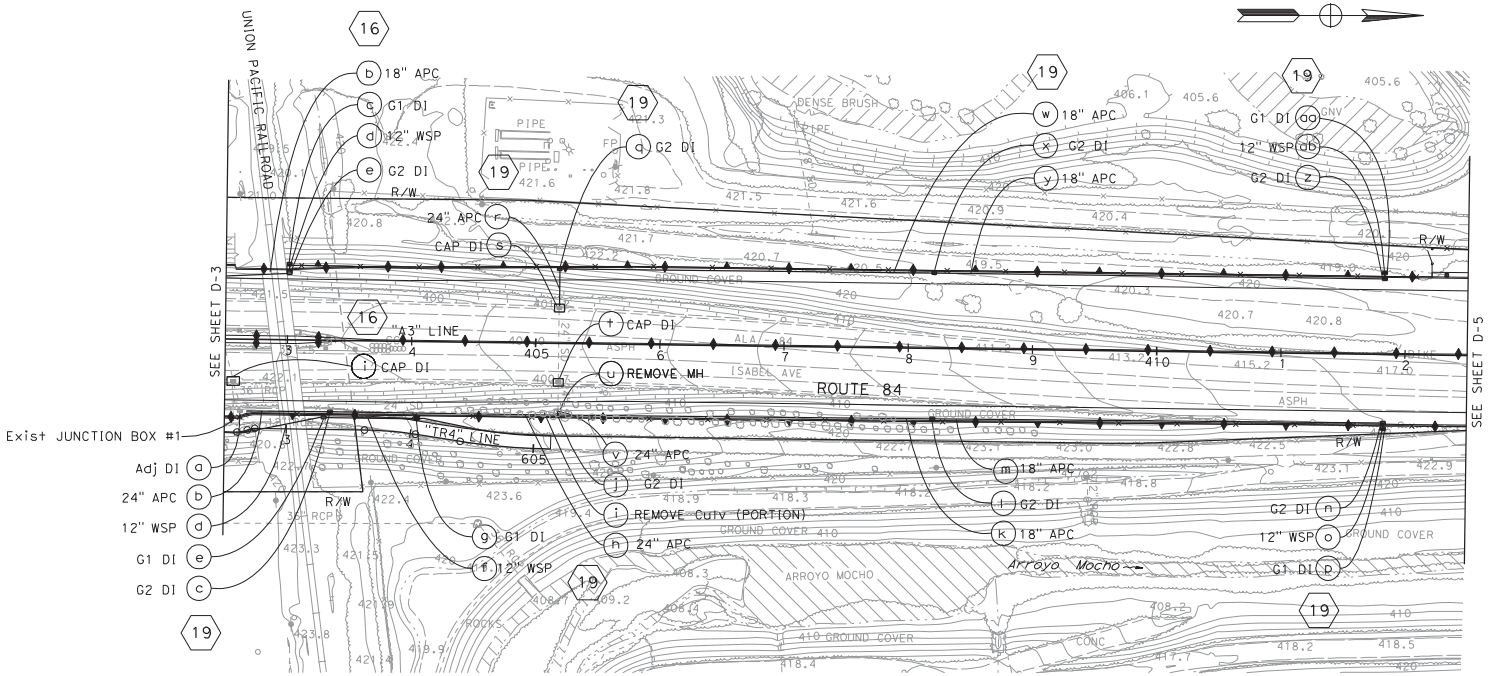

DRAINAGE PLAN

SCALE: 1'' = 50'

D-4

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

LAST REVISION 10-19-10
DATE PLOTTED => 11/14/2011
TIME PLOTTED => 5:43:58 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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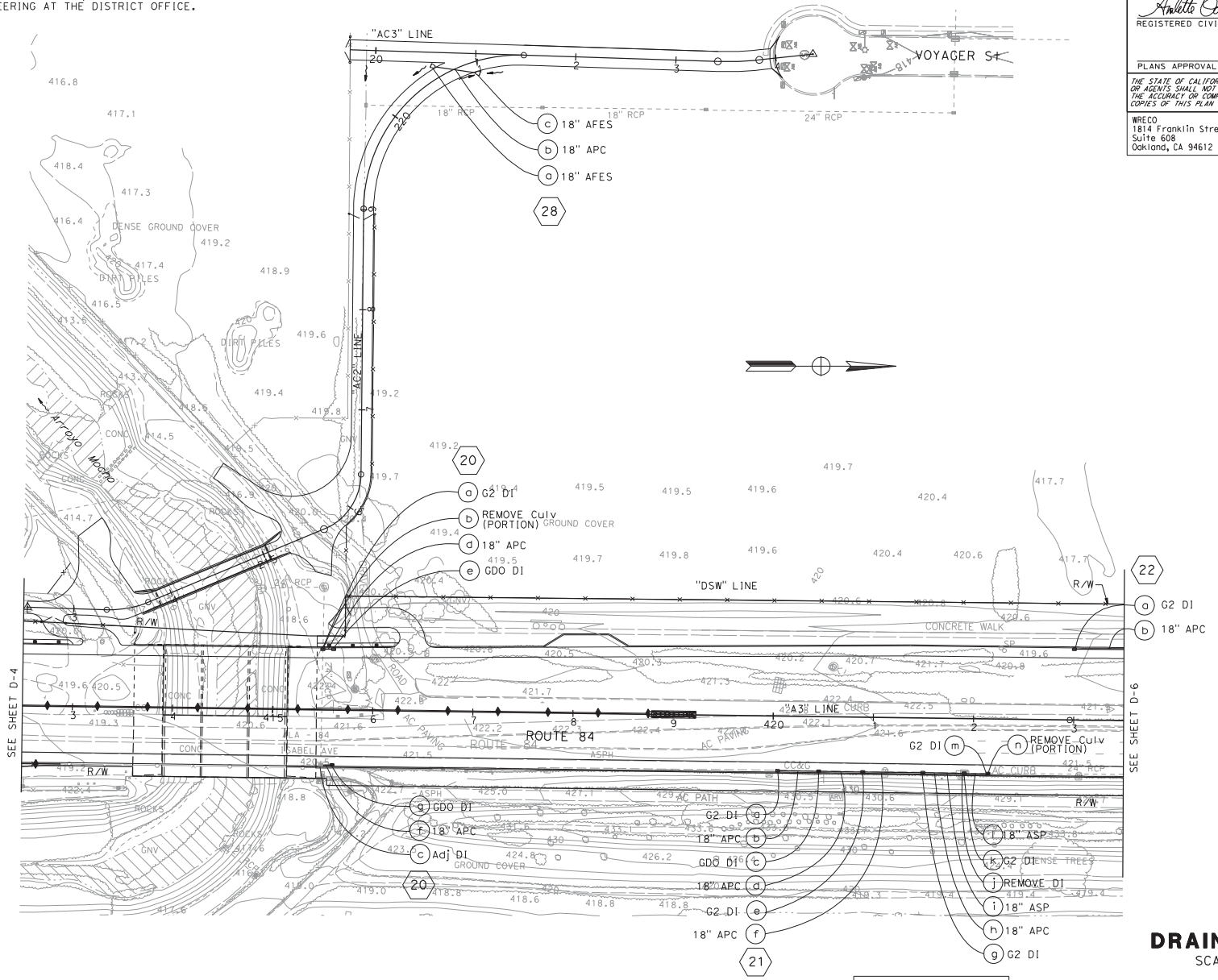

DRAINAGE PLAN

SCALE: 1'' = 50'

D-5

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

LAST REVISION — DATE PLOTTED => 11/14/2011 — TIME PLOTTED => 5:44:03 PM — 10-19-10

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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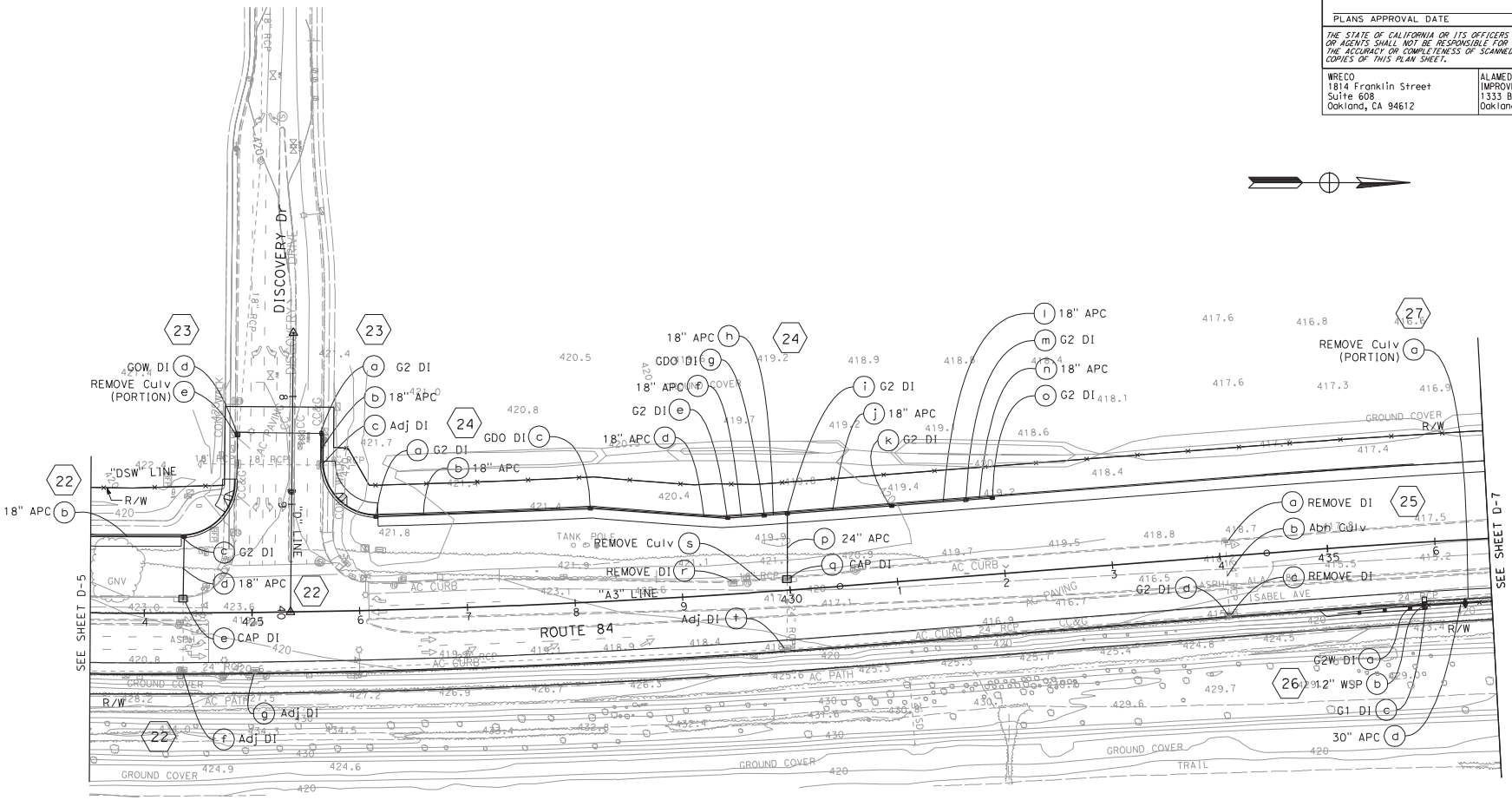

DRAINAGE PLAN
SCALE: 1'' = 50'

D-6

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

LAST REVISION
DATE PLOTTED => 11/14/2011
TIME PLOTTED => 5:44:09 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801a006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — 1/17/11
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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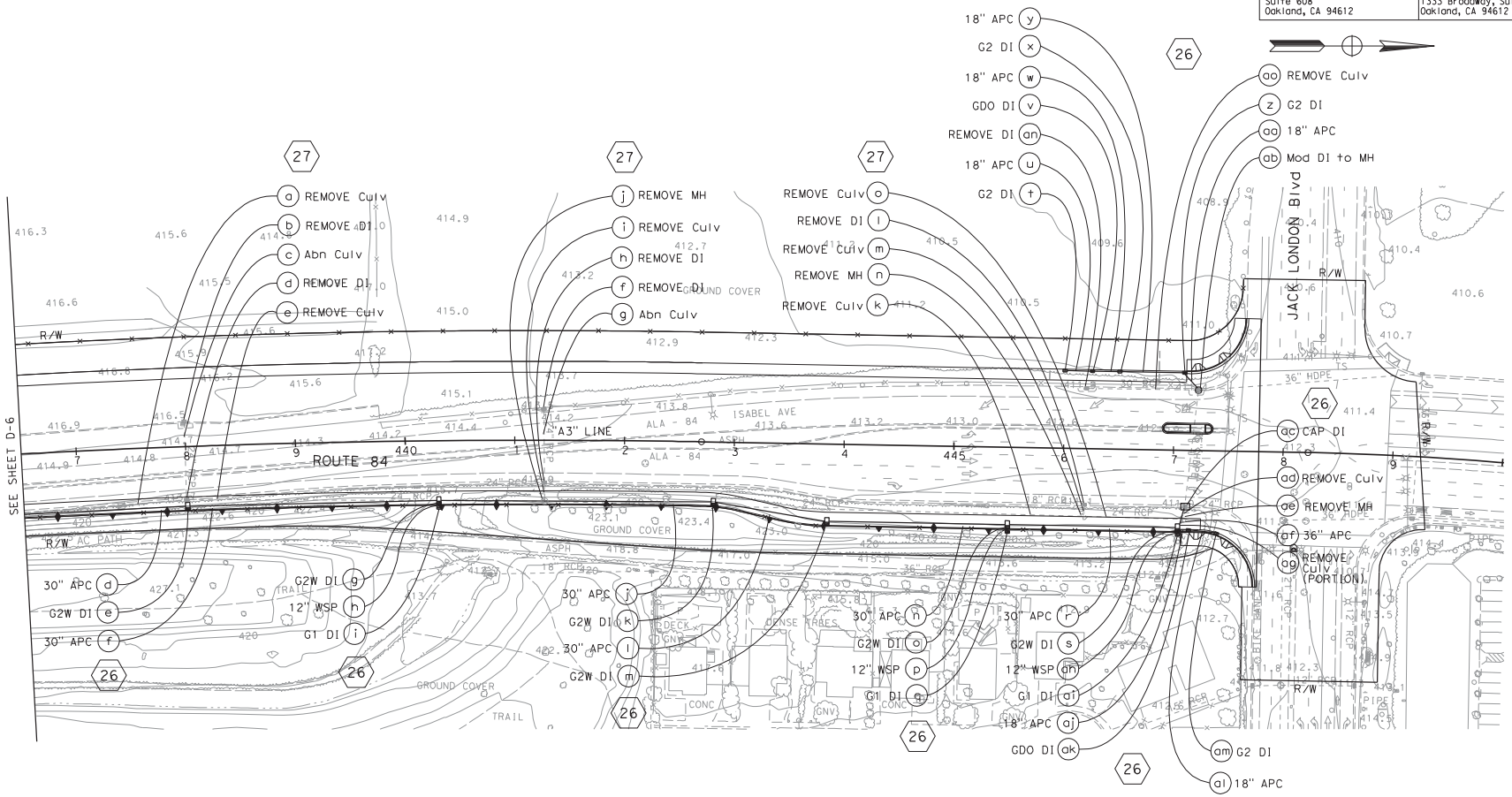

DRAINAGE PLAN

SCALE: 1'' = 50'

D-7

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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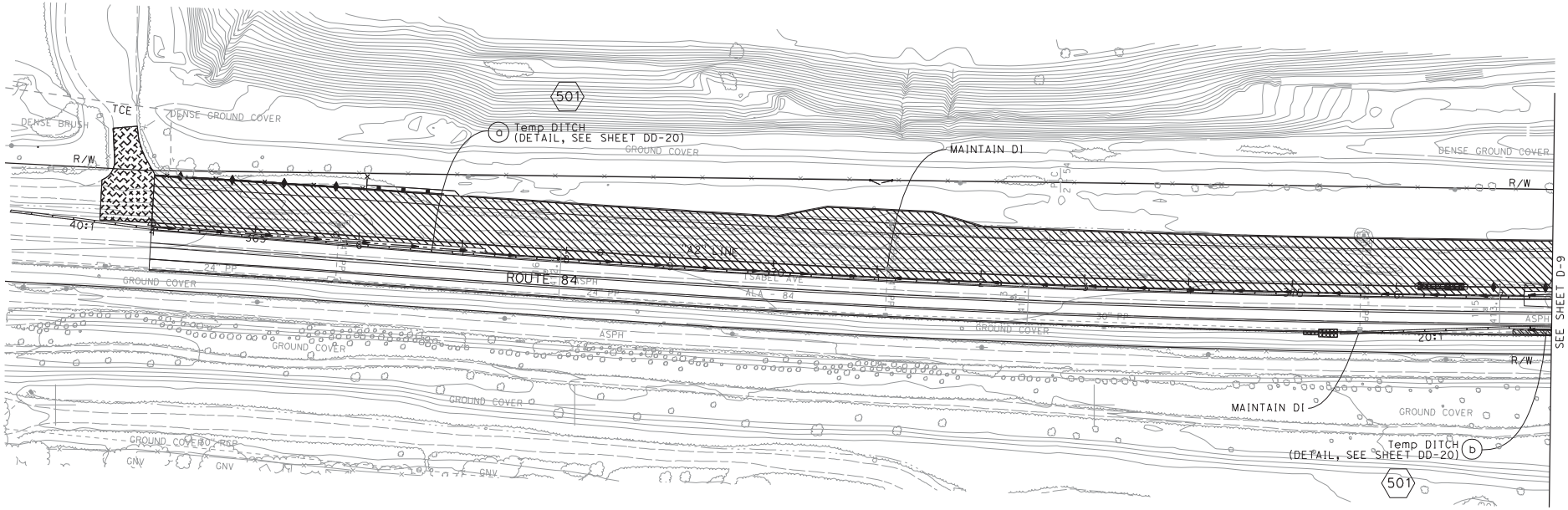
NOTES:

1. CONTRACTOR WILL NOT REMOVE EXISTING OUTFALLS BEFORE NEW OUTFALLS HAVE BEEN CONSTRUCTED TO TAKE ITS PLACE.
2. MAINTAIN DI IS ONLY FOR STAGE 1 OF CONSTRUCTION. THE FINAL CONSTRUCTION SHALL BE DONE ACCORDING TO THE DRAINAGE PLANS.
3. CONTRACTOR SHALL SUBMIT TEMPORARY DRAINAGE PROPOSAL TO THE ENGINEER FOR APPROVAL.

LEGEND:

- TEMPORARY RAILING (TYPE K)
- CONSTRUCTION THIS STAGE
- HMA OVERLAY CONFORM THIS STAGE
- TEMPORARY CONSTRUCTION THIS STAGE



DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

D-8

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
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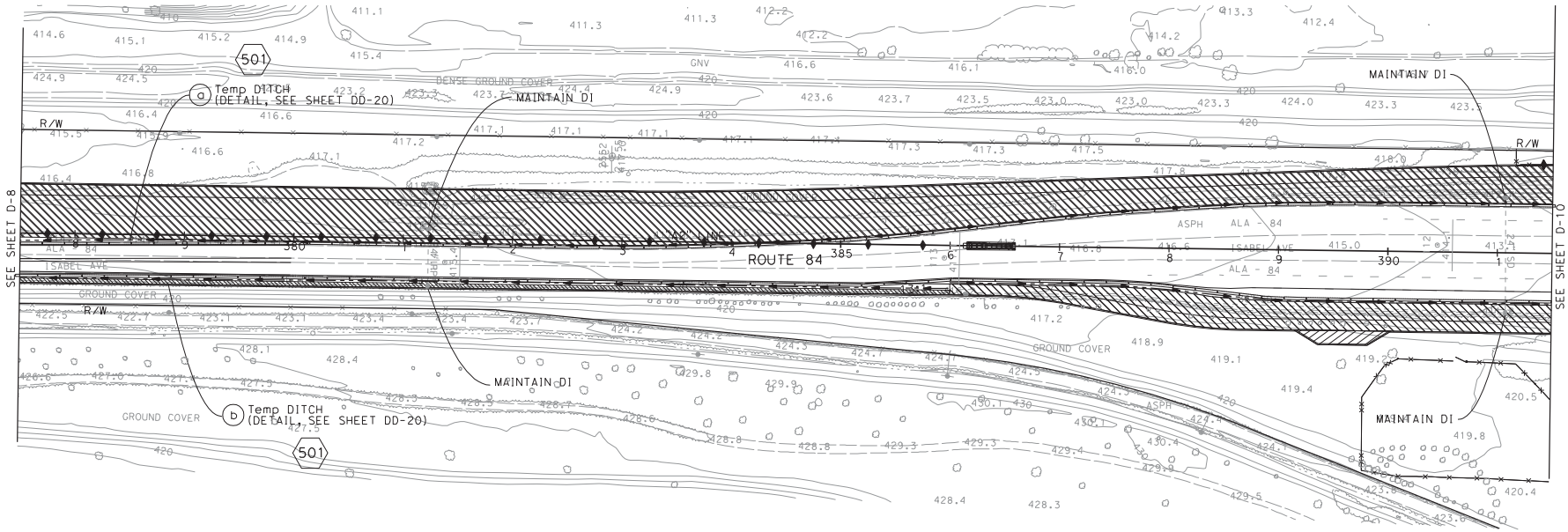

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

D-9

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
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DATE PLOTTED => 11/14/2011
TIME PLOTTED => 5:44:25 PM

BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
DGN FILE => ...\04000205801a009.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
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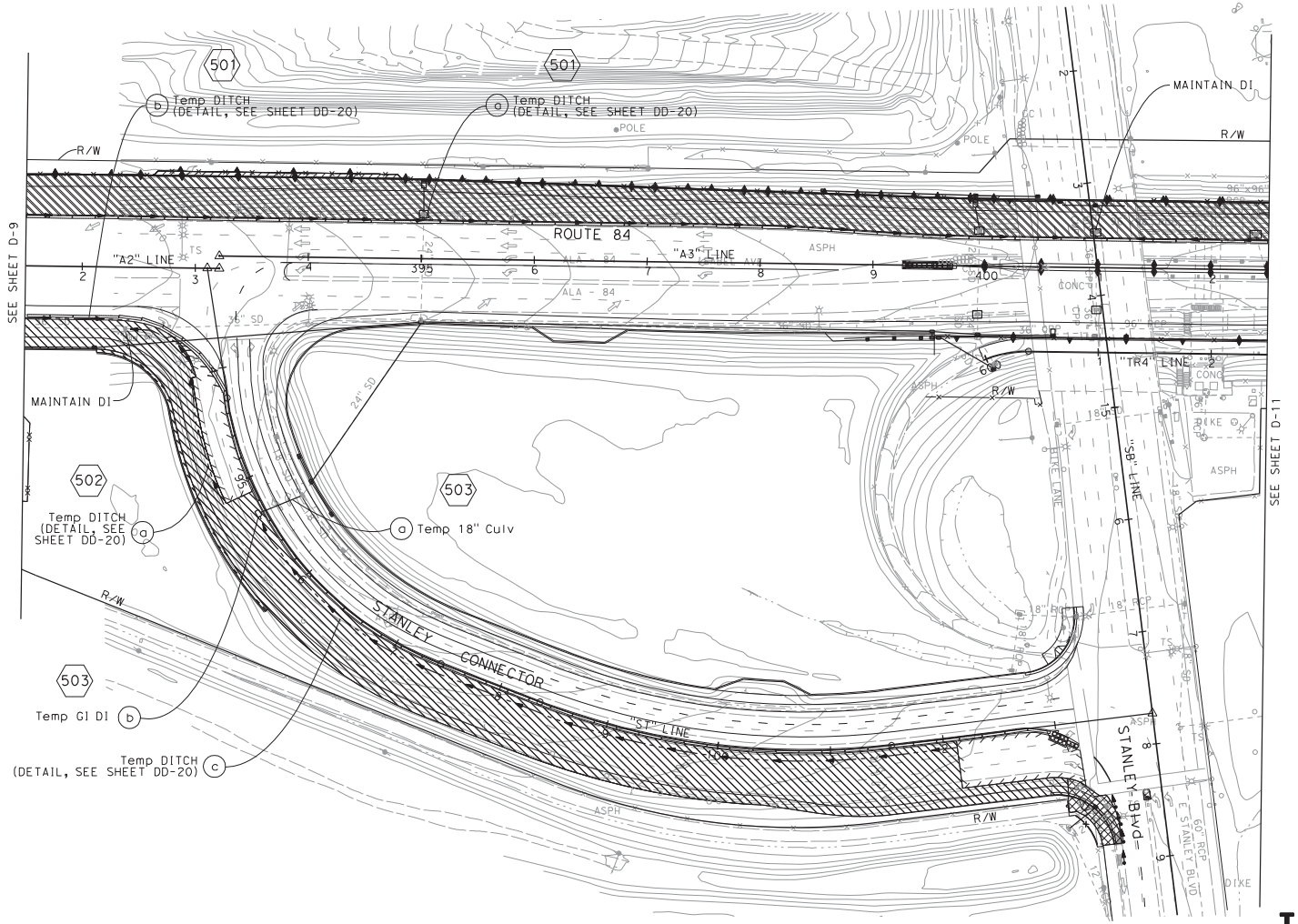

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

D-10

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

LAST REVISION 10-19-10
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BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
DGN FILE => ...\04000205801a010.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
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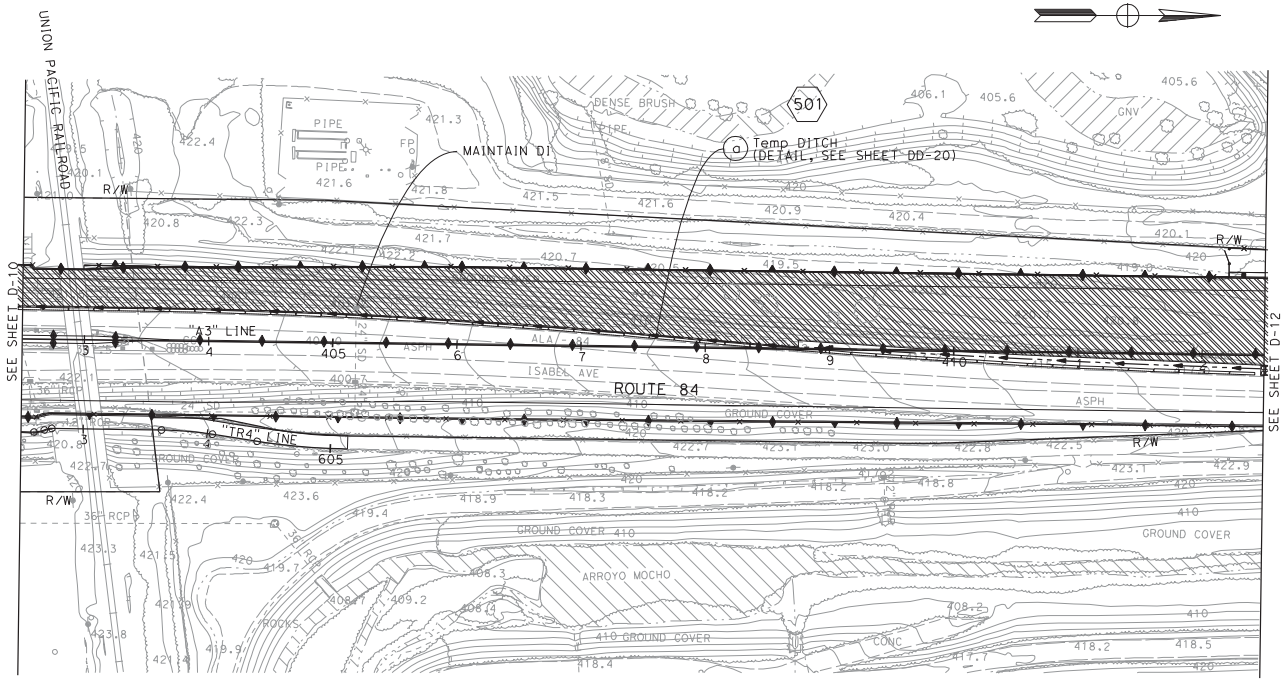

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

D-11

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
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LAST REVISION 10-19-10
DATE PLOTTED => 11/14/2011
TIME PLOTTED => 5:44:35 PM

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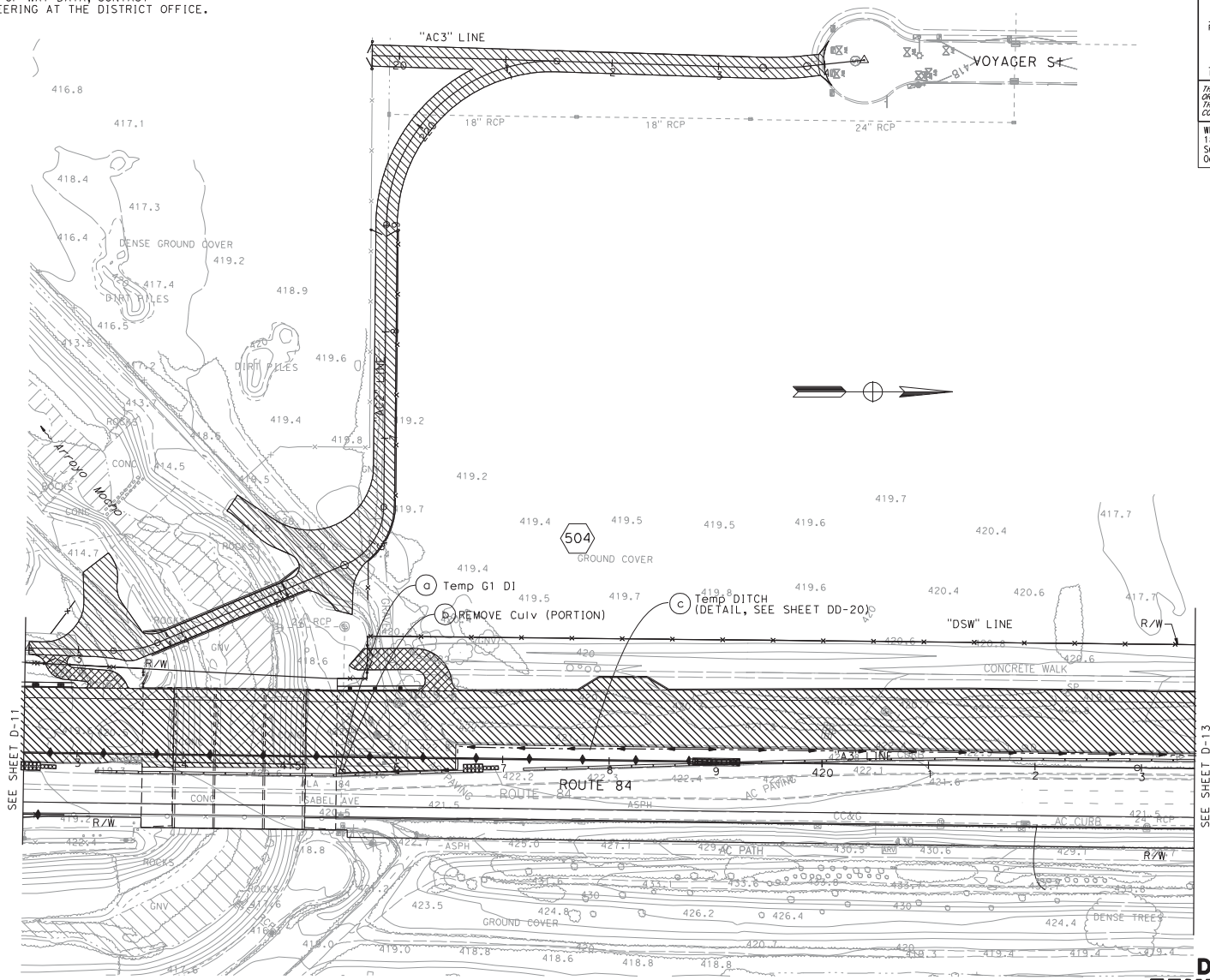

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-12

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

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DATE PLOTTED => 1/14/2011
TIME PLOTTED => 15:44:41 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
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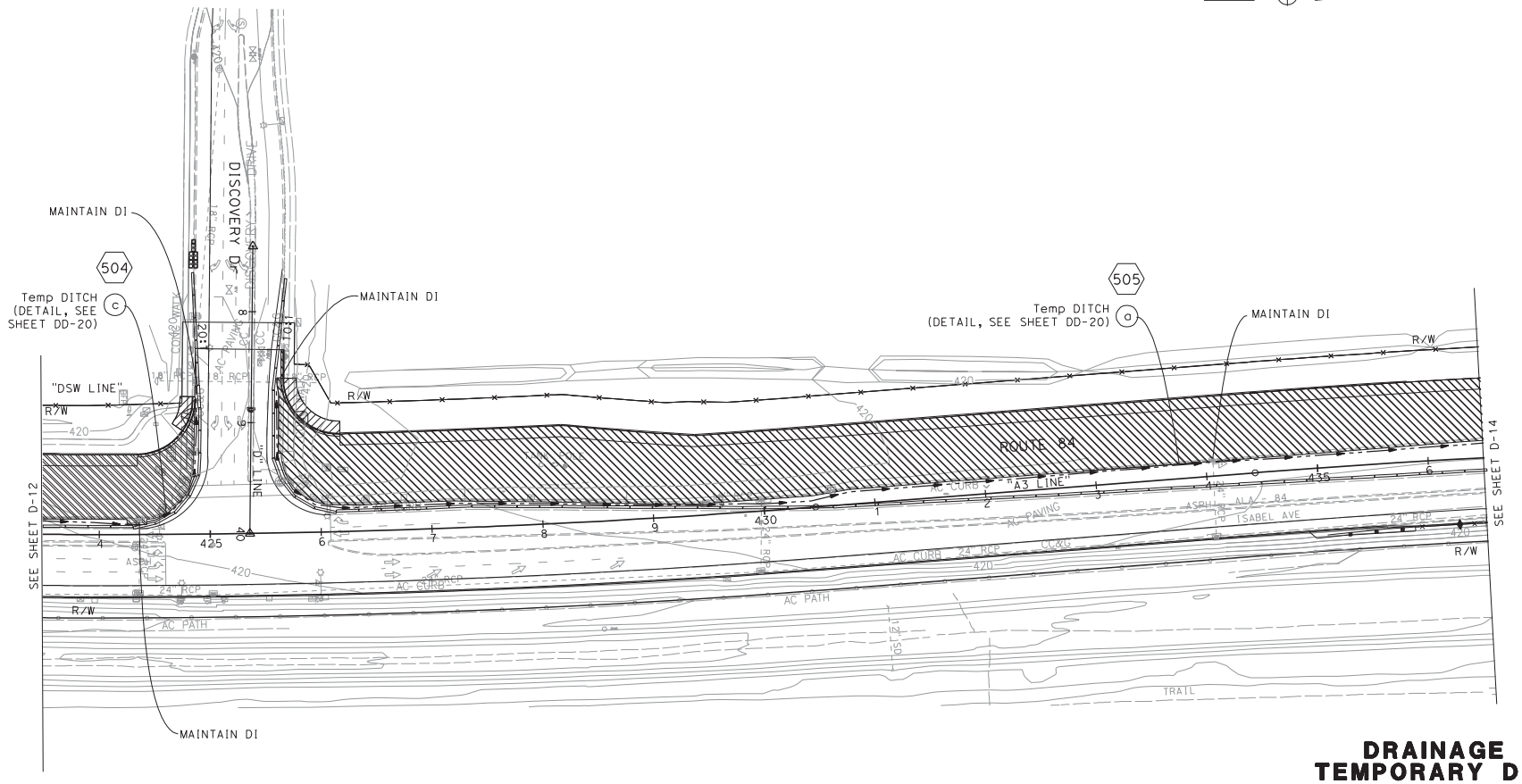
CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
IRENE LIU	ANALETTE OCHOA	JP	1/11/11

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans



DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-13

LAST REVISION: DATE PLOTTED => 1/14/2011
TIME PLOTTED => 5:44:46 PM

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DGN FILE => ...\04000205801a013.dgn

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UNIT 0733

PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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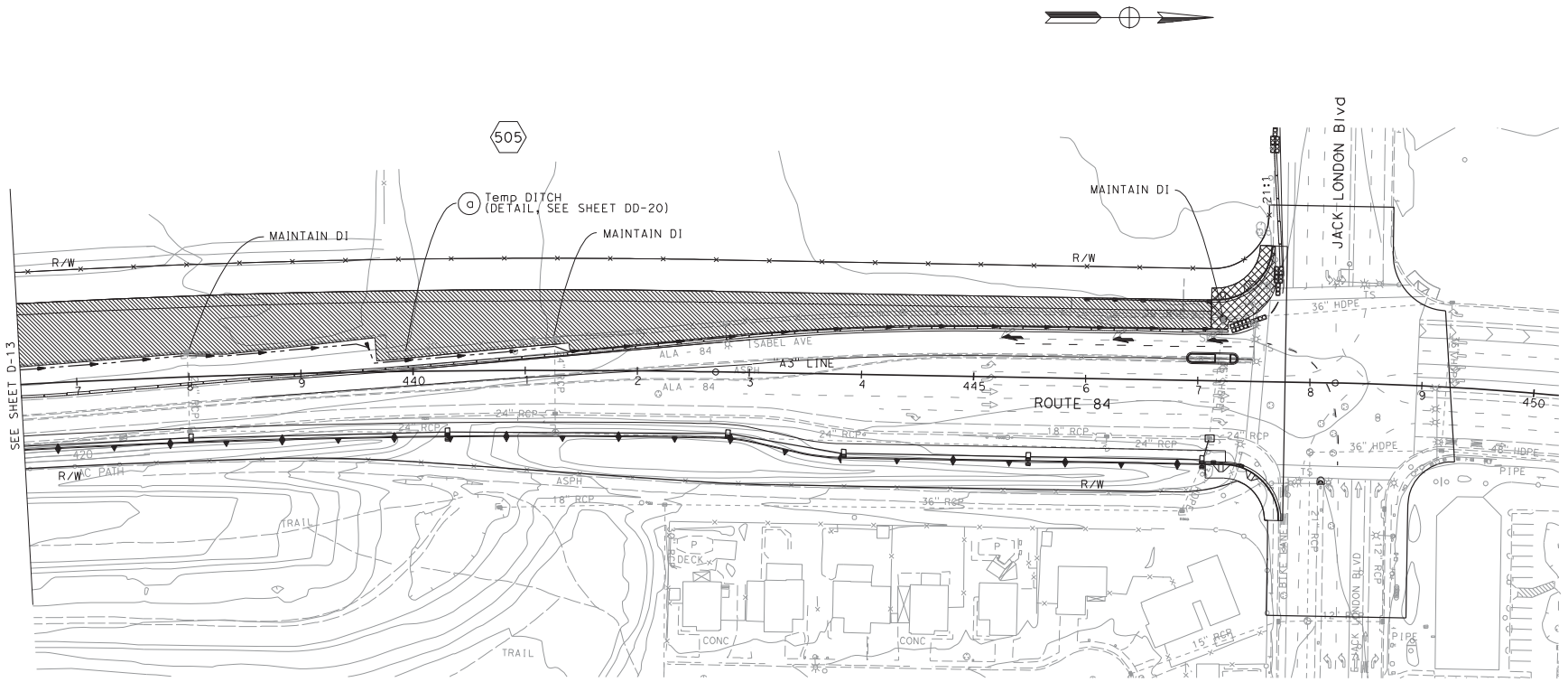

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1″ = 50′

D-14

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LAST REVISION 10-19-10 | DATE PLOTTED => 11/14/2011 | TIME PLOTTED => 5:44:51 PM

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Drainage Profiles and Details (AVSF Only) – Segment A

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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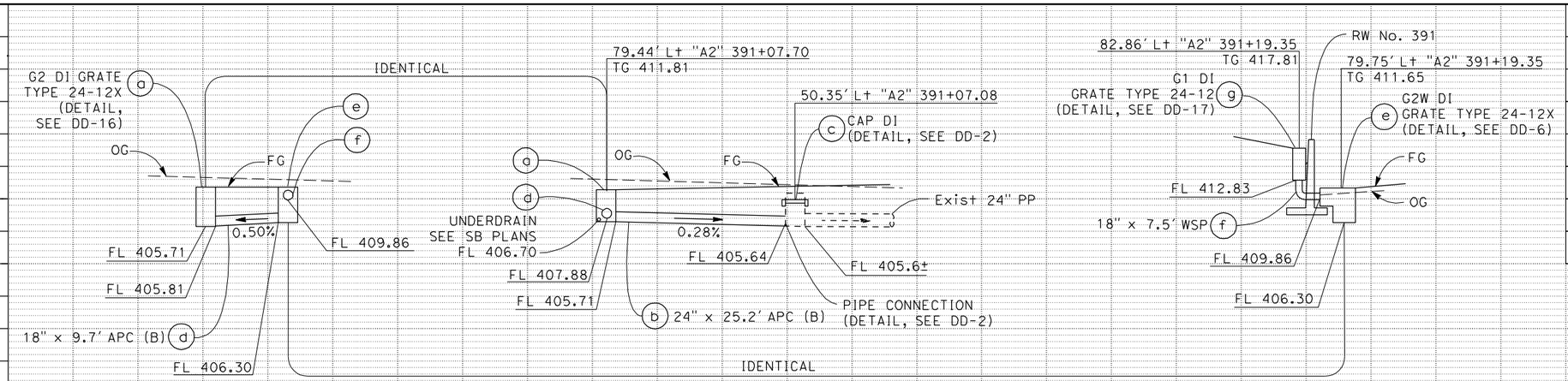
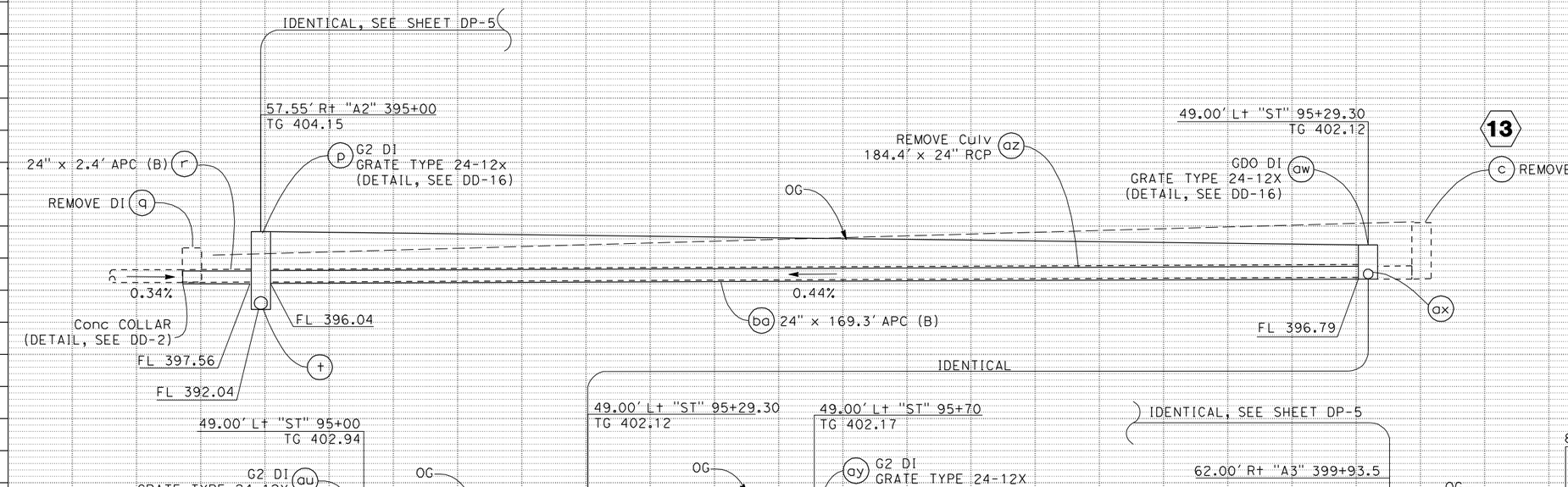
REVISED BY	DATE REVISED
IL	1/11/11

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION



DRAINAGE SYSTEM No. 11



DRAINAGE SYSTEM No. 10

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-4

LAST REVISION	DATE PLOTTED => 1/14/2011
10-19-10	TIME PLOTTED => 3:46:56 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801b004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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REVISED BY: IL — DATE REVISED: 1/11/11

IRENE LIU — ANALETTE OCHOA — CALCULATED-DESIGNED BY — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

REMOVE DI (a)

45.00' Rt "A2" 386+14.60
TG 416.67

(b) G2 DI
GRATE TYPE 24-12X

45.86' Rt "A2" 386+60
TG 416.59

(d) G2 DI
GRATE TYPE 24-12X

OG

FG

(c) 36" x 42.6' APC (A)

0.59%

Exist
36" PP

FL 401.7±

FL 401.45

FL 401.35

(e) 36" x 228.6' APC (A)

0.50%

A

A

IDENTICAL, SEE SHEET DP-6

73.00' Rt "A2" 388+90
TG 414.71

73.00' Rt "A2" 390+04
TG 413.44

(f) G2 DI
GRATE TYPE 24-12X

(h) G2 DI
GRATE TYPE 24-12X

FL 400.20

FL 400.10

(g) 36" x 111.1' APC (A)

FL 399.54

FL 404.05

FL 399.44

(ah)

IDENTICAL, SEE SHEET DP-6

73.00' Rt "A2" 391+21
TC 411.71

(j) G2 DI
GRATE TYPE 24-12X

36" x 113.1' APC (A) (i)

FL 403.48

FL 394.12

36" x 87.8' APC (A) (k)

B

B

73.00' Rt "A2" 392+11.70
TC 410.08

"ST" LINE

GDO DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-16) (l)

UNDERDRAIN
SEE SB PLANS
FL 404.48

66.45' Rt "A2" 392+72.26

70.72' Rt "A3" 393+48.62

57.55' Rt "A3" 395+00
TC 404.15

IDENTICAL, SEE SHEET DP-4

REMOVE DI (q)

G2 DI (p)

C

C

UNDERDRAIN
SEE SB PLANS
FL 399.42

(r)

FL 393.68

FL 393.58

FL 392.56

FL 392.14

FL 392.04

0.79%

36" x 87.8' APC (A) (k)

36" x 59.3' APC (A) (m)

JACKED 36" x 76.6' RCP (n)

36" x 151.1' APC (A) (o)

62.00' Rt "A3" 400+95
TG 394.60

IDENTICAL, SEE SHEET DP-6

59.88' Rt "A3" 399+53.02
TG 395.38

(u) G2 DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-16)

IDENTICAL, SEE SHEET DP-4

62.00' Rt "A3" 399+93.50
TG 394.95

(w) G2 DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-16)

(x) REMOVE MH

62.00' Rt "A3" 400+60
TG 394.64

G2 DI
GRATE TYPE 24-12X (aa)
(DETAIL, SEE DD-3, DD-16)

Exist 36" RCP

62.00' Rt "A3" 401+25
TG 394.63

Mod DI (SEE
Misc DETAIL
OF RW No. 400N)

G2 DI GRATE
TYPE 24-12X (bk)
(DETAIL, SEE
DD-3)

UNDERDRAIN
SEE SB PLANS
FL 390.65

UNDERDRAIN
SEE SB PLANS
FL 390.21

FL 391.63

0.79%

0.48%

0.53%

0.34%±

FL 388.48

FL 388.38

36" x 33.6' APC (A) (v)

FL 388.12

Exist 24" SD

FL 388.22

36" x 63.6' APC (A) (y)

REMOVE Culv (PORTION)
64.1' x 36" RCP (z)

FL 387.78

FL 387.63

FL 387.53

Exist 36" CPP

Exist JUNCTION BOX

12" x 2.1'
CSP RISER
(DETAIL, SEE
DD-16) (bj)

36" x 449.8' APC (A) (t)

REMOVE Culv
488.9' x 36" RCP (s)

Exist 96" RCP STORAGE BAY

DRAINAGE SYSTEM No. 10

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-5

LAST REVISION 10-19-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 3:47:01 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

IL | 1/11/11 — REVISED BY | DATE REVISED
IRENE LIU | ANALETTE OCHOA — CALCULATED-DESIGNED BY | CHECKED BY
HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

IDENTICAL, SEE SHEET DP-5
73.00' Rt "A2" 390+04
TG 413.44
G2 DI (h) GRATE TYPE 24-12X
64.75' Rt "A2" 390+04
TC 413.85
G2 DI (af) GRATE TYPE 24-12X (DETAIL, SEE DD-16)
OG
FG
142.50' Rt "A2" 390+04
TC 413.00
G2 MH (ai) FRAME & COVER TYPE U45 (DETAIL, SEE DD-4)
(ae)
UNDERDRAIN SEE SB PLANS
FL 407.95
0.50%
FL 404.28
24" x 4.0' APC (B) (ag)
FL 404.26
FL 404.05
FL 399.44
(i)
0.50%
FL 399.10
(ah) 18" x 68.0' APC (B)

IDENTICAL, SEE SHEET DP-5
73.00' Rt "A2" 391+21
TC 411.7
142.50' Rt "A2" 391+21
TC 413.00
G2 MH (ar) FRAME & COVER TYPE U45 (DETAIL, SEE DD-4)
OG
FG
G2 DI (j)
(k)
(at) 18" AUTOMATIC DRAINAGE GATE (DETAIL, SEE DD-19)
0.50%
(as) 18" x 68.0' APC (B)
FL 394.12
FL 394.22
FL 394.56

IDENTICAL
142.50' Rt "A2" 390+09.53
TC 409.84
(ai)
(ak) 18" x 3.1' APC (B)
OG
FG
(al) G2 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17)
0.46%
FL 406.13
FL 406.11
(ah)
FL 399.10
FL 399.00
0.46%
Beg CHAMBER
FL 389.48
FL 398.97
(aj) 18" x 6.5' APC (B)

142.50' Rt "A2" 391+15.47
TC 409.84
18" x 3.1' APC (B) (ao)
G2 DI (an) GRATE TYPE 24-12 (DETAIL, SEE DD-17)
FG
0.46%
FL 406.13
FL 400.89
FL 394.89
END CHAMBER
FL 394.72
0.46%
FL 406.11
0.46%
FL 400.56
(as)
0.46%
AUSTIN VAULT SAND FILTER TYPE S-15000-6 (DETAIL, SEE DD-7 TO DD-15, DD-18) (am)
18" x 6.5' APC (B) (ap)
6" x 6.5' PP (aq)
FL 394.56
FL 394.86

IDENTICAL
(ar) G2 MH
64.13' Rt "A3" 399+53.02
TG 395.50
IDENTICAL, SEE SHEET DP-5
59.88' Rt "A3" 399+53.02
TG 395.38
G2 DI (u) GRATE TYPE 24-12X
OG
(bc)
(v)
FL 392.35
FL 388.38
(bd)
FL 392.60
FL 392.50
18" x 2.9' APC (A) w/ Conc Bkf (DETAIL, SEE DD-4) (bb)
5.17%
(bb)
FL 392.50
FL 392.60

RW No. 400N RETURN WALL TYPE 1
IDENTICAL
91.50' Rt "A3" 400+07.92
TG 404.33
G1 DI w/ PCC APRON GRATE TYPE 24-12 (DETAIL, SEE DD-3) (bi)
64.13' Rt "A3" 399+58.99
TG 402.35
(be) G1 DI GRATE TYPE 24-12X (DETAIL, SEE DD-17)
OG
FG
1.93%
FL 399.35
FL 400.33
(bf) 12" x 50.8' WSP (DETAIL, SEE DD-3)
(bd) 12" x 9.9' WSP

IDENTICAL
64.75' Rt "A2" 390+04
TC 413.85
(af) G2 DI
OG
FG
0.50%
FL 404.38
FL 404.28
(ae) 18" x 100.9' APC (B)

64.60' Rt "A2" 391+07.78
TC 412.35
54.81' Rt "A2" 391+07.63
TC 412.60
64.60' Rt "A2" 391+07.78
TC 412.35
(ad) G2 DI GRATE TYPE 24-12X
CAP DI (ab) (DETAIL, SEE DD-2)
FG
OG
(ac)
0.50%±
0.58%
FL 404.88
FL 404.98
Exist 24" PP
FL 405.04
FL 404.98
(ac) 24" x 10.4' APC (B)
PIPE CONNECTION (DETAIL, SEE DD-2)

DRAINAGE SYSTEM No. 10

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-6

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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Anlette Ochoa 1/17/11
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GENERAL NOTES

Designation:
Partial Austin Vault Sand Filters (AVSFs) are open air reinforced concrete vaults utilizing both sedimentation and sand filtration basins. Type designation is based on length configuration, water quality volume to be drained in a 24 hour period, and average depth of water.

Standard configurations are noted for the following design water quality volumes (WQV): 5,000, 10,000, and 15,000 cubic feet. Length configurations are either short (S) or long (L). The average water depth can be either 3 ft, 4.5 ft, or 6 ft as designed in Design Water Quality Volumes (WQV) table.

Special Reinforcement Coverage:
AVSF Standard Details are not to be used in a corrosive environment or where there is a severe abrasive flow condition or in freeze-thaw locations.

Special Design:
Required for the following conditions: ground water conditions above bottom of AVSF, surcharge loads exceeding HS20 truck load, design bearing pressures or sizes greater than those on this plan, inlet velocities which exceed 8.0 ft/sec at gabion wall, and settlement due to liquefaction.

DESIGN WATER QUALITY VOLUMES (WQV)

AVSF Type*	WQV (ft^3)	W(ft)	Ls(ft)	Lf(ft)	Hw(ft)
S-3500-3	3,500	21	14	38	3
L-3500-3	3,500	15	18	53	3
S-3500-4.5	4,380	21	14	38	4.5
L-3500-4.5	4,380	15	18	53	4.5
S-3500-6	5,260	21	14	38	6
L-3500-6	5,260	15	18	53	6
S-5000-3	5,000	27	15	42	3
L-5000-3	5,000	18	21	63	3
S-5000-4.5	6,250	27	15	42	4.5
L-5000-4.5	6,250	18	21	63	4.5
S-5000-6	7,500	27	15	42	6
L-5000-6	7,500	18	21	63	6
S-10000-3	10,000	36	21	63	3
L-10000-3	10,000	24	30	94	3
S-10000-4.5	12,500	36	21	63	4.5
L-10000-4.5	12,500	24	30	94	4.5
S-10000-6	15,000	36	21	63	6
L-10000-6	15,000	24	30	94	6
S-15000-3	15,000	45	25	76	3
L-15000-3	15,000	30	37	115	3
S-15000-4.5	18,750	45	25	76	4.5
L-15000-4.5	18,750	30	37	115	4.5
S-15000-6	22,500	45	25	76	6
L-15000-6	22,500	30	37	115	6

* AVSF Type = Length configuration (S or L) - water quality volume (CF) - design water depth (Hw elevation)

DESIGN NOTES

Specifications:
Design:
Bridge Design Specification April 2000 (LFD)
(1996 AASHTO) with interims and revisions by Caltrans

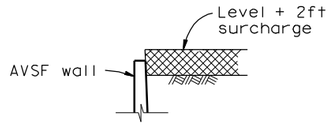
Wall & Footing (LFD): 1.5 D + 1.5 E + 1.5 W + 1.5 SC
Where D = Dead Load
E = Earth Load
W = Water Load
SC = Surcharge

Capacity reduction factor is included.

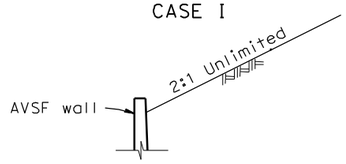
Earth Load:
125 lb/ft^3 vertical,

Water Load:
62.4 lb/ft^3 horizontal/vertical,

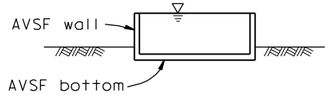
Earth pressure for 2:1 unlimited slope determined from Rankine's formula with ø = 33°42' (Case II).



CASE I



CASE II



CASE III

DETAIL OF DESIGN LOADING CASES

CASE I Level + 2ft surcharge, AVSF empty
CASE II 2:1 Unlimited slope, AVSF empty
CASE III AVSF full of water, no soil pressure

Unit Stresses:
f'_c = 4,000 psi
f_y = 60,000 psi

INDEX TO PLAN

SHEET No.	TITLE
DD-7	GENERAL NOTES
DD-8	LAYOUT No. 1
DD-9	LAYOUT No. 2
DD-10	WALL DETAILS
DD-11	DETAILS No. 1
DD-12	DETAILS No. 2
DD-13	DETAILS No. 3
DD-14	DETAILS No. 4
DD-15	MISCELLANEOUS DETAILS No. 1

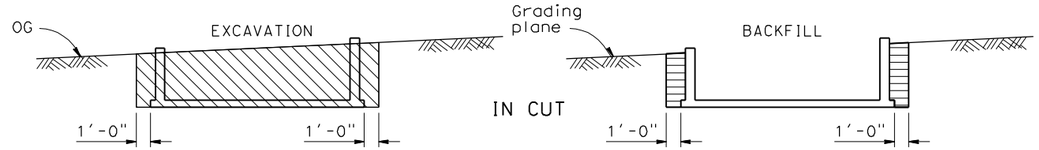
CONSTRUCTION NOTES

Expansion joints:
Inverts and sidewalls - Place ½" expansion joint filler and waterstop where indicated. see "Details No. 2" sheet for specific wall & invert details.

Construction Joints:
Shall be placed where indicated on plans.

Backfill:
See Standard Specifications, except the difference in backfill shall not exceed 8'-0" between side walls and inlet and outlet walls.

Earthwork:
Limits of payment for excavation and backfill.



LEGEND:
Structure excavation (AVSF)
Structure backfill (AVSF)
Original ground, OG

NOTES:
1. Slope or shore excavation sides as necessary.
2. Dimensions shown are minimum.
3. 95% compaction 1'-0" below floor slabs.

STANDARD PLANS DATED JULY 2006

B0-3	BRIDGE DETAILS
B3-9	RETAINING WALL DETAILS No. 2
B6-21	JOINT SEALS (MAXIMUM MOVEMENT RATING = 2")
B11-47	CABLE RAILING
D100A	GABION BASKET DETAILS No. 1
D100B	GABION BASKET DETAILS No. 2

STANDARD PLAN SHEET No.
DETAIL No.

AUSTIN VAULT SAND FILTER GENERAL NOTES

10 am

DRAINAGE DETAILS

NO SCALE

DD-7

REVISED BY	DATE REVISED
IL	1/11/11

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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Analette Ochoa 1/17/11
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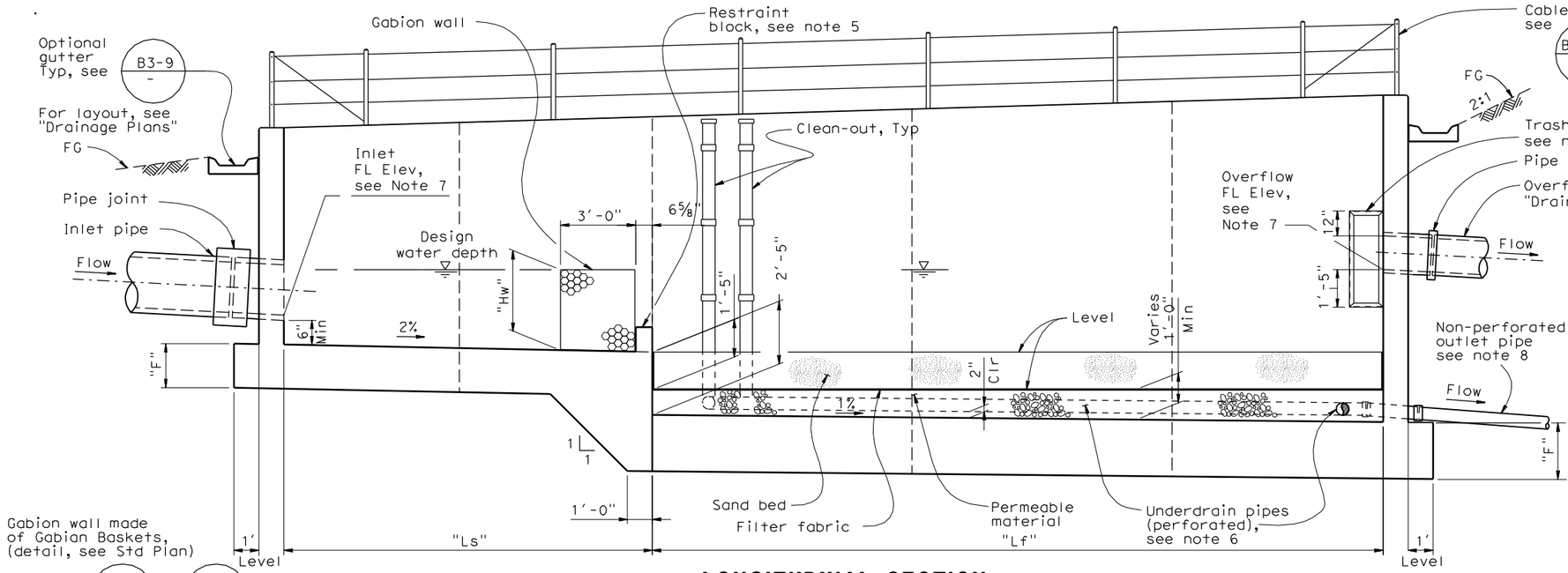
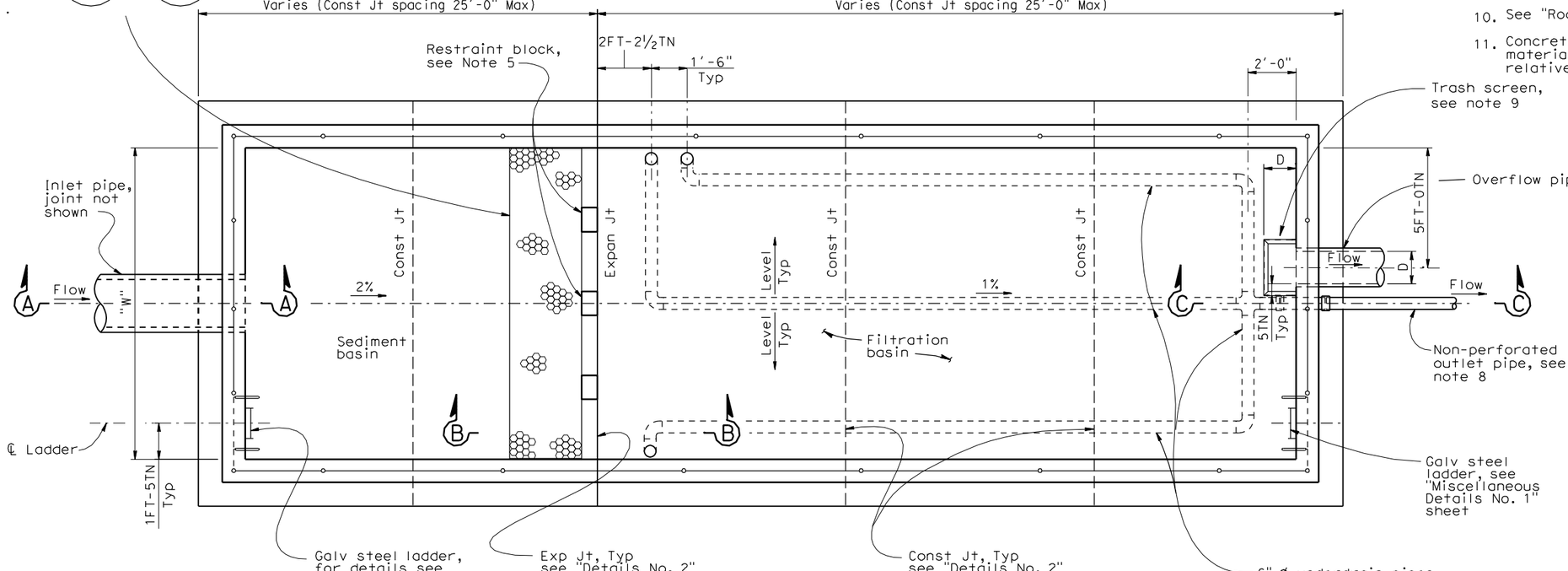


LONGITUDINAL SECTION

No Scale



PLAN

No Scale

Note: Gutter not shown for clarity.

NOTES:

1. For dimensions "W", "Ls", "Lf" and "Hw", see Design WQV table on "General Notes" sheet.
2. For dimensions "C" and "F", see "Wall Details" sheet.
3. For Typical Section, see "Wall Details" sheet.
4. For Section A - A, B - B and C - C, see "Details No. 1" sheet.
5. For restraint block details, see "Details No. 1" and "Details No. 2" sheets.
6. For details of underdrain (sand filter), see "Details No. 4" sheet.
7. For Layout and FL elevation, see "Drainage Plans".
8. For slope of non-perforated outlet pipe, see "Drainage Plans".
9. For trash screen details (frame and perforated metal skin), see "Details No 3" sheet.
10. See "Road Plans" for top of wall elevations.
11. Concrete shall be placed on base or native material which has been compacted to 95% relative compaction.

AUSTIN VAULT SAND FILTER LAYOUT No. 1

DRAINAGE DETAILS

NO SCALE

DD-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL — DATE REVISED: 1/11/11

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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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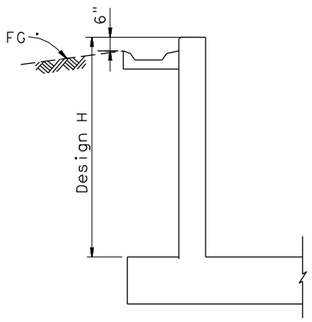
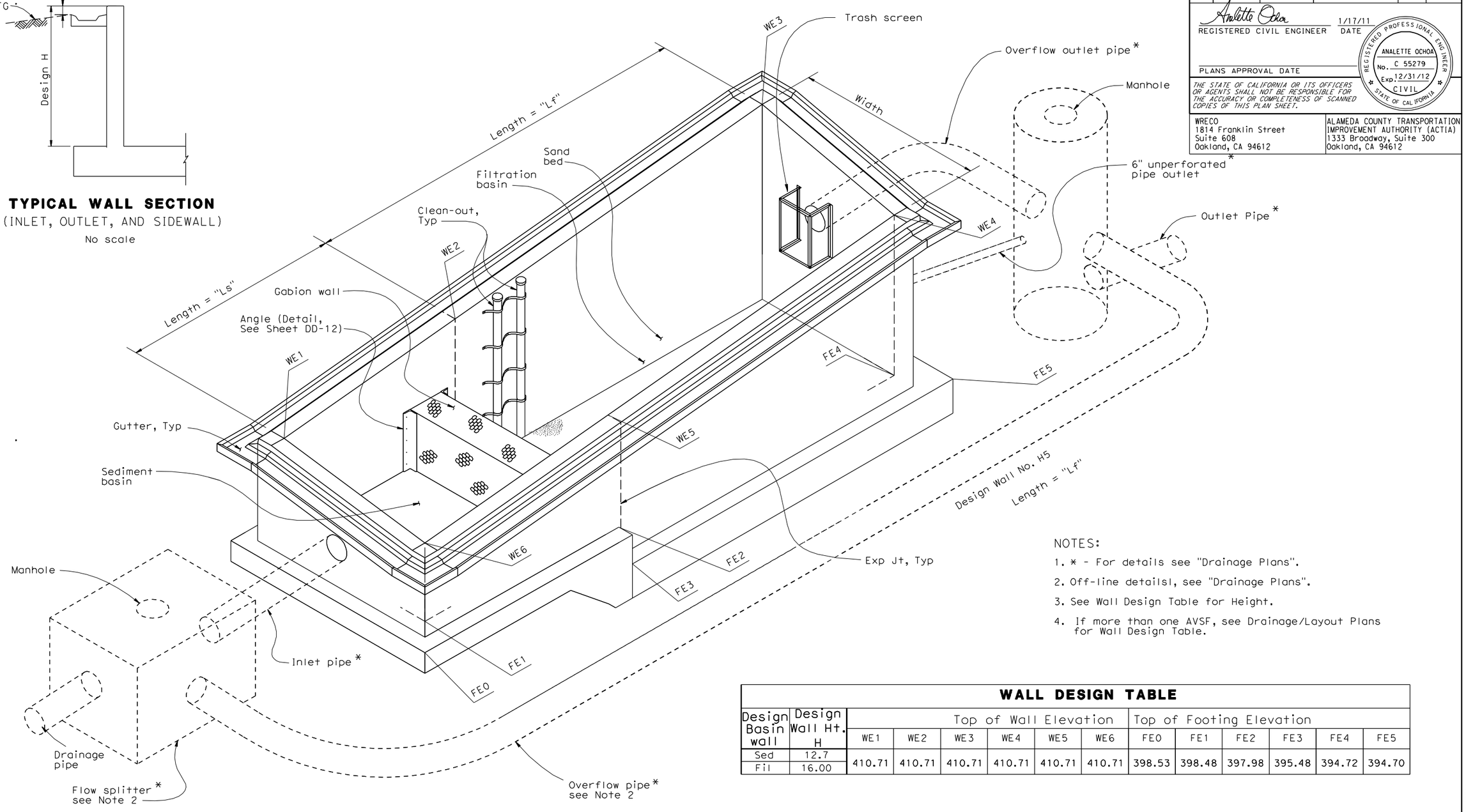


TYPICAL WALL SECTION
(INLET, OUTLET, AND SIDEWALL)
No scale



ISOMETRIC VIEW - AUSTIN VAULT SAND FILTER DRAINAGE SYSTEM
No Scale
NOTE: Steel ladders and cable railings not shown for clarity.

NOTES:
1. * - For details see "Drainage Plans".
2. Off-line detailsl, see "Drainage Plans".
3. See Wall Design Table for Height.
4. If more than one AVSF, see Drainage/Layout Plans for Wall Design Table.

WALL DESIGN TABLE

Design Basin wall	Design Wall Ht. H	Top of Wall Elevation						Top of Footing Elevation					
		WE1	WE2	WE3	WE4	WE5	WE6	FE0	FE1	FE2	FE3	FE4	FE5
Sed	12.7	410.71	410.71	410.71	410.71	410.71	410.71	398.53	398.48	397.98	395.48	394.72	394.70
Fil	16.00												

AUSTIN VAULT SAND FILTER
LAYOUT No. 2

DRAINAGE DETAILS
NO SCALE

DD-9

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CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
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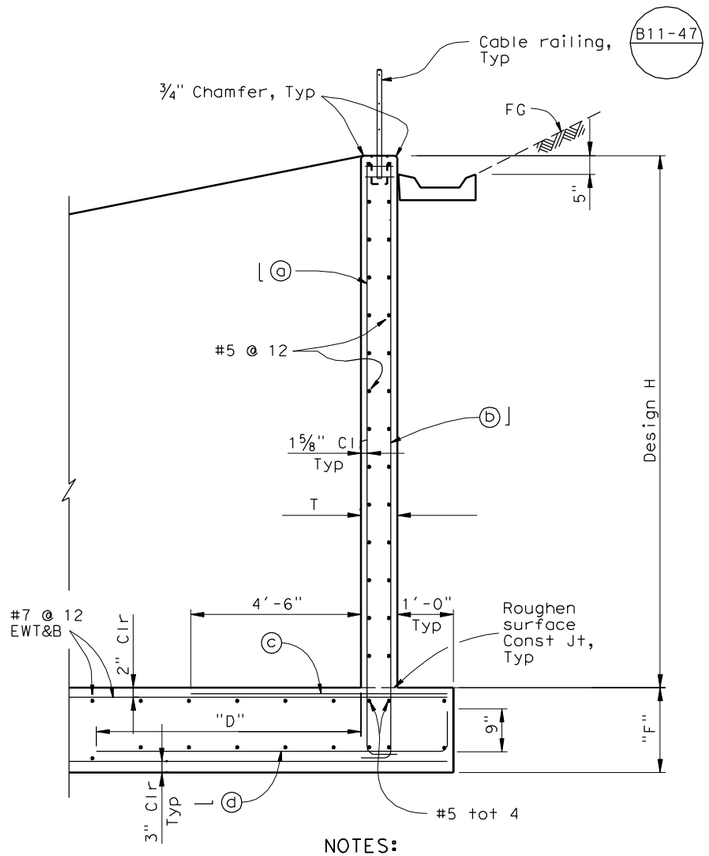

NOTES:

"D" = 8'-0" when "W" ≤ 30'-0"

"D" = 12'-0" when "W" > 30'-0"

TYPICAL SECTION
No Scale

NOTES:

1. For width dimension "W", see "General Notes" sheet.
2. For footing details not shown, see "Footing Details" sheet.
3. The contractor shall have the option of matching the Sedimentation Basin wall thickness with the Filtration Basin wall thickness. This shall be at no
4. additional cost to the State.

   Reinforcement notation "EWT&B" is acronym for "Each Way Top & Bottom".
5. Width "W" is the inside width between walls, see "Layout No. 1" sheet and the Design WQV table on "General Notes" sheet.
6. For additional corner reinforcement not indicated see "Typical Corner Detail" on "Details No. 1" sheet.

TABLE OF REINFORCING STEEL DIMENSIONS AND DATA FOR WALL

Design H	6'	8'	10'	12'	14'	16'
T	12"	12"	12"	12"	14"	14"
F	1'-3"	1'-3"	1'-3"	1'-6"	1'-9"	1'-9"
⌋ ⓐ bars # @ "	6 @ 12	6 @ 12	6 @ 8	7 @ 8	8 @ 8	9 @ 6
⌊ ⓑ bars # @ "	6 @ 12	6 @ 12	6 @ 8	7 @ 8	8 @ 8	8 @ 6
ⓒ bars # @ "	6 @ 12	6 @ 12	6 @ 8	6 @ 8	7 @ 8	7 @ 6
— ⓓ bars # @ "	6 @ 12	6 @ 12	6 @ 8	6 @ 8	7 @ 8	7 @ 6

AUSTIN VAULT SAND FILTER
WALL DETAILS

DRAINAGE DETAILS
NO SCALE

DD-10

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ANALETTE OCHOA			
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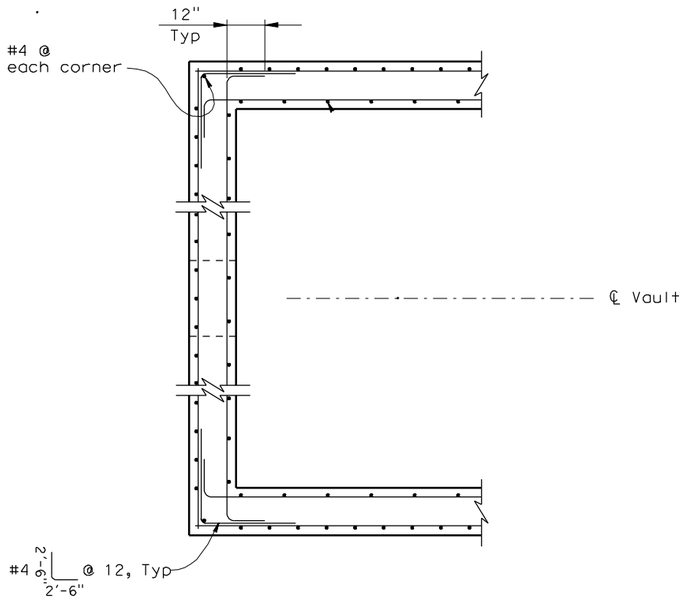
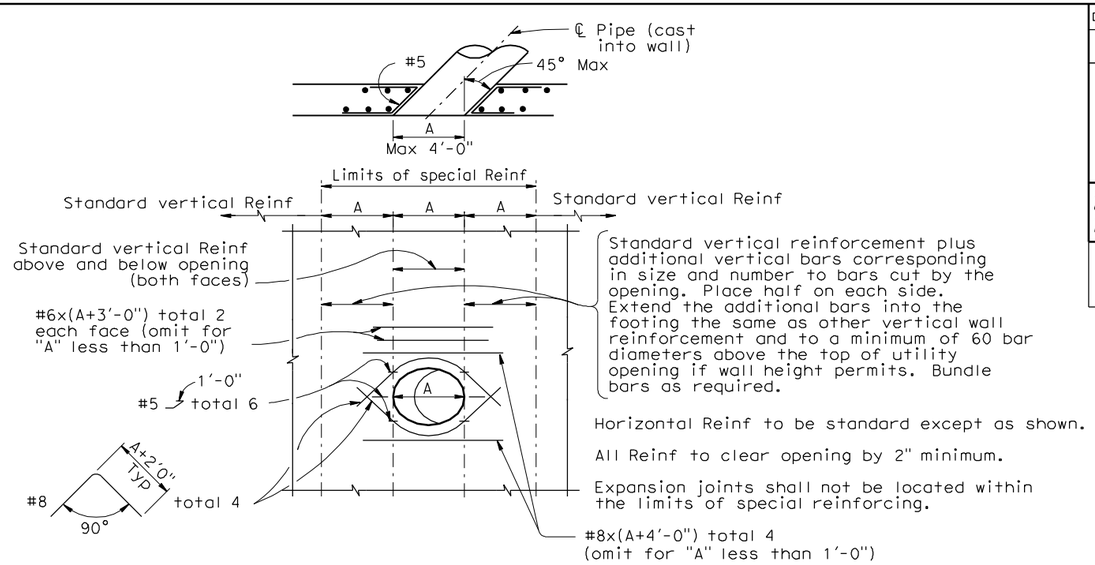


TYPICAL CORNER DETAIL

No Scale

NOTE: Inlet wall shown, outlet wall similar.



WALL OPENING DETAIL

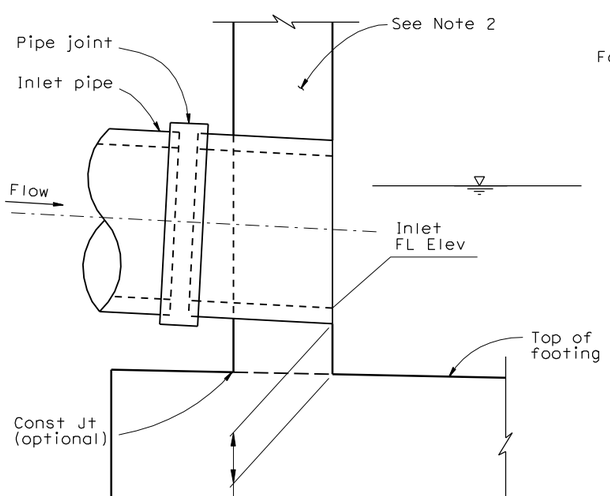
No Scale

To be used at inlet, outlet and overflow pipe locations

NOTE: The rebar lengths shown are maximum and shall be adjusted due to the limitations of space.

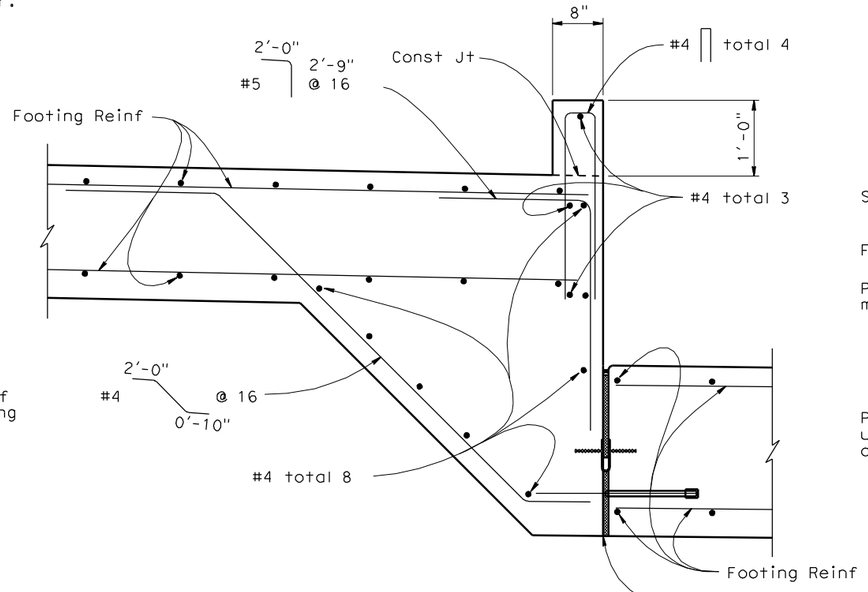
NOTES:

1. For section locations, see "Layout No. 1 " sheet.
2. For wall and footing reinforcement details, see Typical Section on "Wall Details" sheet.



SECTION A - A

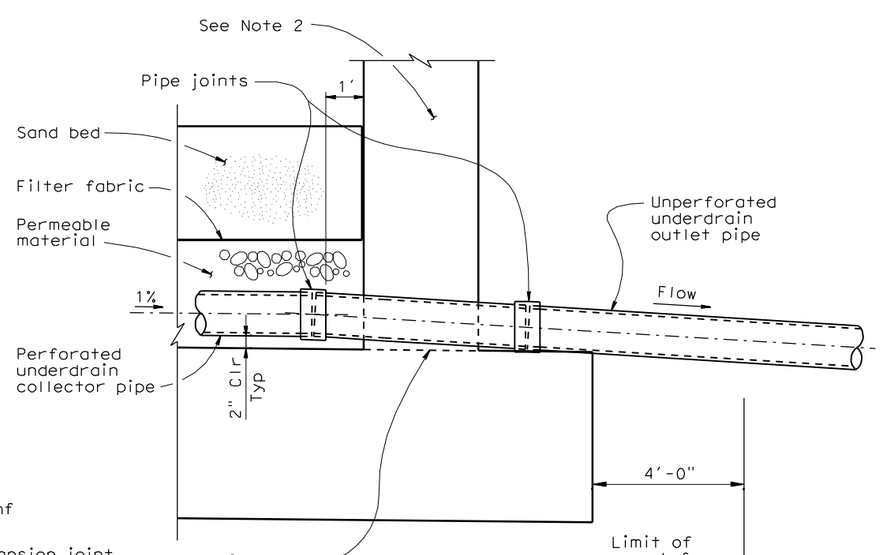
No Scale



SECTION B - B

No Scale

(Gabion wall and other details not shown for clarity)



SECTION C - C

No Scale

AUSTIN VAULT SAND FILTER DETAILS No. 1

DRAINAGE DETAILS

NO SCALE

DD-11

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
DATE REVISED: 1/11/11

LAST REVISION DATE PLOTTED => 1/15/2011
TIME PLOTTED => 2:03:23 PM
10-19-10

BORDER LAST REVISED 7/2/2010
USERNAME => jessica_pollitz
DGN FILE => ...\04000205801ic011.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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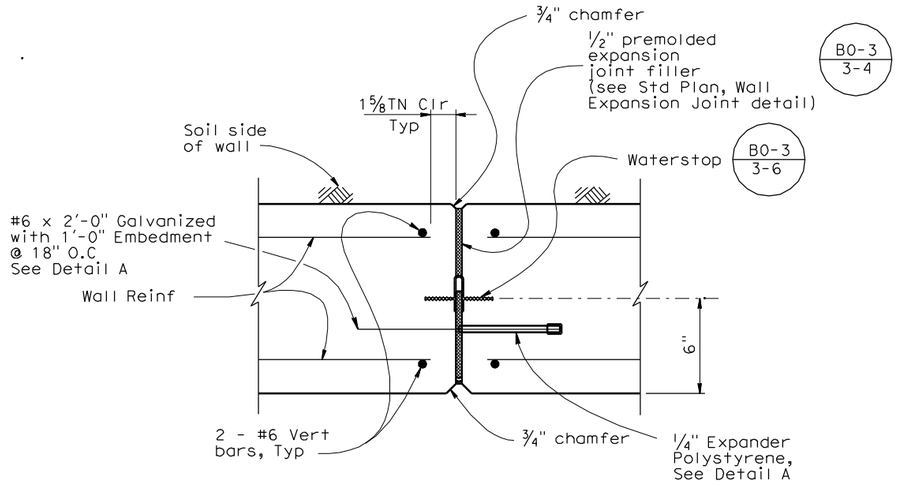
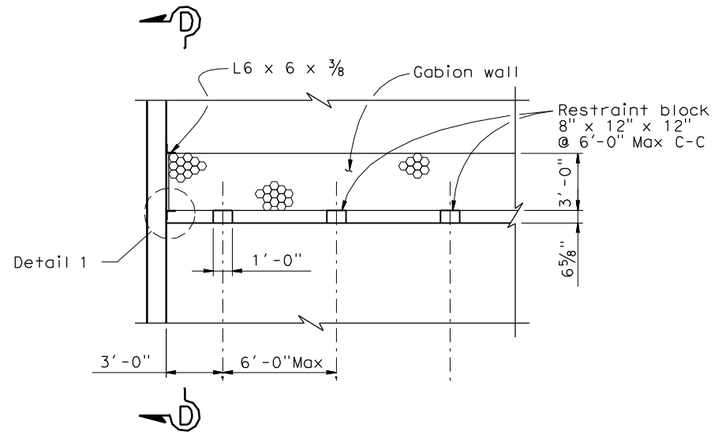


WALL EXPANSION JOINT DETAIL - PLAN SECTION

No Scale

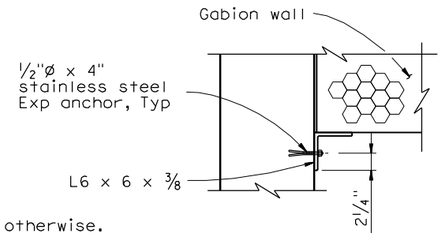


RESTRAINT BLOCK DETAIL

No Scale

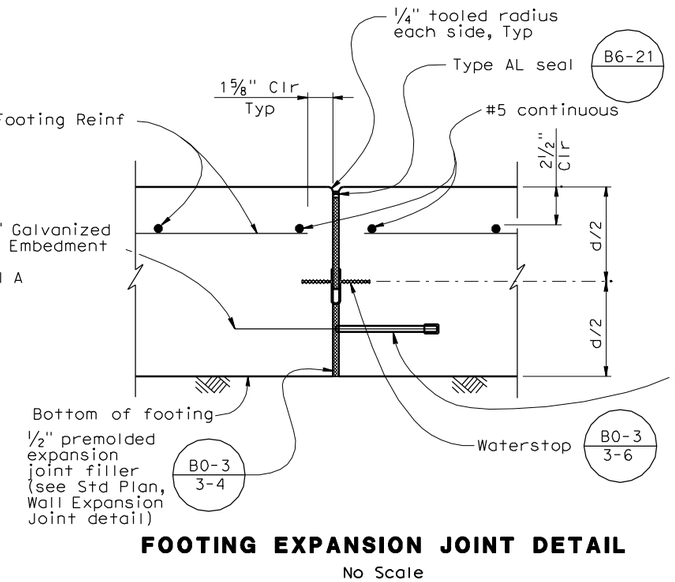
Notes:

1. Stagger splices unless noted otherwise.



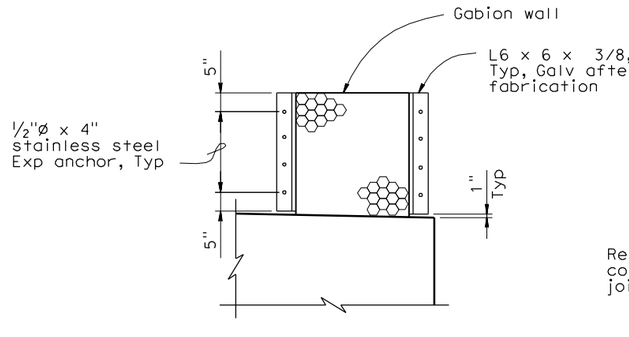
DETAIL 1

No Scale



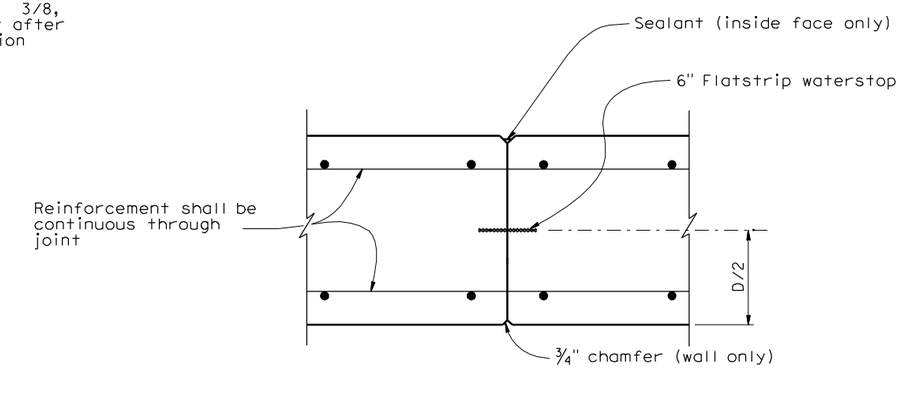
FOOTING EXPANSION JOINT DETAIL

No Scale



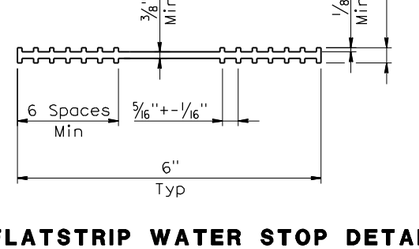
SECTION D - D

No Scale



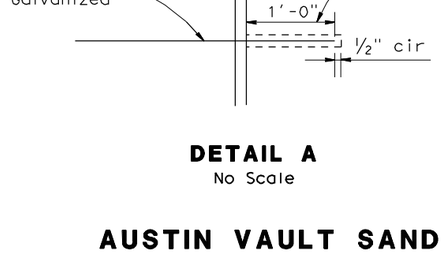
WALL CONSTRUCTION JOINT DETAIL

No Scale



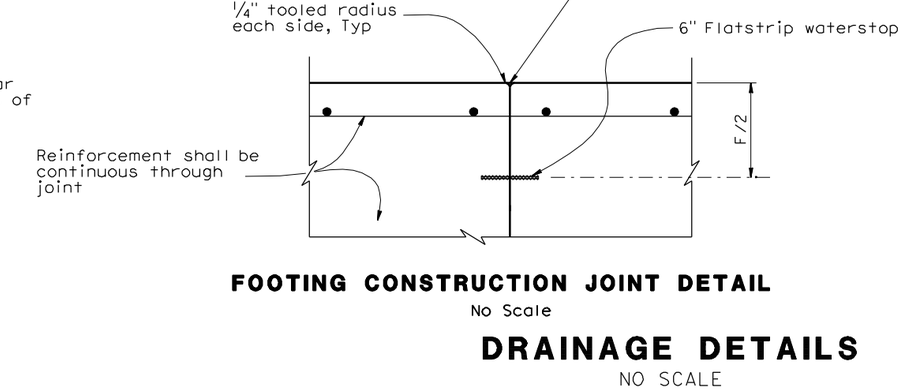
6" FLATSTRIP WATER STOP DETAIL

No Scale



DETAIL A

No Scale



FOOTING CONSTRUCTION JOINT DETAIL

No Scale

AUSTIN VAULT SAND FILTER DETAILS No. 2

DRAINAGE DETAILS

NO SCALE

DD-12

REVISED BY	IL				
DATE REVISED	1/11/11				
IRENE LIU	ANALETTE OCHOA				
CALCULATED-DESIGNED BY	CHECKED BY				

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

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BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\0400020580ic012.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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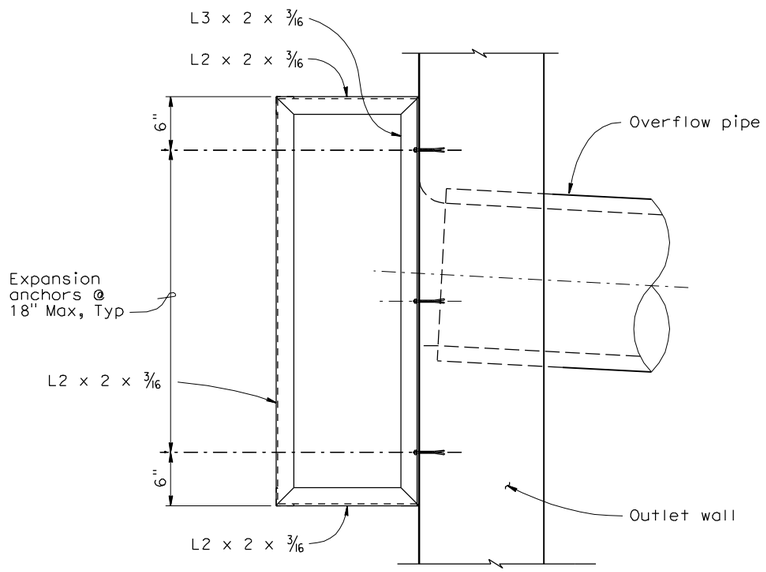
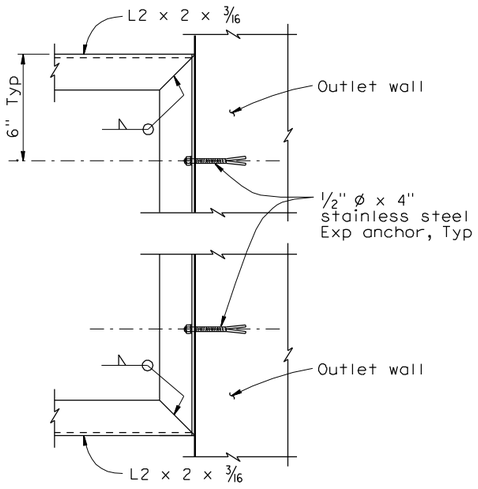
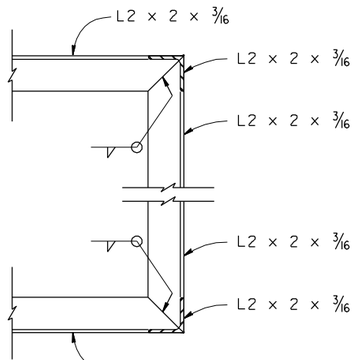


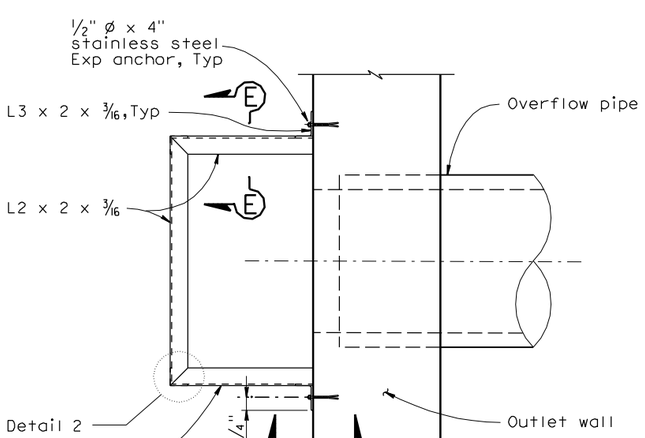
TRASH SCREEN - SIDE ELEVATION
No scale



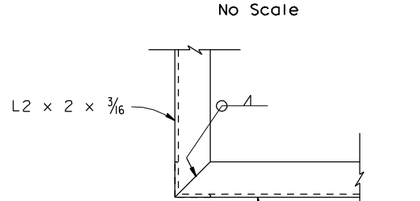
SECTION F - F
No Scale



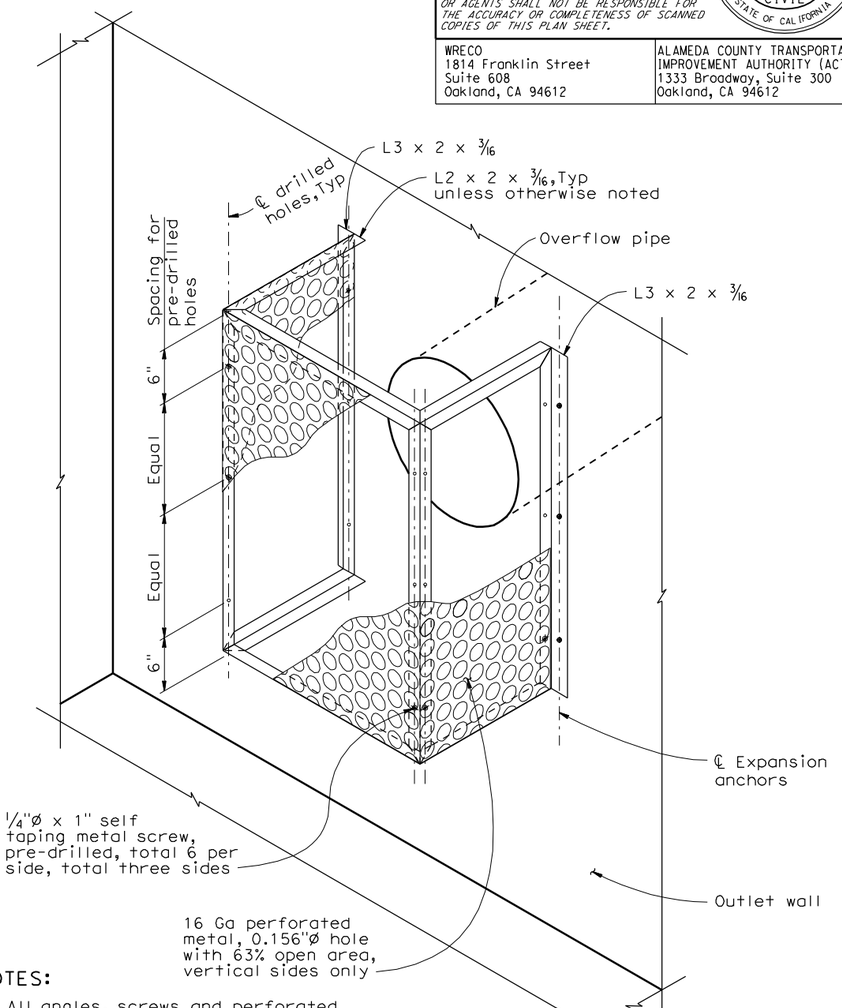
SECTION E - E
No Scale



TRASH SCREEN - PLAN
No Scale



DETAIL 2
No Scale



NOTES:
1. All angles, screws and perforated metal shall be galvanized.
2. Paint all weld joints with zinc rich paint or galvanize after welding.

ISOMETRIC VIEW - TRASH SCREEN
No scale
NOTE: Metal hole ø exaggerated for emphasis.

AUSTIN VAULT SAND FILTER DETAILS No. 3

DRAINAGE DETAILS
NO SCALE

DD-13

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	IL	
CHECKED BY	ANALETTE OCHOA	DATE REVISED	1/11/11	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG			
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans			

LAST REVISION DATE PLOTTED => 1/15/2011
10-19-10 TIME PLOTTED => 2:03:35 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801ic013.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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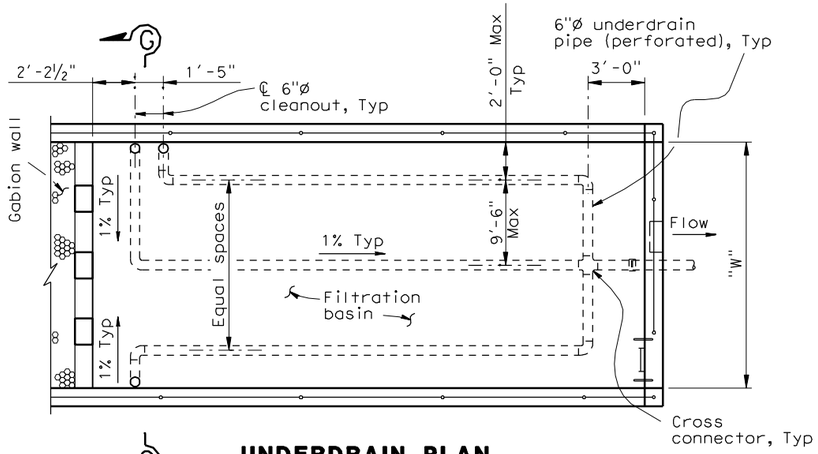
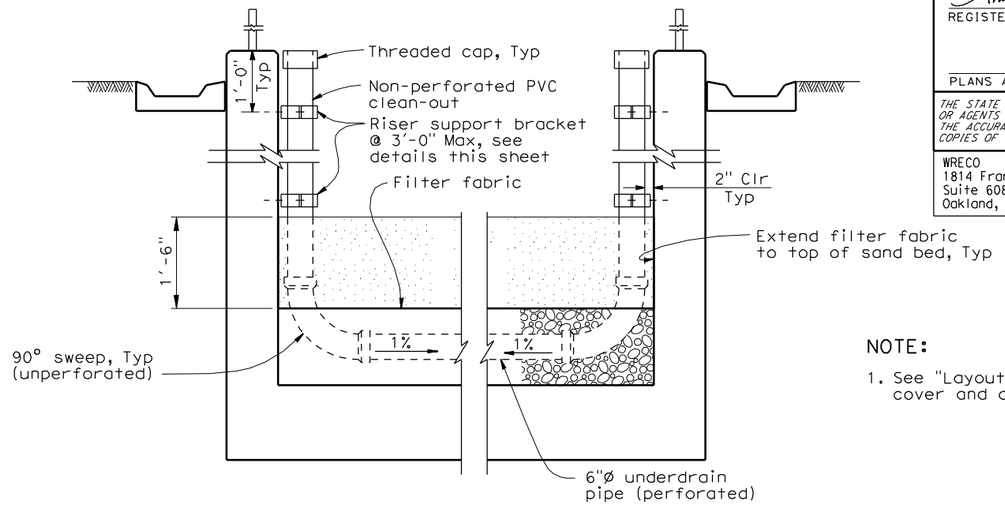


UNDERDRAIN PLAN (FILTRATION BASIN)

"W" = 15' - 21'
No Scale

AVSF Type = (S or L 3500)

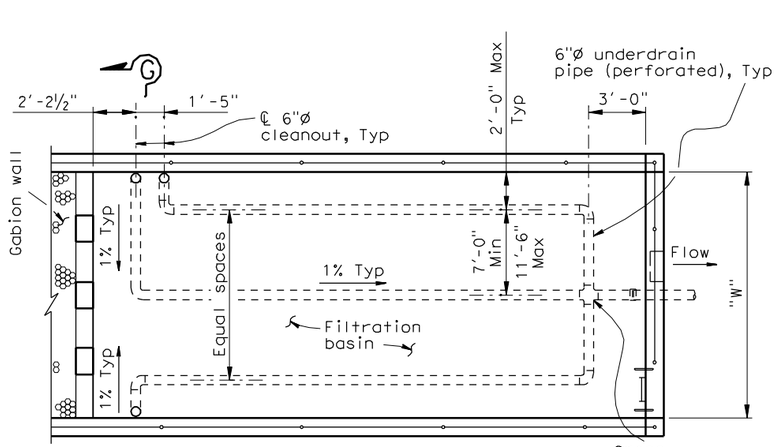


SECTION G - G

No Scale

NOTE:

1. See "Layout No. 1" sheet for Typical cover and depth of sand bed.

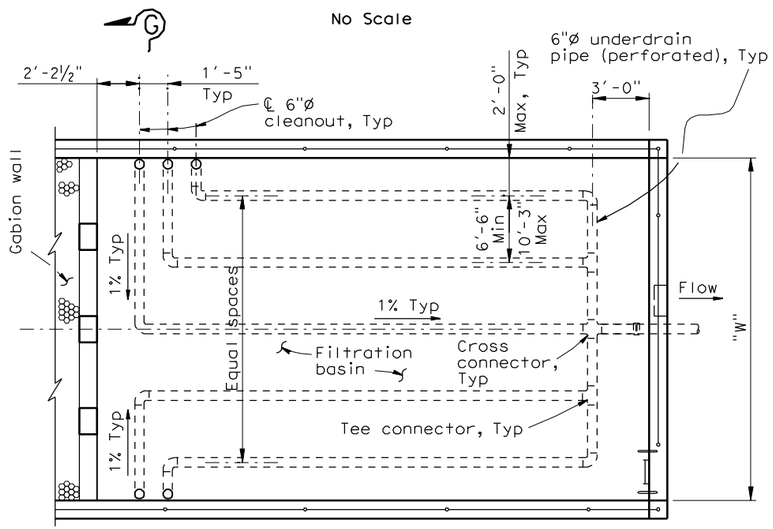


UNDERDRAIN PLAN (FILTRATION BASIN)

"W" = 18' - 24' - 27'
No Scale

AVSF Type = (S or L 5000) L 10000)

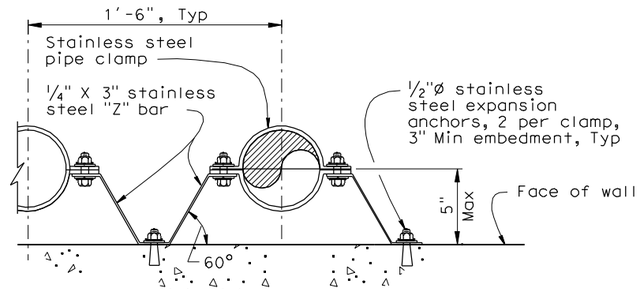
No Scale



UNDERDRAIN PLAN (FILTRATION BASIN)

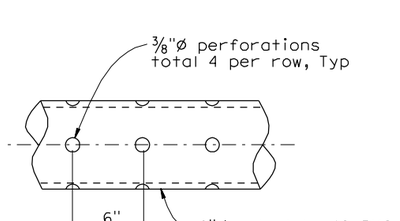
"W" = 30' - 36' - 45'
No Scale

AVSF Type = (S 10000, S or L 15000)



RISER SUPPORT BRACKET DETAIL

No Scale



PERFORATED UNDERDRAIN PIPE

No Scale

AUSTIN VAULT SAND FILTER
DETAILS No. 4

DRAINAGE DETAILS

NO SCALE

DD-14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
DATE REVISED: 1/11/11

LAST REVISION 10-19-10 | DATE PLOTTED => 1/15/2011 | TIME PLOTTED => 2103:39 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801ic014.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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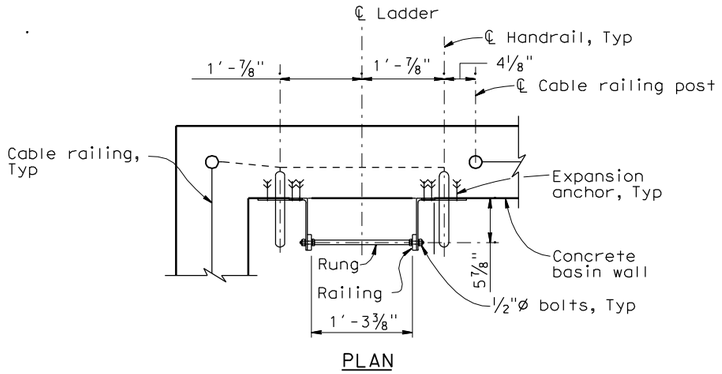
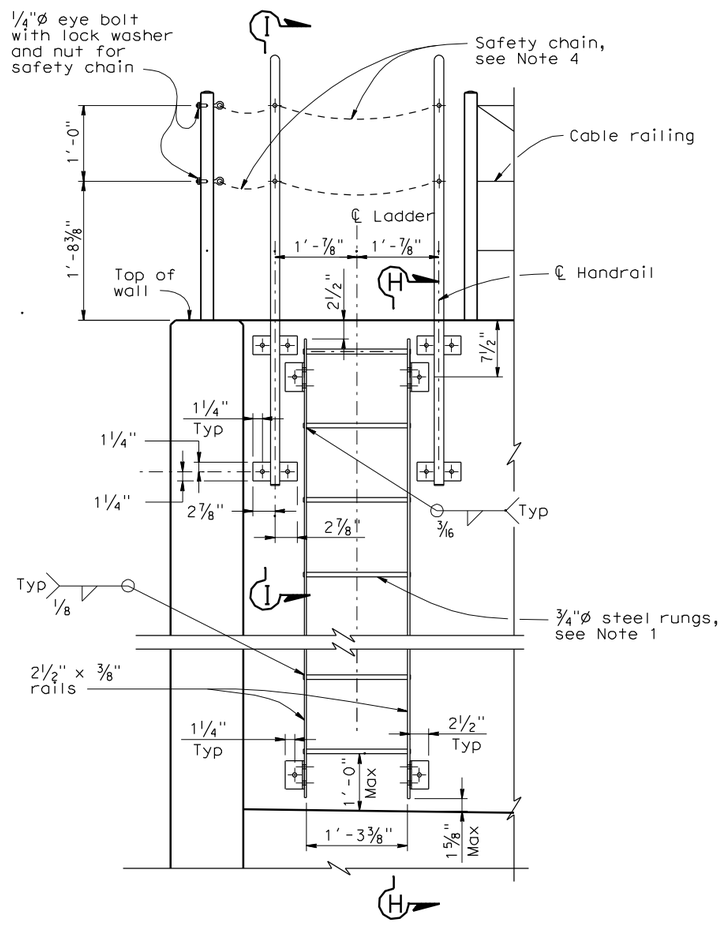


PLAN

NOTES:

1. The distance between rungs shall not exceed 1'-0" and shall be uniform throughout the length of wall.
2. Hardware shall be galvanized after fabrication.
3. Grind exposed corners to 3/16" radius.
4. Safety chain shall be 1/4" galvanized steel coil chain, approximately 12 links per foot. Length shall be minimum which allows lock-up of safety railing. Minimum of two safety chains per safety railing. Material shall be grade 43 high test chain ASTM A413.

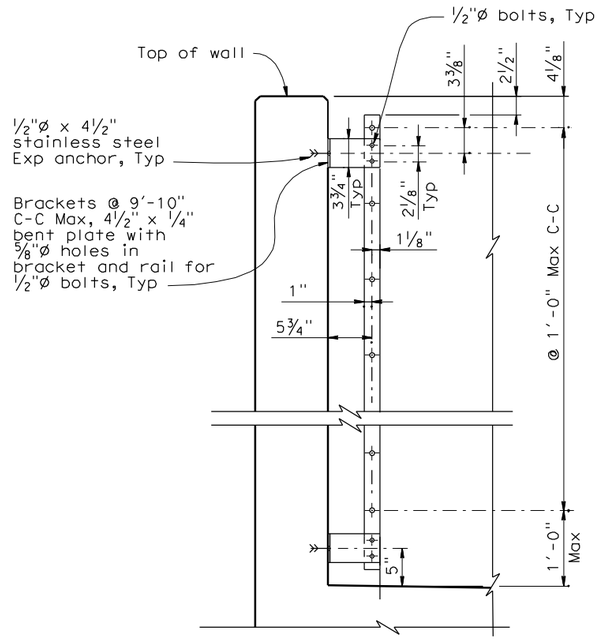


ELEVATION

LADDER

No Scale

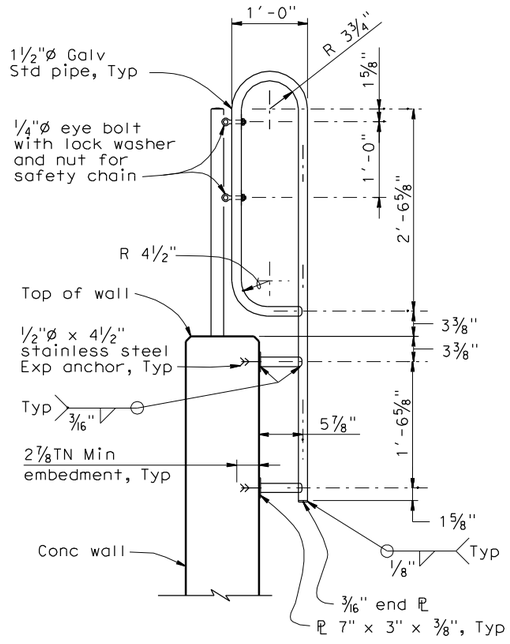
NOTE: Cable railing not shown for clarity.



SECTION H - H

No Scale

NOTE: Handrail and cable railing not shown for clarity.



SECTION I - I

No Scale

AUSTIN VAULT SAND FILTER
MISCELLANEOUS DETAILS No. 1

DRAINAGE DETAILS

NO SCALE

DD-15

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

REVISED BY	DATE REVISED
IL	1/11/11

LAST REVISION 10-19-10 | DATE PLOTTED => 1/15/2011 | TIME PLOTTED => 2:03:46 PM

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Drainage Plans – Segment B

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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Oakland, CA 94612

FOR ACCURATE RIGHT OF WAY AND ACCESS DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

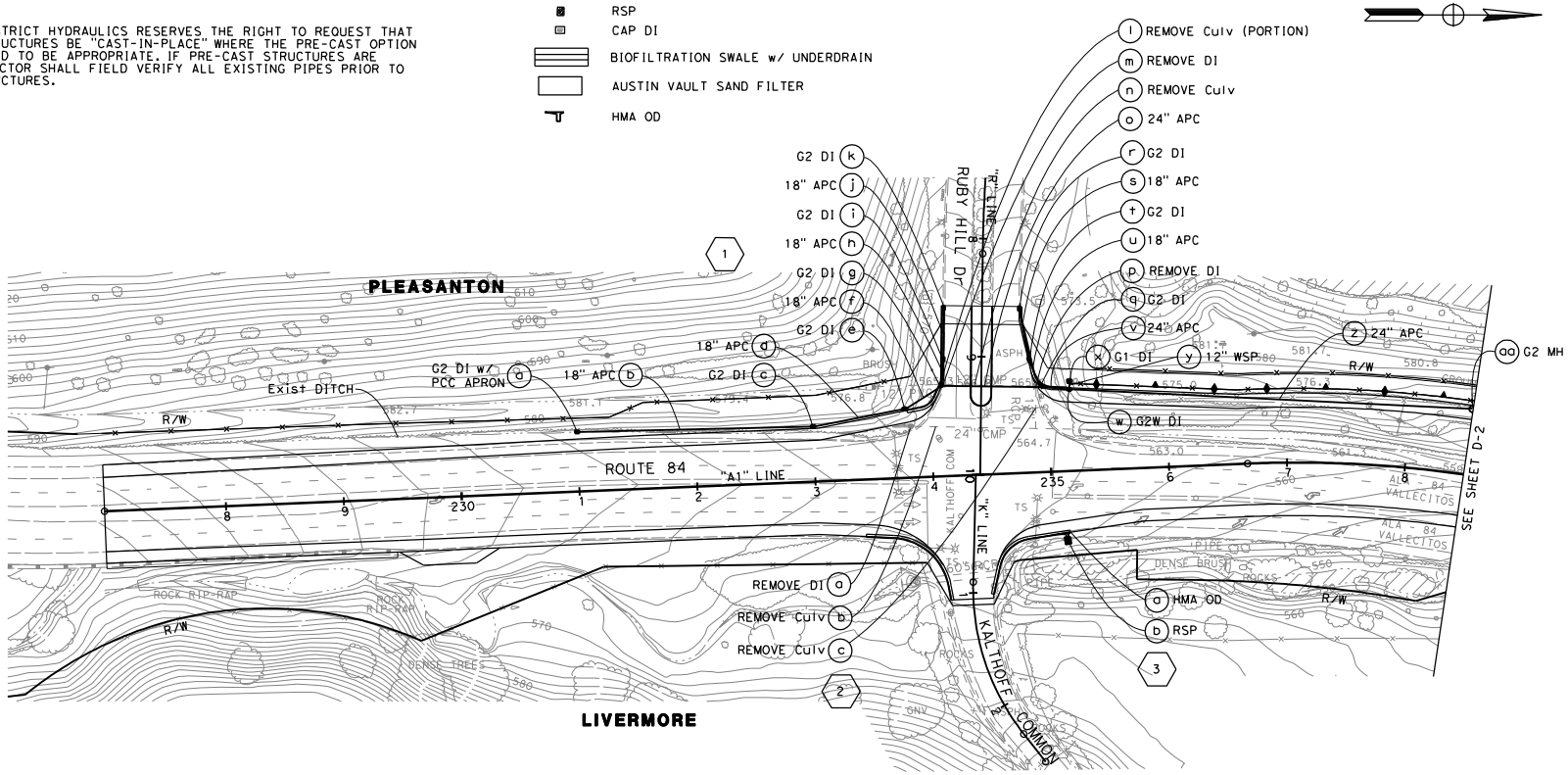
1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
3. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.
4. CONTRACTOR IS RESPONSIBLE TO PROVIDE POSITIVE DRAINAGE FROM ALL ROADWAY AREA AT ALL TIMES.
5. LOCATIONS OF EXISTING DRAINAGE FACILITIES ARE APPROXIMATE. VERIFY LOCATION AND ELEVATION OF EXISTING DRAINAGE FACILITIES PRIOR TO MODIFYING.
6. CALTRANS DISTRICT HYDRAULICS RESERVES THE RIGHT TO REQUEST THAT DRAINAGE STRUCTURES BE "CAST-IN-PLACE" WHERE THE PRE-CAST OPTION IS NOT DEEMED TO BE APPROPRIATE. IF PRE-CAST STRUCTURES ARE USED, CONTRACTOR SHALL FIELD VERIFY ALL EXISTING PIPES PRIOR TO CASTING STRUCTURES.

LEGEND:

- Exist STORM DRAIN
- PROPOSED STORM DRAIN
- GUTTER/DITCH FLOW LINE
- (No.) DRAINAGE SYSTEM No.
- (h) DRAINAGE UNIT
- GRADE TO DRAIN
- INLET
- OMP/GMP DI
- Exist DI
- FES
- RSP
- CAP DI
- BIOFILTRATION SWALE w/ UNDERDRAIN
- AUSTIN VAULT SAND FILTER
- HMA OD

ABBREVIATIONS:

COL	CITY OF LIVERMORE
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA
ASP	ALTERNATIVE SLOTTED PIPE
TC	TOP OF COVER
OD	OVERSIDE DRAIN



DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-1

CALCULATED-DESIGNED BY	CHECKED BY
IRENE LIU	ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

REVISED BY	DATE REVISED
EC	10/19/10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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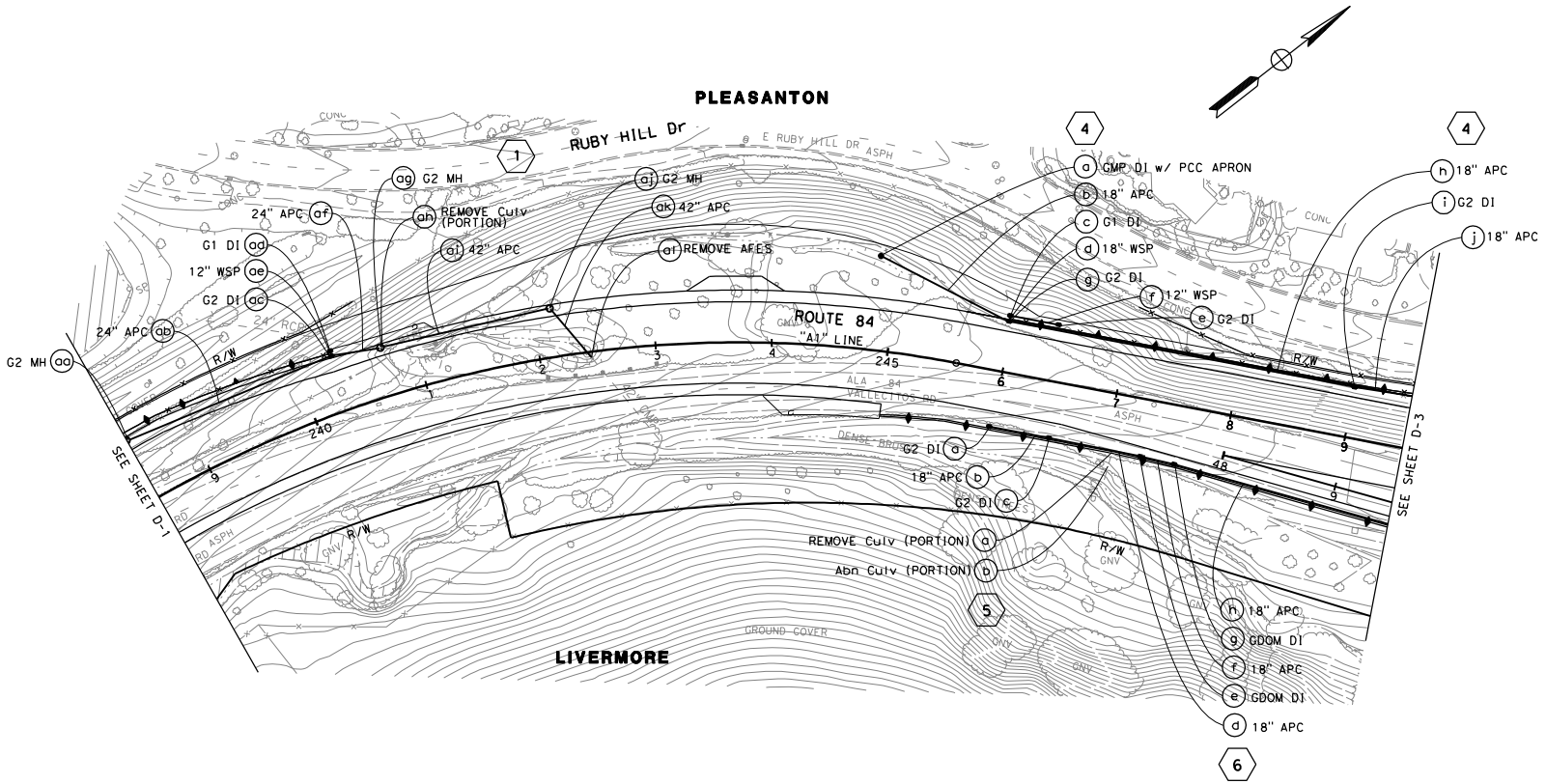

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG | CALCULATED-DESIGNED BY: IRENE LIU | CHECKED BY: ANALETTE OCHOA | REVISED BY: EC | DATE REVISED: 10/19/10

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia002.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:44:43 PM

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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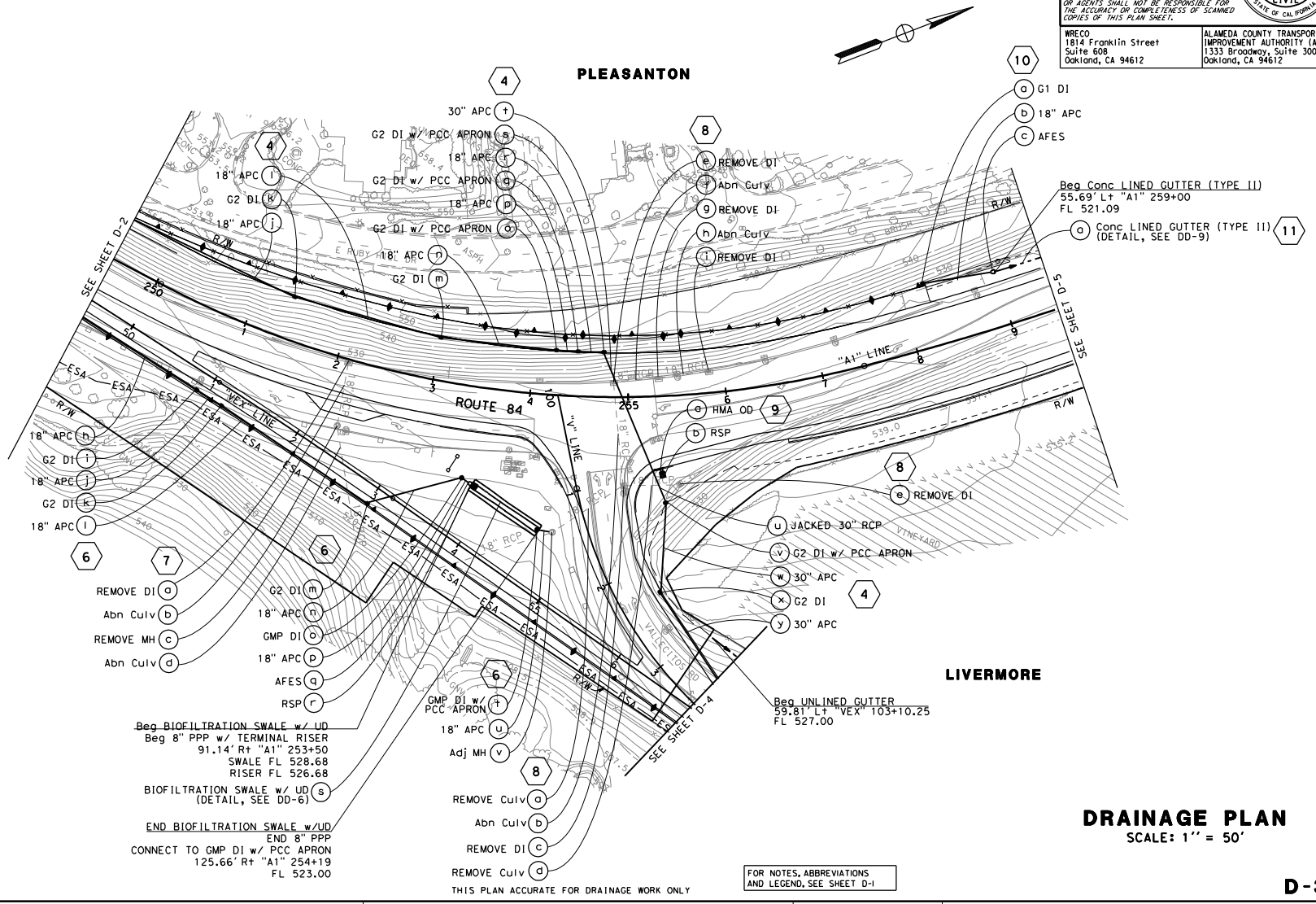

DRAINAGE PLAN

SCALE: 1'' = 50'

D-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
10-19-10 TIME PLOTTED => 1:24:07 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu
DGN FILE => ...\dwg\Seg B\pl\429760ia003.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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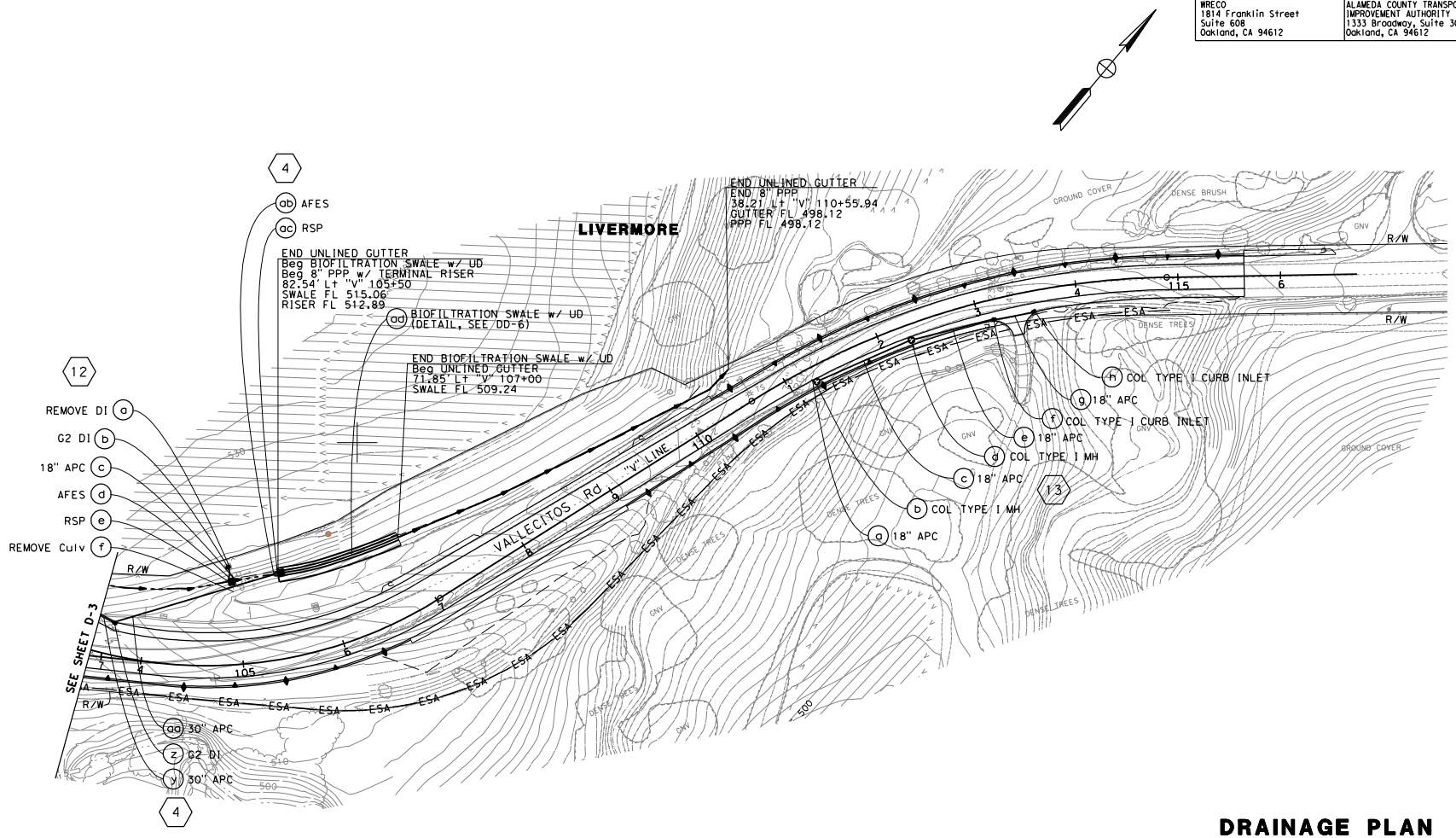

DRAINAGE PLAN
SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-4

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
IRENE LIU	ANALETTE OCHOA	EC	10/19/10

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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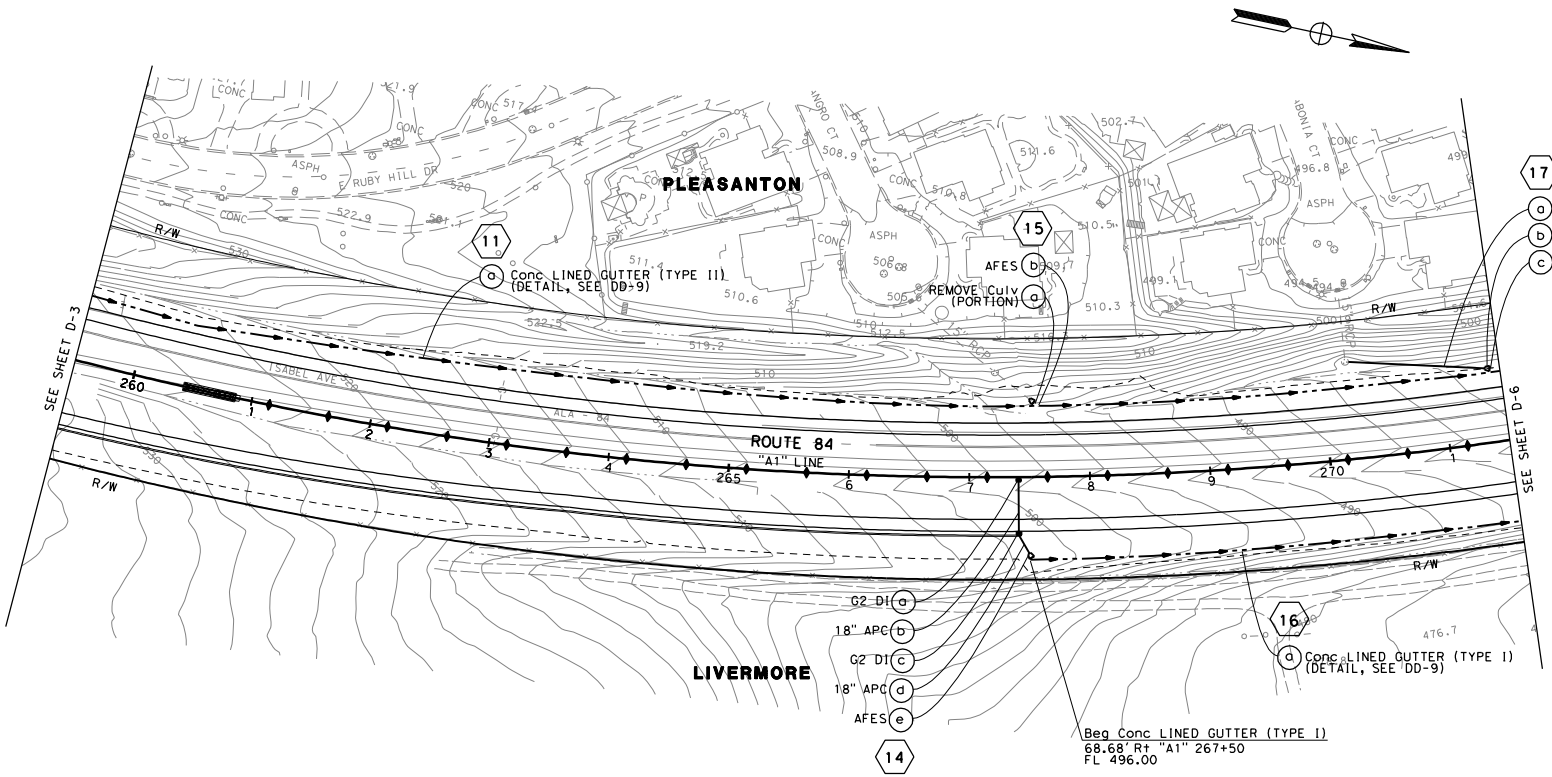

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: EC
DATE REVISED: 10/19/10

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 11:44:13 PM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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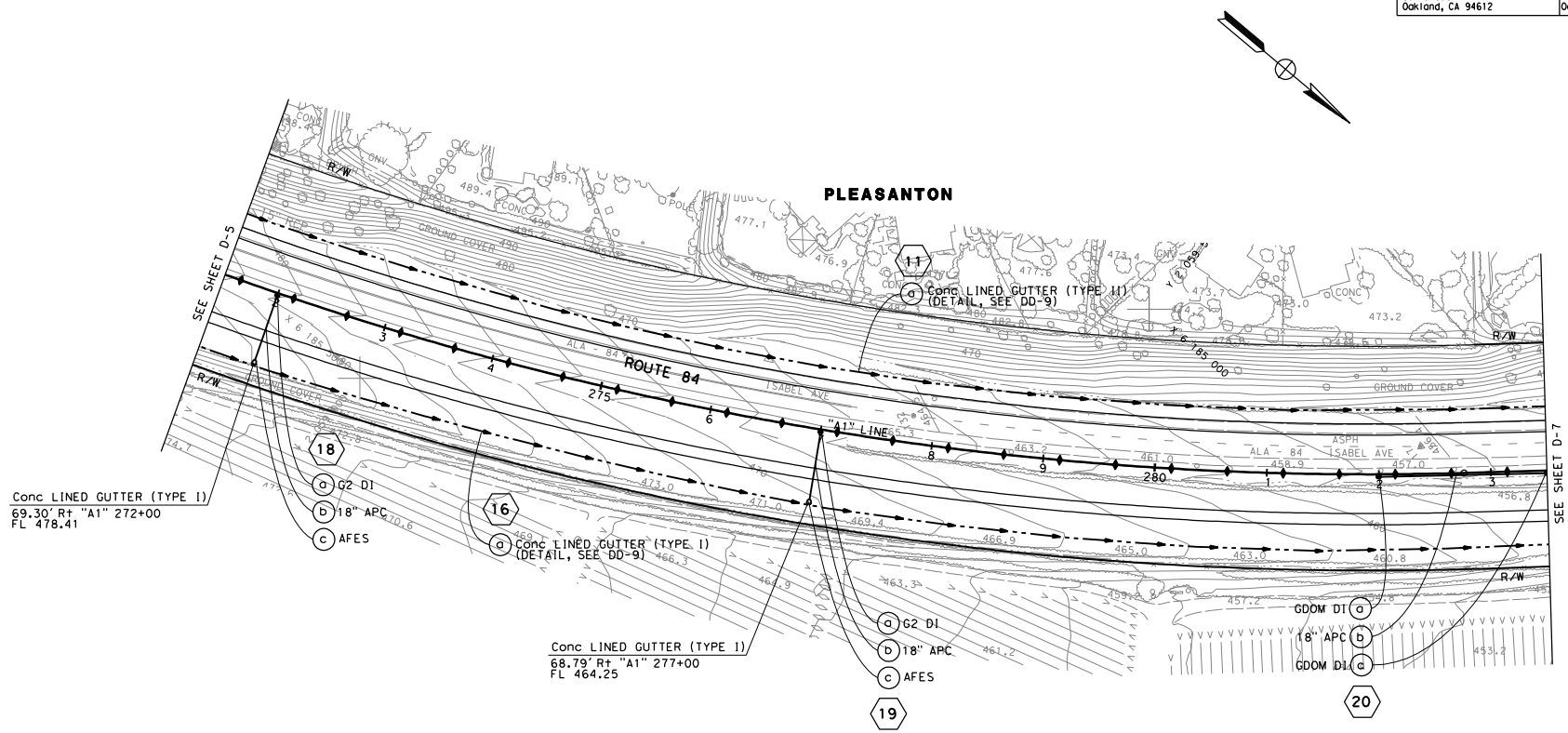

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: EC
DATE REVISED: 10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:44:17 PM

BORDER LAST REVISED 7/2/2010
USERNAME => irene_liu
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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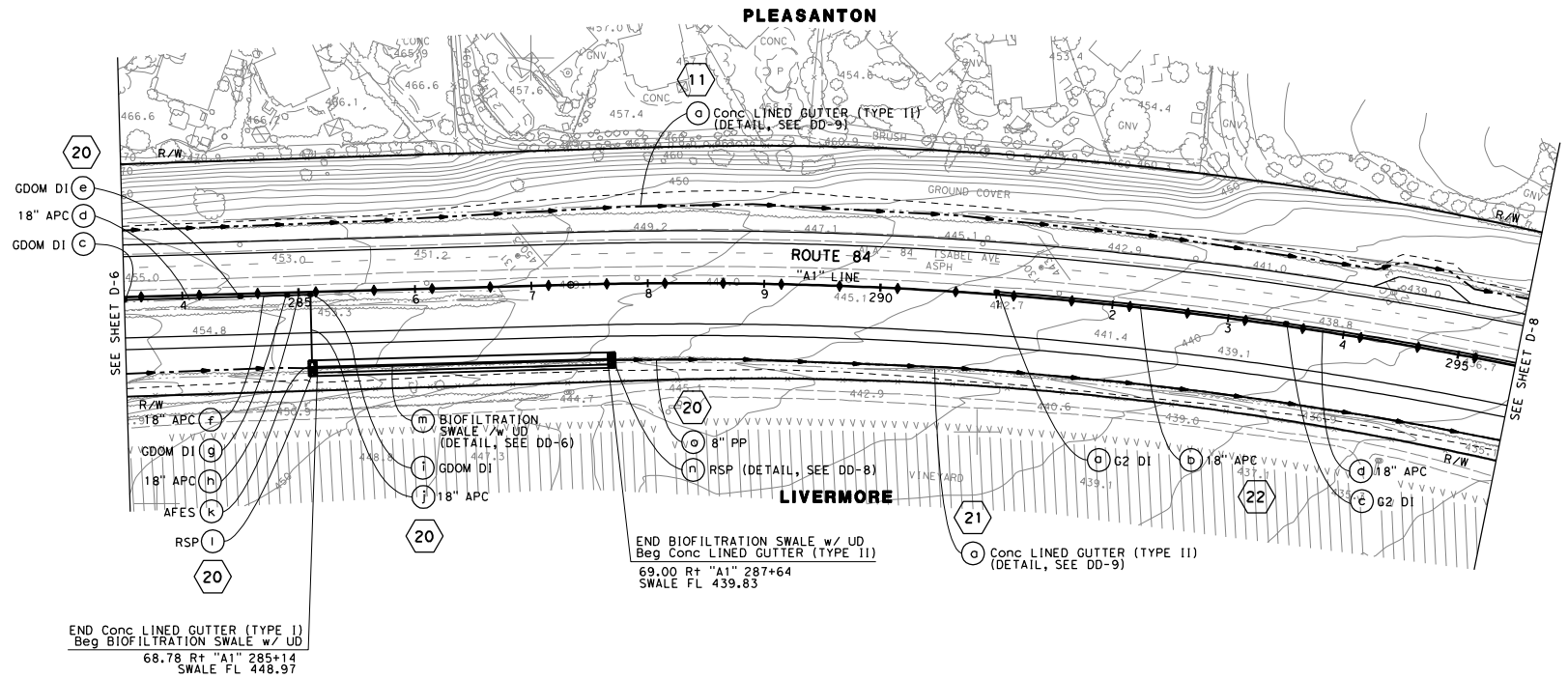

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
	HAN-BIN LIANG	IRENE LIU	DATE REVISED	10/19/10
		CHECKED BY	ANALETTE OCHOA	

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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PLEASANTON

LIVERMORE

ROUTE 84
"A1" LINE

END Conc LINED GUTTER (TYPE II)
Beg BIOFILTRATION SWALE w/ UD
62.50' Lt "A1" 299+00
SWALE FL 432.33

END BIOFILTRATION SWALE w/ UD
END 8" PPP
Beg 8" PP w/ Vert RISER
Beg Conc LINED GUTTER (TYPE II)
67.81' Lt "A1" 301+50.85
SWALE FL 429.45
8" PPP FL 427.28

67.08' Rt "A1" 304+00
RISER FL 425.59

END Conc LINED GUTTER (TYPE II)
END 8" PP CONNECT TO DI
68.16' Lt "A1" 307+35
GUTTER FL 425.44

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

RSP (DETAIL, SEE DD-8)

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP (DETAIL, SEE DD-8)

18" APC

G2 DI

8" PP

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

G2 DI w/ PCC APRON

36" APC

G2 DI

36" APC

SEE SHEET D-7

SEE SHEET D-9

END Conc LINED GUTTER (TYPE II)
65.54' Rt "A1" 295+78.80
FL 431.37

G2 DI w/ PCC APRON

30" APC

RSP BERM (DETAIL, SEE DD-8)

18" APC

AFES

RSP

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP (DETAIL, SEE DD-8)

Beg BIOFILTRATION SWALE w/ UD
68.81' Rt "A1" 296+04
SWALE FL 431.33

END BIOFILTRATION SWALE w/ UD
Beg Conc LINED GUTTER (TYPE II)
68.82' Rt "A1" 298+04
SWALE FL 429.37

30" APC

G2 DI

END Conc LINED GUTTER (TYPE II)
65.49' Rt "A1" 300+78.40
FL 427.00

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

G2 DI w/ PCC APRON

30" APC

RSP BERM (DETAIL, SEE DD-8)

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

G2 DI

18" APC

AFES

RSP

END Conc LINED GUTTER (TYPE II)
Beg BIOFILTRATION SWALE w/ UD
68.84' Rt "A1" 301+04
SWALE FL 427.17

30" APC

G2 DI

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

END BIOFILTRATION SWALE w/ UD
Beg Conc LINED GUTTER (TYPE II)
68.86' Rt "A1" 302+54
SWALE FL 426.11

G2 DI w/ PCC APRON

30" APC

RSP BERM (DETAIL, SEE DD-8)

G2 DI

18" APC

G2 DI

18" APC

AFES

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP

END Conc LINED GUTTER (TYPE II)
Beg BIOFILTRATION SWALE w/ UD
68.92' Rt "A1" 306+77
SWALE FL 423.70

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
10-19-10 TIME PLOTTED => 1:44:23 PM

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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PLEASANTON

LIVERMORE

ROUTE 84 "A1" LINE

"VIN" LINE

VINEYARD Ave

PIEDMONT DR

SEE SHEET D-8

SEE SHEET D-10

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

END Conc LINED GUTTER (TYPE II)
82.18 Rt A1 312+09.75
FL 420.62

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

RSP (DETAIL, SEE DD-8)

END BIOFILTRATION SWALE
Beg Conc LINED GUTTER
84.69 Rt "A1" 308+27
FL 422.69

30: G2 DI (o); 18" APC (p); G2 DI (g); JACKED 36" RCP (h); G2 DI (e); 36" APC (d); 36" APC (i); 36" APC (f); 60" RCP

33: G2 DI (e); 18" APC (d); G2 DI (c); 18" APC (b); G2 DI w/ PCC APRON (a)

33: 18" APC (w); G2 DI (v); 18" APC (u); G2 DI (t); LONG DITCH

33: 18" APC (h); G2 DI (g); 18" APC (f); 18" RCP

33: (n) REMOVE Culv (PORTION); (o) G2 MH; (p) 18" APC; (q) GO DI; (r) JACKED 18" RCP; (x) 18" APC; (y) G2 DI; (s) 18" APC; (z) 18" APC; (i) G2 DI; (j) 18" APC; (k) G2 DI; (l) 18" APC

31: (a) Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

30: (n) G2 DI; (o) 36" APC

29: (g) BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6); (h) RSP (DETAIL, SEE DD-8)

23: G2 DI w/ PCC APRON (j); 36" APC (k); G2 DI w/ PCC APRON (l); 36" APC (m); G2 DI (n); 36" APC (q)

30

32: (d) REMOVE DI; (b) REMOVE DI; (c) REMOVE Culv; (d) REMOVE Culv; (e) REMOVE DI; (f) REMOVE Culv

34: (d) REMOVE Culv; (c) REMOVE DI; (b) REMOVE Culv; (a) REMOVE DI

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	EC
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISION DATE PLOTTED => 10/20/2010
10-19-10 TIME PLOTTED => 1:44:26 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia009.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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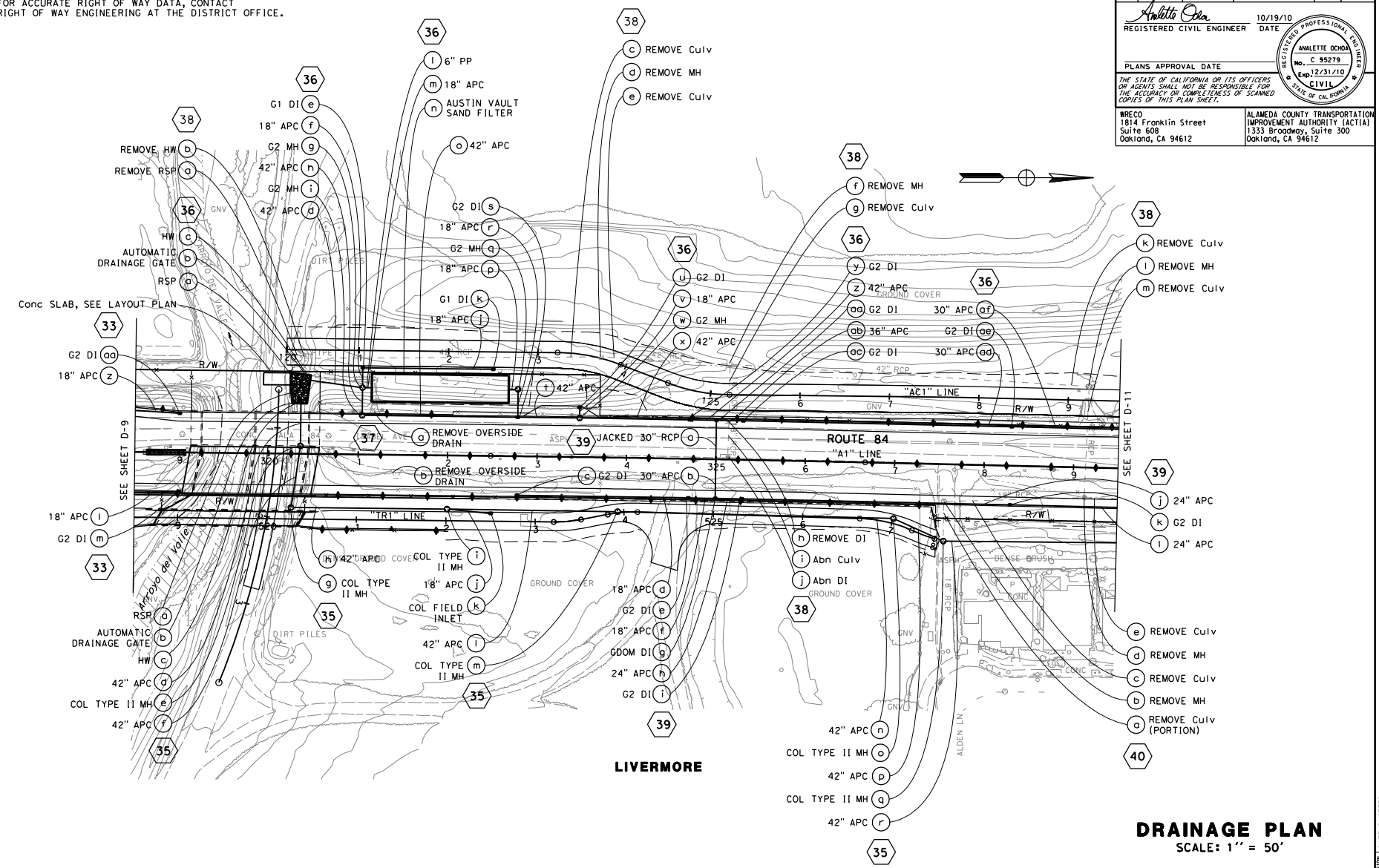

DRAINAGE PLAN
SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:28 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia010.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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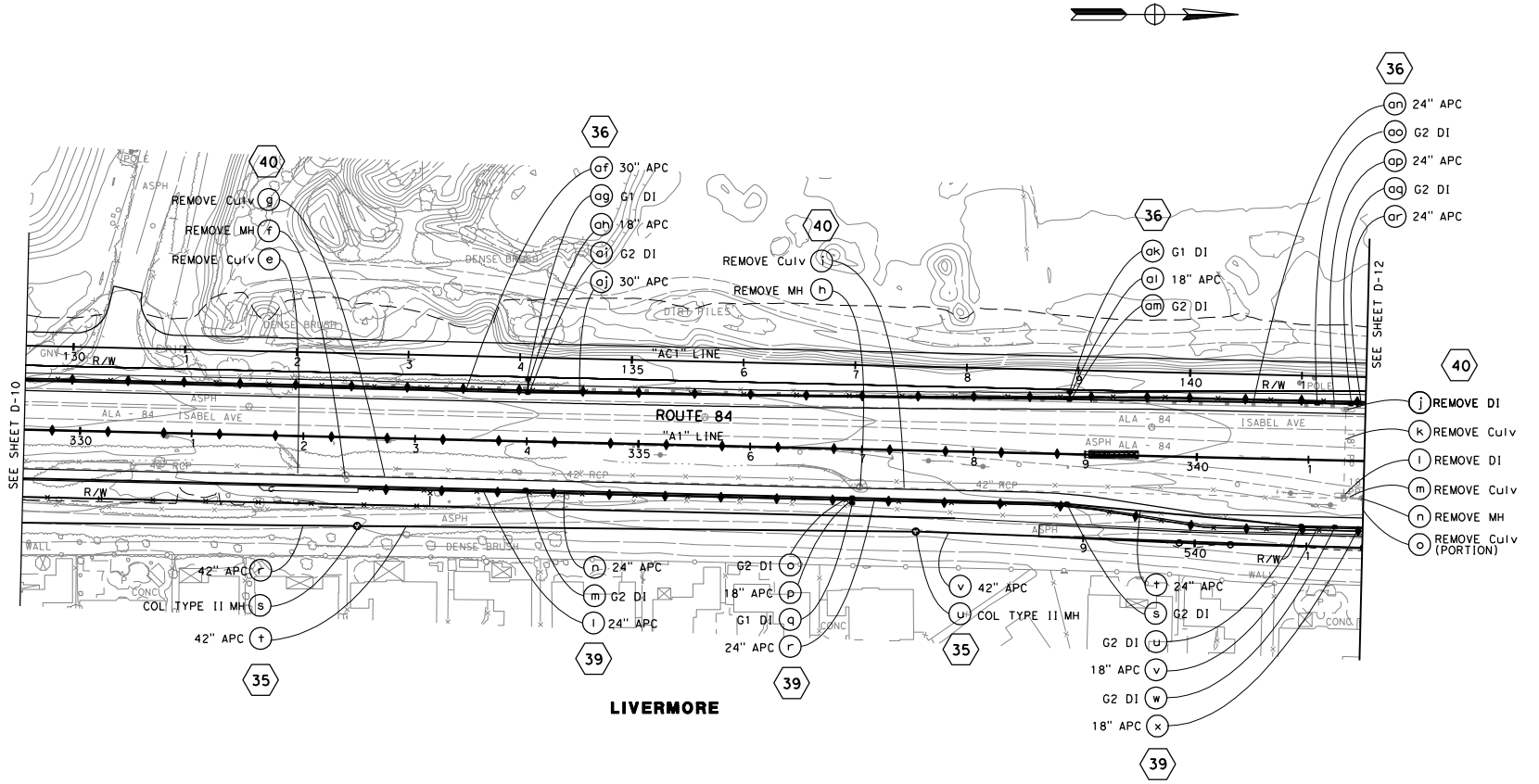

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-11

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 11:44:51 PM

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BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia011.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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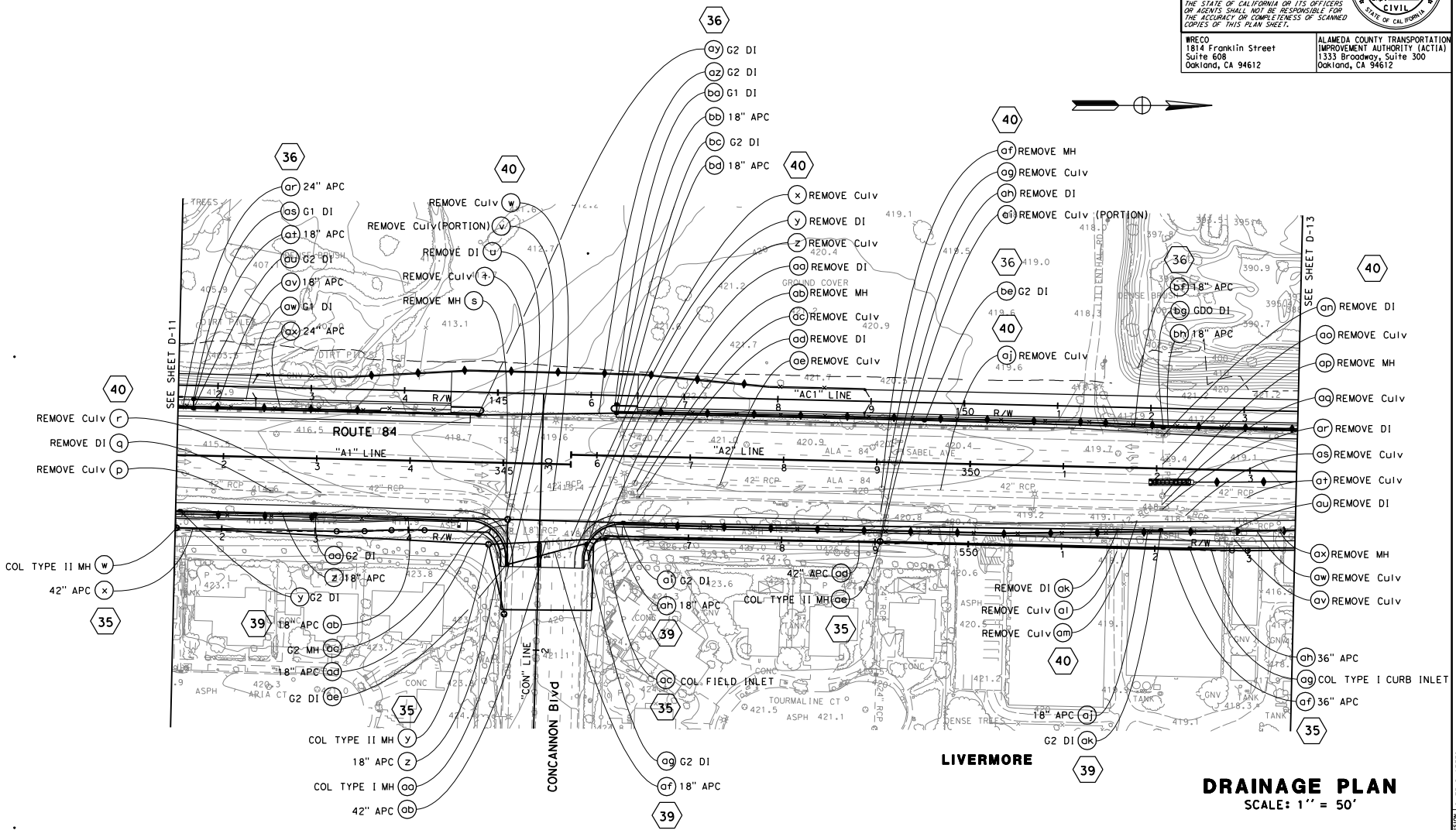

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-12

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

LAST REVISION 10-19-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1:44:34 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia012.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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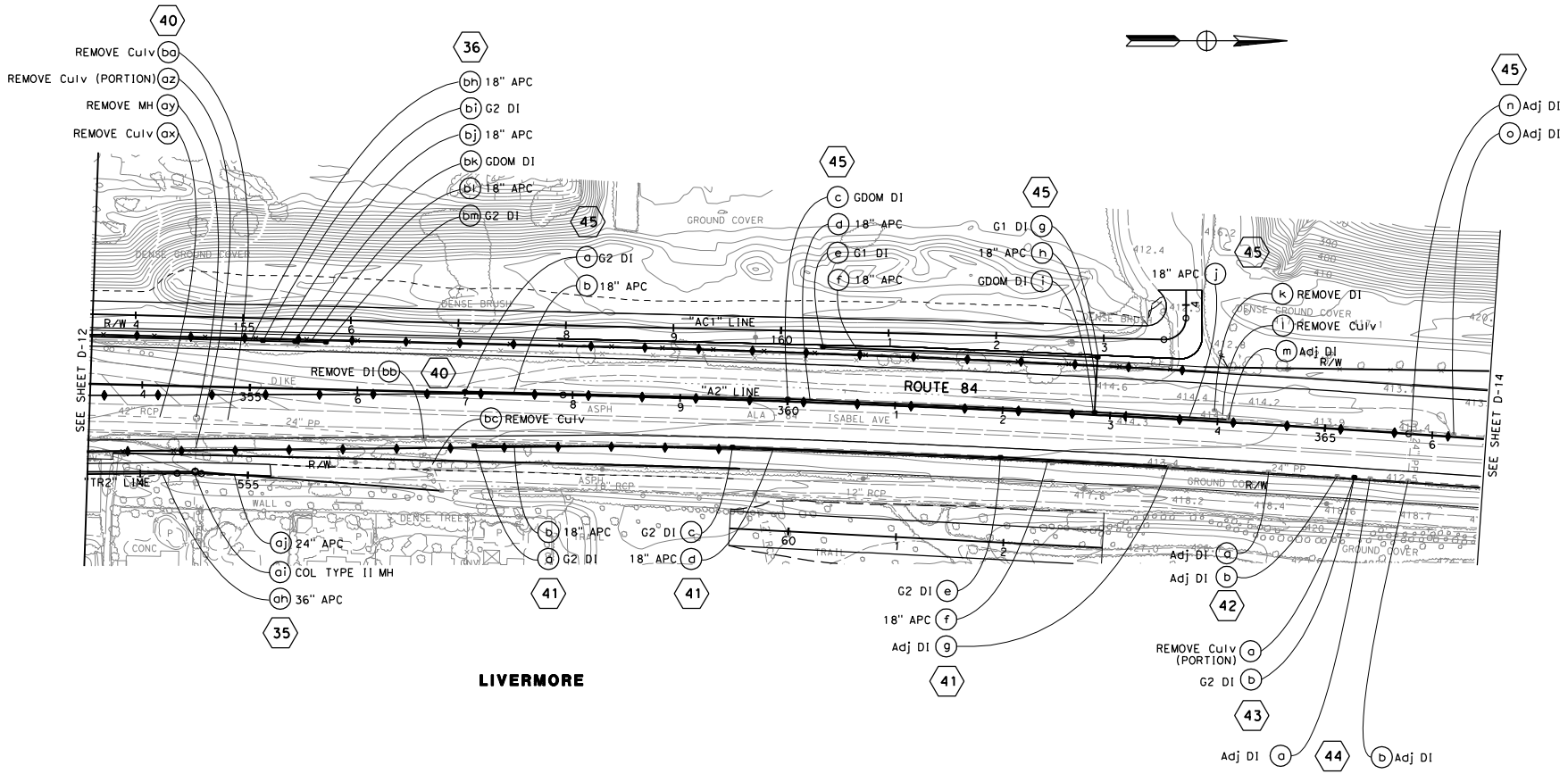

LIVERMORE

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-13

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: EC
DATE REVISED: 10/19/10

LAST REVISION
DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:38 PM

BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\dwg\Seg B\pl\429760ia013.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 95279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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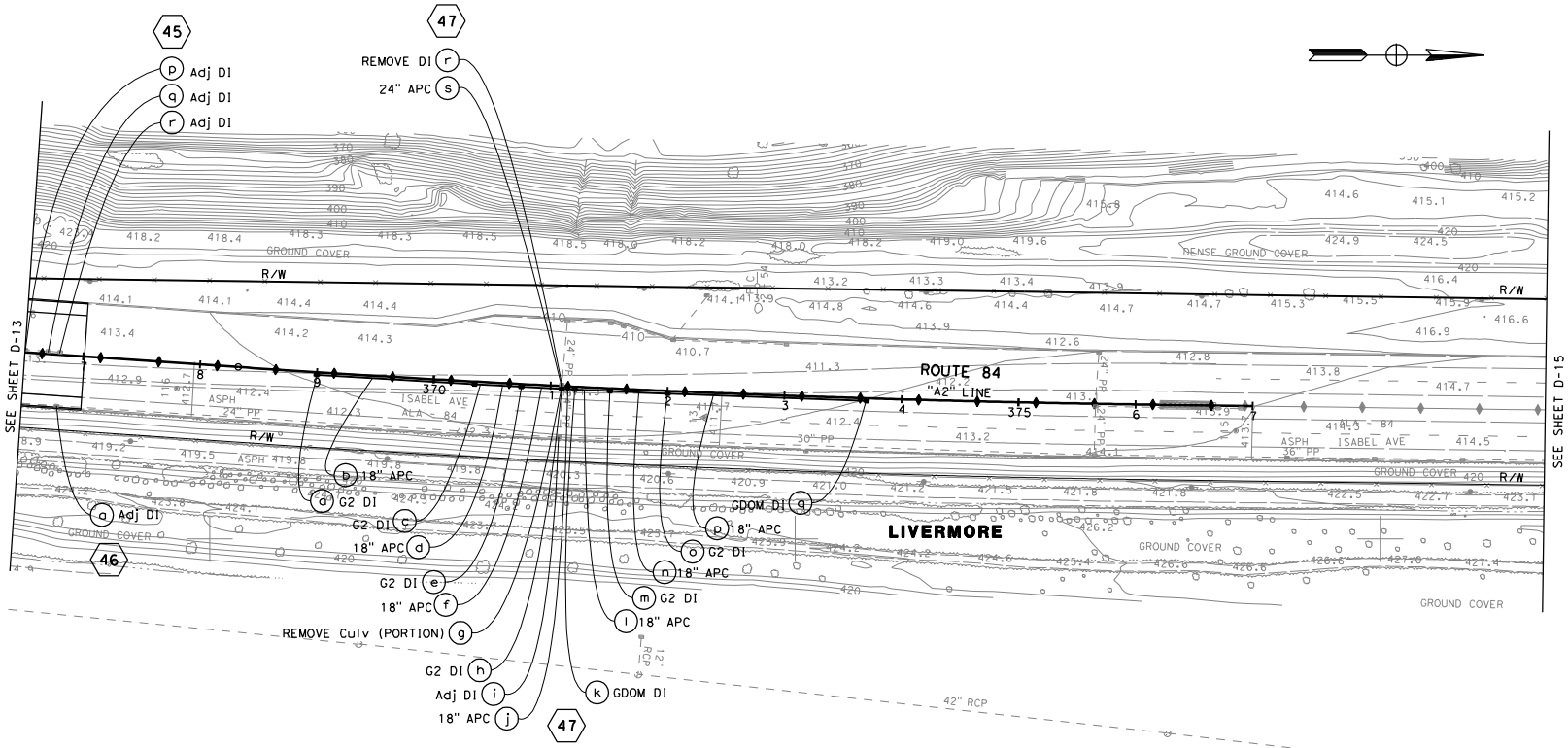

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: EC
DATE REVISED: 10/19/10

LAST REVISION: DATE PLOTTED => 10/20/2010 TIME PLOTTED => 11:44:41 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia014.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Treatment BMP Watershed Maps

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	1	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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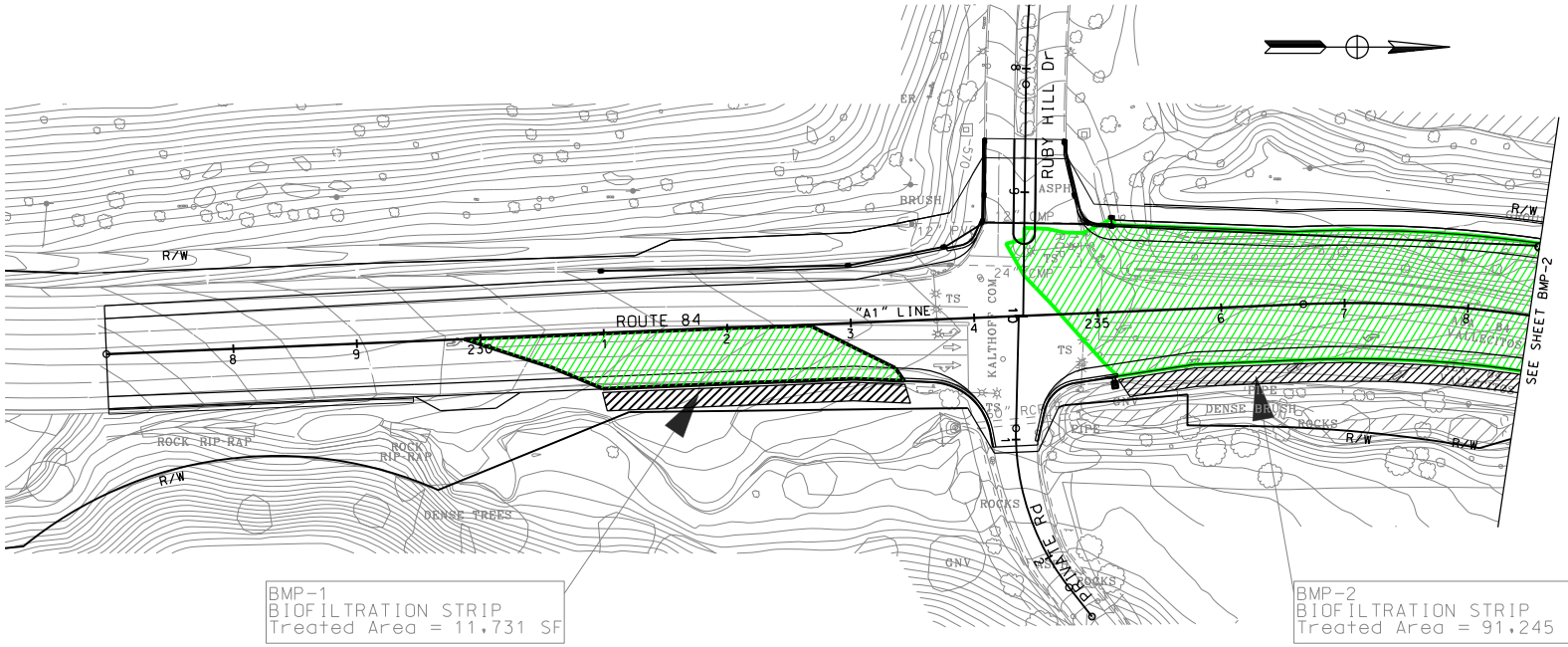
LEGEND:

- PROPOSED TREATMENT BEST MANAGEMENT PRACTICE (BMP) BIOFILTRATION STRIP
- PROPOSED TREATMENT BEST MANAGEMENT PRACTICE (BMP) BIOFILTRATION SWALE
- PAVED TREATED AREA
- ON-SITE WATERSHED BOUNDARAY
- GUTTER/DITCH FLOW LINE
- Exist DITCH FLOW LINE
- GRADE TO DRAIN
- MEDIA FILTER

ABBREVIATIONS:

GCP	CONCRETE PIPE INLET
SGD	STANDARD GUTTER DEPRESSION
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA



BMP-1
BIOFILTRATION STRIP
Treated Area = 11,731 SF

BMP-2
BIOFILTRATION STRIP
Treated Area = 91,245 SF

PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP 1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

REVISED BY	DATE REVISED
ANALETTE OCHOA	

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 5:18:40 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

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DGN FILE = $FILE$

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA.
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	2	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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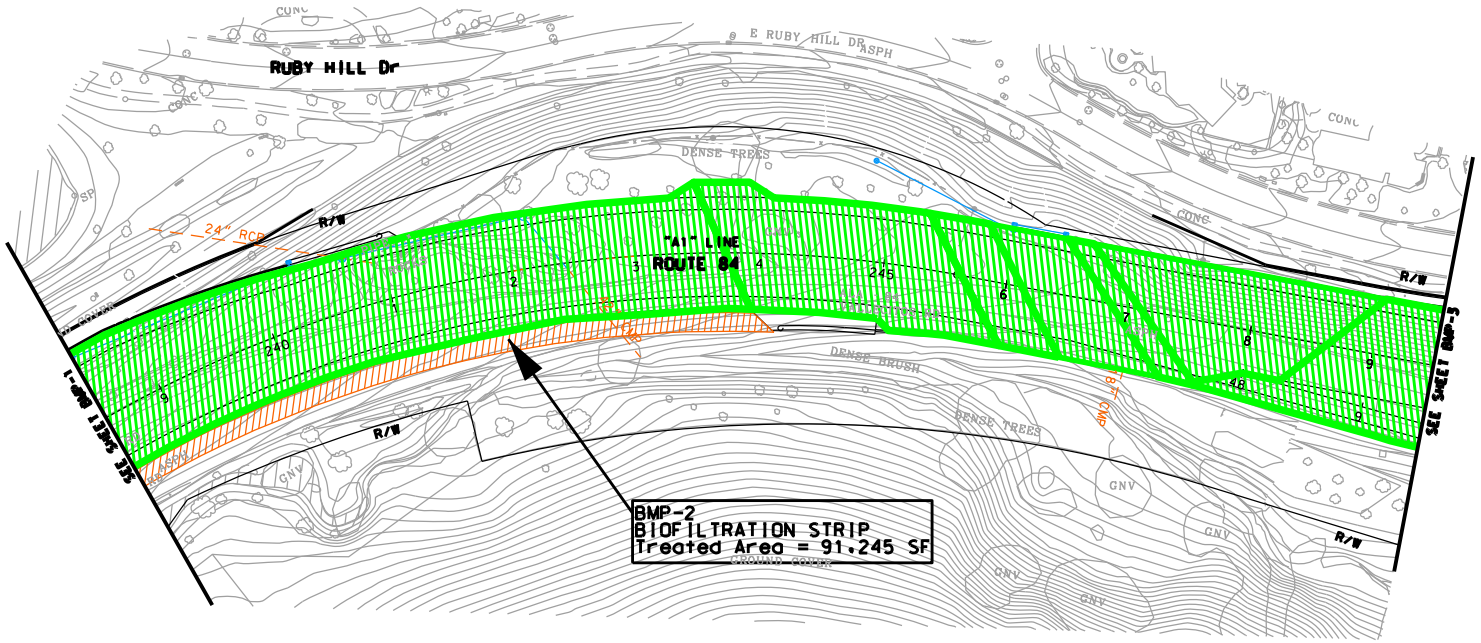

PROPOSED TREATMENT BMPS

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

BMP- 2

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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HAN-BIN LIANG

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$PROJECT

LAST REVISION 00-00-00 | DATE PLOTTED =£$DATE | TIME PLOTTED =£$TIME

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME =£$USER
DGN FILE =£$FILE

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	3	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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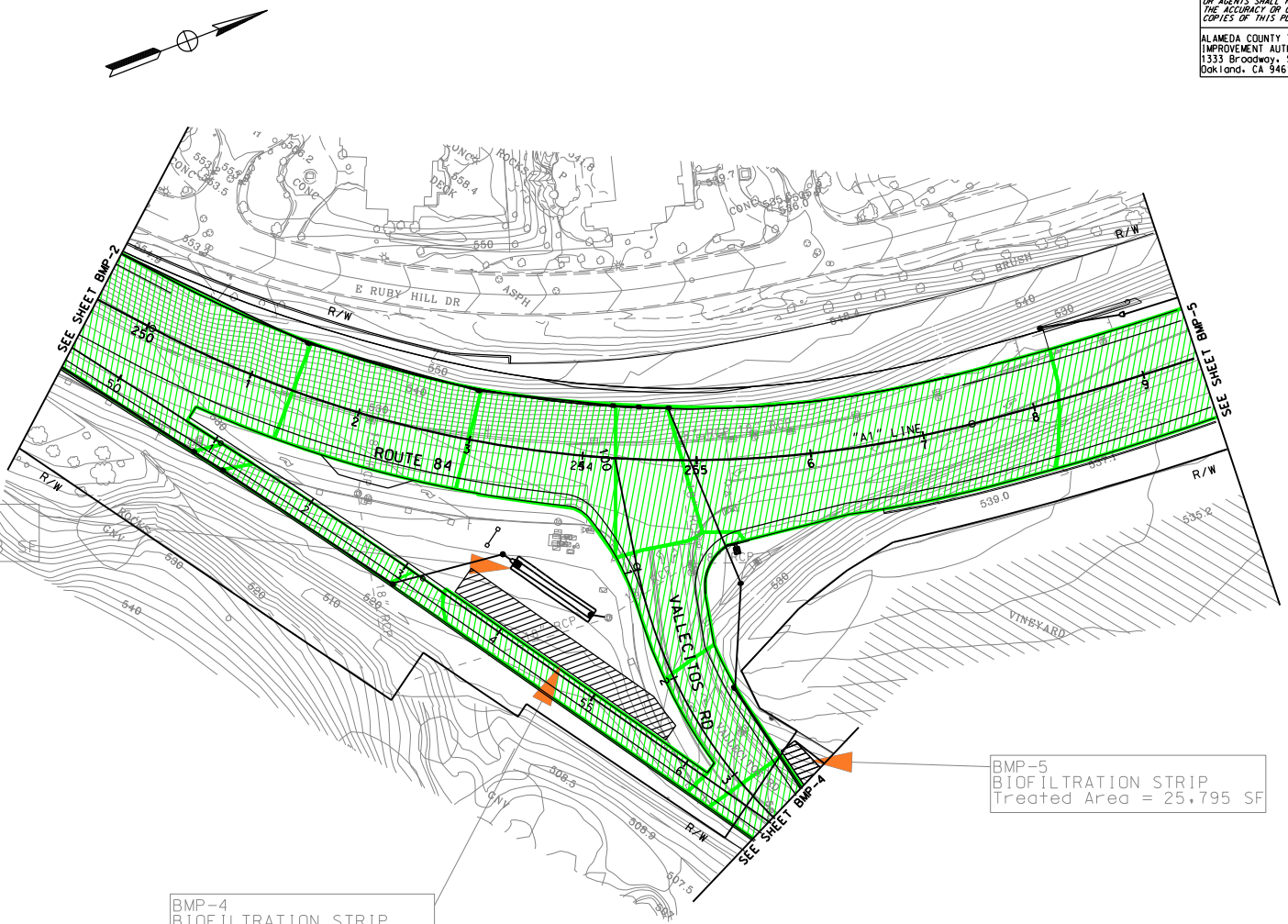

PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP- 3

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	CALCULATED-DESIGNED BY	CHECKED BY
ANALETTE OCHOA			
REVISED BY	DATE REVISED		

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 4:58:05 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = $FILE$

CU 00000

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	4	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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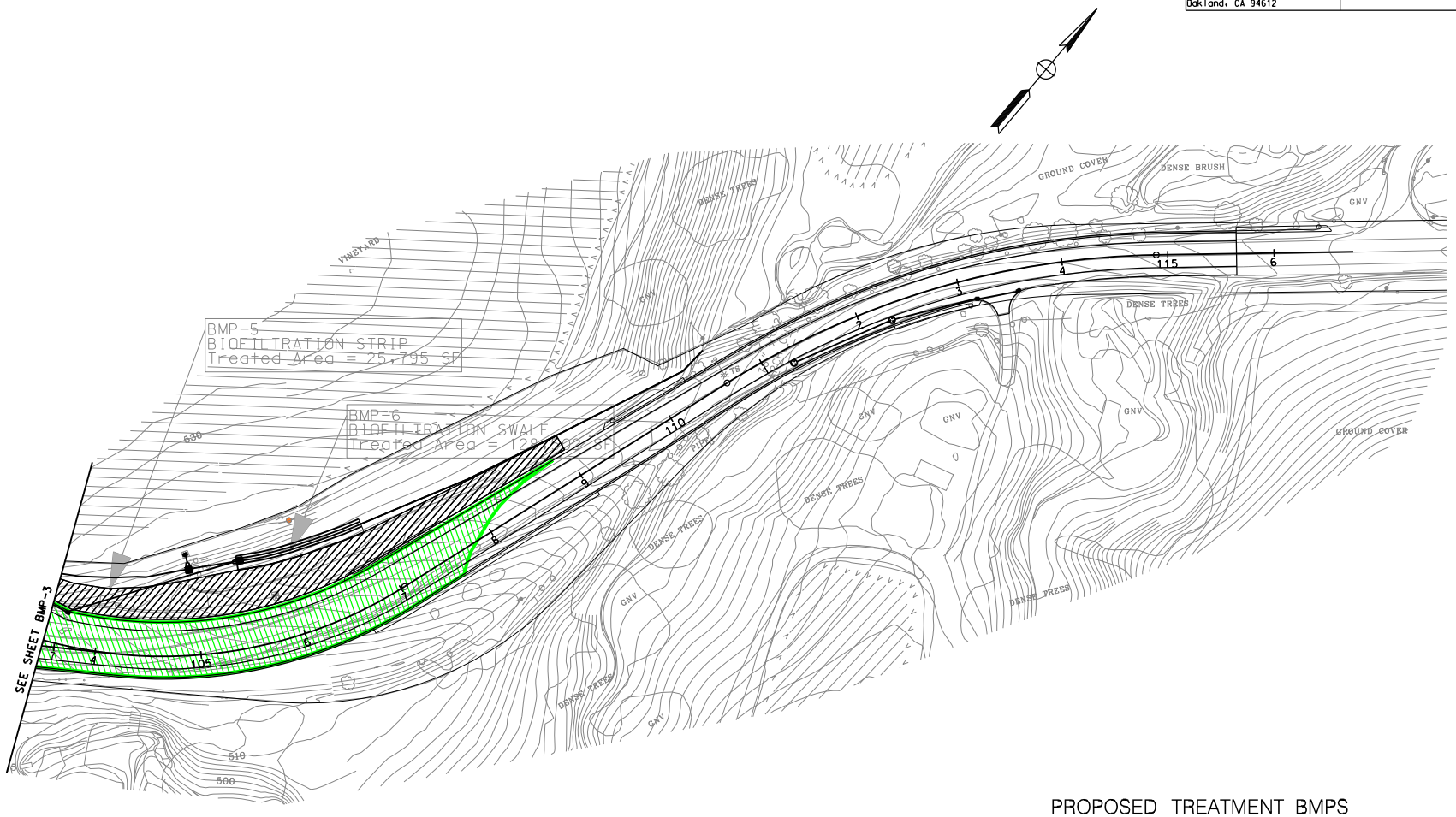

PROPOSED TREATMENT BMPS

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

BMP- 4

DATE REVISED	REVISED BY	CALCULATED-DESIGNED BY	CONSULTANT FUNCTIONAL SUPERVISOR	STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DATE REVISED	ANALETTE OCHOA	CHECKED BY	HAN-BIN LIANG	Caltrans

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DATE PLOTTED = 10/14/2010
TIME PLOTTED = 5:27:01 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = $FILE$

CU 00000

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	5	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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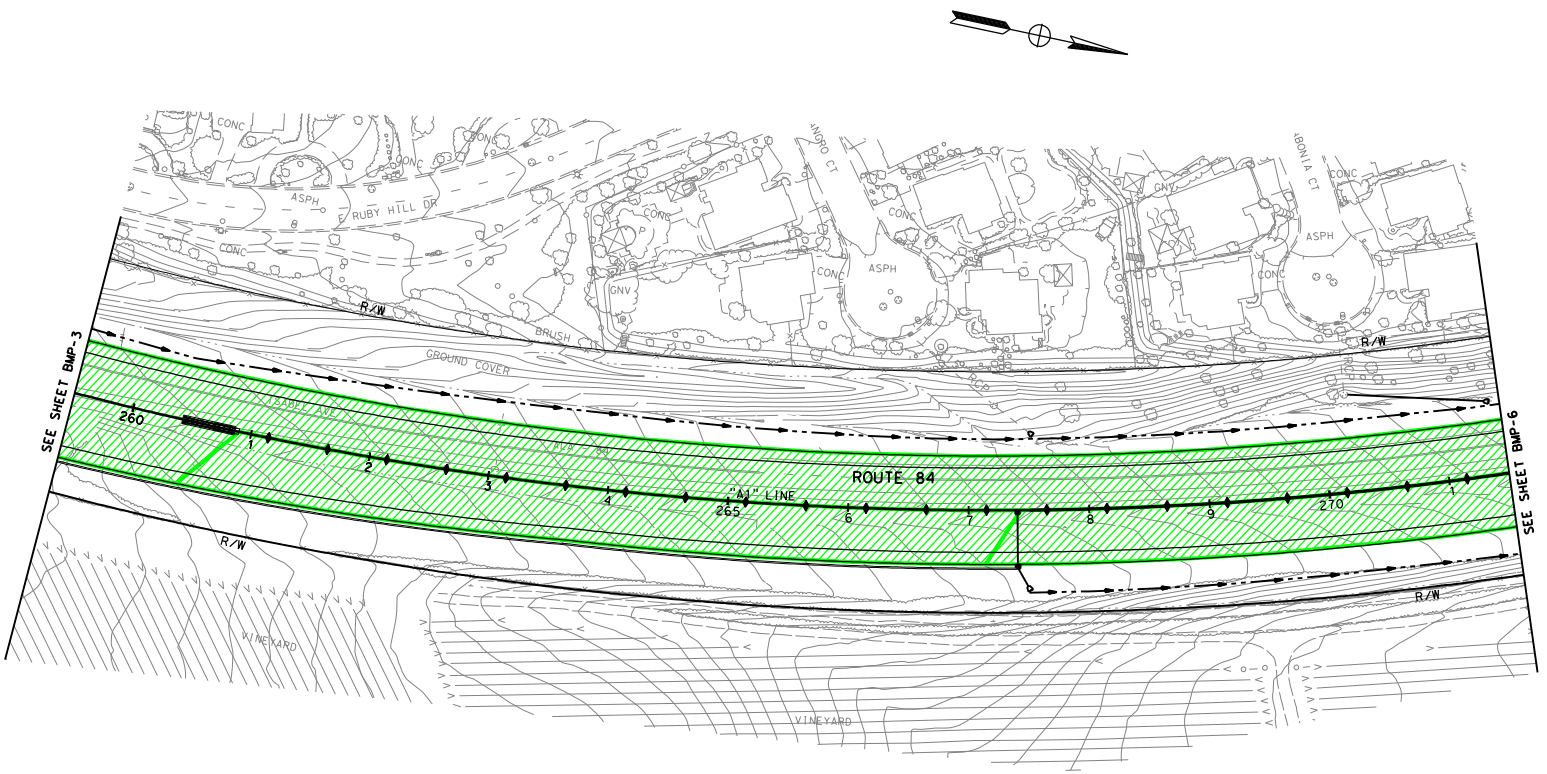

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

BMP-5

REVISED BY	DATE REVISED
ANALETTE OCHOA	

CALCULATED-DESIGNED BY	CHECKED BY
HAN-BIN LIANG	

CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Irene_liu
DGN FILE => $FILE$

CU 00000

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	6	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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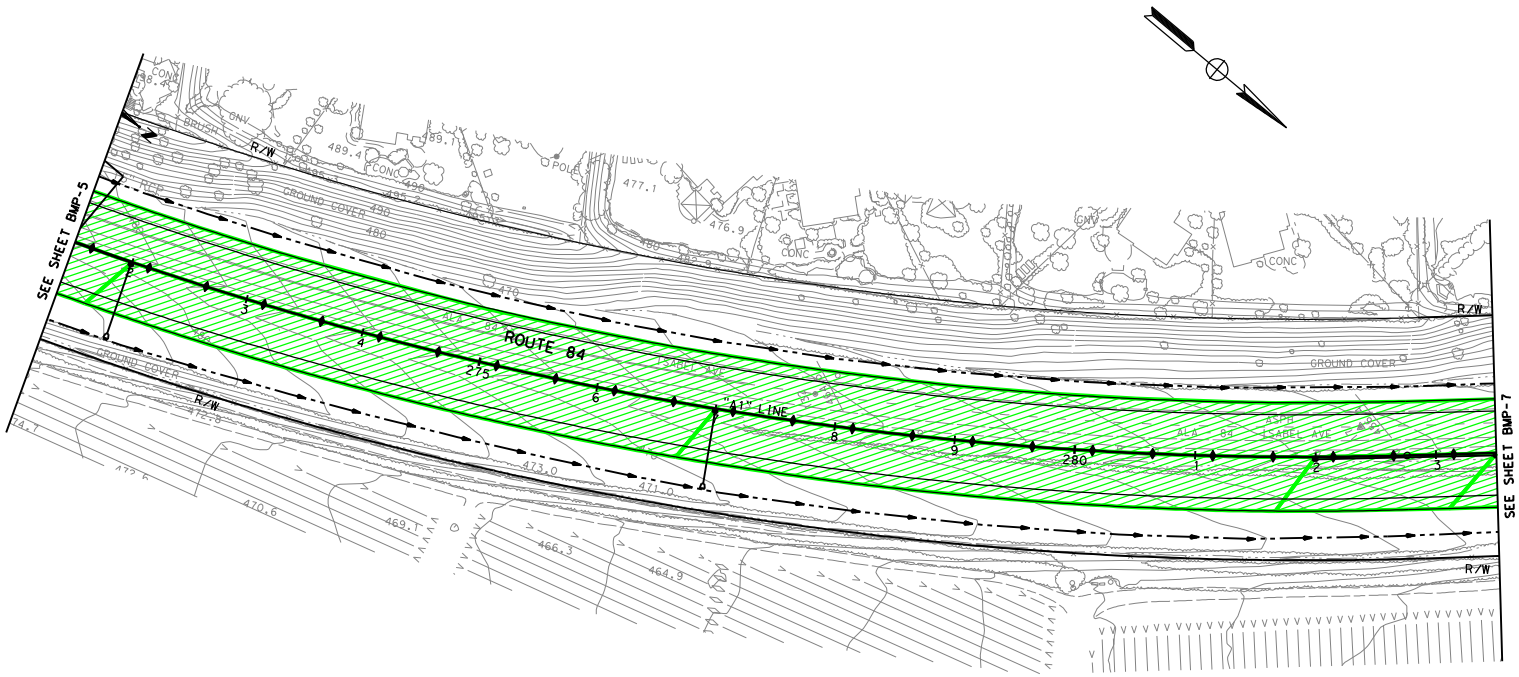
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

BMP-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG	CALCULATED-DESIGNED BY	ANALETTE OCHOA	REVISED BY
		CHECKED BY		DATE REVISED

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NOTE:
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SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	7	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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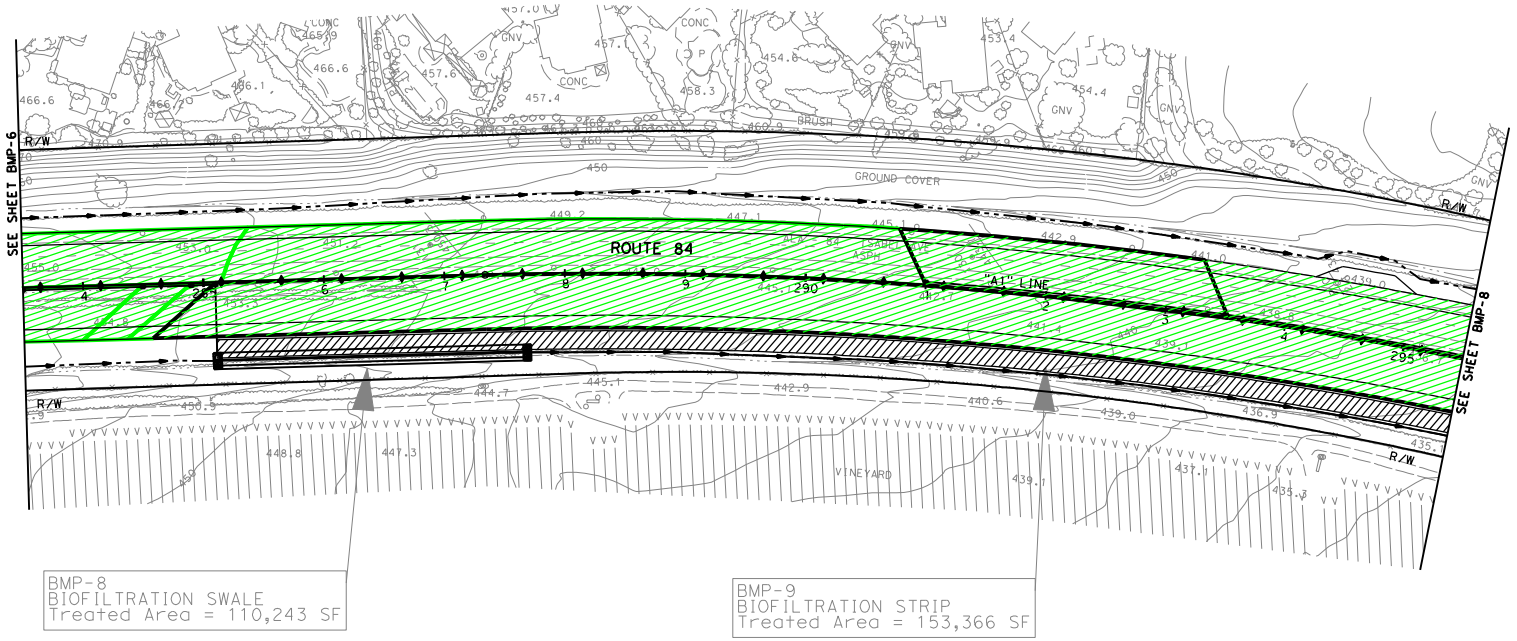

PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP-7

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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CALCULATED-DESIGNED BY	ANALETTE OCHOA	REVISED BY		
CHECKED BY		DATE REVISED		
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG			
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION				

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	8	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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NOTE:
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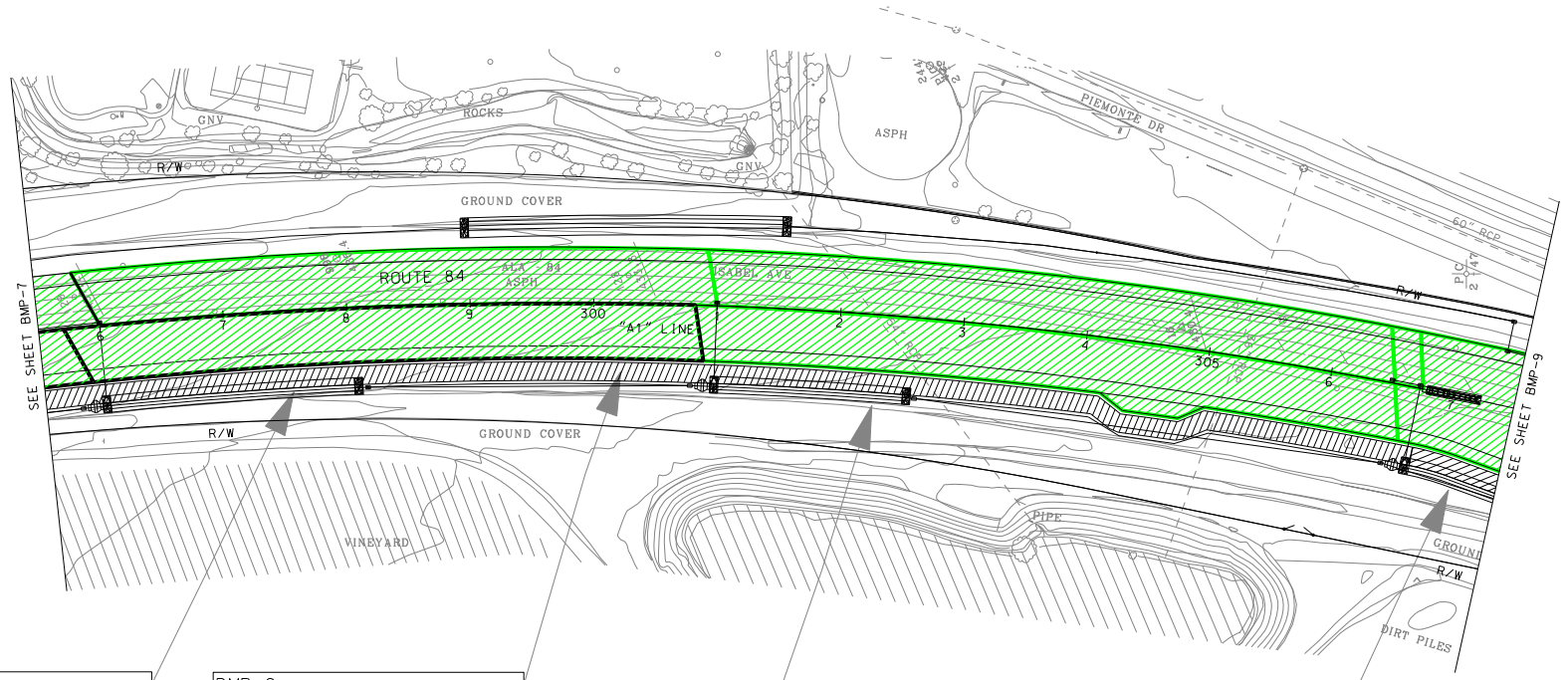

BMP-10
BIOFILTRATION SWALE
Treated Area = 48,720 SF

BMP-9
BIOFILTRATION STRIP
Treated Area = 153,366 SF

BMP-11
BIOFILTRATION SWALE
Treated Area = 22,647 SF

BMP-12
BIOFILTRATION SWALE
Treated Area = 26,355 SF

PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP- 8

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY | CHECKED BY
ANALETTE OCHOA
REVISED BY | DATE REVISED

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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 5:08:27 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = $FILE$

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	9	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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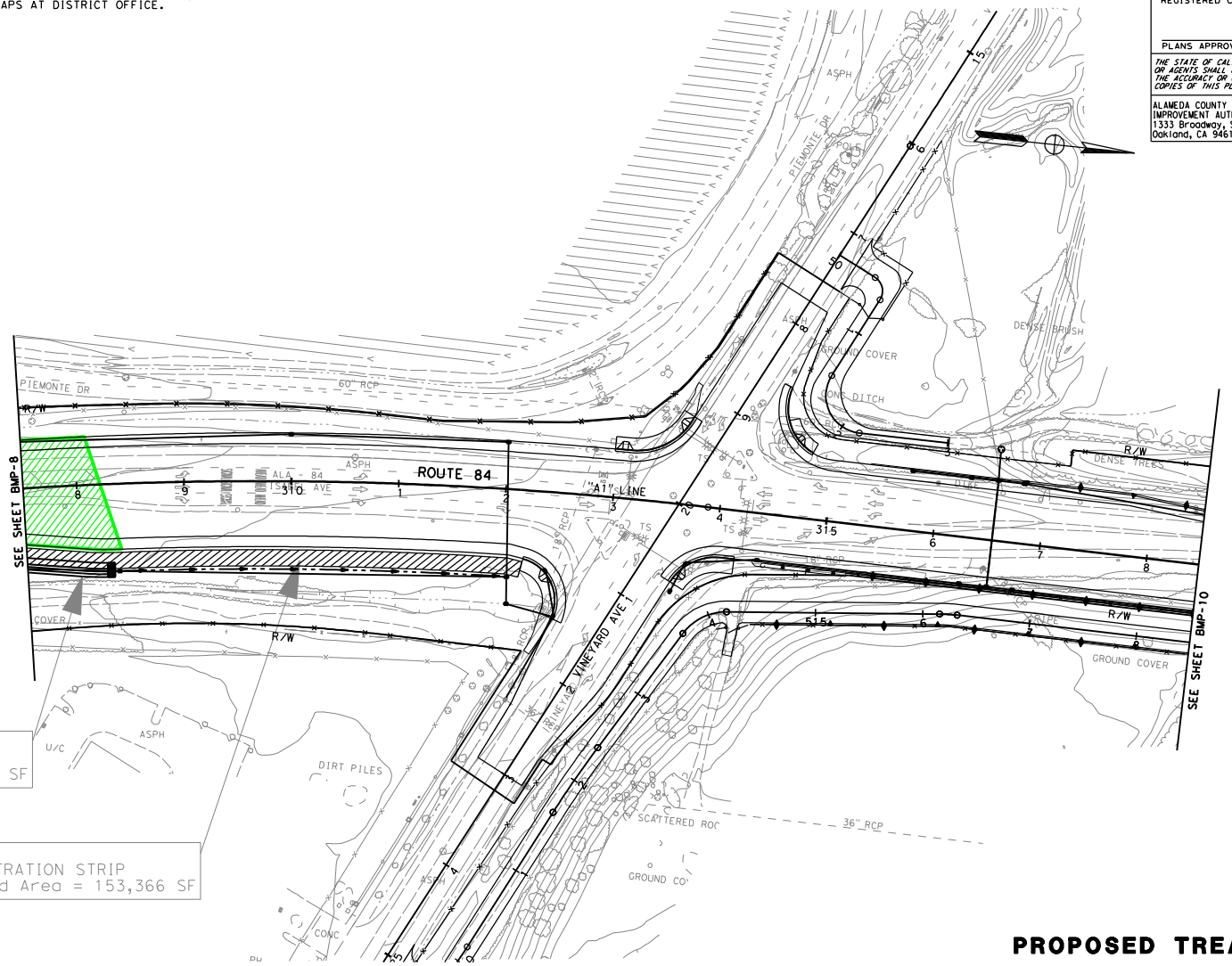

BMP-12
BIOFILTRATION STRIP
Treated Area = 26,355 SF

BMP-9
BIOFILTRATION STRIP
Treated Area = 153,366 SF

PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP-9

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	
		ANALETTE OCHOA		

LAST REVISION 00-00-00
DATE PLOTTED => 10/14/2010
TIME PLOTTED => 12:28:28 PM

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BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Irene_liu
DGN FILE => $FILE$

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	10	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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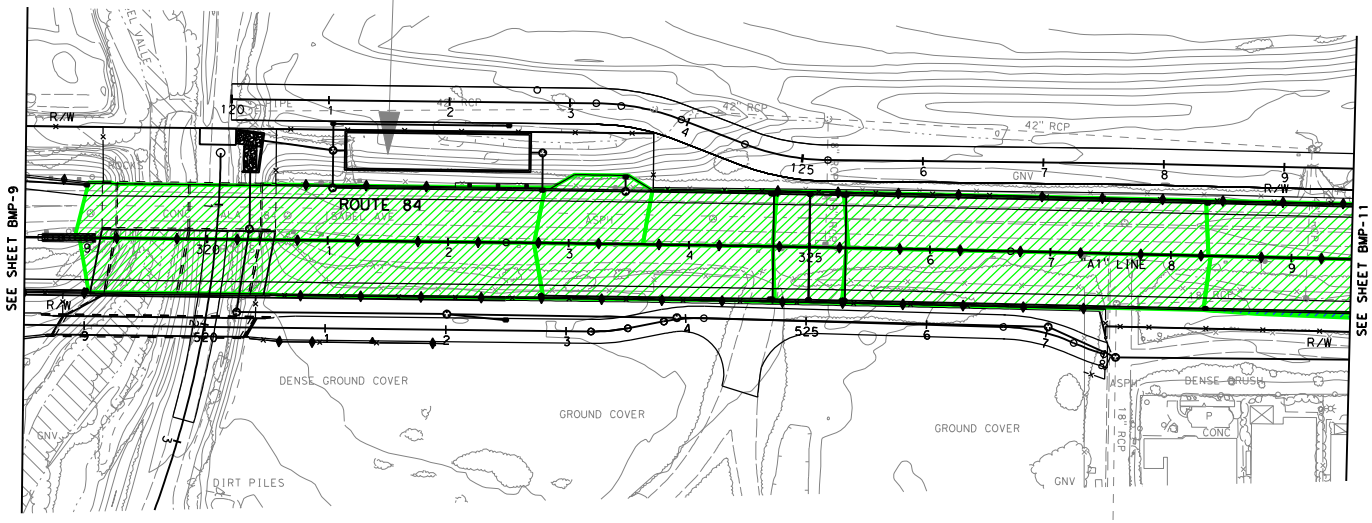
BMP-13
AUSTIN VAULT SAND FILTER
Treated Area = 451,148 SF



PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP-10

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

REVISED BY	DATE REVISED
ANALETTE OCHOA	

CALCULATED-DESIGNED BY

CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

g:\projects\y2007\p0728 sr 84 widening\dwg\bmps\BMP-10.dgn

LAST REVISION 00-00-00
DATE PLOTTED => 10/14/2010
TIME PLOTTED => 12:12:32 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Irene_Liu
DGN FILE => $FILE$

CU 00000

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	11	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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WRECO
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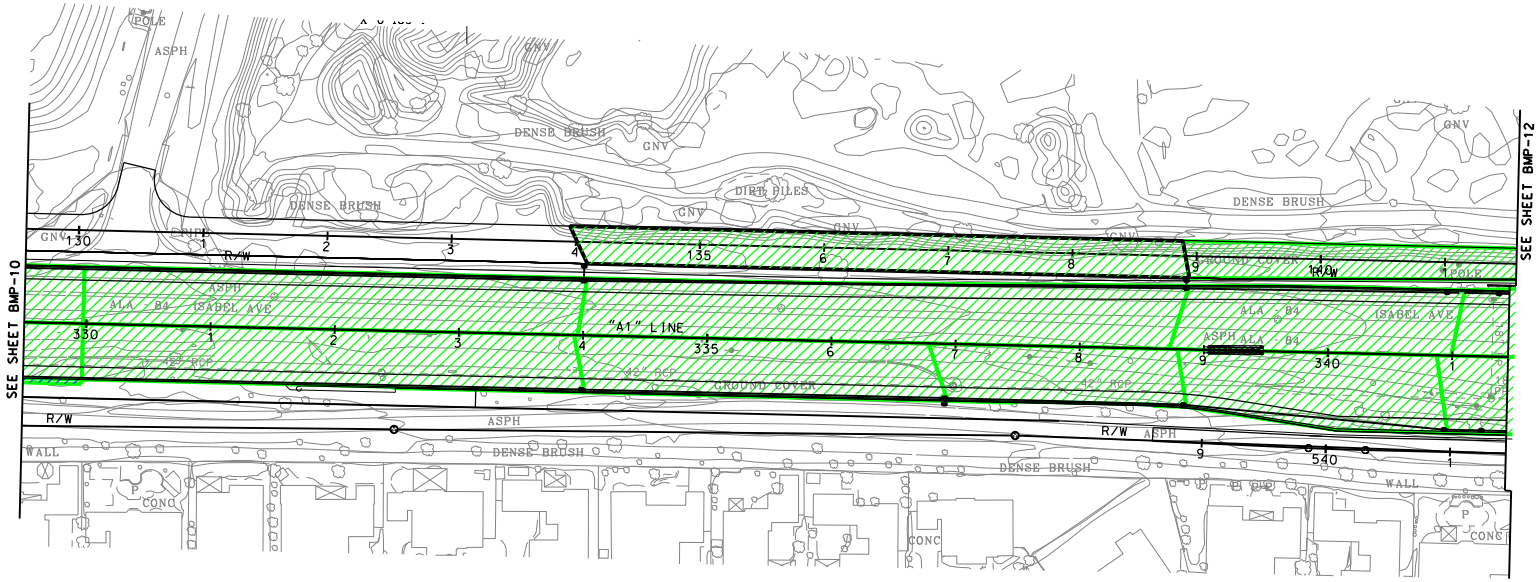
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

SCALE 1"=50'

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BMP- 11

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Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY
CHECKED BY
ANALETTE OCHOA
REVISED BY
DATE REVISED

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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 5:12:32 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = $FILE$

CU 00000

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	12	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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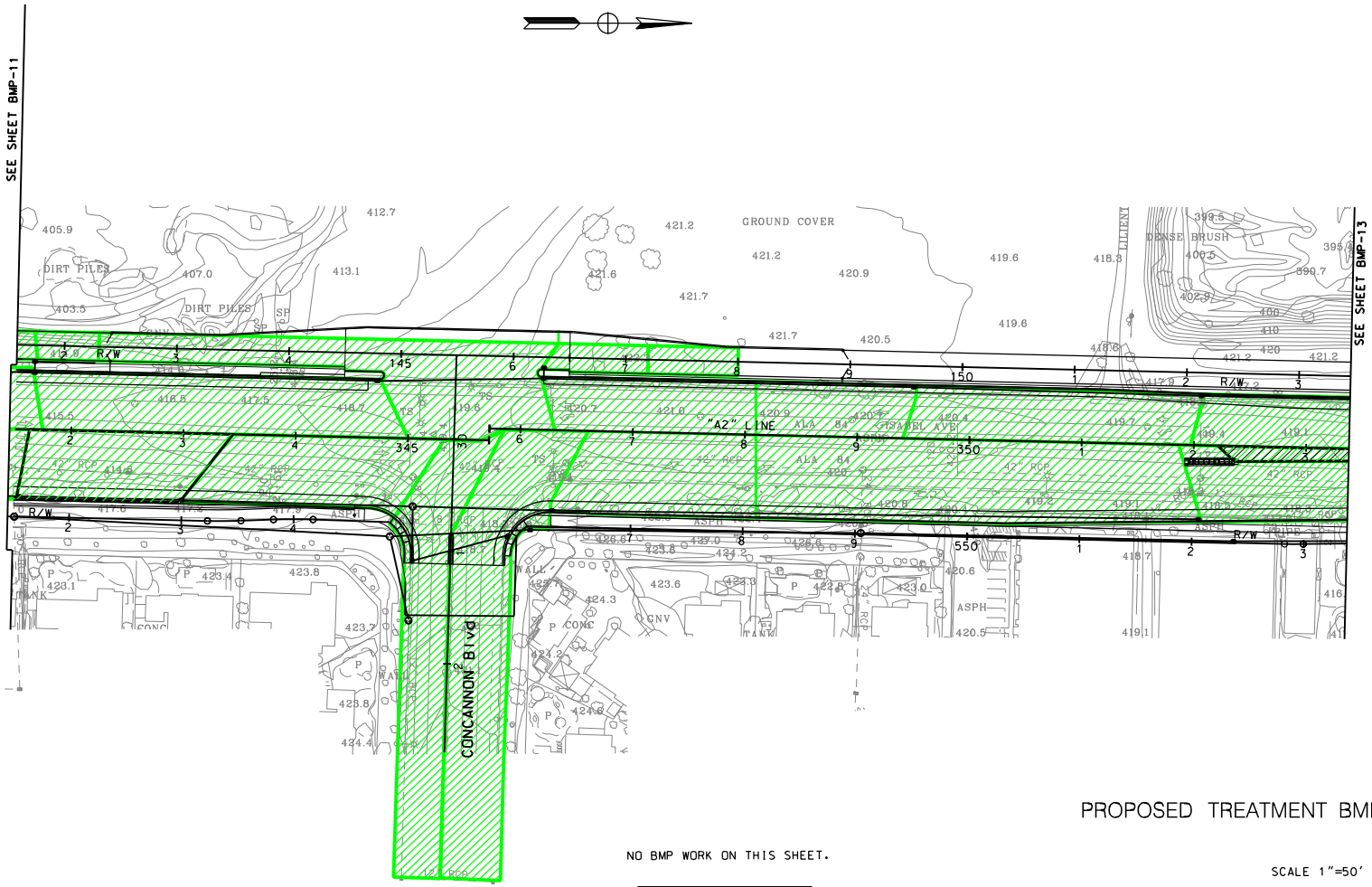

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

SCALE 1"=50'

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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BMP- 12

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
ANALETTE OCHOA			

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 5:17:31 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = $FILE$

CU 00000

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	13	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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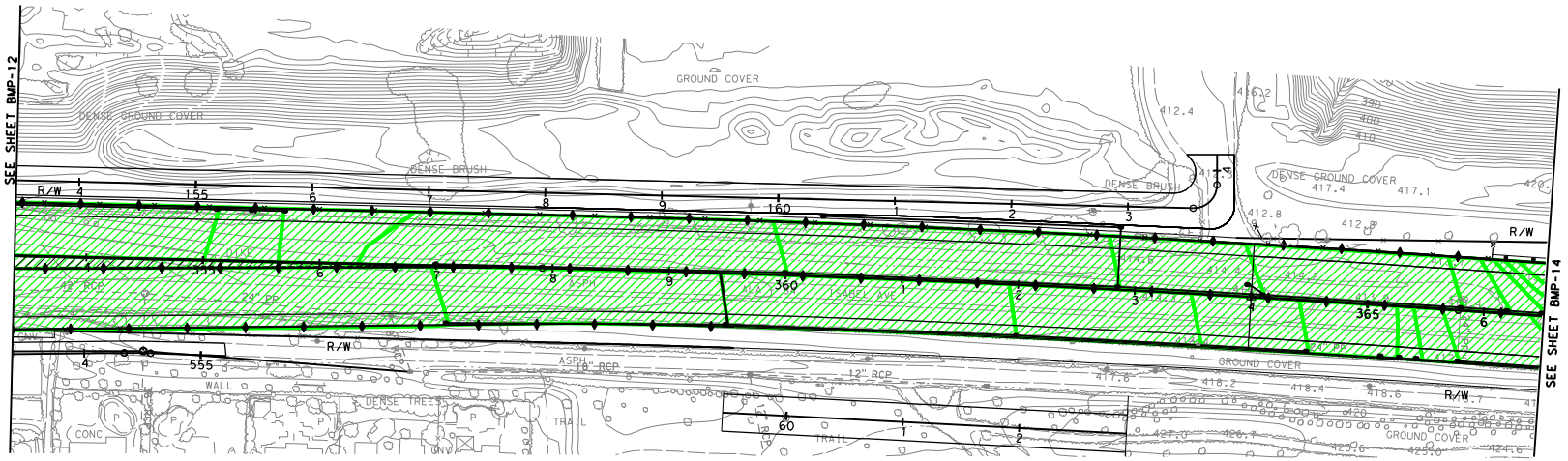

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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BMP-13

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
ANALETTE OCHOA			

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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LAST REVISION 00-00-00 | DATE PLOTTED => 10/14/2010 | TIME PLOTTED => 1:28:50 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Irene_liu
DGN FILE => $FILE$

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	14	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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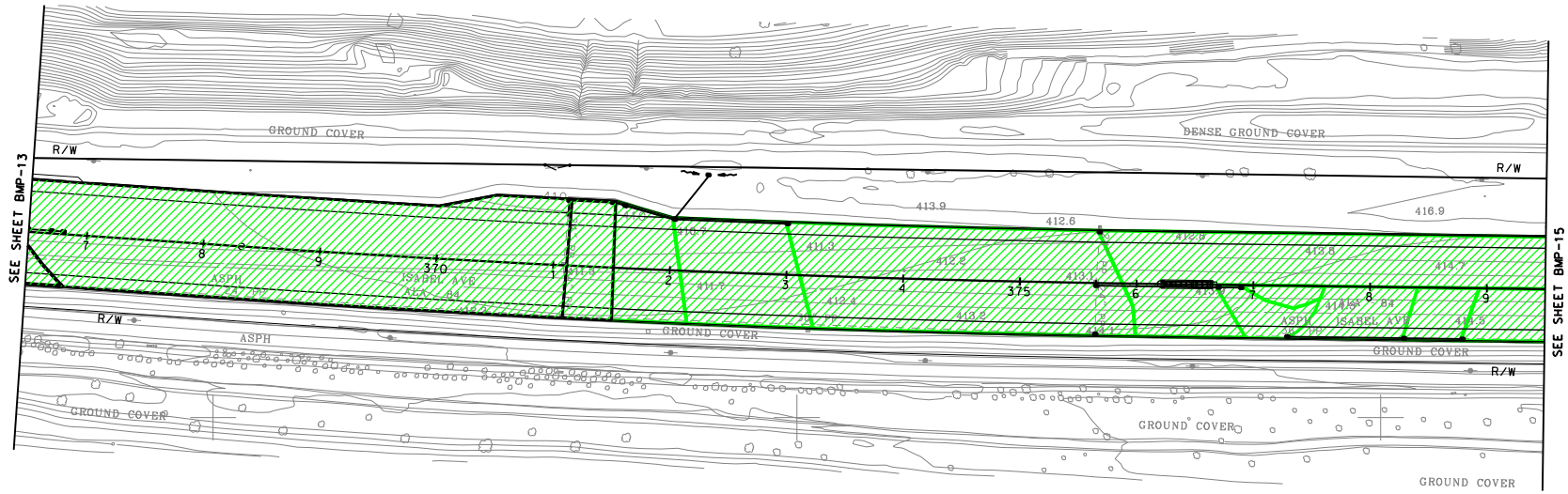

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

SCALE 1"=50'

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

BMP- 14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG | CALCULATED-DESIGNED BY | CHECKED BY | ANALETTE OCHOA | REVISED BY | DATE REVISED

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LAST REVISION 00-00-00 | DATE PLOTTED = 10/14/2010 | TIME PLOTTED = 5:18:28 PM

BORDER LAST REVISED 3/1/2007 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME = catherine_byun | DGN FILE = $FILE$ | CU 00000 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	15	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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NOTE:
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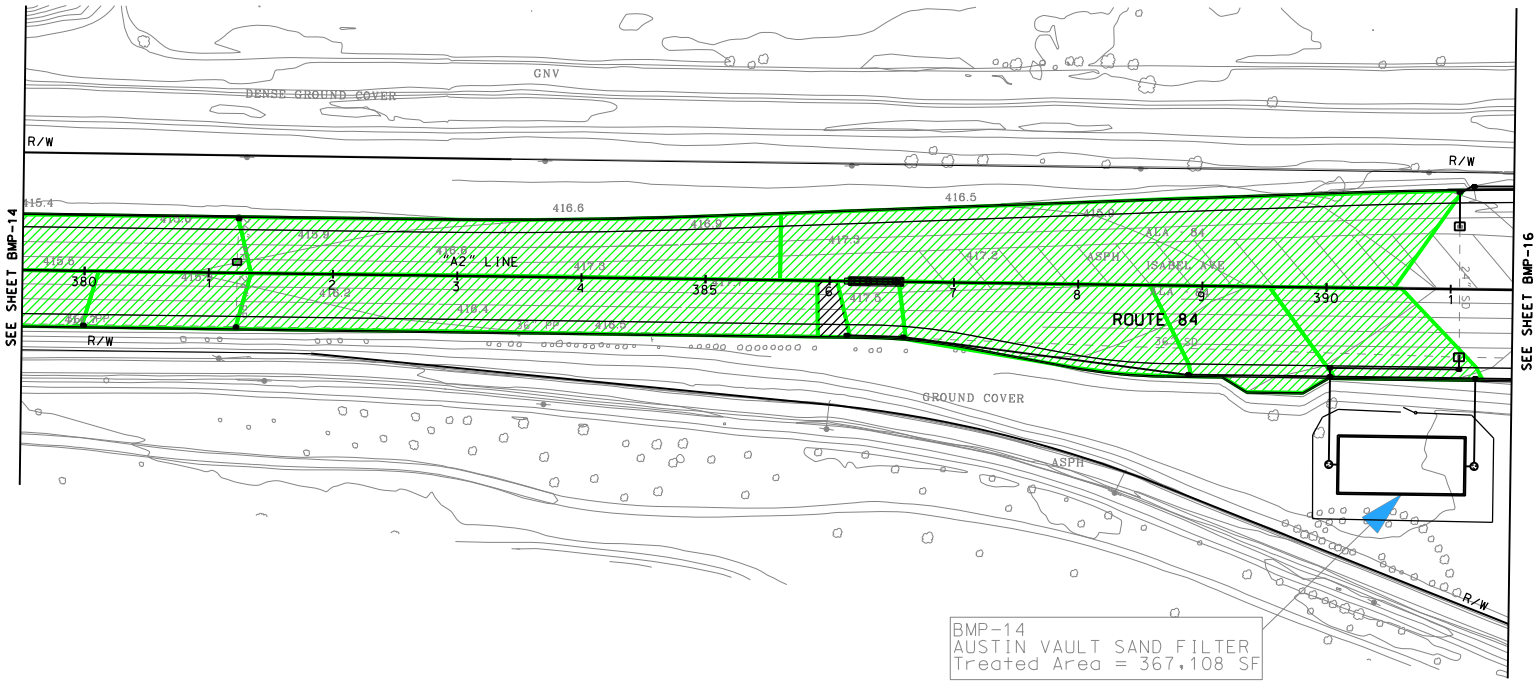
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP- 15

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	LAST REVISION
Caltrans	HAN-BIN LIANG	ANALETTE OCHOA	DATE REVISED	00-00-00
		CHECKED BY		DATE PLOTTED = 10/14/2010
				TIME PLOTTED = 5:19:05 PM

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BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = $FILE$

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA.
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	16	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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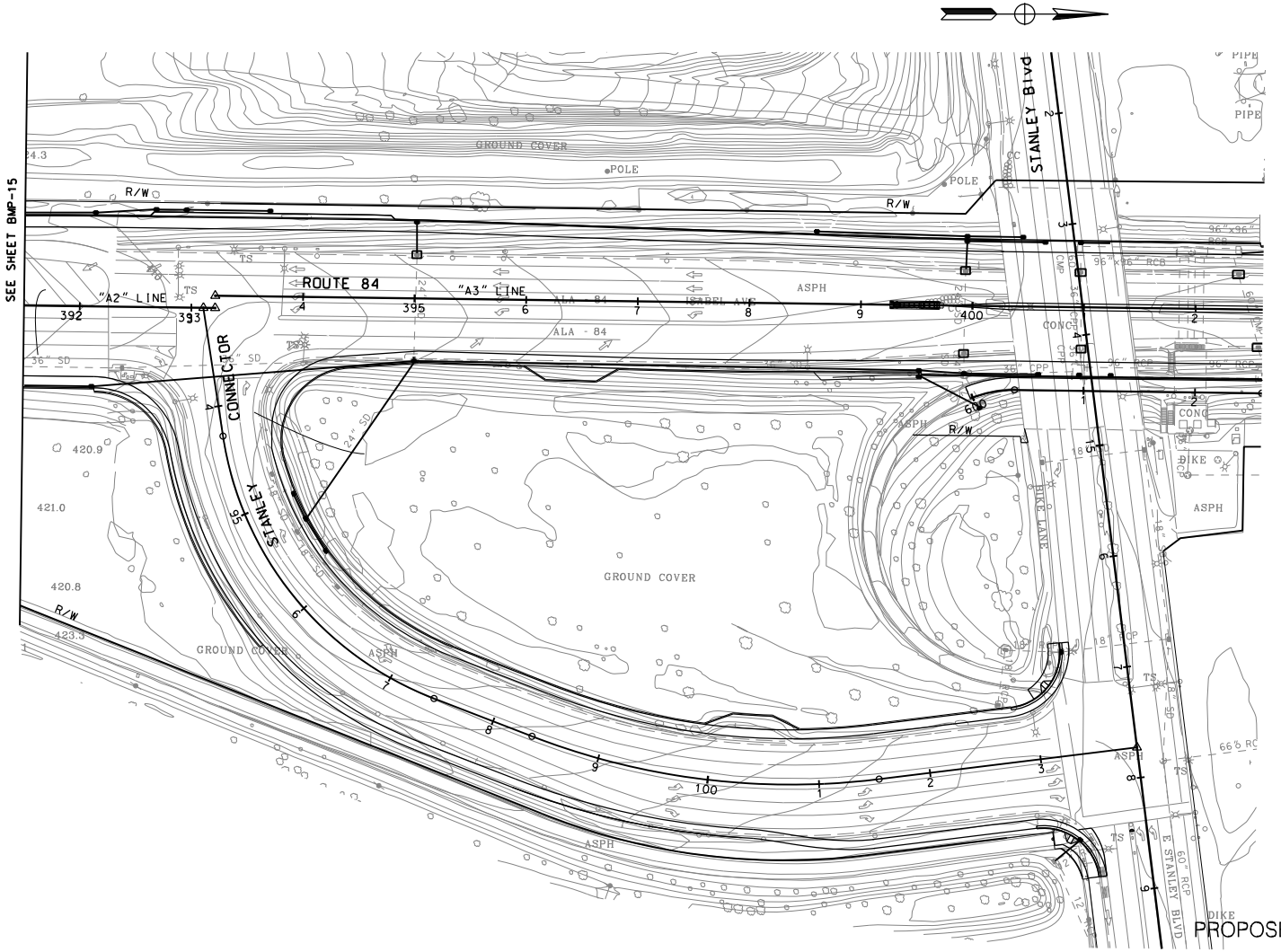

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

BMP– 16

DESIGNED BY	CALCULATED–	CHECKED BY	REVISED BY	DATE REVISED
ANALETTE OCHOA				

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA – DEPARTMENT OF TRANSPORTATION

Caltrans

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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 5:19:55 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = $FILE$

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	17	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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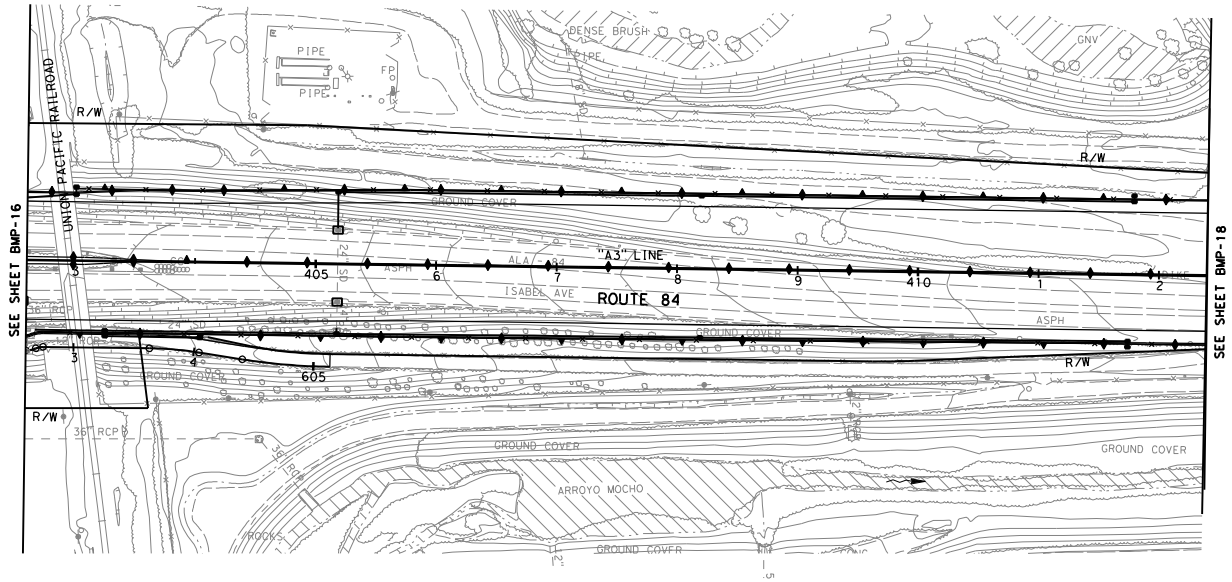

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

BMP-17

CALCULATED-DESIGNED BY	ANALETTE OCHOA	REVISED BY	
CHECKED BY		DATE REVISED	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION			

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LAST REVISION 00-00-00 | DATE PLOTTED => 10/14/2010 | TIME PLOTTED => 1:29:19 PM

BORDER LAST REVISED 3/1/2007 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => Irene_liu | DGN FILE => $FILE$ | CU 00000 | EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	18	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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NOTE:
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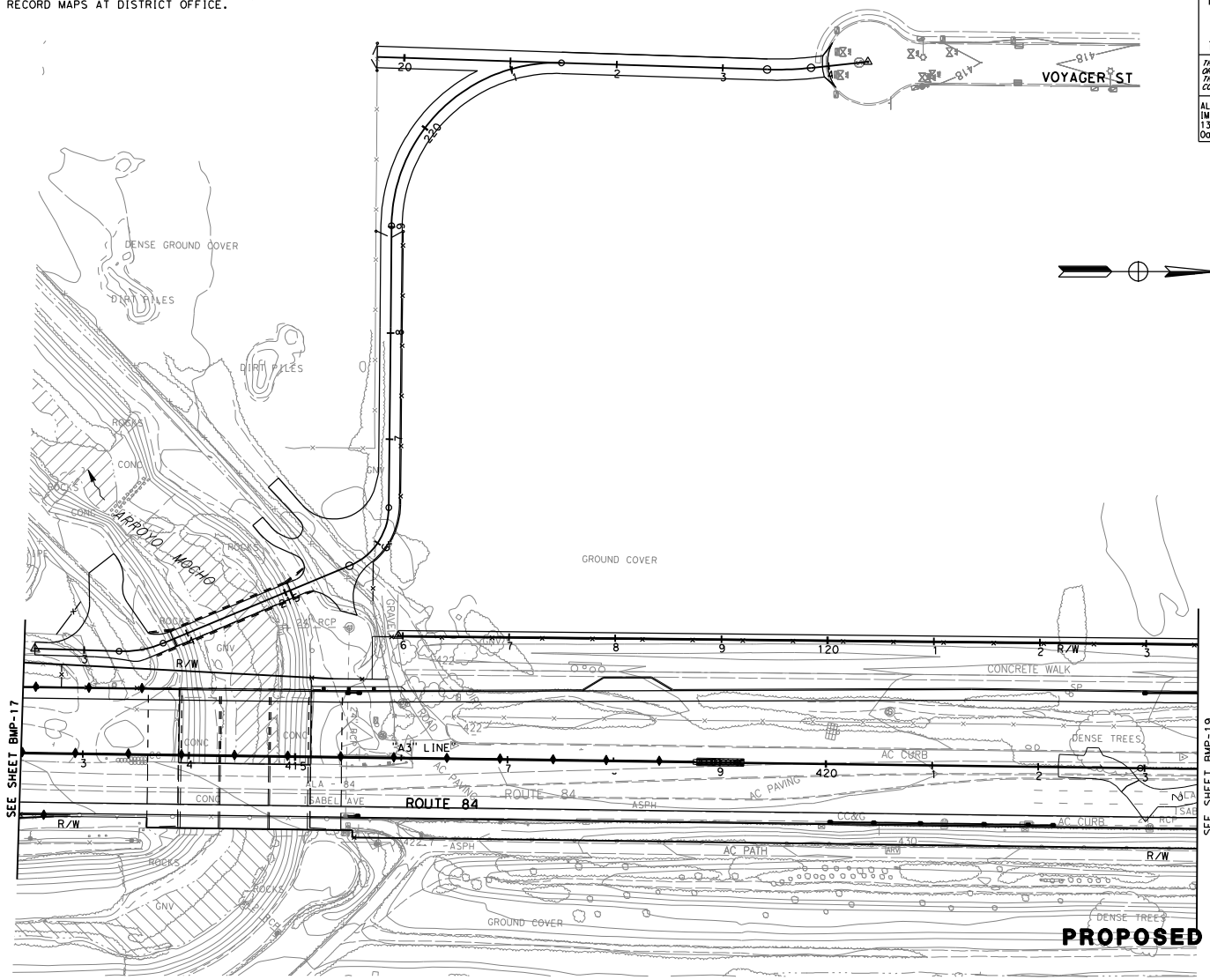

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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BMP-18

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY:
CHECKED BY:
ANALETTE OCHOA
REVISED BY
DATE REVISED

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LAST REVISION 00-00-00
DATE PLOTTED => 10/14/2010
TIME PLOTTED => 12:29:25 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Irene_liu
DGN FILE => $FILE$

CU 00000

EA 297601

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	19	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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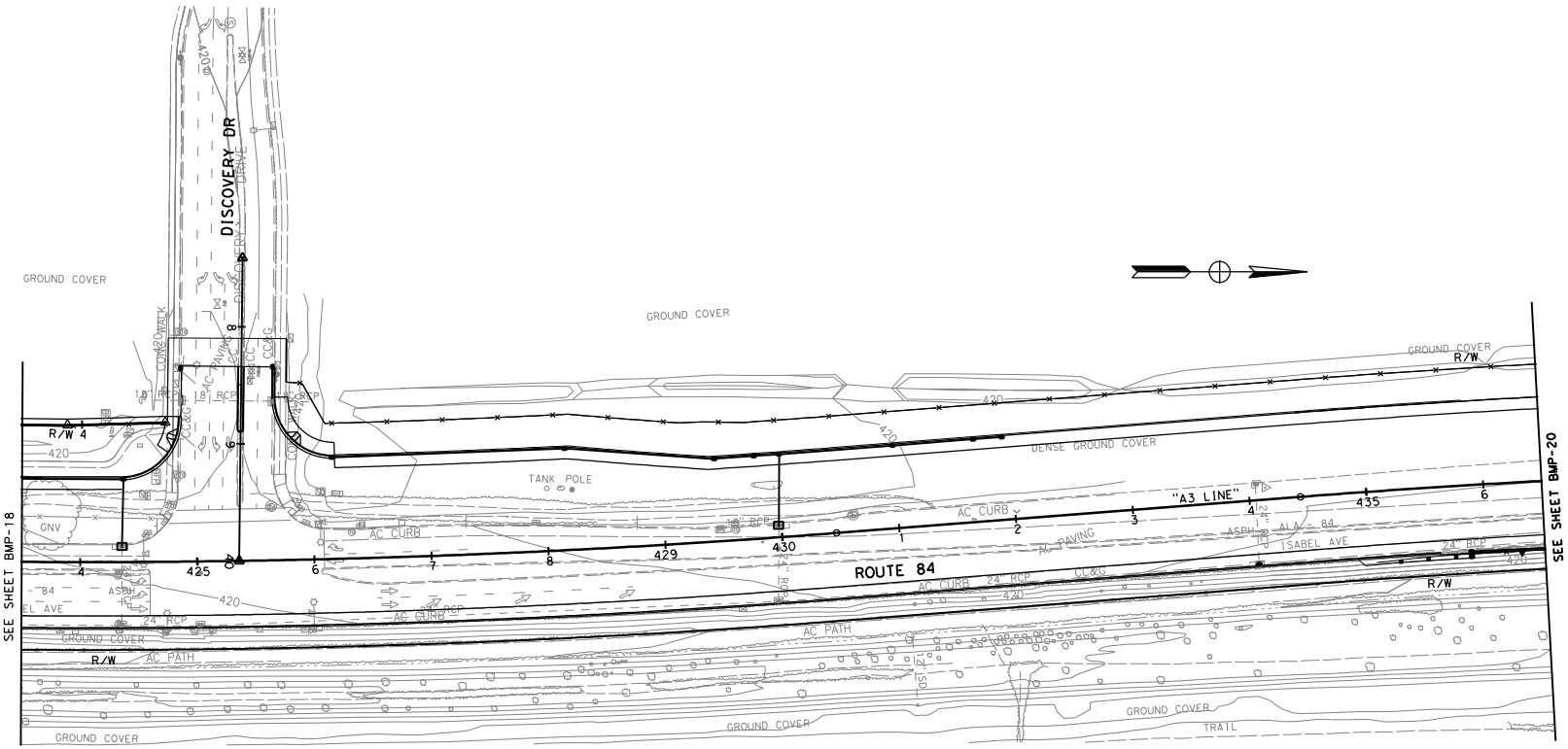

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

BMP-19

REVISED BY	DATE REVISED
ANALETTE OCHOA	

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => Irene_liu
DGN FILE => $FILE$

CU 00000

EA 297601

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SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	20	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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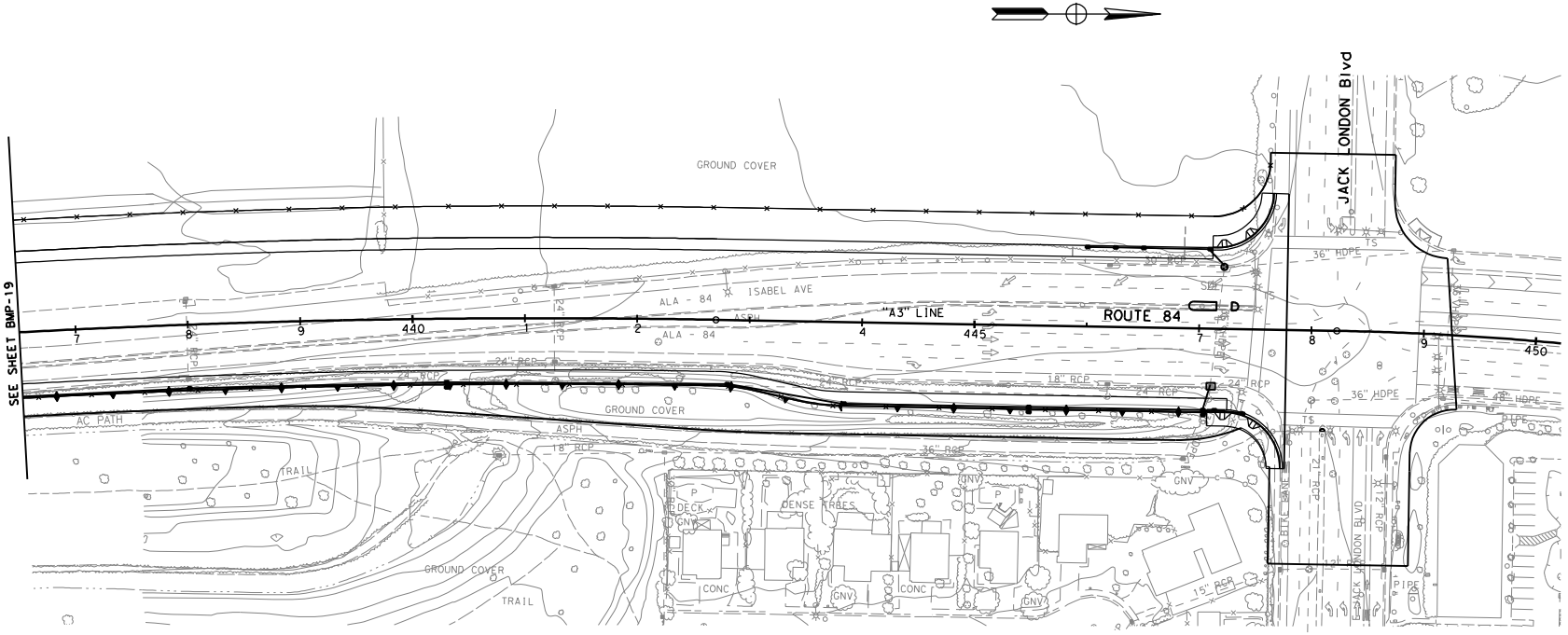

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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BMP-20

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY
CHECKED BY
ANALETTE OCHOA
REVISED BY
DATE REVISED

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LAST REVISION 00-00-00 DATE PLOTTED => 10/14/2010 TIME PLOTTED => 12:29:54 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

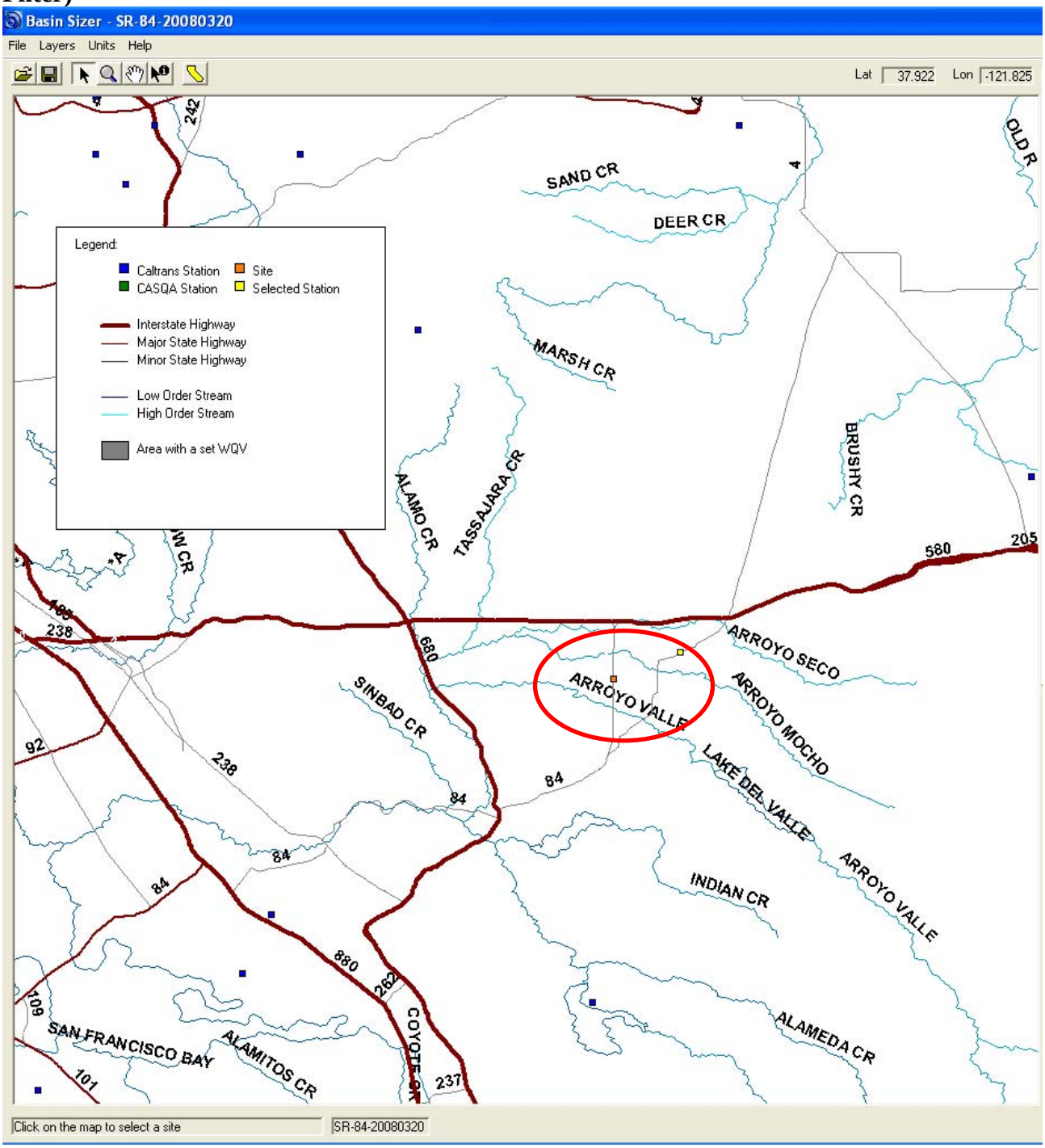
USERNAME => Irene_liu
DGN FILE => $FILE$

CU 00000

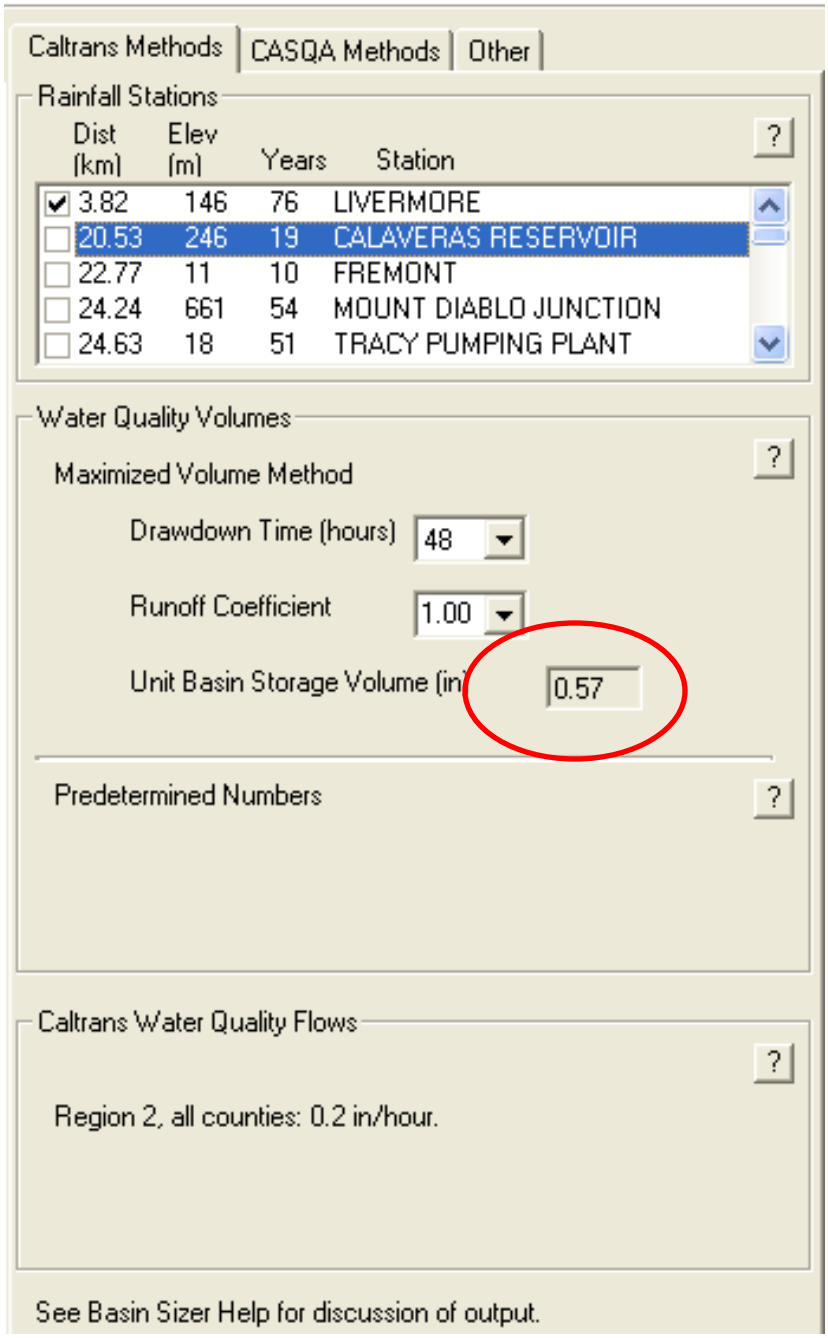
EA 297601

Treatment BMP Calculations

Basin Sizer for Rainfall Intensity for Water Quality Volume (Austin Sand Vault Media Filter)



Basin Sizer for Rainfall Intensity for Water Quality Volume (Austin Sand Vault Media Filter)



Austin Sand Vault Filters Dimensions

ASVF BMP-13 WQV
WQV = Unit Basin Storage Volume (0.0475 ac-ft) multiplied times treatment area = 21,115 cubic feet

DESIGN WATER QUALITY VOLUMES (WQV)					
AVSF Type*	WQV (ft*)	W(ft)	Ls(ft)	Lf(ft)	Hw(ft)
S-3500-3	3.500	21	14	38	3
L-3500-3	3.500	15	18	53	3
S-3500-4.5	4.380	21	14	38	4.5
L-3500-4.5	4.380	15	18	53	4.5
S-3500-6	5.260	21	14	38	6
L-3500-6	5.260	15	18	53	6
S-5000-3	5.000	27	15	42	3
L-5000-3	5.000	18	21	63	3
S-5000-4.5	6.250	27	15	42	4.5
L-5000-4.5	6.250	18	21	63	4.5
S-5000-6	7.500	27	15	42	6
L-5000-6	7.500	18	21	63	6
S-10000-3	10.000	36	21	63	3
L-10000-3	10.000	24	30	94	3
S-10000-4.5	12.500	36	21	63	4.5
L-10000-4.5	12.500	24	30	94	4.5
S-10000-6	15.000	36	21	63	6
L-10000-6	15.000	24	30	94	6
S-15000-3	15.000	45	25	76	3
L-15000-3	15.000	30	37	115	3
S-15000-4.5	18.750	45	25	76	4.5
L-15000-4.5	18.750	30	37	115	4.5
S-15000-6	22.500	45	25	76	6
L-15000-6	22.500	30	37	115	6

* AVSF Type = Length configuration (S or L) - water quality volume (CF) - design water depth (Hw elevation)

ASVF BMP-14 WQV

WQV = Unit Basin Storage Volume (0.0475 ac-ft) multiplied times treatment area = 23,434 cubic feet

DESIGN WATER QUALITY VOLUMES (WQV)

AVSF Type*	WQV (ft*)	W(ft)	Ls(ft)	Lf(ft)	Hw(ft)
S-3500-3	3,500	21	14	38	3
L-3500-3	3,500	15	18	53	3
S-3500-4.5	4,380	21	14	38	4.5
L-3500-4.5	4,380	15	18	53	4.5
S-3500-6	5,260	21	14	38	6
L-3500-6	5,260	15	18	53	6
S-5000-3	5,000	27	15	42	3
L-5000-3	5,000	18	21	63	3
S-5000-4.5	6,250	27	15	42	4.5
L-5000-4.5	6,250	18	21	63	4.5
S-5000-6	7,500	27	15	42	6
L-5000-6	7,500	18	21	63	6
S-10000-3	10,000	36	21	63	3
L-10000-3	10,000	24	30	94	3
S-10000-4.5	12,500	36	21	63	4.5
L-10000-4.5	12,500	24	30	94	4.5
S-10000-6	15,000	36	21	63	6
L-10000-6	15,000	24	30	94	6
S-15000-3	15,000	45	25	76	3
L-15000-3	15,000	30	37	115	3
S-15000-4.5	18,750	45	25	76	4.5
L-15000-4.5	18,750	30	37	115	4.5
S-15000-6	22,500	45	25	76	6
L-15000-6	22,500	30	37	115	6

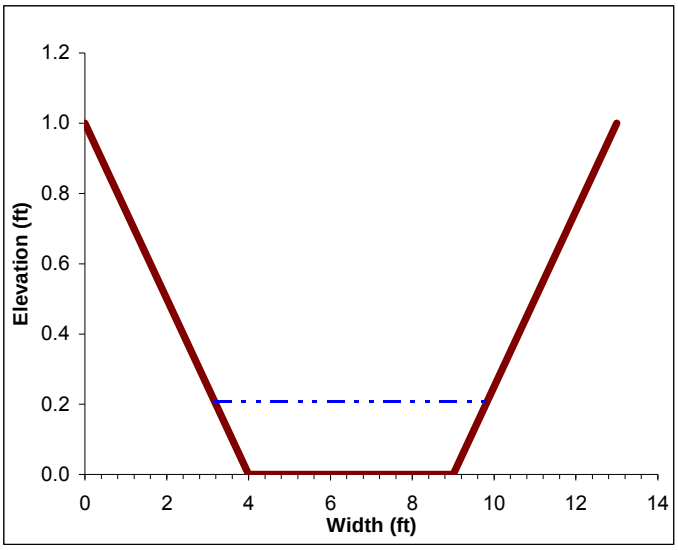
* AVSF Type = Length configuration (S or L) - water quality volume (CF) - design water depth (Hw elevation)

For detailed AVSF calculations, refer to the earlier section of these Supplemental Attachments entitled *Austin Vault Sand Filter Cost Estimate.*

Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 53+76 to 54+59 Lt "Vex" Line 4u

Input Values

Height	1	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.24	
Slope	0.0125	ft/ft
Design Flow	0.27	cfs



Normal Depth for Channel

Depth	0.208	ft
Area	1.22	ft^2
Perimeter	6.72	ft
Rh	0.18	ft
V	0.22	ft/s
Q	0.27	cfs
Goal Seek	0.00	

WQF Calculation, i= 0.2 in/hr

WQF= 0.27 cfs
Length of Swale= 83 feet
HRT (L/(60xV))= 6.2 minutes
Top width of swale= 13 feet

Tributary area for paved areas
37,500 sf
0.86 acre
1 C for paved areas

Tributary area for unpaved areas
35,149 sf
0.81 acre
0.6 C for unpaved areas

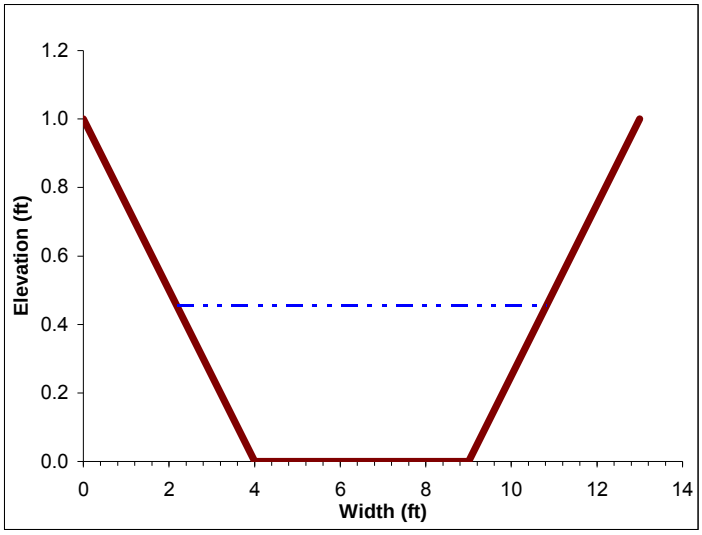
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 53+76 to 54+59 Lt "Vex" Line 4u

Input Values

Height	1	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.05	
Slope	0.009	ft/ft
Design Flow	4.37	cfs

Normal Depth for Channel

Depth	0.454	ft
Area	3.10	ft^2
Perimeter	8.75	ft
Rh	0.35	ft
V	1.41	ft/s
Q	4.37	cfs
Goal Seek	0.00	



Q_{25} Calculation, i= 3.25 in/hr

Outfall Q_{25}(cfs)= 2.80 (paved from drainage outfall)
Q_{25}(cfs)= 1.57 (unpaved)
Length of Swale= 83 feet
Top width of swale= 13 feet
Energy head (He)= 0.49 feet
Freeboard (0.2He)= 0.10 feet

Tributary area for paved areas
37,508 sf
0.86 acre
1 C for paved areas

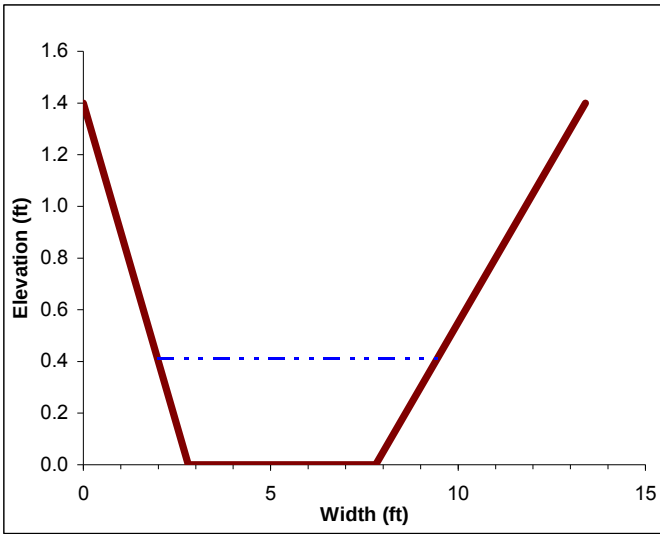
Tributary area for unpaved areas
35,149 sf
0.81 acre
0.6 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation

Biofiltration Swale at Station 105+50 to 107+00 Lt "V" Line 6u

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.24	
Slope	0.018	ft/ft
Design Flow	1.03	cfs



Normal Depth for Channel

Depth	0.412	ft
Area	2.57	ft^2
Perimeter	7.62	ft
Rh	0.34	ft
V	0.40	ft/s
Q	1.03	cfs
Goal Seek	0.00	

WQF Calculation, i= 0.2 in/hr

WQF= 1.03 cfs
Length of Swale= 150 feet
HRT (L/(60xV))= 6.2 minutes
Top width of swale= 13.4 feet

Tributary area for paved areas

128,502 sf
2.95 acre
1 C for paved areas

Tributary area for unpaved areas

160,628 sf
3.69 acre
0.6 C for unpaved areas

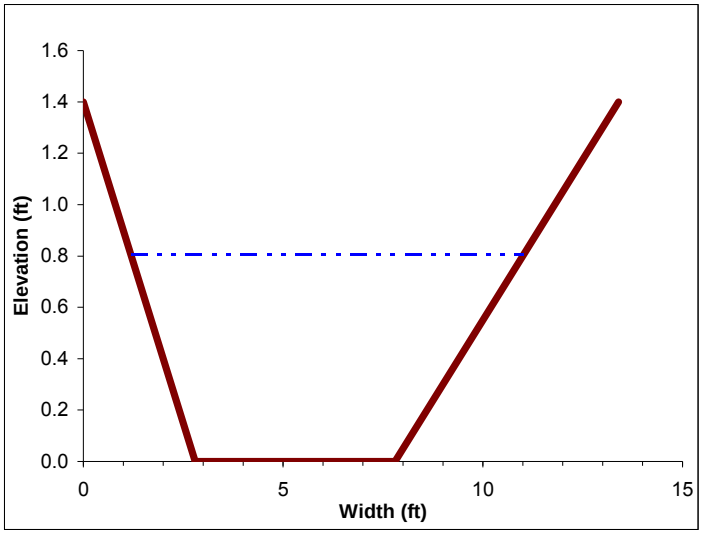
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 105+50 to 107+00 Lt "V" Line 6u

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.05	
Slope	0.018	ft/ft
Design Flow	16.78	cfs

Normal Depth for Channel

Depth	0.806	ft
Area	5.98	ft^2
Perimeter	10.13	ft
Rh	0.59	ft
V	2.81	ft/s
Q	16.78	cfs
Goal Seek	0.00	



Q_{25} Calculation, i= 3.25 in/hr

Outfall Q_{25}(cfs)= 9.59 (paved from drainage outfall)
Q_{25}(cfs)= 7.19 (unpaved)
Length of Swale= 150 feet
Top width of swale= 13.4 feet
Energy head (He)= 0.93 feet
Freeboard (0.2He)= 0.19 feet

Tributary area for paved areas
128,502 sf
2.95 acre
1 C for paved areas

Tributary area for unpaved areas
160,628 sf
3.69 acre
0.6 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation

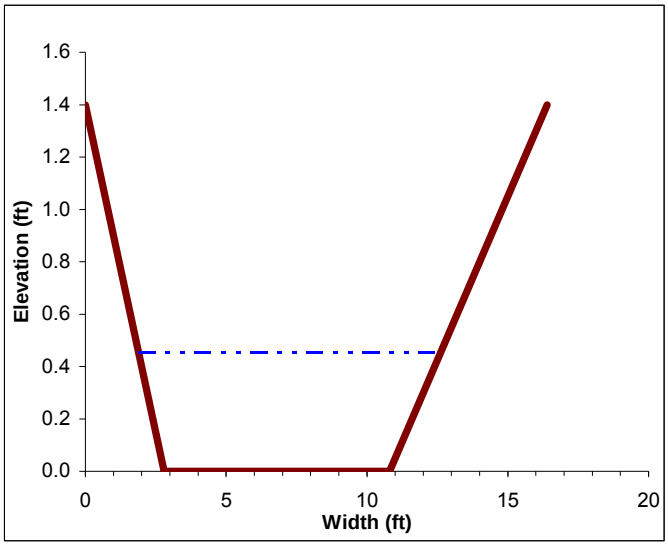
Biofiltration Swale at Station 299+00 to 301+50 Lt "A1" Line 17b

Input Values

Height	1.4	ft
Width	8	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.24	
Slope	0.0115	ft/ft
Design Flow	1.51	cfs

Normal Depth for Channel

Depth	0.455	ft
Area	4.26	ft^2
Perimeter	10.89	ft
Rh	0.39	ft
V	0.36	ft/s
Q	1.51	cfs
Goal Seek	0.00	



WQF Calculation, i= 0.2 in/hr

WQF= 1.51 cfs
Length of Swale= 250 feet
HRT (L/(60xV))= 11.7 minutes
Top width of swale= 16.4 feet

Tributary area for paved areas

135,043 sf
3.10 acre
1 C for paved areas

Tributary area for unpaved areas

324,104 sf Does not include cul-de-sac flows
7.44 acre
0.6 C for unpaved areas

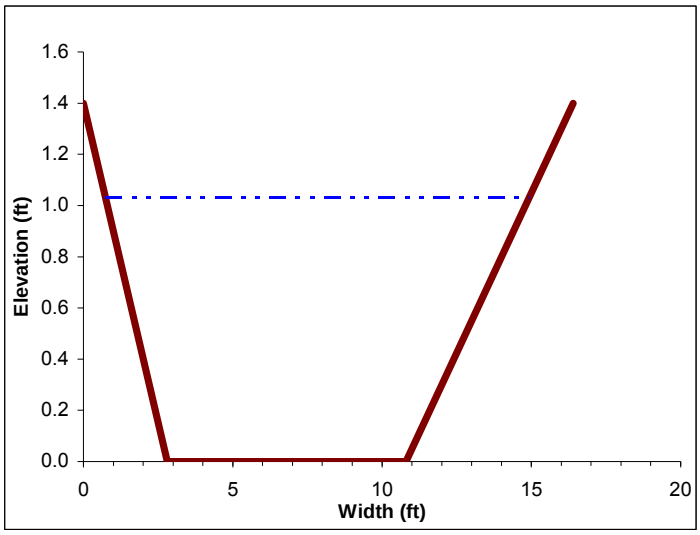
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 299+00 to 301+50 Lt "A1" Line 17b

Input Values

Height	1.4	ft
Width	8	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.05	
Slope	0.013	ft/ft
Design Flow	32.94	cfs

Normal Depth for Channel

Depth	1.030	ft
Area	11.42	ft^2
Perimeter	14.55	ft
Rh	0.79	ft
V	2.88	ft/s
Q	32.94	cfs
Goal Seek	0.00	



Q_{25} Calculation, i= 3.25 in/hr

Outfall Q_{25}(cfs)= 10.08 (paved from drainage outfall)
Q_{25}(cfs)= 22.86 (unpaved)
Length of Swale= 250 feet
Top width of swale= 16.4 **feet**
Energy head (He)= 1.16 feet
Freeboard (0.2He)= 0.23 feet

Tributary area for paved areas
135,043 sf
3.10 acre
1 C for paved areas

Tributary area for unpaved areas
324,104 sf
7.44 acre
0.6 C for unpaved areas

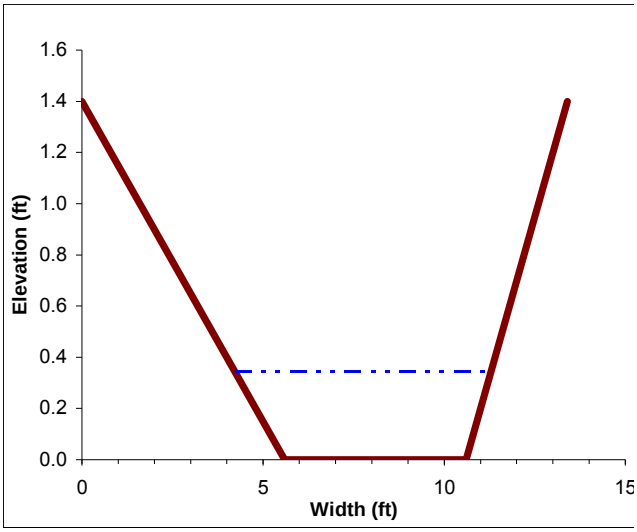
Tributary area for unpaved cul-de-sac areas
279,955 sf
6.43 acre
0.4 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation

Biofiltration Swale at Station 285+14 to 287+64 Rt "A1" Line 16m

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.24	
Slope	0.019	ft/ft
Design Flow	0.77	cfs



Normal Depth for Channel

Depth	0.344	ft
Area	2.07	ft^2
Perimeter	7.19	ft
Rh	0.29	ft
V	0.37	ft/s
Q	0.77	cfs
Goal Seek	0.00	

WQF Calculation, i= 0.2 in/hr

WQF= 0.77 cfs
Length of Swale= 250 feet
HRT (L/(60xV))= 11.2 minutes
Top width of swale= 13.4 feet

Tributary area for paved areas

110,243 sf
2.53 acre
1 C for paved areas

Tributary area for unpaved areas

96,651 sf
2.22 acre
0.6 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation

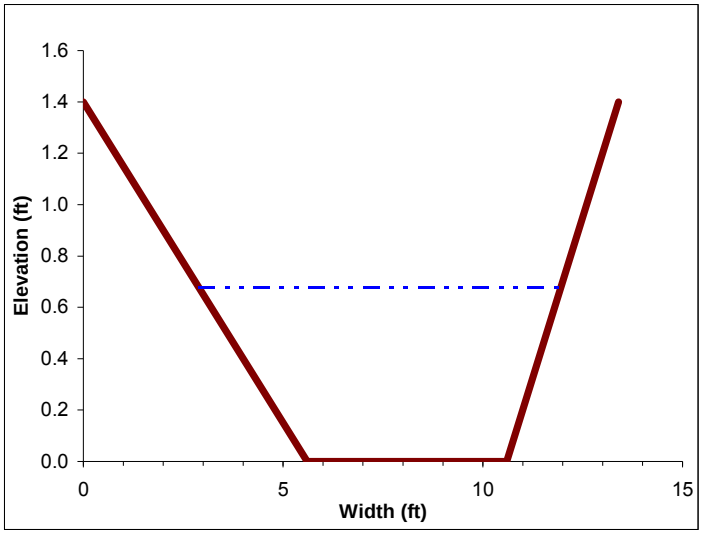
Biofiltration Swale at Station 285+14 to 287+64 Rt "A1" Line 16m

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.05	
Slope	0.019	ft/ft
Design Flow	12.55	cfs

Normal Depth for Channel

Depth	0.679	ft
Area	4.78	ft^2
Perimeter	9.32	ft
Rh	0.51	ft
V	2.63	ft/s
Q	12.55	cfs
Goal Seek	0.00	



Q_{25} Calculation, i= 3.25 in/hr

Outfall Q_{25}(cfs)= 8.2 (paved from drainage outfall)
Q_{25}(cfs)= 4.33 (unpaved)
Length of Swale= 250 feet
Top width of swale= 13.4 feet
Energy head (He)= 0.79 feet
Freeboard (0.2He)= 0.16 feet

Tributary area for paved areas

110,243 sf
2.53 acre
1 C for paved areas

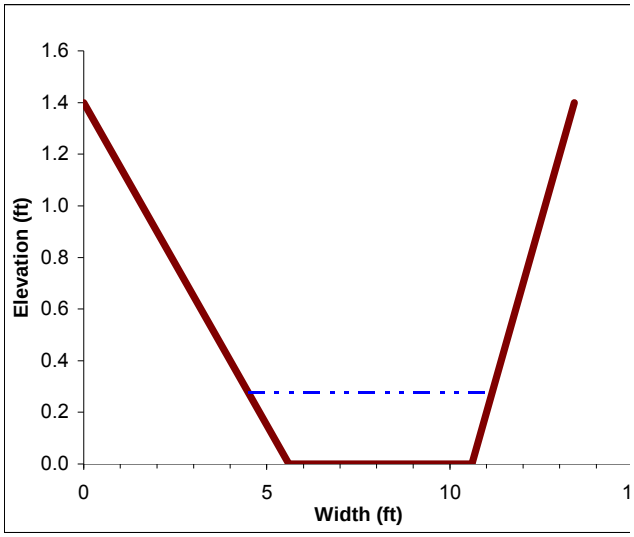
Tributary area for unpaved areas

96,651 sf
2.22 acre
0.6 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 296+04 to 298+04 Rt "A1" Line 18i

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.24	
Slope	0.007	ft/ft
Design Flow	0.32	cfs



Normal Depth for Channel

Depth	0.277	ft
Area	1.61	ft^2
Perimeter	6.76	ft
Rh	0.24	ft
V	0.20	ft/s
Q	0.32	cfs
Goal Seek	0.00	

WQF Calculation, i= 0.2 in/hr

WQF= 0.32 cfs
Length of Swale= 200 feet
HRT (L/(60xV))= 16.7 minutes
Top width of swale= 13.4 feet

Tributary area for paved areas
48,720 sf
1.12 acre
1 C for paved areas

Tributary area for unpaved areas
35,377 sf
0.81 acre
0.6 C for unpaved areas

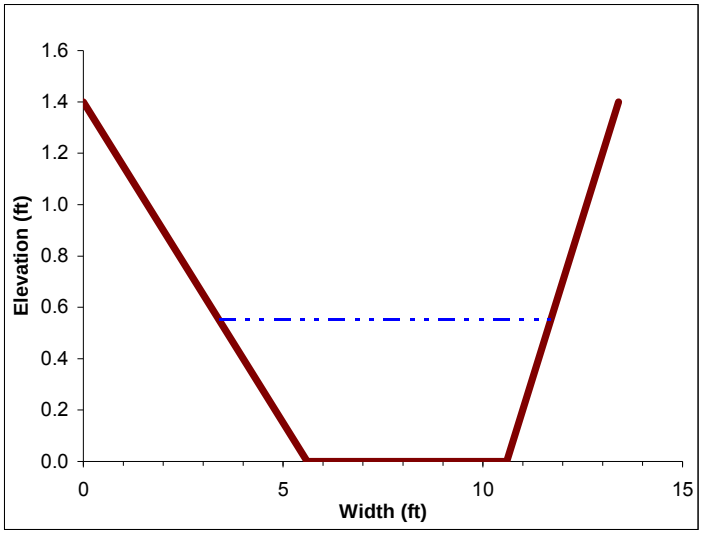
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 296+04 to 298+04 Rt "A1" Line 18i

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.05	
Slope	0.007	ft/ft
Design Flow	5.22	cfs

Normal Depth for Channel

Depth	0.552	ft
Area	3.67	ft^2
Perimeter	8.51	ft
Rh	0.43	ft
V	1.42	ft/s
Q	5.22	cfs
Goal Seek	0.00	



Q_{25} Calculation, i= 3.25 in/hr

Outfall Q_{25}(cfs)= 3.6 (paved from drainage outfall)
Q_{25}(cfs)= 1.58 (unpaved)
Length of Swale= 200 feet
Top width of swale= 13.4 feet
Energy head (He)= 0.58 feet
Freeboard (0.2He)= 0.12 feet

Tributary area for paved areas
48,720 sf
1.12 acre
1 C for paved areas

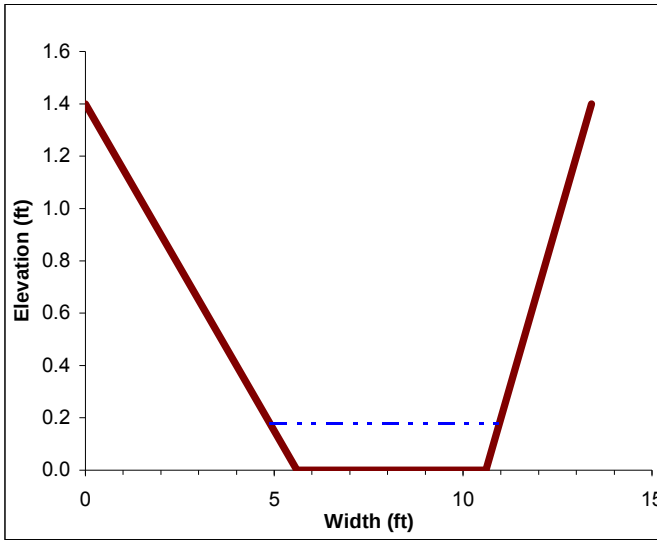
Tributary area for unpaved areas
35,377 sf
0.81 acre
0.6 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation

Biofiltration Swale at Station 301+04 to 302+54 Rt "A1" Line 19e

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.24	
Slope	0.007	ft/ft
Design Flow	0.15	cfs



Normal Depth for Channel

Depth	0.178	ft
Area	0.98	ft^2
Perimeter	6.13	ft
Rh	0.16	ft
V	0.15	ft/s
Q	0.15	cfs
Goal Seek	0.00	

WQF Calculation, i= 0.2 in/hr

WQF= 0.15 cfs
Length of Swale= 150 feet
HRT (L/(60xV))= 16.3 minutes
Top width of swale= 13.4 feet

Tributary area for paved areas

22,846 sf
0.52 acre
1 C for paved areas

Tributary area for unpaved areas

16,517 sf
0.38 acre
0.6 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation

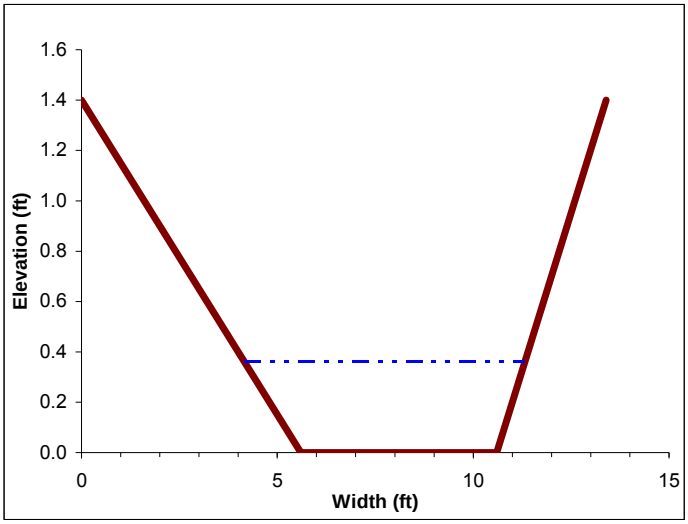
Biofiltration Swale at Station 301+04 to 302+54 Rt "A1" Line 19e

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.05	
Slope	0.007	ft/ft
Design Flow	2.44	cfs

Normal Depth for Channel

Depth	0.360	ft
Area	2.19	ft^2
Perimeter	7.29	ft
Rh	0.30	ft
V	1.12	ft/s
Q	2.44	cfs
Goal Seek	0.00	



Q_{25} Calculation, i= 3.25 in/hr

Outfall Q_{25}(cfs)= 1.7 (paved from drainage outfall)
Q_{25}(cfs)= 0.74 (unpaved)
Length of Swale= 150 feet
Top width of swale= 13.4 feet
Energy head (He)= 0.38 feet
Freeboard (0.2He)= 0.08 feet

Tributary area for paved areas

22,846 sf
0.52 acre
1 C for paved areas

Tributary area for unpaved areas

16,517 sf
0.38 acre
0.6 C for unpaved areas

Normal Depth Calculations for Channels using Manning's Equation

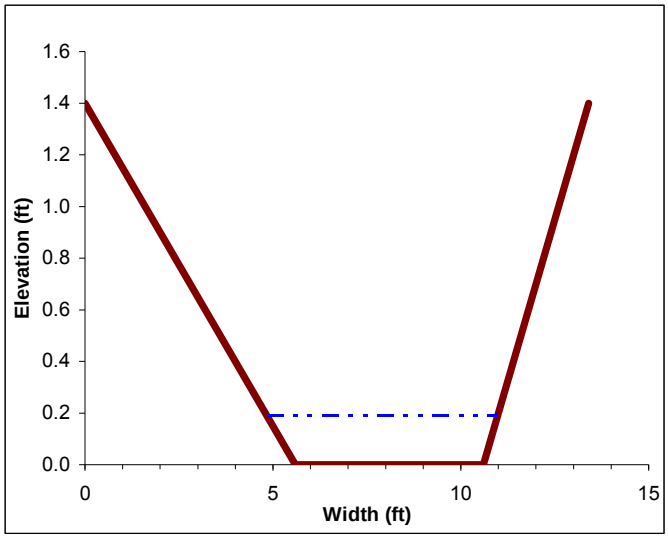
Biofiltration Swale at Station 306+75 to 308+25 Rt "A1" Line 20g

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	4	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.24	
Slope	0.007	ft/ft
Design Flow	0.17	cfs

Normal Depth for Channel

Depth	0.192	ft
Area	1.07	ft^2
Perimeter	6.22	ft
Rh	0.17	ft
V	0.16	ft/s
Q	0.17	cfs
Goal Seek	0.00	



WQF Calculation, i= 0.2 in/hr

WQF= 0.17 cfs
Length of Swale= 150 feet
HRT (L/(60xV))= 15.6 minutes
Top width of swale= 13.4 feet

Tributary area for paved areas

26,355 sf
0.61 acre
1 C for paved areas

Tributary area for unpaved areas

18,094 sf
0.42 acre
0.6 C for unpaved areas

Construction Dewatering Considerations Memo

URS

M E M O R A N D U M

To: Abhijeet Bhoi
URS – San Jose

From: Stephen Huang
URS – San Jose

Date: August 5, 2010

Subject: Construction Dewatering Considerations
Route 84 Expressway Widening
Livermore, CA
Project 28649640

As requested, we have identified locations where construction dewatering might be required. We have assumed groundwater levels encountered in nearby borings will be similar to groundwater levels during construction. In particular we have reviewed the groundwater and soil conditions at these structure locations:

- Bridges
  - Arroyo Del Valle Trail Bridge
    - Abut 1
    - Bent 2
    - Abut 3
  - Arroyo Del Valle (Widen)
    - Abut 1
    - Bent 2
    - Abut 3
  - Arroyo Mocho Access Bridge
    - Abut 1
    - Abut 2
  - Arroyo Mocho (Widen)
    - Abut 1
    - Bent 2
    - Bent 3
    - Abut 4
- Retaining Walls
  - Special
    - RW 246, 391, 400N, 400S and 403
  - Standard Walls
    - RW 109, 110, 236, 245, 314, 317, 320 and 437

Our comments are included herewith.

BRIDGES

It is our engineering opinion that excavations to bottom of pile cap or spread footing will be made in the dry (groundwater below bottom of excavation) at most bridge locations. However, construction dewatering is anticipated at the following locations.

- Arroyo Del Valle Trail Bridge
  - Bent 2; water head of 3.5 feet; clayey sand (SC)
- Arroyo Del Valle Widen
  - Bent 2; water head of 2 feet; clayey sand (SC) and clayey gravel (GC)

Water head is defined as the difference of elevation of water level in boring at time of drilling minus elevation of bottom of excavation.

RETAINING WALLS

It is our engineering opinion that excavations to bottom of spread footings will be made in the dry (groundwater below bottom of excavation) at all retaining wall locations.

ROADWAY CUTS

The roadway cross sections indicate a maximum excavation depth (cut) on the order of 4 feet. The "RB" series hollow stem borings were drilled in the roadway to depths generally in the range of 10 to 15 feet; none of the shallow "RB" borings encountered groundwater. Therefore, in general construction dewatering is not anticipated for the roadway cuts.

DEWATERING RATES

It is difficult to estimate construction pumping rates since (1) neither laboratory permeability tests on soil samples nor (2) field pumping tests were within the scope of work. Nevertheless, it appears where heads are small (less than 5 feet) and SC, GC and CL soils were encountered, that pumping rates might be relatively small. Where heads are moderate (5 to 10 feet) in sands, flow rates may be moderate. Where heads exceed 10 feet in sands, flow rates may be high.

We have performed engineering calculations to estimate the construction dewatering (pumping) rates at Bent 2 of both the (1) Arroyo Del Valle Trail Bridge and (2) Arroyo Del Valle Bridge (Widen). These estimates were based on formula derived from empirical relationships and numerous assumptions; therefore, the estimates are only orders of magnitude approximation. No field pumping tests have been performed at the bridge sites to measure pumping design parameters including, but not limited to, the hydraulic conductivity of the soil. In addition, no laboratory permeability tests have been performed on soil samples from the bridge sites. Based on the site soil conditions and the empirical relationships between grain sizes and permeability, we estimate order of magnitude pumping rates ranging from 30 to 200 gallons per minutes (gpm).

OTHER GROUNDWATER CONSIDERATIONS

CIDH piles that will extend below groundwater are planned at several bridge foundation

locations. Since the tremie method of installing these piles below groundwater will likely be used, only the displaced water will be pumped. If polymer slurry is required to stabilize the hole, additional water may be introduced.

Seasonal fluctuations in groundwater level should be anticipated throughout the year with fluctuations in precipitation, evaporation and surface runoff, as well as any fluctuations in the level of nearby ponds and Arroyo Mocho and Arroyo Del Valle. Groundwater levels encountered during construction could be either higher or lower than the levels measured during this investigation.

LIMITATIONS

The opinions and recommendations presented in this report were developed with the standard of care commonly used by other professionals practicing at the same time, within the same locality and under the same limitations. No other warranties are included, either express or implied, as to the professional advice included in this report.

FOR CONTRACT NO. 297614

DRAINAGE/HYDRAULIC INFORMATION

STORM WATER INFORMATION HANDOUT

DATED 1/2011

State Route 84 Expressway Widening Project – Segment A
Alameda County, California
EA 04-297601
January 2011

Storm Water Information Handout

Prepared for:

Caltrans

Prepared by:

WRECO

January 2011

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Disclaimer

A "Disclaimer" is required specifying that the information provided in the Storm Water Information Handout is just a guideline and is to be used for information purposes only and should not be considered a sole source document to adhere to the requirements of the new National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP), Number CAS000002, adopted on September 2, 2009. The contractor is required to provide water quality monitoring, sampling and implement best management practices (BMPs) based on standard industry operations, field conditions and conditions encountered based on the contractor's means and methods. The information in this handout is not to be construed in any way as a waiver of the provisions in the CGP. Bidders and contractors are cautioned to make independent investigations and examinations as they deem necessary to satisfy the conditions encountered in performance of work, with respect to the following: sampling and monitoring locations, distribution of watershed areas for sizing of BMPs, and selection of BMPs in order to conform to the requirement of the contract documents and the CGP.

1 OVERVIEW

1.1 Intent of this Document

The objectives of this Water Quality Information Handout are: to summarize general water quality information of the Project; to summarize updated requirements per the new Construction General Permit (CGP) adopted on September 2, 2009; to provide general guidelines for contractors to bid on the project; to aid in developing the Storm Water Pollution Prevention Plan (SWPPP) of the project; and to highlight information necessary to file Project Registration Documents (PRDs) to the State Water Resources Control Board via the Stormwater Multi Application Reporting and Tracking System (SMARTS) and file the Notice of Intent at the start of construction.

1.2 Summary of New Requirements

A new CGP was adopted on September 2, 2009 and has been effective starting July 1, 2010. This revised "National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities" (NPDES Number CAS000002) regulates discharges from construction activities within the Project area.

The new CGP is based on a risk level (RL) permitting approach. There are three levels of risk, with RL 3 being the highest. The RL is calculated by 1) project sediment risk, and 2) receiving water risk.

Risk Level 1 projects will be subject to minimum best management practice (BMP) implementation and visual monitoring requirements. Risk Level 2 projects will be subject to Numeric Action Levels (NALs) and some additional monitoring requirements. Risk Level 3 projects will be subject to Numeric Effluent Limitations (NELs) and more rigorous monitoring requirements such as receiving water monitoring and, in some cases, bioassessments. All projects will have to upload storm water data into SMARTS, such as Notices of Intent (NOIs), SWPPPs, annual reports, and monitoring data, as applicable.

A risk assessment was done for the **State Route 84 Expressway Widening Project** (Project), and based on a number of factors set forth in the CGP, it was determined to be **Risk Level 2.** See the risk assessment calculations in Section 3 of this document for details.

2 GENERAL PROJECT INFORMATION

This section summarizes the Project location, features, site information, and site impacts.

2.1 Location

The Project is one segment of a larger project located along State Route 84 (SR 84)/Isabel Avenue in Alameda County, between the cities of Livermore and Pleasanton. The Project has been split into two segments for construction according to the table below. This document concerns Segment A.

Table 1. Project Location by Segment

	Start Location		End Location	
	PM	**Description**	**PM**	**Description**
Segment A	25.5	0.4 mi. north of Concannon Blvd	27.1	Intersection with Jack London Blvd
Segment B	22.9	0.1 mi. south of Ruby Hill Drive	25.7	0.6 mi. north of Concannon Blvd

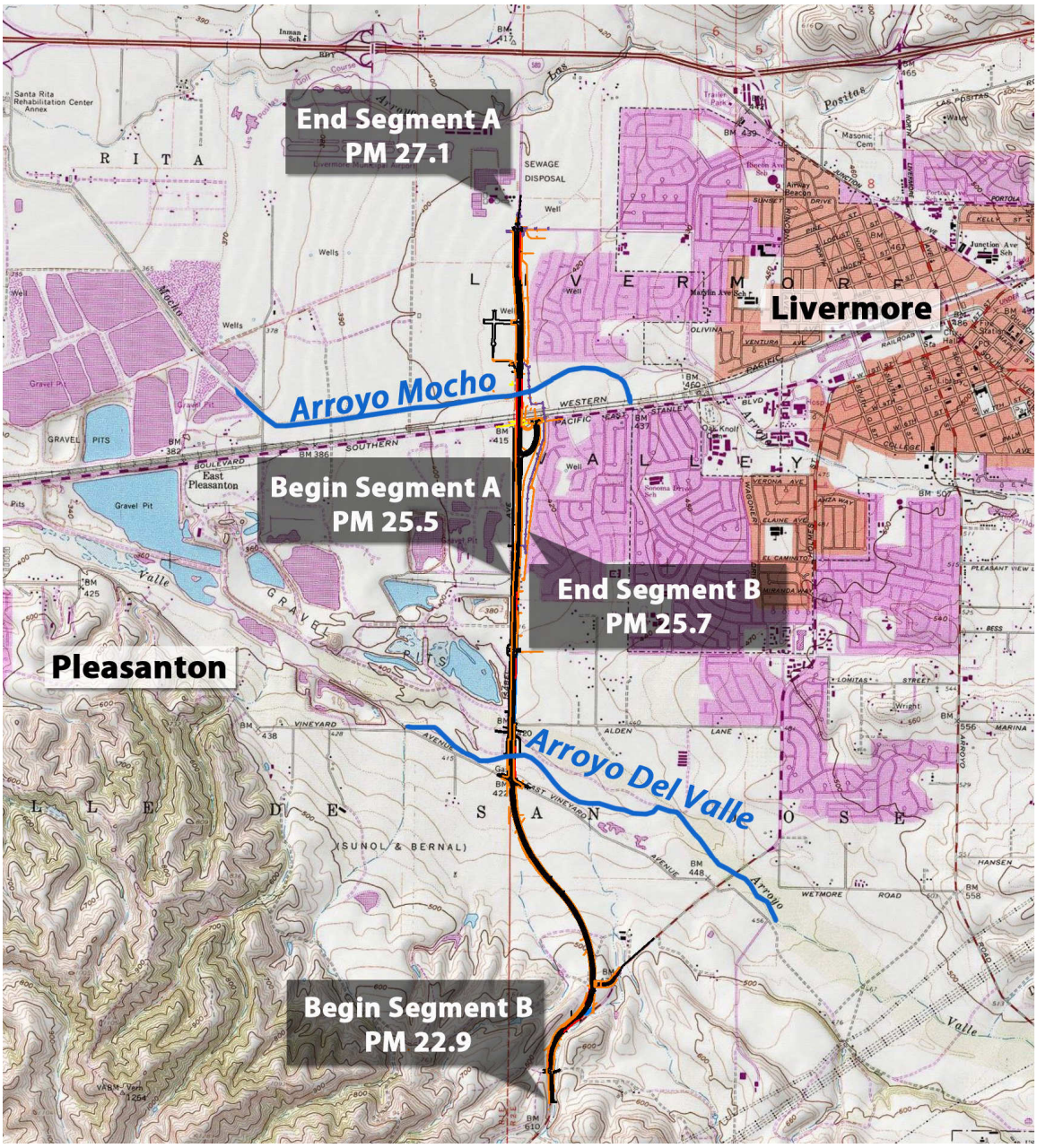

Figure 1. Vicinity Map
Source: USGS

2.2 Major Engineering Features

The Project proposes to widen and upgrade SR 84. The widening would: 1) improve the route as a regional connection between State Routes 680 (SR 680) and 580 (SR 580); 2) improve the local traffic circulation; 3) upgrade the route to expressway standards; and 4) improve pedestrian and bicycle access.

SR 84 would be widened to four lanes between Ruby Hill Drive and Stanley Boulevard, and to six lanes between Stanley Boulevard and Jack London Boulevard. The widening would

generally conform to the existing roadway alignment. Improvements would include: 1) the widening of the Arroyo del Valle and Arroyo Mocho Bridges; 2) the widening and upgrading of signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Discovery Drive and Jack London Boulevard; 3) relocating existing private driveway access to signalized intersections on SR 84; and 4) constructing new bridge crossings at Arroyo Mocho and Arroyo del Valle for private and recreational access.

The roadway cross section would consist of 12-ft wide traveled lanes and 10-ft wide shoulders, divided by a concrete median barrier. Where practical, side slopes would be 4:1 (H:V) or flatter to provide a Clear Recovery Zone (CRZ) for errant vehicles. Outside the CRZ, side slopes would be 2:1 (H:V) or flatter. The roadway median at intersections would be widened up to 36 ft to accommodate left-turn lanes.

2.3 Receiving Water Bodies

The Project falls under the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). It is located in the Alameda Creek Hydrologic Area (Sub-Area number 204.30) of the San Francisco Bay Region's South Bay Hydrologic Unit.

Generally, Segment A runoff discharges to Arroyo Mocho and Arroyo Las Positas, which is 0.3 mi away from the northern Project limit and is a tributary of Arroyo Mocho. Storm water flows from Arroyo Mocho throughout the year, eventually discharging into Arroyo de la Laguna (which is approximately 9 mi from the Project limits).

The State Water Resources Control Board's (SWRCB) *Water Quality Control Plan for the RWQCB Region 2* (SWRCB, 2007), also called the Basin Plan, lists the existing beneficial uses of Arroyo de la Laguna, including uses that generally apply to its tributary streams:

- Groundwater Recharge (GWR)
- Migration of Aquatic Organisms (MIGR)
- Non-contact Water Recreation (REC-2)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Water Contact Recreation (REC-1)
- Wildlife Habitat (WILD)

The potentially beneficial uses of the Arroyo de la Laguna include:

- Cold Freshwater Habitat (COLD)
- Warm Freshwater Habitat (WARM)

The Basin Plan does not list any beneficial uses for Arroyo Mocho and Arroyo Las Positas.

2.4 Creek Crossings

There is one major creek crossing in Segment A. Arroyo Mocho crosses SR 84 underneath a bridge between Stanley Boulevard and Discovery Drive, between Sta "A3" 413+90 to Sta "A3" 415+15. The bridges would be widened as part of this Project. Arroyo Las Positas, which locates

approximately 0.5 mile north of the Project limit, is also a receiving water body for the Project but does not cross SR 84. The locations of these creeks are shown in Figure 2

One new trail bridge and one access bridge would be constructed also as part of the Project. The trail bridge at Arroyo Del Valle would be located 19 ft upstream of the proposed SR 84/Arroyo Del Valle bridge; and the access bridge at Arroyo Mocho would be located approximately 64 ft downstream of the proposed SR 84/Arroyo Mocho bridge. Both bridges would be located outside of Caltrans' R/W. Detailed hydrologic and hydraulic analysis for the bridges proposed for the Project are discussed in the *Final Bridge Design Hydraulic Study Report* (WRECO, 2009).

Figure 2. Creek Crossings
Source: URS

2.5 Climate and Rainfall

According to weather station data from the National Oceanic and Atmospheric Administration (NOAA), the Project area has an average of 36 rainy days (≥ 0.1 in.) per year; the Project areas has an average of 9 days per year that receive at least 0.5 inches of precipitation. See Figure 3 for a table of NOAA precipitation data for the Project site.

Rainfall events are used for Rain Event Action Plans (REAPs), sampling, and monitoring..

2.6 Soils and Geology

The general description of the subsurface soils within the Project is described by the geotechnical report as consisting of a few feet of fill overlying alluvium. The fill is made up of locally derived silt, sand and clay with gravel and occasionally contains asphalt-concrete fragments. The alluvium consists of complexly interbedded sand, silt and clay with gravel and extensive channel deposits of silty gravel, clayey gravel, and poorly graded sand/gravel mixtures (AGS, 2006).

North of Arroyo Del Valle the fine grained soils were generally stiff to hard, with occasional softness, and the coarse grained soils were typically medium dense, to very dense. Cobble and boulders were also identified (AGS, 2006). The *Web Soil Survey*, created by the Natural Resources Conservation Service, is an online program used to identify general soil information of a given area. Using this tool, soils within the Project were identified as being within Hydrologic Soil Groups (HSG) for A, B, or D (see Figure 5). Soils classified as HSG A or HSG B have a higher chance of promoting infiltration. See the soil map in Figure 4.

The soil-erodibility factor (K factor) for this Project is 0.2. Refer to Section 3 of this document for more information about K factor.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data,
and Information Service

Climatography of the United States No. 20 1971-2000

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801
www.ncdc.noaa.gov

Station: LIVERMORE, CA **COOP ID: 044997**

Climate Division: CA 4 **NWS Call Sign:** **Elevation: 480 Feet** **Lat: 37°42N** **Lon: 121°47W**

Precipitation (inches)

	Precipitation Totals									Mean Number of Days (3)				Precipitation Probabilities (1) Probability that the monthly/annual precipitation will be equal to or less than the indicated amount									
	Means/ Medians(1)		Extremes							Daily Precipitation				Monthly/Annual Precipitation vs Probability Levels These values were determined from the incomplete gamma distribution									
Month	Mean	Median	Highest Daily(2)	Year	Day	Highest Monthly(1)	Year	Lowest Monthly(1)	Year	>= 0.01	>= 0.10	>= 0.50	>= 1.00	.05	.10	.20	.30	.40	.50	.60	.70	.80	.90	.95
Jan	2.99	1.94	3.45	1952	12	6.64	1995	.30	1976	10.1	6.2	1.9	.7	.28	.49	.90	1.31	1.77	2.28	2.89	3.65	4.70	6.44	8.14
Feb	2.77	2.71	2.93	1963	1	7.30	1998	.15	1997	9.2	6.2	2.1	.5	.28	.48	.86	1.25	1.67	2.14	2.69	3.38	4.32	5.89	7.42
Mar	2.47	2.32	2.00	1937	21	6.66	1995	.06	1997	9.9	6.4	1.4	.3	.18	.34	.66	.99	1.37	1.81	2.33	3.00	3.92	5.47	7.00
Apr	.96	.76	1.80	1958	3	3.51	1983	.15	1997	5.7	3.0	.3	@	.13	.21	.35	.48	.62	.77	.95	1.17	1.46	1.93	2.39
May	.43	.18	.82	1990	28	2.00	1998	.00+	1992	3.1	1.3	.1	.0	.00	.00	.00	.03	.10	.19	.31	.49	.74	1.21	1.70
Jun	.09	.04	.60	1995	16	.70	1995	.00+	1996	.9	.3	@	.0	.00	.00	.00	.00	.00	.02	.06	.11	.17	.27	.38
Jul	.03	.00	.67	1980	2	.70	1980	.00+	2000	.2	.1	@	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.07	.21
Aug	.08	.00	.50	1983	19	.91	1976	.00+	1998	.5	.2	@	.0	.00	.00	.00	.00	.00	.00	.00	.00	.04	.25	.50
Sep	.24	.04	1.53	1959	19	1.48	1982	.00+	1997	1.4	.6	.1	@	.00	.00	.00	.00	.00	.04	.11	.22	.40	.74	1.09
Oct	.84	.58	2.17	1962	13	2.98	1972	.00+	1995	3.3	1.8	.6	.1	.00	.03	.12	.24	.37	.54	.74	1.01	1.39	2.05	2.71
Nov	1.88	1.37	3.05	1950	19	5.44	1983	.01	1995	7.7	4.4	1.2	.2	.06	.14	.33	.57	.85	1.20	1.64	2.23	3.06	4.52	6.00
Dec	2.04	1.96	3.26	1955	23	5.37	1995	.10	1989	8.4	4.9	1.3	.2	.25	.41	.70	.98	1.28	1.62	2.01	2.49	3.14	4.21	5.25
Ann	14.82	13.37	3.45	Jan 1952	12	7.30	Feb 1998	.00+	Jul 2000	60.4	35.4	9.0	2.0	6.77	8.08	9.88	11.35	12.71	14.08	15.54	17.21	19.32	22.50	25.38

\+ Also occurred on an earlier date(s)
# Denotes amounts of a trace
@ Denotes mean number of days greater than 0 but less than .05
** Statistics not computed because less than six years out of thirty had measurable precipitation

(1) From the 1971-2000 Monthly Normals
(2) Derived from station's available digital record: 1930-2001
(3) Derived from 1971-2000 serially complete daily data
Complete documentation available from:
www.ncdc.noaa.gov/oa/climate/normals/usnormals.html

Figure 3. Rainfall Data
Source: NOAA

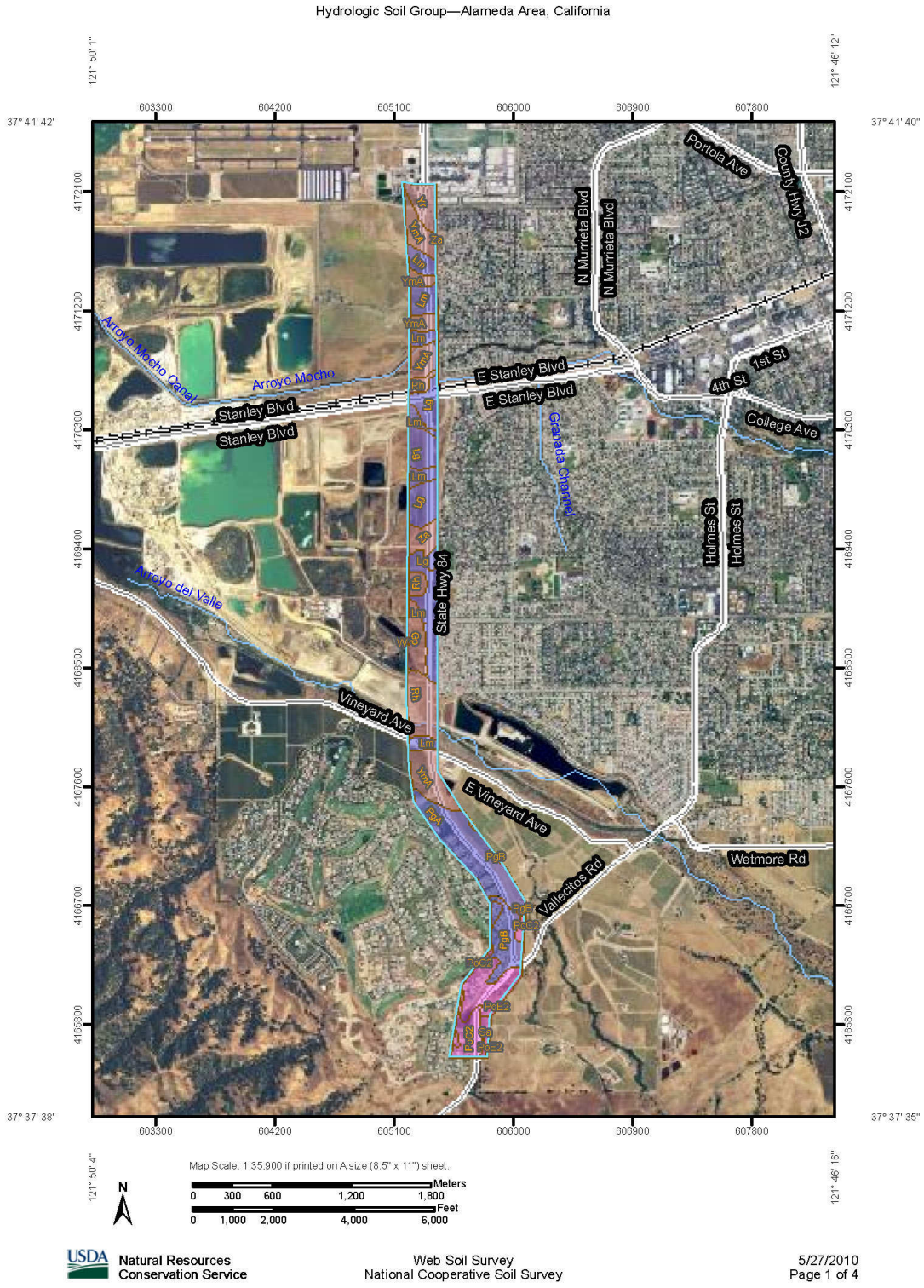

Figure 4. Soil Map
Source: USDA NRCS Web Soil Survey

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Alameda Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Gp	Gravel pit	A	15.5	3.9%
Lg	Livermore gravelly loam	B	49.6	12.4%
Lm	Livermore very gravelly coarse sandy loam	B	69.1	17.2%
PgA	Pleasanton gravelly loam, 0 to 3 percent slopes	B	60.5	15.1%
PgB	Pleasanton gravelly loam, 3 to 12 percent slopes	B	26.3	6.6%
PoC2	Positas gravelly loam, 2 to 20 percent slopes, eroded	D	19.7	4.9%
PoE2	Positas gravelly loam, 20 to 40 percent slopes, eroded	D	32.1	8.0%
PtB2	Positas gravelly loam, thick surface, 2 to 10 percent slopes, eroded	D	0.0	0.0%
Rh	Riverwash	A	36.5	9.1%
Sa	San Ysidro loam	D	3.3	0.8%
W	Water		0.1	0.0%
YmA	Yolo loam, 0 to 3 percent slopes	A	61.9	15.4%
Yr	Yolo gravelly loam, 0 to 3 percent slopes	A	14.6	3.6%
Za	Zamora silt loam, 0 to 4 percent slopes	A	12.0	3.0%
Totals for Area of Interest			**401.2**	**100.0%**

Figure 5. Hydrologic Soil Group
Source: USDA NRCS Web Soil Survey

2.7 Hazardous Waste

The *Initial Site Assessment* (ISA), prepared for the Project by BASELINE Environmental Consulting in December 2005, identifies areas of potential concern due to the presence of hazardous materials. The potential sources of contamination included: agriculture, chemical residue, Aerially Deposited Lead (ADL) from vehicle exhaust, and the dumping of household refuse near the intersection of Isabel Avenue and Jack London Boulevard. The ISA states that, while there may be residue from a remediated site at 1901 Isabel Avenue (between Concannon Boulevard and Vineyard Avenue), none of the other reported releases would be likely to affect Project development.

A soil and groundwater investigation was conducted in April 2008. The conclusion mentions that the soils in the Project area would be considered non-hazardous; in addition, the hazardous issues mentioned in the 2005 ISA are dated to have existed before completion of several recent projects in the area.

The ISA suggests excavation activities may uncover soils within the alignment that could be potentially classified as hazardous waste, depending on the total or soluble lead content in the soils. These contaminated lead soils within Caltrans' R/W are known as ADL. However, the

soil and groundwater investigation conducted in April 2008 did not find any presence of ADL above the Total Threshold Limit Concentration (TTLC) and STLC threshold. In addition, most of the Project area has been reconstructed after 1993, and no ADL has been found in the Project area by earlier projects. Therefore, there are no special handling instructions for ADL, and the ADL variance would not be invoked for this Project.

2.8 Existing (Pre-Construction) Control Practices

There are no existing BMPs in Segment A.

3 CONSTRUCTION GENERAL PERMIT

To minimize the potential effects of construction runoff on the quality of the receiving water bodies, any construction activity affecting one acre or more must obtain coverage under the CGP. Permit applicants are required to prepare a SWPPP and implement BMPs to reduce construction effects on receiving water quality. The CGP risk assessment is for the project as a whole.

3.1 Risk Assessment

The new CGP requirements include a risk assessment to determine the Project's impact risk to receiving water bodies. The risk assessment uses measurements of the Project's potential sediment risk and the sensitivity of the receiving water bodies to sediment to determine the risk level of the Project. Risk was assessed as an average for the entire Project, including both segments in the calculations. This Project has a **Medium Site Sediment Risk Factor** and a **Low Receiving Water Risk Factor**; the combined risk is **Level 2.** The risk factors are detailed in the following sections.

3.1.1 Sediment Risk

The sediment risk is based on the following equation from the adopted NPDES permit "Fact Sheet" (Section J.1.a pg. 28):

Equation 1. Sediment Risk Equation
A = (R)(K)(LS)(C)(P)

Where:

R = Runoff erosivity factor
K = Soil erodibility factor
LS = Length-slope
C = Cover
P = Management operations and support practices
A = Rate of sheet and rill erosion (tons per acre)

The rainfall runoff erosivity factor (R) of **79.68** was determined from the United States Environmental Protection Agency (EPA) "Rainfall Erosivity Factor Calculator for Small Construction Sites."

The soil erodibility factor (K) of **0.2** was determined from the United States Department of Agriculture Natural Resources Conservation Services "Web Soil Survey."

The length-slope factor (LS) of **1.51** was determined by examining the original grade delineated on the Typical Cross Sections included in the Contract Project Plans.

The cover factor (C) and management operations and support practices (P) are given values of 1.0 by the adopted NPDES permit to simulate bare ground conditions.

Based on these factors, the rate of sheet and rill erosion (A) is **24.06** tons per acre.

Table 2. Sediment Risk Factor

R Factor	Rainfall runoff erosivity	**79.68**
K Factor	Soil erodibility	**0.2**
LS Factor	Length-slope	**1.51**
RxKxLS	Watershed Erosion Estimate	**24.06 tons/acre**
Site Sediment Risk Factor	Low Sediment Risk: < 15 tons/acre Medium Sediment Risk: >=15 and <75 High Sediment Risk: >= 75	**MEDIUM**

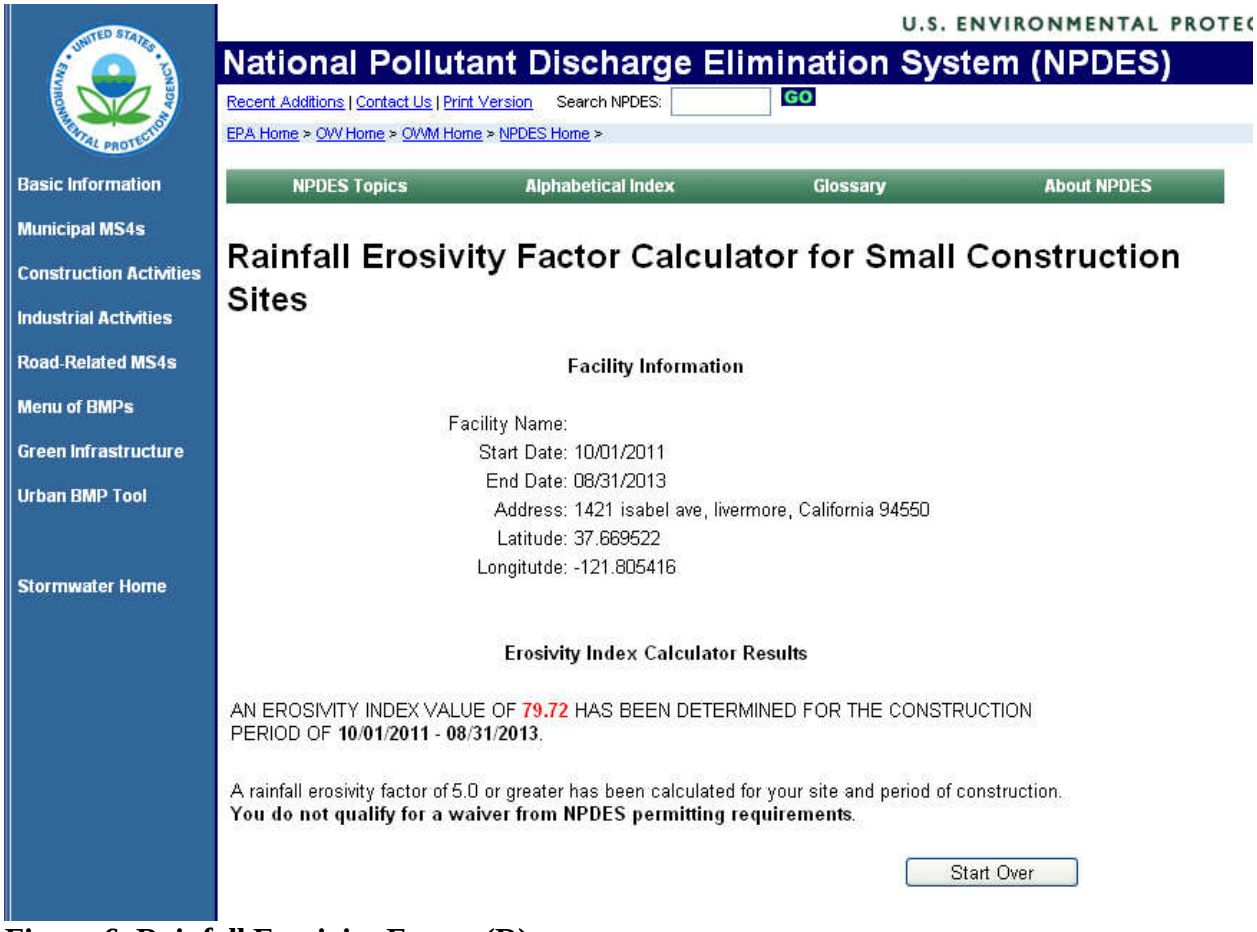

Figure 6. Rainfall Erosivity Factor (R)

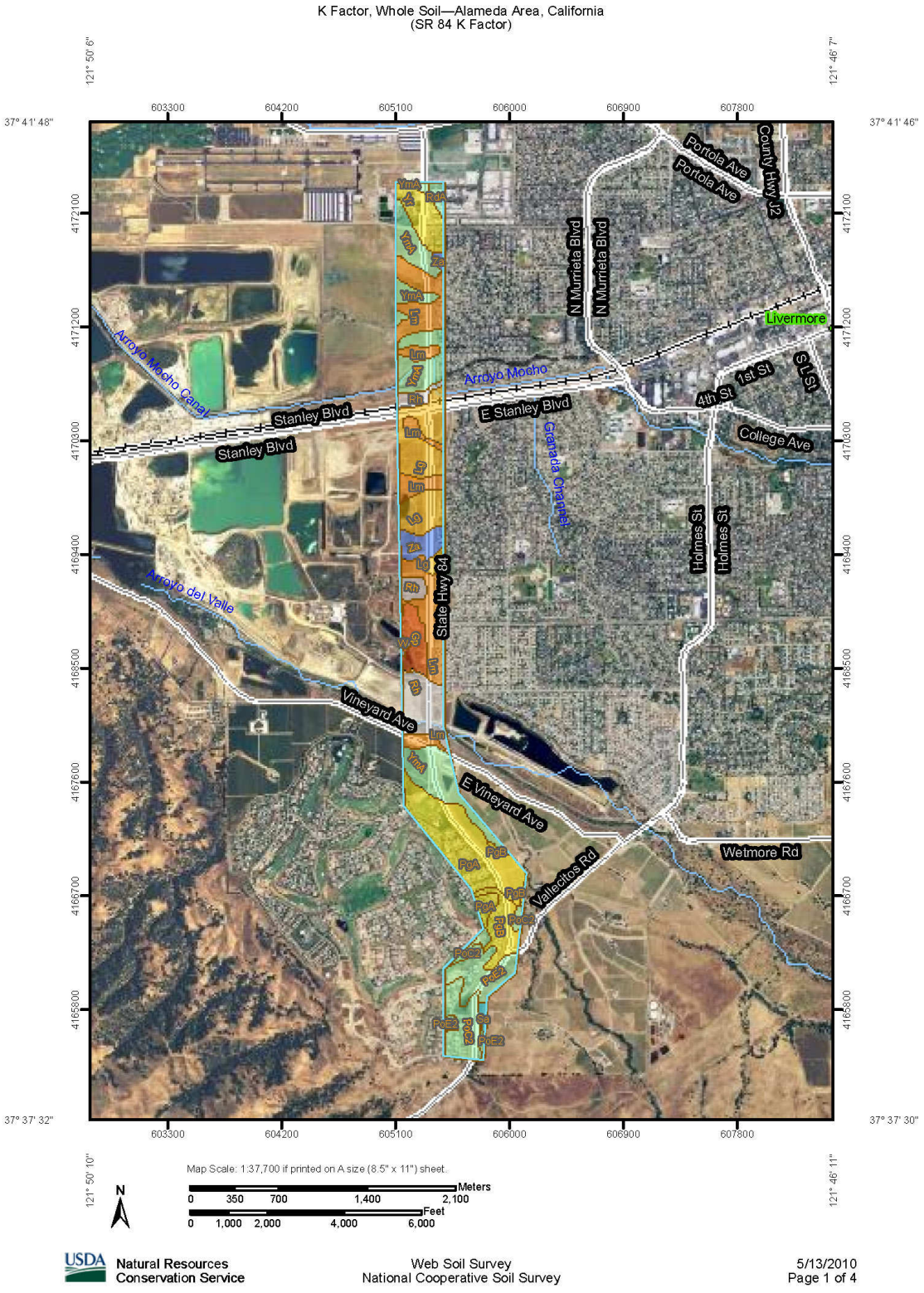

Figure 7. K Factor Soil Map

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Alameda Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Gp	Gravel pit	.05	21.2	3.2%
Lg	Livermore gravelly loam	.15	79.0	12.1%
Lm	Livermore very gravelly coarse sandy loam	.10	110.9	16.9%
PgA	Pleasanton gravelly loam, 0 to 3 percent slopes	.17	97.9	15.0%
PgB	Pleasanton gravelly loam, 3 to 12 percent slopes	.17	30.3	4.6%
PoC2	Positas gravelly loam, 2 to 20 percent slopes, eroded	.28	40.8	6.2%
PoE2	Positas gravelly loam, 20 to 40 percent slopes, eroded	.28	44.3	6.8%
PtB2	Positas gravelly loam, thick surface, 2 to 10 percent slopes, eroded	.28	1.1	0.2%
RdA	Rincon clay loam, 0 to 3 percent slopes	.28	6.1	0.9%
Rh	Riverwash		56.3	8.6%
Sa	San Ysidro loam	.37	3.5	0.5%
W	Water		1.2	0.2%
YmA	Yolo loam, 0 to 3 percent slopes	.28	112.5	17.2%
Yr	Yolo gravelly loam, 0 to 3 percent slopes	.17	29.1	4.4%
Za	Zamora silt loam, 0 to 4 percent slopes	.49	20.5	3.1%
Totals for Area of Interest			**654.8**	**100.0%**

Figure 8. Soil erodibility factor (K) based on soil map

Table 3. LS Factor Calculations

Station	Line	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Length - L (ft)	Slope - S	L x S	Total L (ft)	Avg S
227+00	A1	4.24	0.16	0.67	2.45	0.06	0.14	1.58	0.57	0.91	4.86	0.41	2.00	9.60	0.21	2.00							22.73	0.25
237+00	A1	24.85	0.07	1.62	30.04	0.45	13.50	13.87	0.04	0.62	14.24	0.08	1.08										83.00	0.20
247+00	A1	46.79	0.32	14.88	10.06	0.03	0.27	40.85	0.07	2.95													97.70	0.19
257+00	A1	25.56	0.39	10.00	14.25	0.10	1.43	56.50	0.02	1.30	9.70	0.03	0.33	34.14	0.39	13.20	14.05	0.04	0.50				154.19	0.17
267+00	A1	8.80	0.23	2.04	12.83	0.02	0.25	22.85	0.04	1.01													44.47	0.07
277+00	A1	3.98	0.00	0.01	33.17	0.04	1.44	4.54	0.33	1.51													41.69	0.07
287+00	A1	4.46	0.04	0.19	4.59	0.30	1.38	4.22	0.28	1.18	16.65	0.01	0.09	21.51	0.01	0.24	4.34	0.04	0.17	3.17	0.19	0.60	58.94	0.07
297+00	A1	3.83	0.01	0.03	6.09	0.08	0.46	11.00	0.01	0.13	30.02	0.02	0.69										50.94	0.03
307+00	A1	7.56	0.02	0.14	12.23	0.09	1.12	4.24	0.07	0.28	8.46	0.18	1.51	31.05	0.02	0.65							63.54	0.06
317+00	A1	10.19	0.37	3.80	18.80	0.21	3.89	8.20	0.47	3.87	18.39	0.03	0.60										55.58	0.22
327+00	A1	28.59	0.00	0.00	14.12	0.23	3.19	15.41	0.25	3.86	41.33	0.00	0.14										99.45	0.07
337+00	A1	30.54	0.01	0.32	13.03	0.16	2.10	17.31	0.60	10.33	16.44	0.02	0.25	4.43	0.09	0.40	6.15	0.27	1.64	6.75	0.08	0.51	94.65	0.16
345+00	A1	49.26	0.08	3.75	33.33	0.02	0.60																82.59	0.05
364+00	A2_A	7.65	0.00	0.00	11.21	0.03	0.33			0.00			0.00										18.86	0.02
374+00	A2_A	13.40	0.00	0.00	2.89	0.17	0.49	1.75	0.00	0.00	2.77	0.24	0.66										20.81	0.06
384+00	A2_A	17.61	0.03	0.61																			17.61	0.03
392+00	A2_A	36.30	0.20	7.26	18.31	-0.01	-0.22																54.61	0.13
393+00	A2_A	5.75	0.02	0.12	4.15	0.21	0.89																9.90	0.10
346+00	A2_B	8.51	0.00	0.01	4.16	0.06	0.25																12.67	0.02
356+00	A2_B	6.52	0.02	0.10	6.79	0.20	1.39	8.96	0.08	0.69													22.27	0.10
366+00	A2_B	4.40	0.09	0.40	14.20	0.01	0.08																18.60	0.03
395+00	A3_A	6.58	0.60	3.97	23.55	0.42	9.87	24.41	0.11	2.74	33.05	0.02	0.69										87.59	0.20
405+00	A3_A	13.82	0.03	0.47	10.39	0.04	0.46			0.00			0.00										24.21	0.04
413+50	A3_A	29.10	0.00	0.03	12.73	0.21	2.70	40.48	0.01	0.25	3.06	0.04	0.12	8.14	0.03	0.25							93.51	0.04
423+00	A3_A	5.29	0.06	0.32	13.25	0.01	0.11																18.54	0.02
433+00	A3_A	21.89	0.01	0.13																			21.89	0.01
443+00	A3_A	20.80	0.02	0.48																			20.80	0.02
122+00	AC1_A	15.69	0.00	0.07																			15.69	0.00
133+00	AC1_A	3.99	0.03	0.13	24.49	0.12	3.06	5.43	0.29	1.57	11.55	0.46	5.31										45.46	0.22
143+00	AC1_A	29.75	0.02	0.48	10.36	0.30	3.15	6.39	0.55	3.53													46.50	0.15
153+00	AC1_A	9.24	0.02	0.16	16.71	0.32	5.35	17.56	0.65	11.49	26.56	0.49	12.99	14.39	0.02	0.27							84.46	0.36
162+00	AC1_A	10.87	0.02	0.17	7.15	0.23	1.68	16.12	0.47	7.58			0.00										34.14	0.28
95+00	ST_A	50.51	0.01	0.41	16.48	0.08	1.35	7.95	0.33	2.62	14.57	0.49	7.14	10.62	0.48	5.05	4.51	0.22	1.00	40.41	0.02	0.64	145.05	0.13
103+00	V_B	18.64	0.22	4.06	8.28	0.27	2.24																26.92	0.23
113+00	V_B	4.10	0.40	1.64	9.75	0.07	0.64																13.85	0.16
53+30	VEX_B	72.36	0.04	2.72	66.76	0.07	4.73																139.12	0.05
18+70	VIN_B	34.70	0.00	0.09	3.08	0.06	0.17	1.85	0.06	0.12			0.00										39.63	0.01
																						AVERAGE	73.04	0.12

Table 4. LS Factor Table

L / Slope	12%
50	1.15
73	**1.5088**
75	1.54

3.1.2 Receiving Water Body Risk

The receiving water risk is classified as **Low** because none of the receiving water bodies is on the 303(d) List as impaired for sediment; additionally, none of the receiving water bodies has the beneficial uses of SPWN, COLD and MIGR.

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**
2	**A) R Factor**		
3	Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site.		
4	http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm		
5	**R Factor Value**		79.68
6	**B) K Factor (weighted average, by area, for all site soils)**		
7	The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because of high infiltration resulting in low runoff even though these particles are easily detached. Medium-textured soils, such as a silt loam, have moderate K values (about 0.25 to 0.45) because they are moderately susceptible to particle detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted.		
8	Site-specific K factor guidance		
9	**K Factor Value**		0.2
10	**C) LS Factor (weighted average, by area, for all slopes)**		
11	The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.		
12	LS Table		
13	**LS Factor Value**		1.51
14			
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**		24.06336
16	**Site Sediment Risk Factor**		**Medium**
17	Low Sediment Risk: < 15 tons/acre		
18	Medium Sediment Risk: >=15 and <75 tons/acre		
19	High Sediment Risk: >= 75 tons/acre		
20			

Figure 9. Sediment Risk Factor Worksheet

Receiving Water (RW) Risk Factor Worksheet	Entry	Score
A. Watershed Characteristics	**yes/no**	
A.1. Does the disturbed area discharge (either directly or indirectly) to a **303(d)-listed waterbody impaired by sediment**? For help with impaired waterbodies please check the attached worksheet or visit the link below:	**No**	**Low**
2006 Approved Sediment-impared WBs Worksheet		
http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml		
OR		
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY?		
http://www.ice.ucdavis.edu/geowbs/asp/wbguse.asp		

Figure 10. Receiving Water Risk Worksheet

Combined Risk Level Matrix

Receiving Water Risk	Sediment Risk: Low	Sediment Risk: Medium	Sediment Risk: High
Low	Level 1	Level 2	
High	Level 2		Level 3

Project Sediment Risk:	**Medium**
Project RW Risk:	**Low**
Project Combined Risk:	**Level 2**

Figure 11. Combined Risk Level Matrix

3.2 Notice of Termination (NOT)

The CGP provides both revised and new requirements for completion and approval of the NOT. The NOT requirements are presented in Section II.D of the new CGP permit "Order." These requirements include demonstrating through photos, computational proof or other "custom methods," such as results of testing and analysis, that the terms of the NOT have been satisfied.

While these methods of demonstrating compliance are at the option of the contractor, should the RWQCB determine that the visual photos do not adequately show compliance, further computational efforts may be required. This computational proof is obtained through the use of the Revised Universal Soil Loss Equation 2 (RUSLE2) program.

4 RUN-ON DISCHARGES

The calculations are based on a rainfall intensity for a 2-year, 24-hour event. The calculations use the watershed delineations created with Microstation software. Off-site watershed plans are included in Appendix H. These discharge calculations are used to design storm water BMPs during construction. Figure 10 shows the calculations based on the equation below.

Equation 1. Run-on Discharge Equation

$$Q = CiA$$

Where:

C = Area Runoff Coefficient
i = Area Rainfall Intensity (in/hr)
A = Drainage Area (ac)

And:

Q = Site Area Run-on Discharge (cfs)
i = 1.471 in/hr

Table 5. Run-On Discharge Calculations

Watershed 1:		**2.535** **ac**			
Area (ac)	C	Intensity (in/hr)	C*A	Weighted C	Q=CiA (cfs)
0.14	0.60	0.084	0.087		
0.15	0.60	0.084	0.090		
0.32	0.60	0.084	0.191		
0.04	0.60	0.084	0.026		
0.04	0.60	0.084	0.025		
0.02	0.60	0.084	0.011		
0.05	0.60	0.084	0.028		
0.20	0.60	0.084	0.120		
0.02	0.60	0.084	0.012		
0.03	0.60	0.084	0.018		
0.05	0.60	0.084	0.031		
0.13	0.60	0.084	0.080		
0.04	0.60	0.084	0.027		
0.02	0.60	0.084	0.010		
0.05	0.60	0.084	0.028		
0.02	0.60	0.084	0.014		
0.06	0.60	0.084	0.035		
0.06	0.60	0.084	0.038		
0.35	0.60	0.084	0.212		
0.03	0.60	0.084	0.017		
0.06	0.60	0.084	0.034		
0.38	0.60	0.084	0.226		
0.27	0.60	0.084	0.162		
0.00	0.60	0.084	0.000		
0.00	0.60	0.084	0.000		
0.00	0.60	0.084	0.000		
2.54			**1.521**	**0.60**	**0.127782**

Watershed 2:		**5.090** **ac**			
Area (ac)	C	Intensity (in/hr)	C*A	Weighted C	Q=CiA (cfs)
0.44	0.60	0.084	0.261		
0.44	0.60	0.084	0.265		
0.23	0.60	0.084	0.138		
0.30	0.60	0.084	0.180		
0.30	0.60	0.084	0.181		
0.58	0.60	0.084	0.345		
0.08	0.60	0.084	0.049		
0.08	0.60	0.084	0.050		
0.13	0.60	0.084	0.076		
0.78	0.60	0.084	0.469		
0.03	0.60	0.084	0.015		
0.12	0.60	0.084	0.074		
0.11	0.60	0.084	0.064		
0.38	0.60	0.084	0.230		
0.38	0.60	0.084	0.226		
0.44	0.60	0.084	0.263		
0.26	0.60	0.084	0.157		
0.02	0.60	0.084	0.009		
0.00	0.60	0.084	0.000		
0.00	0.60	0.084	0.000		
0.00	0.60	0.084	0.000		
5.09			**3.054**	**0.60**	**0.256517**

Watershed 3:		**1.257** **ac**			
Area (ac)	C	Intensity (in/hr)	C*A	Weighted C	Q=CiA (cfs)
0.13	0.60	0.084	0.079		
0.06	0.60	0.084	0.038		
0.04	0.60	0.084	0.023		
0.03	0.60	0.084	0.017		
0.02	0.60	0.084	0.012		
0.01	0.60	0.084	0.007		
0.10	0.60	0.084	0.058		
0.04	0.60	0.084	0.023		
0.02	0.60	0.084	0.011		
0.02	0.60	0.084	0.013		
0.09	0.60	0.084	0.052		
0.07	0.60	0.084	0.044		
0.03	0.60	0.084	0.019		
0.04	0.60	0.084	0.021		
0.03	0.60	0.084	0.017		
0.13	0.60	0.084	0.080		
0.09	0.60	0.084	0.052		
0.08	0.60	0.084	0.051		
0.07	0.60	0.084	0.043		
0.12	0.60	0.084	0.069		
0.04	0.60	0.084	0.024		
0.00	0.60	0.084	0.000		
1.26			**0.754**	**0.60**	**0.063337**

Watershed 4:		**4.959** **ac**			
Area (ac)	C	Intensity (in/hr)	C*A	Weighted C	Q=CiA (cfs)
0.00	0.60	0.084	0.002		
0.01	0.60	0.084	0.005		
0.00	0.60	0.084	0.001		
0.00	0.60	0.084	0.003		
0.18	0.60	0.084	0.109		
3.41	0.60	0.084	2.047		
0.02	0.60	0.084	0.009		
0.02	0.60	0.084	0.015		
0.06	0.60	0.084	0.037		
0.18	0.60	0.084	0.108		
0.25	0.60	0.084	0.152		
0.18	0.60	0.084	0.108		
0.21	0.60	0.084	0.128		
0.04	0.60	0.084	0.027		
0.13	0.60	0.084	0.081		
0.03	0.60	0.084	0.019		
0.08	0.60	0.084	0.051		
0.12	0.60	0.084	0.074		
0.00	0.60	0.084	0.000		
4.96			**2.976**	**0.60**	**0.249943**

Watershed 5:		**2.112** **ac**			
Area (ac)	C	Intensity (in/hr)	C*A	Weighted C	Q=CiA (cfs)
0.54	0.60	0.084	0.326		
0.10	0.60	0.084	0.058		
0.28	0.60	0.084	0.167		
0.19	0.60	0.084	0.112		
0.02	0.60	0.084	0.011		
0.27	0.60	0.084	0.162		
0.08	0.60	0.084	0.048		
0.07	0.60	0.084	0.039		
0.18	0.60	0.084	0.109		
0.37	0.60	0.084	0.221		
0.03	0.60	0.084	0.016		
0.00	0.60	0.084	0.000		
0.00	0.60	0.084	0.000		
2.11			**1.267**	**0.60**	**0.106451**

Watershed 6:		**1.915** **ac**			
Area (ac)	C	Intensity (in/hr)	C*A	Weighted C	Q=CiA (cfs)
0.27	0.60	0.084	0.162		
0.08	0.60	0.084	0.048		
0.07	0.60	0.084	0.039		
0.18	0.60	0.084	0.109		
0.37	0.60	0.084	0.221		
0.03	0.60	0.084	0.016		
0.22	0.60	0.084	0.132		
0.15	0.60	0.084	0.093		
0.07	0.60	0.084	0.042		
0.12	0.60	0.084	0.071		
0.07	0.60	0.084	0.042		
0.02	0.60	0.084	0.014		
0.13	0.60	0.084	0.078		
0.08	0.60	0.084	0.047		
0.02	0.60	0.084	0.010		
0.01	0.60	0.084	0.007		
0.02	0.60	0.084	0.010		
0.00	0.60	0.084	0.002		
0.01	0.60	0.084	0.007		
0.00	0.60	0.084	0.000		
1.91			**1.149**	**0.60**	**0.096505**

Total Watershed Area (ac)	**17.868**
Total Flow (cfs)	**0.901**

5 PROJECT REGISTRATION DOCUMENTS

To obtain permit coverage under the CGP, all dischargers must electronically file PRDs, NOTs, changes of information, sampling and monitoring information, annual reporting, and other compliance documents required by this CGP through the SWRCB's SMARTS. The contractor will have to coordinate these submittals with Caltrans within the timeframe allotted in the contract special provisions and as specified in the permit. SMARTS is found under the following website:

https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.jsp

PRDs include the following information:

1. Notice of Intent (NOI)
2. Site Map(s) Includes:
    a. The project's surrounding area (vicinity)
    b. Site layout
    c. Construction site boundaries
    d. Drainage areas
    e. Discharge locations
    f. Sampling locations
    g. Areas of soil disturbance (temporary or permanent)
    h. Active areas of soil disturbance (cut or fill)
    i. Locations of all runoff BMPs
    j. Locations of all erosion control BMPs
    k. Locations of all sediment control BMPs
    l. Active Treatment System (ATS) location (if applicable)
    m. Locations of sensitive habitats, watercourses, or other features which are not to be disturbed
    n. Locations of all post-construction BMPs
    o. Locations of storage areas for waste, vehicles, service, loading/unloading of materials, access (entrance/exits) points to construction site, fueling and water storage, water transfer for dust control and compaction practices

3. SWPPPs

4. Risk Assessment

a. The Standard Risk Assessment includes utilization of the following:
    i. Receiving water Risk Assessment interactive map
    ii. EPA Rainfall Erosivity Factor Calculator Website
    iii. Sediment Risk interactive map
    iv. Sediment sensitive water bodies list

b. The Site-Specific Risk Assessment includes the completion of the hand calculated R value Risk Calculator

5. ATS Design Document and Certification

a. All dischargers using ATS must submit electronically their system design (as well as any supporting documentation) and proof that the system was designed by a qualified ATS design professional (See Attachment F)

5.1 General Information Included

The following is a list of information included in this Storm Water Information Handout that can be used for the PRDs:

- Vicinity Map
- Risk Assessment

5.2 Storm Water Pollution Prevention Plan

The contractor for the Project is required to prepare a SWPPP because the Project involves disturbing more than 1 ac of soil. The SWPPP must include the following information:

- Active areas of cut and fill
- Areas of soil disturbance (temporary and permanent)
- Locations of storage areas for waste, vehicles, access, etc.
- Locations of all runoff BMPs
- Locations of all erosion control BMPs
- Locations of all sediment control BMPs

The SWPPP should be submitted with the PRDs and will be forthcoming from the Contractor.

5.3 Notice of Intent (NOI)

The NOI must be submitted once the contractor submits the SWPPP. A draft of the NOI is included in Appendix A.

5.4 Site Maps

Registration requirements can be met by the inclusion of the following plans, which can be found in the appendices.

- Layout Plans (Appendix B)
  - Site layout with construction boundaries
  - ESA locations
- Drainage Plans (Appendix C)
  - Drainage areas
- Sampling Plan (Appendix D)
  - Discharge Locations (Subject to changes by the Contractor and approved by the Engineer)
  - Sampling locations (Subject to changes by the Contractor and approved by the Engineer)
- Off-site Watershed Map (Appendix E)

Appendix A Notice of Intent (NOI)

State Water Resources Control Board

NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF THE
GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY (WQ ORDER No. 99-08-DWQ)

I. NOI STATUS (SEE INSTRUCTIONS)

MARK ONLY ONE ITEM 1. [X] New Construction 2. [ ] Change of Information for WDID# _____

II. PROPERTY OWNER

Name	Contact Person		
California Department of Transportation (Caltrans)	Issa Bouri		
Mailing Address	Title		
111 Grand Ave	Project Manager		
City	State	Zip	Phone
Oakland	CA	94612	

Owner Type (*check one*) 1.[ ] Private Individual 2.[ ] Business 3.[ ] Municipal 4.[ ] State 5.[ ] Federal 6.[ ] Other

III. DEVELOPER/CONTRACTOR INFORMATION

Developer/Contractor	Contact Person		
Mailing Address	Title		
City	State	Zip	Phone

IV. CONSTRUCTION PROJECT INFORMATION

Site/Project Name	Site Contact Person		
State Route 84 Expressway Widening Project - Segment A			
Physical Address/Location	Latitude	Longitude	County
	____ °	____ °	Alameda County
City (or nearest City)	Zip	Site Phone Number	Emergency Phone Number
Livermore			

A. Total size of construction site area: _____ Acres

B. Total area to be disturbed: 29.96 Acres (% of total _____)

C. Percent of site imperviousness (including rooftops):
Before Construction: _____%
After Construction: _____%

D. Tract Number(s): _____, _____

E. Mile Post Marker: _____

F. Is the construction site part of a larger common plan of development or sale? [X] YES [ ] NO

G. Name of plan or development: State Route 84 Expressway Widening Project

H. Construction commencement date: 10 / 1 / 2011

I. % of site to be mass graded: _____

J. Projected construction dates:
Complete grading: 8 / 1 / 2013 Complete project: ____/____/____

K. Type of Construction (Check all that apply):
1. [ ] Residential 2. [ ] Commercial 3. [ ] Industrial 4. [ ] Reconstruction 5. [X] Transportation
6. [ ] Utility Description: _____ 7. [ ] Other (Please List): _____

V. BILLING INFORMATION

SEND BILL TO:	Name	Contact Person	
[ ] OWNER (as in II. above)			
[ ] DEVELOPER (as in III. above)	Mailing Address	Phone/Fax	
[ ] OTHER (enter information at right)	City	State	Zip

VI. REGULATORY STATUS

A. Has a local agency approved a required erosion/sediment control plan? ☐ YES ☐ NO

Does the erosion/sediment control plan address construction activities such as infrastructure and structures? ☐ YES ☐ NO

Name of local agency: _____ Phone: _____

B. Is this project or any part thereof, subject to conditions imposed under a CWA Section 404 permit of 401 Water Quality Certification? ☒ YES ☐ No

If yes, provide details: 404 permit & 401 cert. required. Applications submitted. Anticipated approval May 2011.

VII. RECEIVING WATER INFORMATION

A. Does the storm water runoff from the construction site discharge to (Check all that apply):

1. ☒ **Indirectly to waters of the U.S.**
2. ☒ **Storm drain system - Enter owner's name:** Alameda County Phase I MS4
3. ☒ **Directly to waters of U.S. (e.g. , river, lake, creek, stream, bay, ocean, etc.)**

B. Name of receiving water: (river, lake, creek, stream, bay, ocean): Arroyos Mocho, Del Valle, Las Positas, and de la Laguna

VIII. IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

A. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) (check one)

☐ A SWPPP has been prepared for this facility and is available for review: Date Prepared: ____/____/____ Date Amended: ____/____/____

☐ A SWPPP will be prepared and ready for review by (enter date): ____/____/____

☐ A tentative schedule has been included in the SWPPP for activities such as grading, street construction, home construction, etc.

B. MONITORING PROGRAM

☐ A monitoring and maintenance schedule has been developed that includes inspection of the construction BMPs before anticipated storm events and after actual storm events and is available for review.

If checked above: A qualified person has been assigned responsibility for pre-storm and post-storm BMP inspections to identify effectiveness and necessary repairs or design changes. ☐ YES ☐ NO

Name: _____ Phone: _____

C. PERMIT COMPLIANCE RESPONSIBILITY

A qualified person has been assigned responsibility to ensure full compliance with the Permit, and to implement all elements of the Storm Water Pollution Prevention Plan including:

1. Preparing an annual compliance evaluation. ☐ YES ☐ NO

Name: _____ Phone: _____

2. Eliminating all unauthorized discharges. ☐ YES ☐ NO

IX. VICINITY MAP AND FEE (must show site location in relation to nearest named streets, intersections, etc.)

Have you included a vicinity map with this submittal? ☐ YES ☐ NO

Have you included payment of the annual fee with this submittal? ☐ YES ☐ NO

X. CERTIFICATIONS

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. In addition, I certify that I have read the entire General Permit, including all attachments, and agree to comply with and be bound by all of the provisions, requirements, and prohibitions of the permit, including the development and implementation of a Storm Water Pollution Prevention Plan and a Monitoring Program Plan will be complied with."

Printed Name: _____

Signature: _____ **Date:** _____

Title: _____

Appendix B Layout Plans

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. COORDINATES, DISTANCES AND BEARINGS SHOWN ARE BASED ON CALIFORNIA COORDINATE SYSTEM ZONE 3. THE HORIZONTAL DATUM IS NAD 83 (1991.35). THE VERTICAL DATUM IS NAVD 1988.
2. FOR LIMITS OF MBGR AND Conc REMOVAL ITEMS, SEE SUMMARY OF QUANTITY SHEETS.
3. FOR LIMITS OF CONTRACT ITEMS AND OTHER INFORMATION NOT SHOWN ON LAYOUT SHEETS, SEE CONSTRUCTION DETAILS.
4. FOR QUANTITY OF TFESA, SEE TEMPORARY WATER POLLUTION CONTROL TABLE OF QUANTITIES.

LEGEND:

- OVERLAY
- 0.15′ COLD PLANE AC Pvmt
- IRRIGATION CROSSOVER
- No. — Prop Pvmt STRUCTURAL SECTION (SEE SHEET X-1)
- HMA PAVEMENT DATA CORE LOCATION
- TFESA — TEMPORARY FENCE (TYPE ESA)

ABBREVIATIONS:

MBGR (SP)	METAL BEAM GUARD RAILING (STEEL POST)
MVP	MAINTAINANCE VEHICLE PULLOUT
VEG CTRL	VEGETATION CONTROL (MINOR Conc)
w/	WITH
TCE	TEMPORARY CONSTRUCTION EASEMENT
SSE	SANITARY SEWER EASEMENT
UPRR	UNION PACIFIC RAILROAD
LSE	LANDSCAPE EASEMENT

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi — 10/21/10
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi, No. 68606, Exp. 09-30-11, CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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1333 Broadway
Suite 800
Oakland, CA 94612

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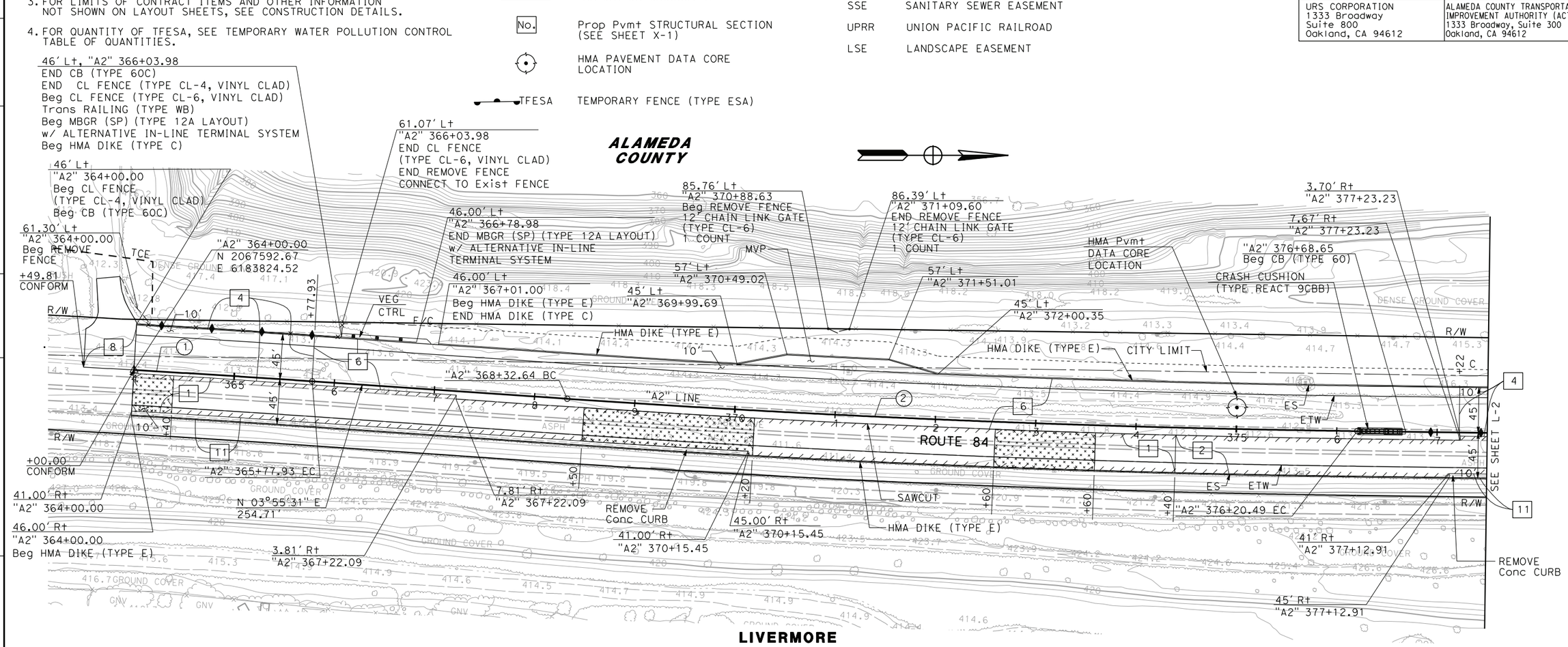
1333 Broadway, Suite 300
Oakland, CA 94612



CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
①	17,450.00′	02°35′00"	393.46′	786.78′	2066575.677	6201244.854
②	14,280.00′	03°09′40"	394.03′	787.85′	2069001.915	6169606.726

LAYOUT

SCALE: 1" = 50′

L-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans®
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: AB
DATE REVISED: 10/18/10
LAST REVISION: 10-21-10
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 12:19:39 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 0400020580ea001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Abhijeet R. Bhoi
No. 68606
Exp. 09-30-11
CIVIL
STATE OF CALIFORNIA

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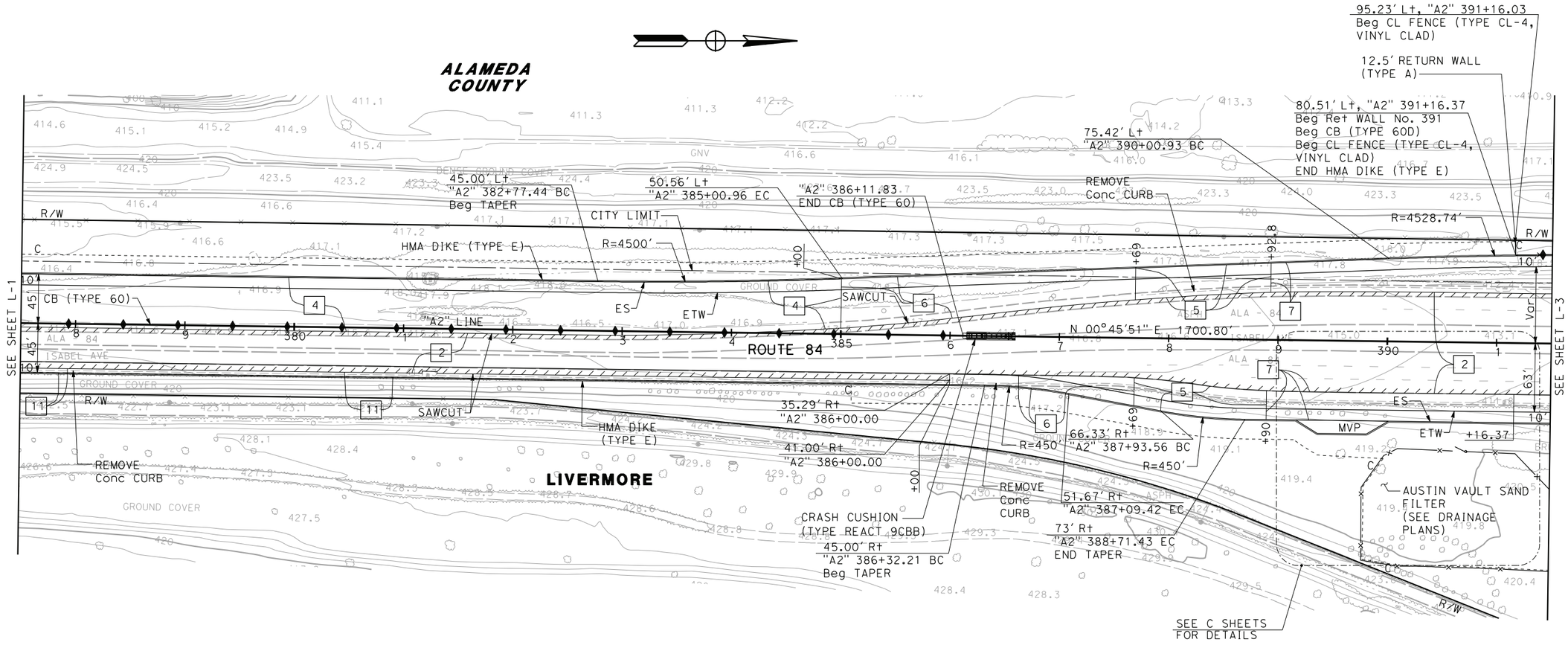
Oakland, CA 94612



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50'

L-2

REVISED BY	ABHIJEET BHOI	CALCULATED-DESIGNED BY		CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN
DATE REVISED	ELIE ABI-JAOUDE	CHECKED BY		STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans
AB					
10/18/10					

LAST REVISION 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 12:19:57 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 0400020580ea002.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
6	301.00′	60°11′53"	174.48′	316.25′	2070816.683	6183977.418
7	645.00′	28°07′55"	161.61′	316.69′	2071028.324	6183690.368
8	100.00′	23°18′20"	20.62′	40.68′	2071227.233	6184081.528

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

ALAMEDA COUNTY

LIVERMORE

"A2" 392+62.31
END CB (TYPE 60D)
Beg CB (TYPE 60D Mod)

"A2" 393+10.75 POT=
"ST" 93+10.75 POB

81.00′ Lt
"A2" 392+25.65 EC
END TAPER

"A3" 393+21.29 POT (AHEAD)=
11′ Lt
"A2" 393+21.29 POT (BACK)

R=4528.74′

70.00′ Lt
"A3" 394+38.23 BC
Beg TAPER

"A3" 394+81.43
END CB (TYPE 60D Mod)
Beg CB (TYPE 60D)

Ret WALL No. 391
w/ CB (TYPE 60D)

"A3" 395+40.10 EC
68.85′ Lt

"A3" 399+73.89
Beg CB (TYPE 60R)

CRASH CUSHION
(TYPE REACT 9CBB)

60.14′ Lt
"A3" 399+26.56 BC

9.96′ Lt
"A3" 400+10.00

10.53′ Rt
"A3" 400+10.00

59.85′ Lt
"A3" 400+14.43
END Ret WALL No. 391
Beg Ret WALL No. 400S
END CL FENCE (TYPE CL-4, VINYL CLAD)

59.00′ Lt
"A3" 400+25.03 EC
END TAPER

STANLEY Blvd OC
Br No. 33-0711

59.84′ Lt
"A3" 401+36.02
Beg CL FENCE
(TYPE CL-4, VINYL CLAD)

REMOVE MBGR

CB (TYPE 60R)

R/W

ES

ETW

SAWCUT

REMOVE Conc CURB

CITY LIMIT

ROUTE 84

"A2" LINE

"A3" LINE

N 00°45′51" E 2974.82′

SEE SHEET L-2

SEE SHEET L-4

N 0°45′51" E 1700.80′

+70.82

N 81°18′05" E 116.28′

REMOVE Conc CURB

+47.22′ Rt
"A3" 395+04.27

71.23′ Rt
"A3" 396+18.51

REMOVE CRASH CUSHION

HMA Pvmt
DATA CORE
LOCATION

REMOVE GATE

"TR4" LINE

REMOVE Conc STAIRS

58.88′ Rt
"A3" 395+98.73

60.37′ Rt
"A3" 396+83.71

72.02′ Rt
"A3" 396+63.51

VEG CTRL

MVP

62.88′ Rt
"A3" 394+37.00
END HMA DIKE (TYPE A)
Beg HMA DIKE (TYPE E)

111.62′ Rt
"A3" 393+83.72
END HMA DIKE (TYPE E)
Beg HMA DIKE (TYPE A)

"A3" 398+75.50
END HMA DIKE (TYPE E)
Beg MBGR (SP) (TYPE 12C LAYOUT)
w/ BURIED POST
END ANCHOR
Beg HMA DIKE (TYPE C)

62.83′ Rt
"A3" 399+30.00
END MBGR (SP)
(TYPE 12C LAYOUT)

62.83′ Rt
"A3" 399+55.00
Trans RAILING (TYPE WB)
END HMA DIKE (TYPE C)
Beg Ret WALL No 400N
Beg CB (TYPE 60D)
Beg CL FENCE (TYPE CL-6, VINYL CLAD)

116.47′ Rt
"A3" 399+47.99
Beg CL FENCE
(TYPE CL-6, VINYL CLAD)

109.20′ Rt
"A3" 400+47.97
END CL FENCE
(TYPE CL-6, VINYL CLAD)

11′
N 00°45′51" E 221.63′

"TR4" 600+38.29 EC

CONFORM
"TR4" 599+97.61 POC=
82.99′ Rt
"A3" 399+99.11 POT
Beg CURB (TYPE A1-8)

73.00′ Rt
"A2" 392+13.67
END HMA DIKE
(TYPE E)

REMOVE Conc CURB

56.86′ Rt
"ST" 94+10.00
END HMA DIKE
(TYPE A)
Beg HMA DIKE
(TYPE E)

76.00′ Rt
"A2" 392+13.67
Beg SIDE GUTTER
Beg HMA DIKE
(TYPE A)

"ST" 94+27.03 BC

SAWCUT SIDE GUTTER

REMOVE Conc CURB

HMA DIKE (TYPE E)
R= 252′
R= 260′

SAWCUT

R= 584′
R= 596′
R= 604′

STANLEY CONNECTOR

49′ Lt
"ST" 102+78.81
Beg CURB (TYPE A2-6)
Beg HMA DIKE (TYPE E)

REMOVE Conc SW
CURB RAMP
(CASE A)

"SB" LINE

"SB" 16+71.27
57.48′ Rt
END CURB (TYPE A2-6)

+29.20
CONFORM

"ST" 103+86.85 POT=
"AB" 17+72.74 POT

CURB RAMP
(CASE A)
REMOVE Conc MEDIAN
REMOVE BOLLARD
REMOVE Conc SW

52.00′ Rt
"ST" 96+00.00
END SIDE GUTTER
END HMA DIKE
(TYPE E)

R= 342′

HMA Pvmt
DATA CORE
LOCATION

R= 350′

"ST" 97+43.28 EC

N 21°06′12" E
94.09′

"ST" 98+37.37 BC

REMOVE Conc CURB

R=686′
R=694′

49′ Rt
"ST" 100+43.15
Beg TAPER

"ST" 101+54.06 EC

61.09′ Rt
"ST" 101+43.95
END TAPER

R=230′

N 7°01′43" W 232.79′

IRRIGATION CROSSOVER

61′ Rt
"ST" 102+88.85
Beg CURB
(TYPE A2-6)

72.38′ Rt
"ST" 103+02.09
BOLLARD

78.48′ Rt
"SB" 18+54.19
Beg CL FENCE (TYPE CL-4)
Beg REMOVE FENCE

47.51′ Rt
"SB" 18+83.69
END CURB (TYPE A2-6)

62.64′ Rt
"SB" 18+82.48
END CL FENCE (TYPE CL-4)
END REMOVE FENCE

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-3

CALCULATED-DESIGNED BY	AB	10/18/10	
CHECKED BY	ELIE ABI-JAOUDE	ABHIJEET BHOI	
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN	REVISED BY	DATE REVISED

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 10-21-10
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 12:20:10 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 0400020580ea003.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(9)	21.00′	23°33′21"	4.38′	8.63′	2071450.454	6183963.494
(10)	15.00′	23°33′20"	3.13′	6.17′	2071464.400	6183996.684
(11)	289.00′	08°11′28"	20.69′	41.32′	2071549.016	6184271.837
(12)	508.94′	08°13′26"	36.59′	73.05′	2071709.213	6183489.299

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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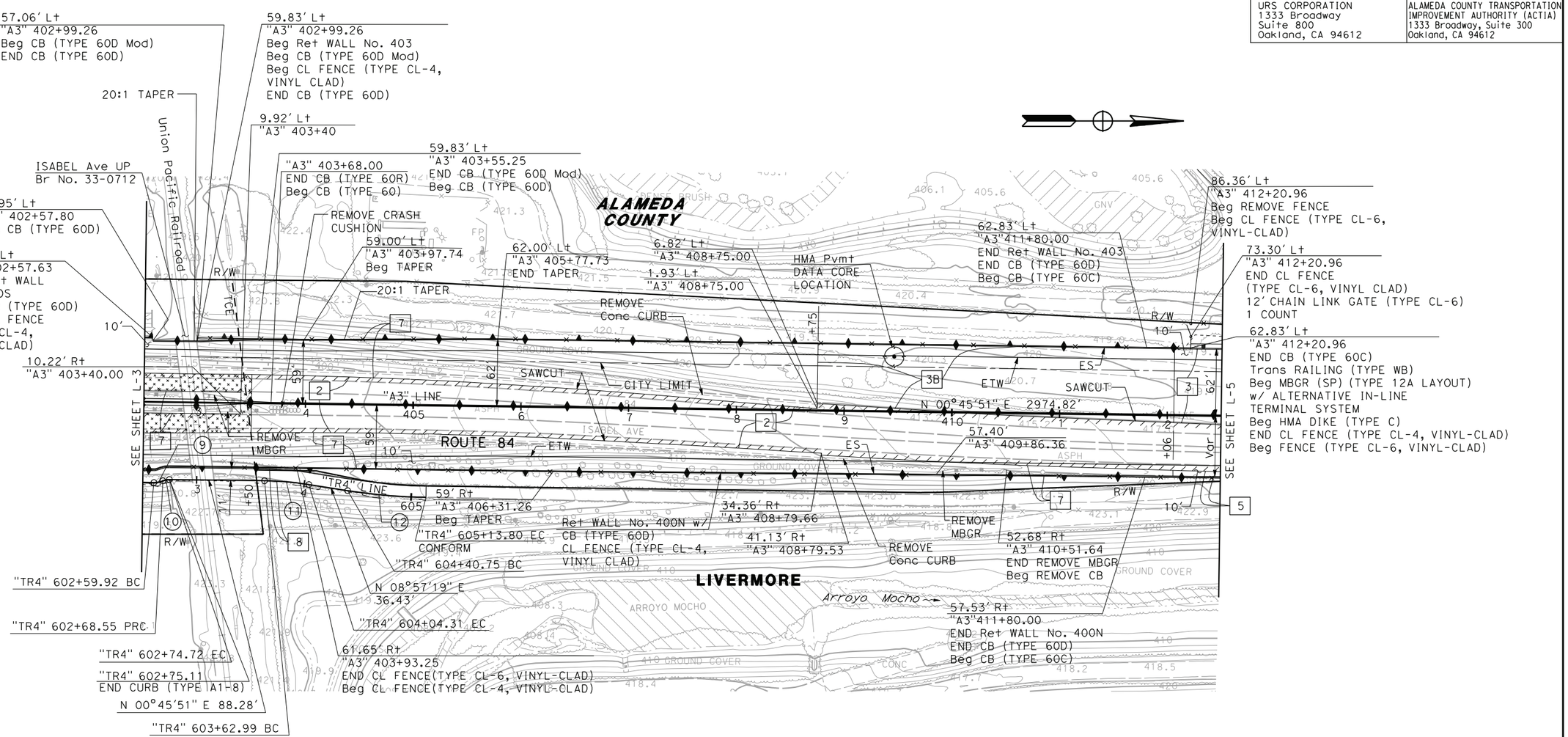

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-4

CALCULATED-DESIGNED BY	ABHIJEET BHOI	REVISED BY	AB	
CHECKED BY	ELIE ABI-JAOUDE	DATE REVISED	10/18/10	
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN			

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 10-21-10 | DATE PLOTTED => 11/14/2011 | TIME PLOTTED => 12:20:28 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 0400020580ea004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(3)	8,237.67′	05°13′07"	375.41′	750.31′	2073596.670	6175699.887
(13)	100.00′	24°21′25"	21.58′	42.51′	2072528.182	6183726.685
(14)	60.00′	66°53′24"	39.63′	70.05′	2072719.042	6183690.763
(15)	155.00′	91°16′02"	158.47′	246.90′	2072936.650	6183427.381
(16)	300.00′	07°54′36"	20.74′	41.42′	2073144.970	6182978.813

"AC3" 19+73.42
HMA Pvmt DATA CORE LOCATION
N 1°49′56" E 173.55′
TCE N 1°49′56" E 193.87′
"AC3" LINE
N 6°04′39" W 53.81′
REMOVE Conc SW
"AC2" 224+37.07 POT= N 2073230.243 E 6183271.430
VOYAGER St
ALAMEDA COUNTY
LIVERMORE
TCE
"AC2" 221+47.98 EC= "AC3" 21+47.98 POT
"AC2" 223+41.85 BC
"AC2" 223+83.26 EC
DRIVEWAY (CASE A)
"AC2" 219+01.08 BC
14.60′ Lt "AC2" 218+95.72 12′ CHAIN LINK GATE (TYPE CL-6) 1 COUNT CONNECT TO Exist FENCE
11.00′ Rt "AC2" 218+95.71 12′ CHAIN LINK GATE (TYPE CL-6) 1 COUNT
N 89°26′06" W 265.51′
3" GALVANIZED STEEL PIPE (SUPPLY LINE)
2" SPRINKLER CONTROL CONDUIT (BRIDGE)
CITY LIMIT
62.00′ Lt "A3" 415+43.33 Beg TAPER
"A3" 415+43.75 Trans RAILING (TYPE WB) Beg MBGR (SP) (TYPE 12A LAYOUT) w/ ALTERNATIVE IN-LINE TERMINAL SYSTEM Beg HMA DIKE (TYPE C)
105.54′ Lt "A3" 415+71.38 Beg CL FENCE (TYPE CL-6, VINYL CLAD)
63.78′ Lt "A3" 416+20.85 END MBGR (SP) (TYPE 12A LAYOUT) w/ ALTERNATIVE IN-LINE TERMINAL SYSTEM END HMA DIKE (TYPE C)
63.85′ Lt "A3" 416+56.82 Beg HMA DIKE (TYPE E)
78.16′ Lt "A3" 417+89.53
78.92′ Lt "A3" 418+34.52
CL FENCE (TYPE CL-6, VINYL CLAD)
"A3" 422+96.11 BC
72.00′ Lt "A3" 421+35.98 END TAPER
"AC2" 216+35.57 EC
BB "AC2" 213+85.63
"AC2" 215+65.52 BC
"AC2" 213+75.47 EC
"AC2" 213+32.96 BC
EB "AC2" 215+05.63
N 22°32′41" W 190.05′
ARROYO MOCHO ACCESS BRIDGE
42.68′ Lt "A3" 413+50.40 Beg REMOVE FENCE
N 01°48′43" E 78.28′
84.52′ Lt "A3" 412+67.83 END CL FENCE (TYPE CL-6, VINYL CLAD) 12′ CHAIN LINK GATE (TYPE CL-6) 1 COUNT
"AC2" 212+53.68 POT= 98.80′ Lt "A3" 412+53.68 POT
65.55′ Lt "A3" 412+94.83 END REMOVE FENCE
62.83′ Lt "A3" 412+95.96 END MBGR (SP) (TYPE 12A LAYOUT) w/ ALTERNATIVE IN-LINE TERMINAL SYSTEM END HMA DIKE (TYPE C)
CB (TYPE 60C)
57.50′ Rt "A3" 412+89.06 END CB (TYPE 60C) END CL FENCE (TYPE CL-4, VINYL CLAD) END REMOVE CB CONFORM
56.00′ Rt "A3" 412+98.08 END TAPER
EXTEND Exist IRRIGATION CROSSOVER
HMA DIKE (TYPE E)
MVP
67.25′ Lt "A3" 418+54.72
REMOVE Conc SW
65.82′ Lt "A3" 417+69.73
VEG CTRL
N 00°45′51" E 2074.82
CRASH CUSHION (TYPE REACT 9CBB)
"A3" LINE
SAWCUT
"A3" 418+76.51 END CB (TYPE 60)
ROUTE 84
SAWCUT
ETW
ES
REMOVE Conc CURB
HMA DIKE (TYPE E)
LSE
SSE
R/W
C
SEE SHEET L-4
SEE SHEET L-6
REMOVE CRASH CUSHION
"A3" 413+60.57 END CB (TYPE 60) Beg CB (TYPE 60A)
6.64′ Rt "A3" 413+86.33 END REMOVE FENCE
BB "A3" 413+90.57
ARROYO MOCHO BRIDGE (WIDEN) Br No. 33-0713
REMOVE MBGR
13.52′ Lt "A3" 416+55.89
9.92′ Rt "A2" 416+55.85
"A3" 415+44.40 END CB (TYPE 60A) Beg CB (TYPE 60)
52.3′ Rt "A2" 416+56.40
56′ Rt "A2" 416+56.40
56.00′ Rt "A3" 415+43.83 Beg REMOVE CURB Beg HMA DIKE (TYPE E)
EB "A3" 415+14.40
LIVERMORE
DENSE GROUND
DIRT PILES
DENSE TREES
CONCRETE WALK
AC PATH
ASPH
CONC
ROCKS
DRIVEWAY
ROAD
ISABEL
ARROYO MOCHO

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-5

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

LAST REVISION: DATE PLOTTED => 1/14/2011 10-21-10 TIME PLOTTED => 12:20:43 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant DGN FILE => 0400020580ea005.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

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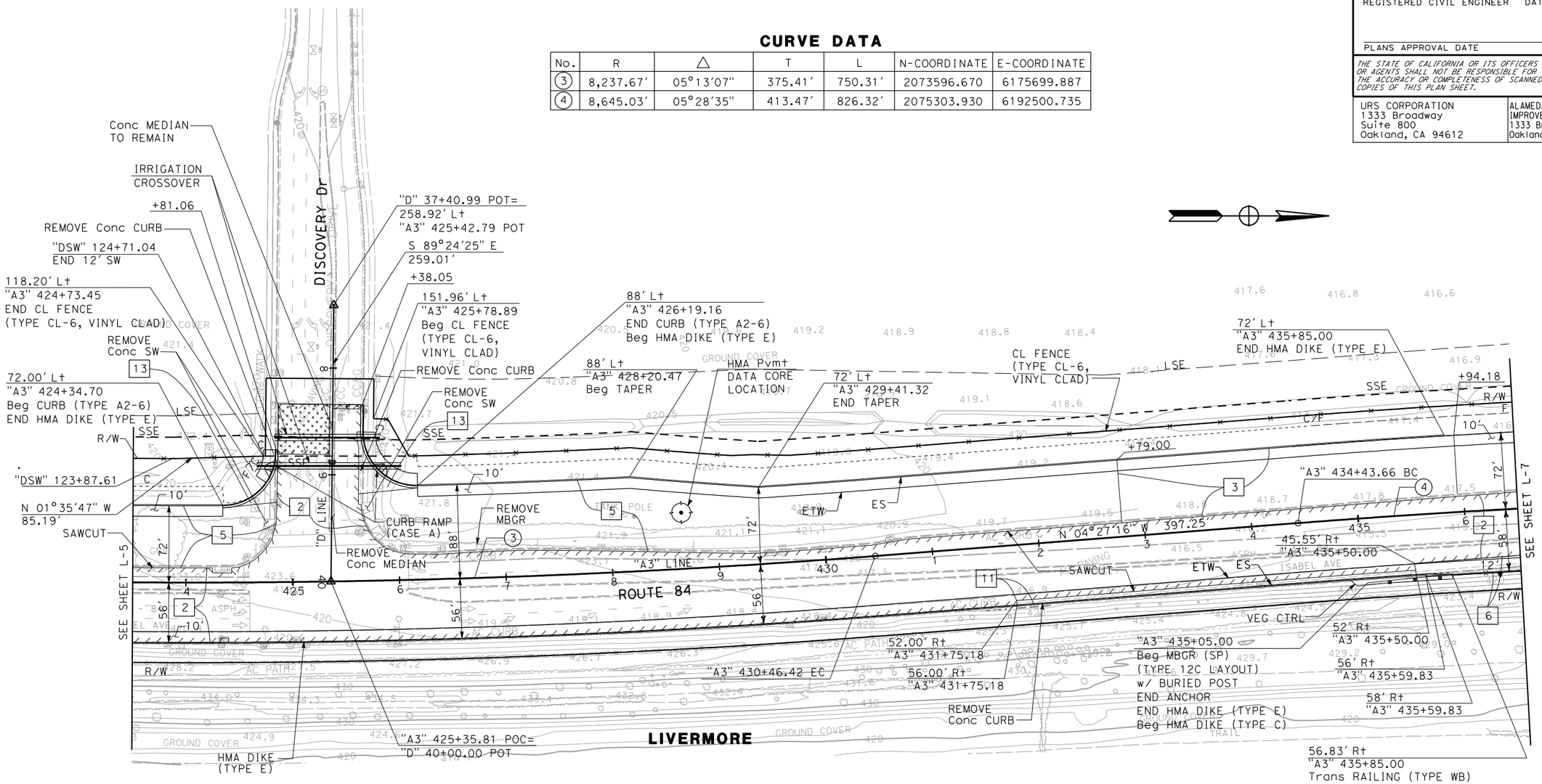
(4)	8,645.03′	05°28′35"	413.47′	826.32′	2075303.930	6192500.735



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-6

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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Oakland, CA 94612

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION: DATE PLOTTED => 1/14/2011
10-21-10 TIME PLOTTED => 12:20:59 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 0400020580ea006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
④	8,645.03′	05°28′35"	413.47′	826.32′	2075303.930	6192500.735
⑤	2,624.67′	08°32′31"	196.01′	391.30′	2075963.855	6186491.187

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

ARBhoi
REGISTERED CIVIL ENGINEER — 10/21/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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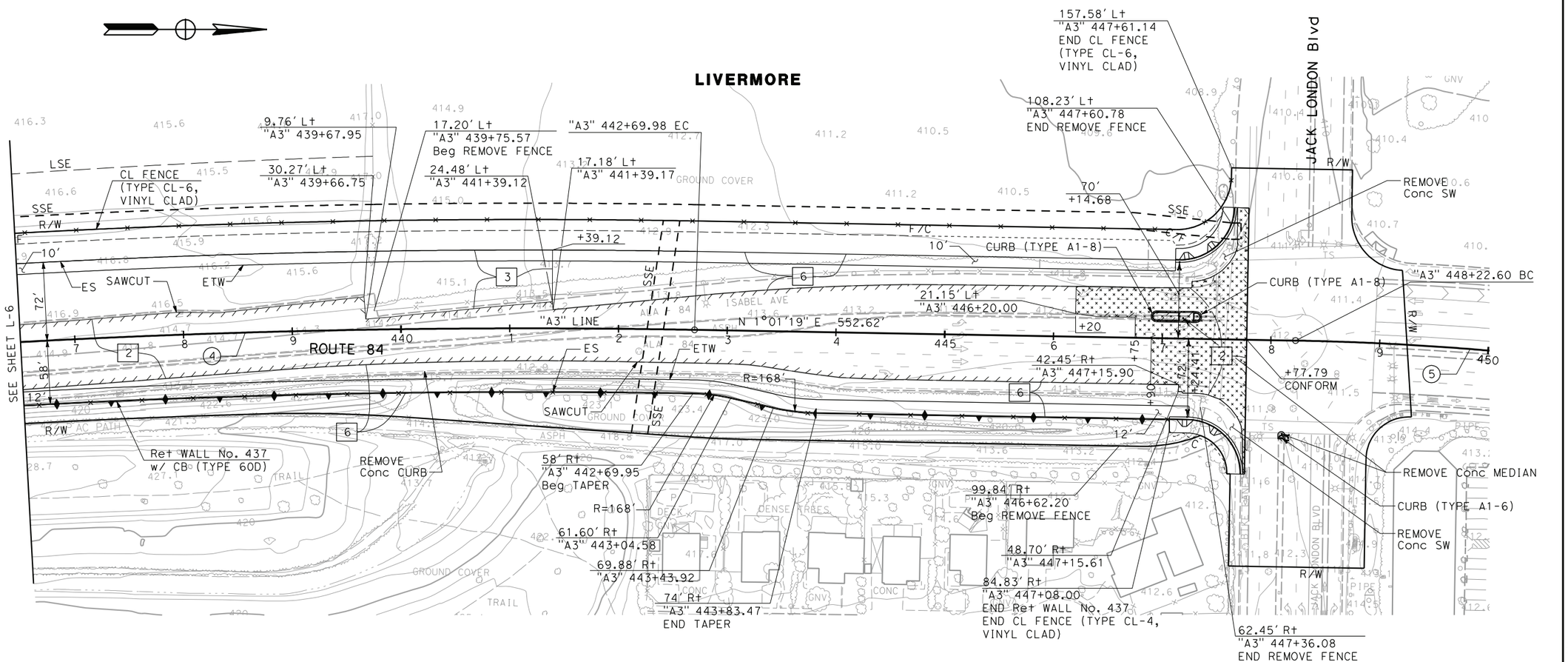
Oakland, CA 94612



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET L-1.

LAYOUT

SCALE: 1" = 50′

L-7

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION: DATE PLOTTED => 1/14/2011
10-21-10 TIME PLOTTED => 12:21:11 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 0400020580ea007.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Appendix C Drainage Plans

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
3. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.
4. CONTRACTOR IS RESPONSIBLE TO PROVIDE POSITIVE DRAINAGE FROM ALL ROADWAY AREA AT ALL TIMES.
5. LOCATIONS OF EXISTING DRAINAGE FACILITIES ARE APPROXIMATE. VERIFY LOCATION AND ELEVATION OF EXISTING DRAINAGE FACILITIES PRIOR TO MODIFYING.
6. CALTRANS DISTRICT HYDRAULICS RESERVES THE RIGHT TO REQUEST THAT DRAINAGE STRUCTURES BE "CAST-IN-PLACE" WHERE THE PRE-CAST OPTION IS NOT DEEMED TO BE APPROPRIATE. IF PRE-CAST STRUCTURES ARE USED, CONTRACTOR SHALL FIELD VERIFY ALL EXISTING PIPES PRIOR TO CASTING STRUCTURES.

LEGEND:

- Exist STORM DRAIN
- PROPOSED STORM DRAIN
- GUTTER/DITCH FLOW LINE
- No. — DRAINAGE SYSTEM No.
- h — DRAINAGE UNIT
- GRADE TO DRAIN
- INLET
- Exist DI
- CAP DI
- AUSTIN VAULT SAND FILTER

ABBREVIATIONS:

COL	CITY OF LIVERMORE
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA
ASP	ALTERNATIVE SLOTTED PIPE
TC	TOP OF COVER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — 1/17/11
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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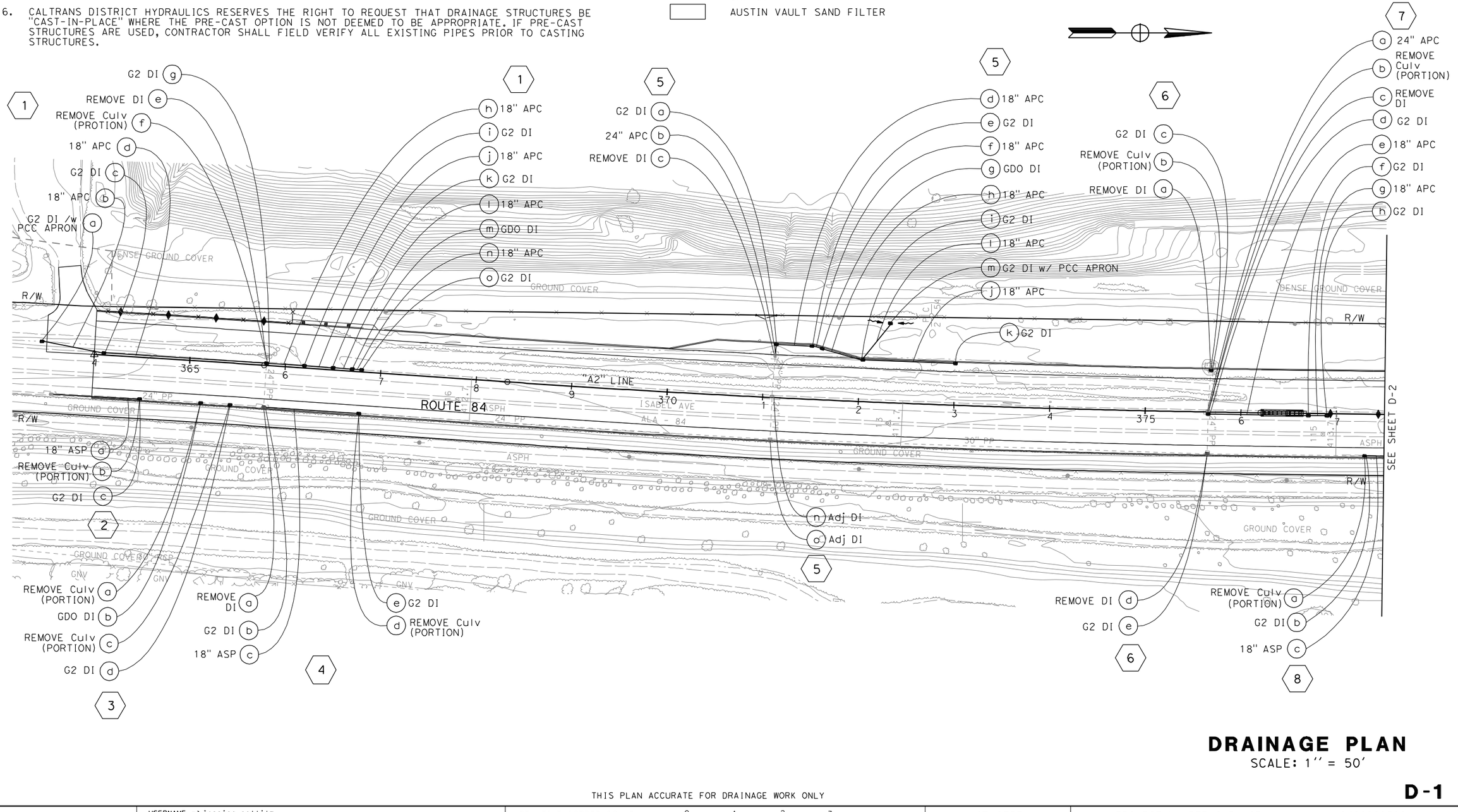

DRAINAGE PLAN

SCALE: 1'' = 50'

D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

REVISED BY	DATE REVISED
JP	1/11/11

IRENE LIU — CALCULATED-DESIGNED BY
ANALETTE OCHOA — CHECKED BY
HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

LAST REVISION — DATE PLOTTED => 1/14/2011
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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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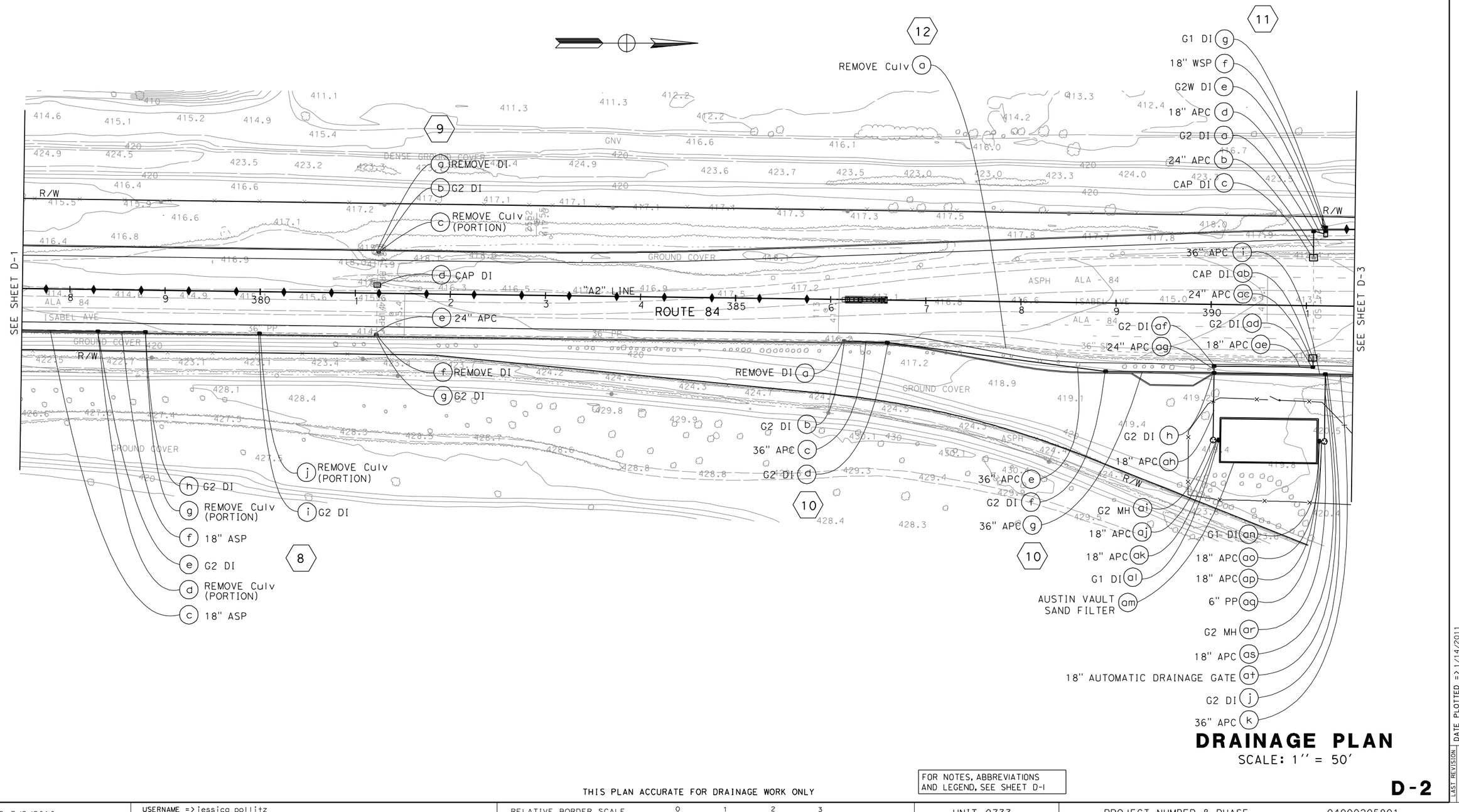

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

CALCULATED-DESIGNED BY			
CHECKED BY			
IRENE LIU	JP	1/11/11	
ANALETTE OCHOA	REVISED BY	DATE REVISED	
CONSULTANT FUNCTIONAL SUPERVISOR			
HAN-BIN LIANG			

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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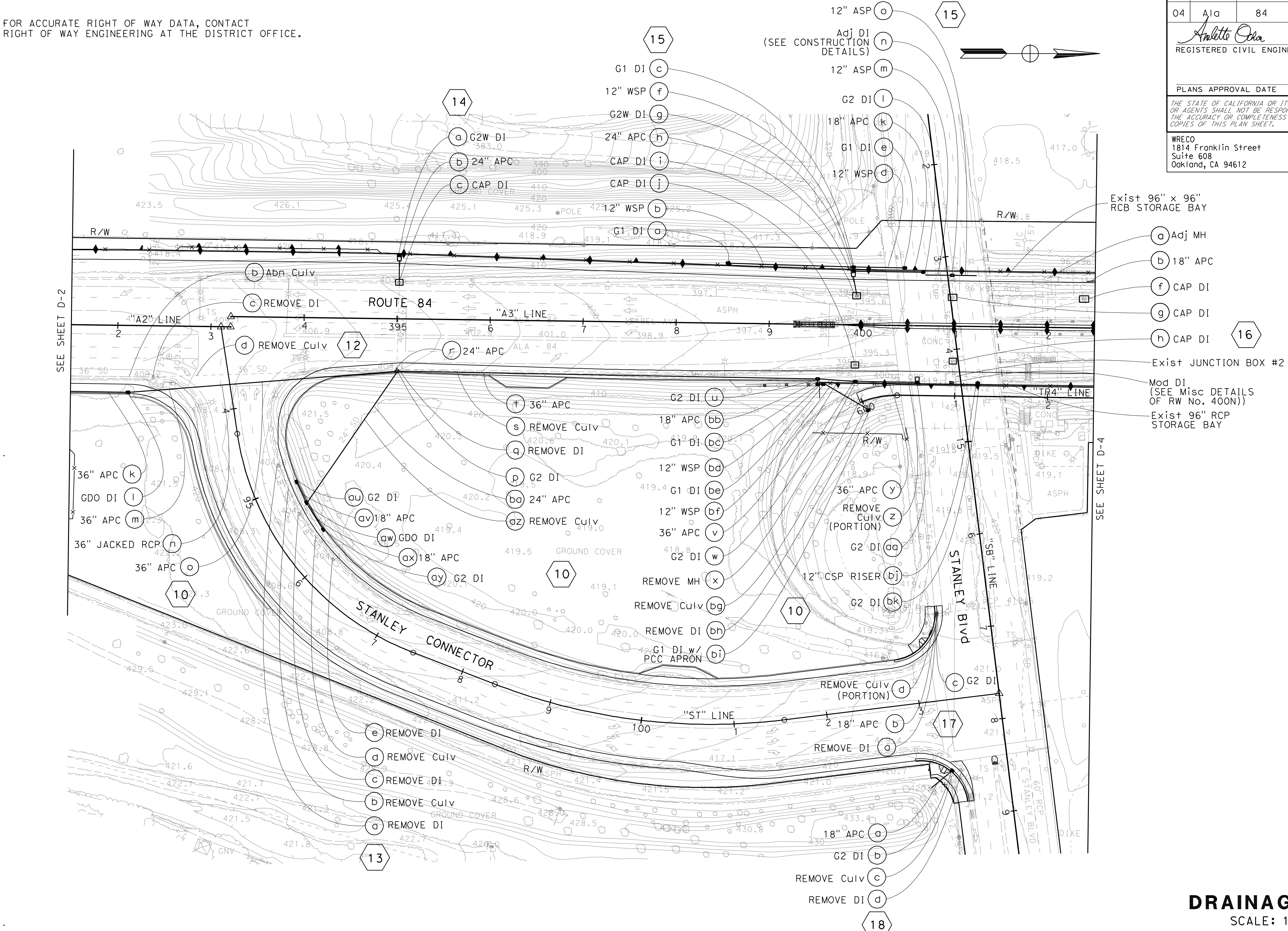
BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801a002.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa
REGISTERED CIVIL ENGINEER — DATE 1/17/11

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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DRAINAGE PLAN

SCALE: 1" = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY: IRENE LIU — CHECKED BY: ANALETTE OCHOA

REVISED BY: JP — DATE REVISED: 1/11/11

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BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
DGN FILE => ...\0400020580ia003.dgn

RELATIVE BORDER SCALE IS IN INCHES — 0 1 2 3

UNIT 0733 — PROJECT NUMBER & PHASE — 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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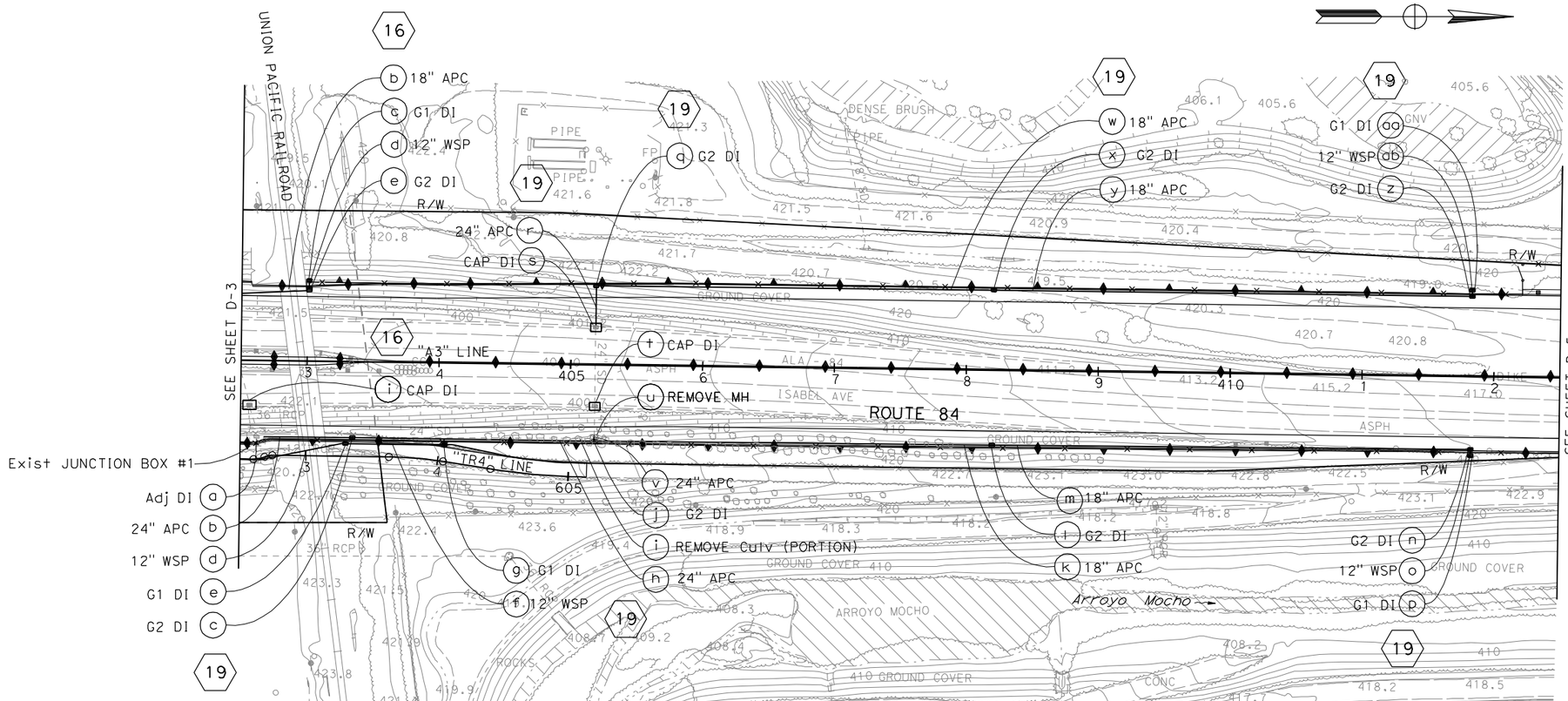

DRAINAGE PLAN

SCALE: 1'' = 50'

D-4

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	JP
CHECKED BY	ANALETTE OCHOA	DATE REVISED	1/11/11
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		

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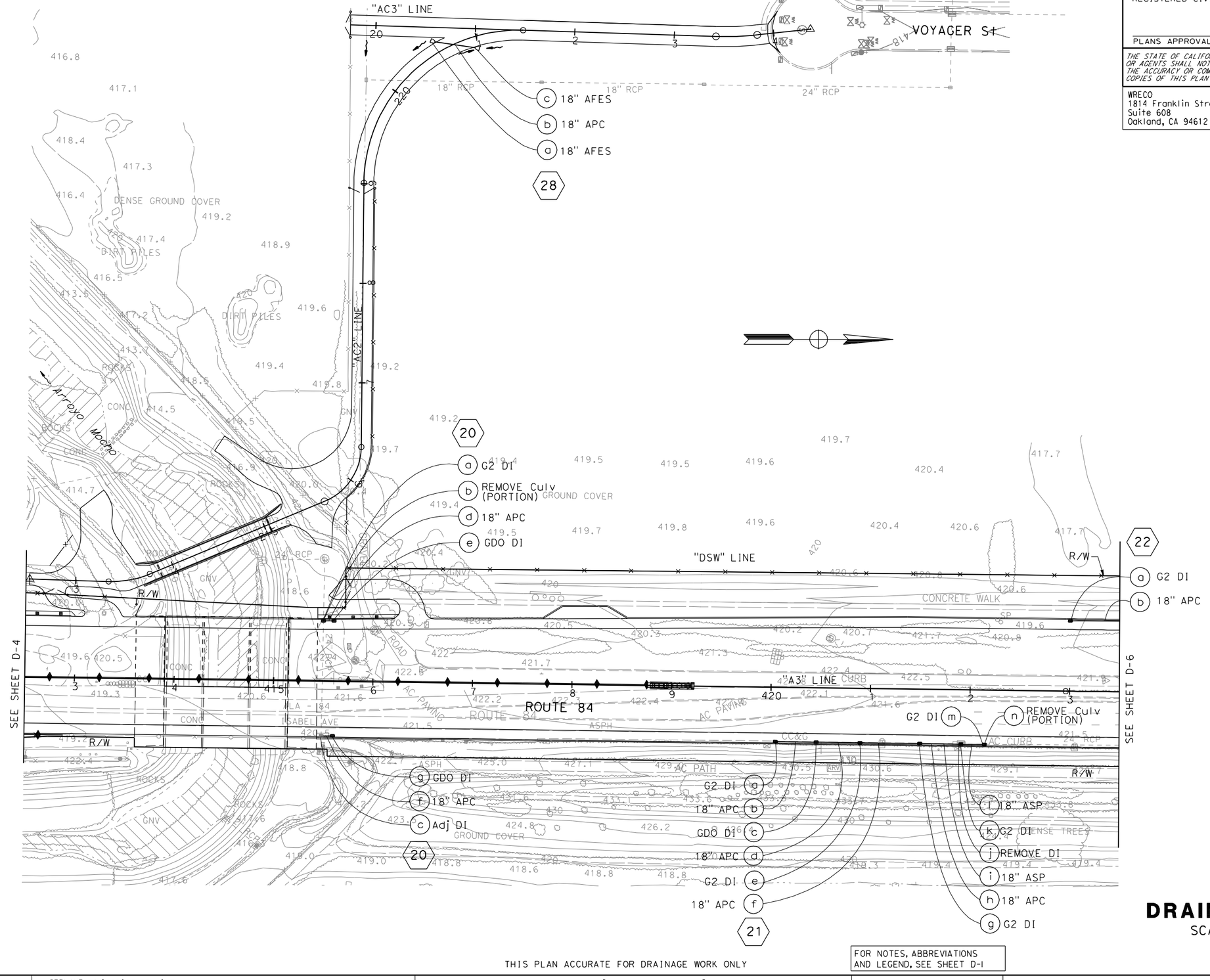
FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1'' = 50'

D-5

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa — 1/17/11
REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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CALCULATED-DESIGNED BY: IRENE LIU
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CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
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DGN FILE => ...\04000205801a005.dgn
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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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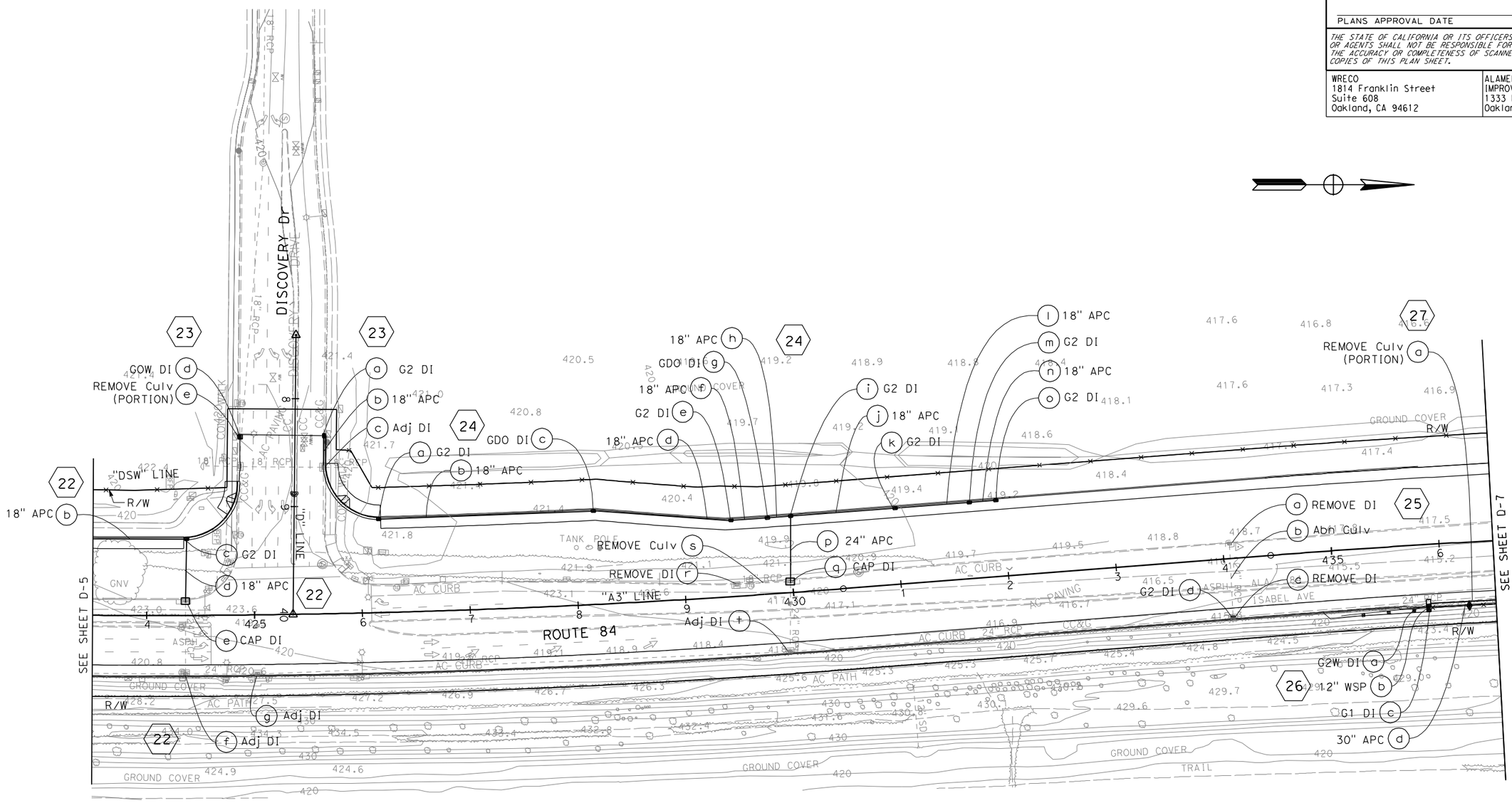

DRAINAGE PLAN

SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-6

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	JP	
CHECKED BY	ANALETTE OCHOA	DATE REVISED	1/11/11	

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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LAST REVISION | DATE PLOTTED => 1/14/2011
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BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801a006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 1/17/11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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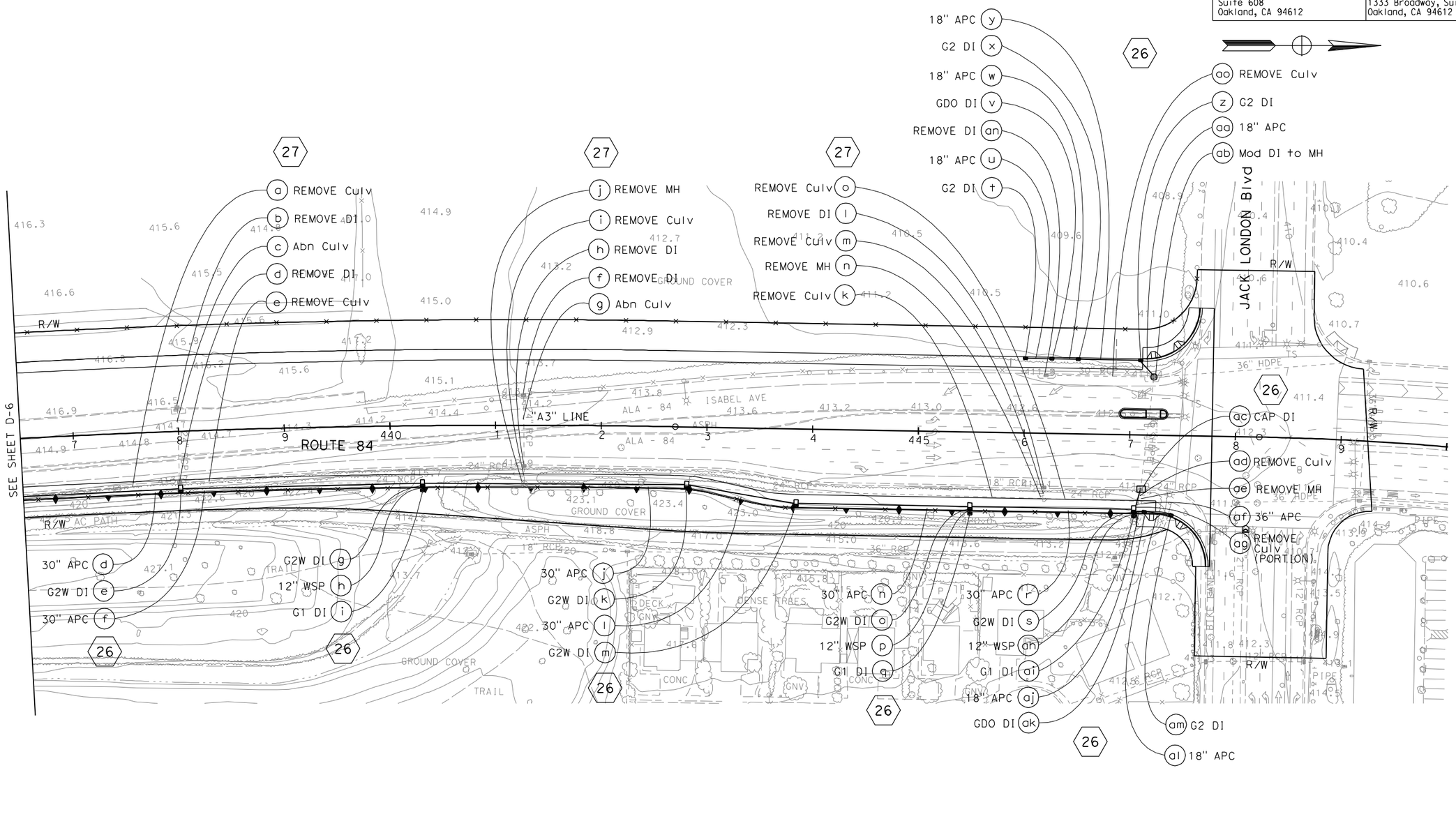

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-7

REVISED BY	JP		
DATE REVISED	1/11/11		
IRENE LIU	ANALETTE OCHOA		
CALCULATED-DESIGNED BY	CHECKED BY		
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		
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Appendix D Sampling Plan

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

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LEGEND:

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- PROPOSED STORM DRAIN
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- (No.) DRAINAGE SYSTEM No.
- (h) DRAINAGE UNIT
- GRADE TO DRAIN
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- Exist DI
- CAP DI
- AUSTIN VAULT SAND FILTER

ABBREVIATIONS:

COL	CITY OF LIVERMORE
TW	TOP OF WALL
w/	WITH
ESA	ENVIRONMENTALLY SENSITIVE AREA
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TC	TOP OF COVER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Anlette Ocha 1/17/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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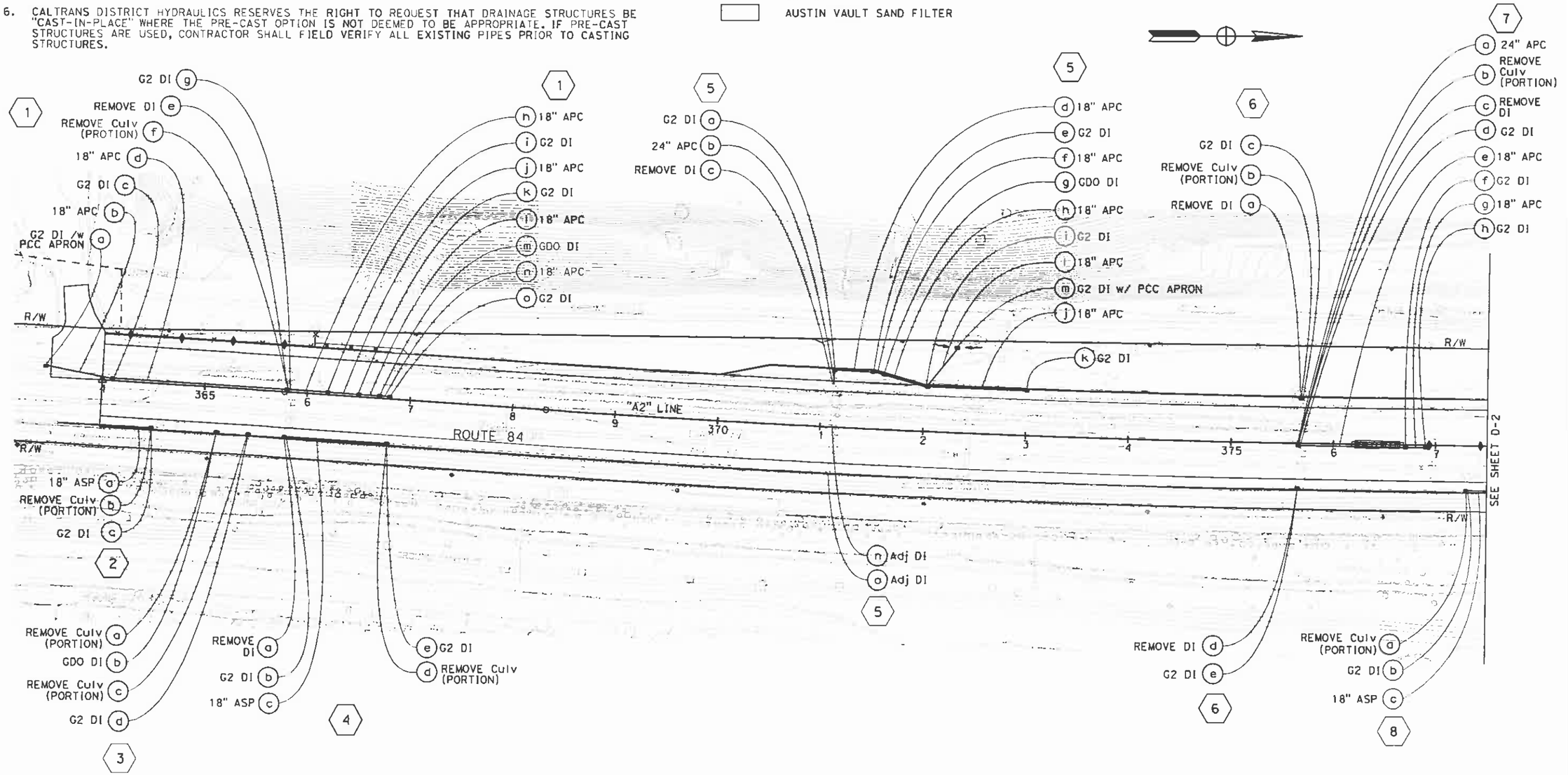

DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-1

CALCULATED-DESIGNED BY	IRENE LIU				
CHECKED BY	ANALETTE OCHOA				
DRAWN BY					
REVISED BY	JP				
DATE REVISED	1/11/11				

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — EXP 12/31/12 — CIVIL — STATE OF CALIFORNIA

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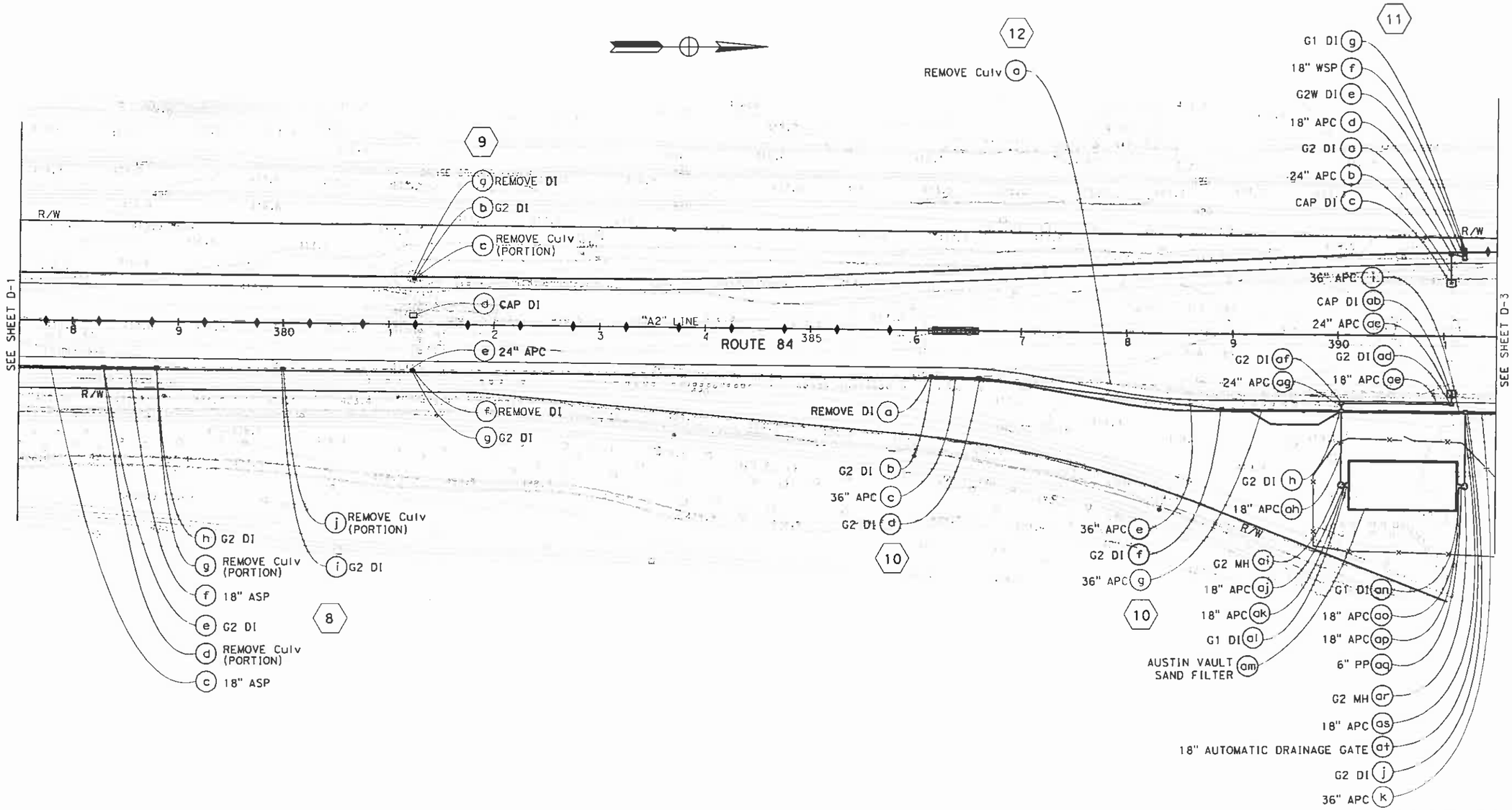

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

LAST REVISION DATE PLOTTED => 1-14-2011
10-19-10 TIME PLOTTED => 15:43:46 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_poli1tz | DGN FILE => ...\04000205801a002.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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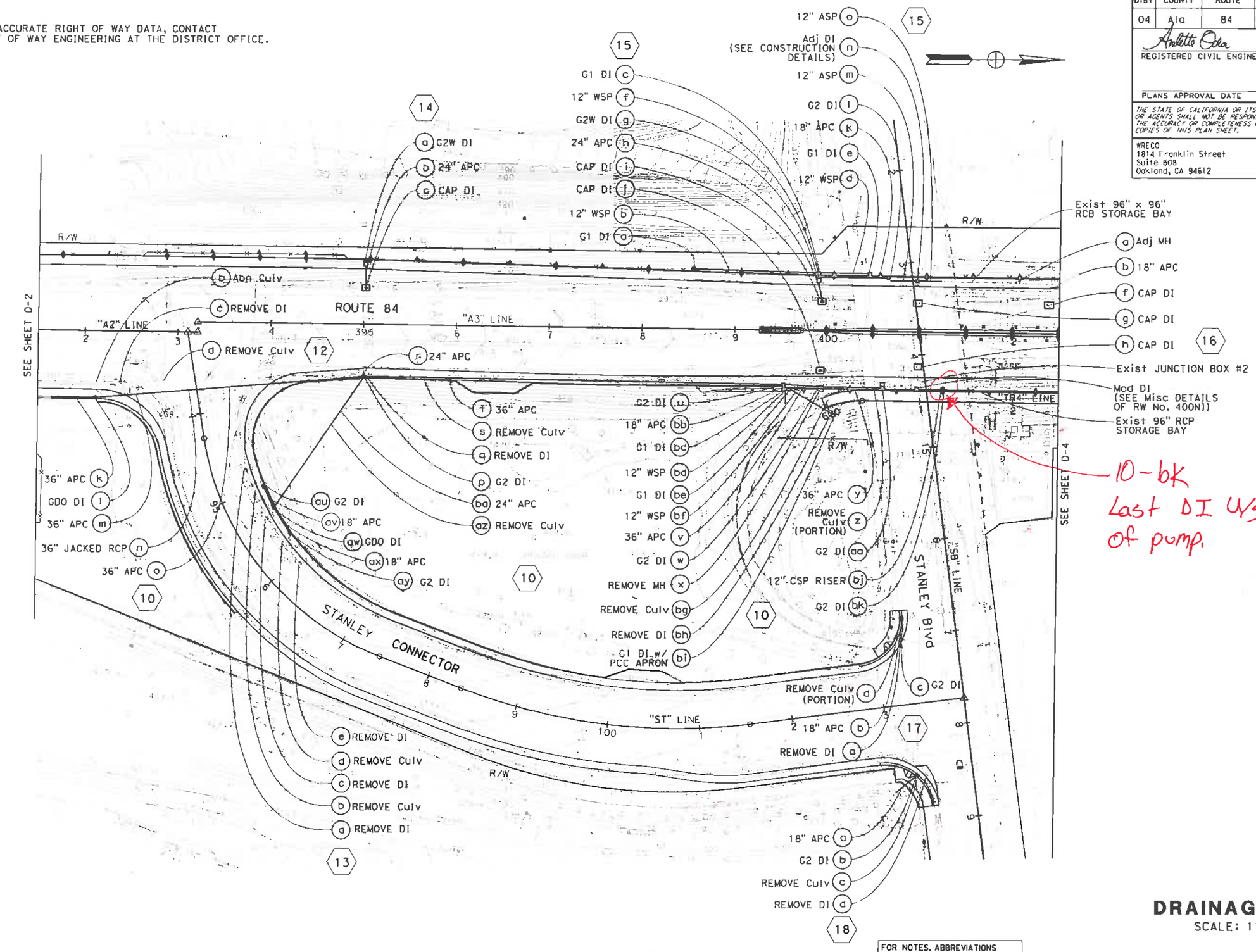

DRAINAGE PLAN

SCALE: 1" = 50'

D-3

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

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Caltrans	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	JP	1/11/11

BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
DGN FILE => ...\04000205801g003.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

LAST REVISION DATE PLOTTED => 1/14/2011
TIME PLOTTED => 5:43:50 PM
10-19-10

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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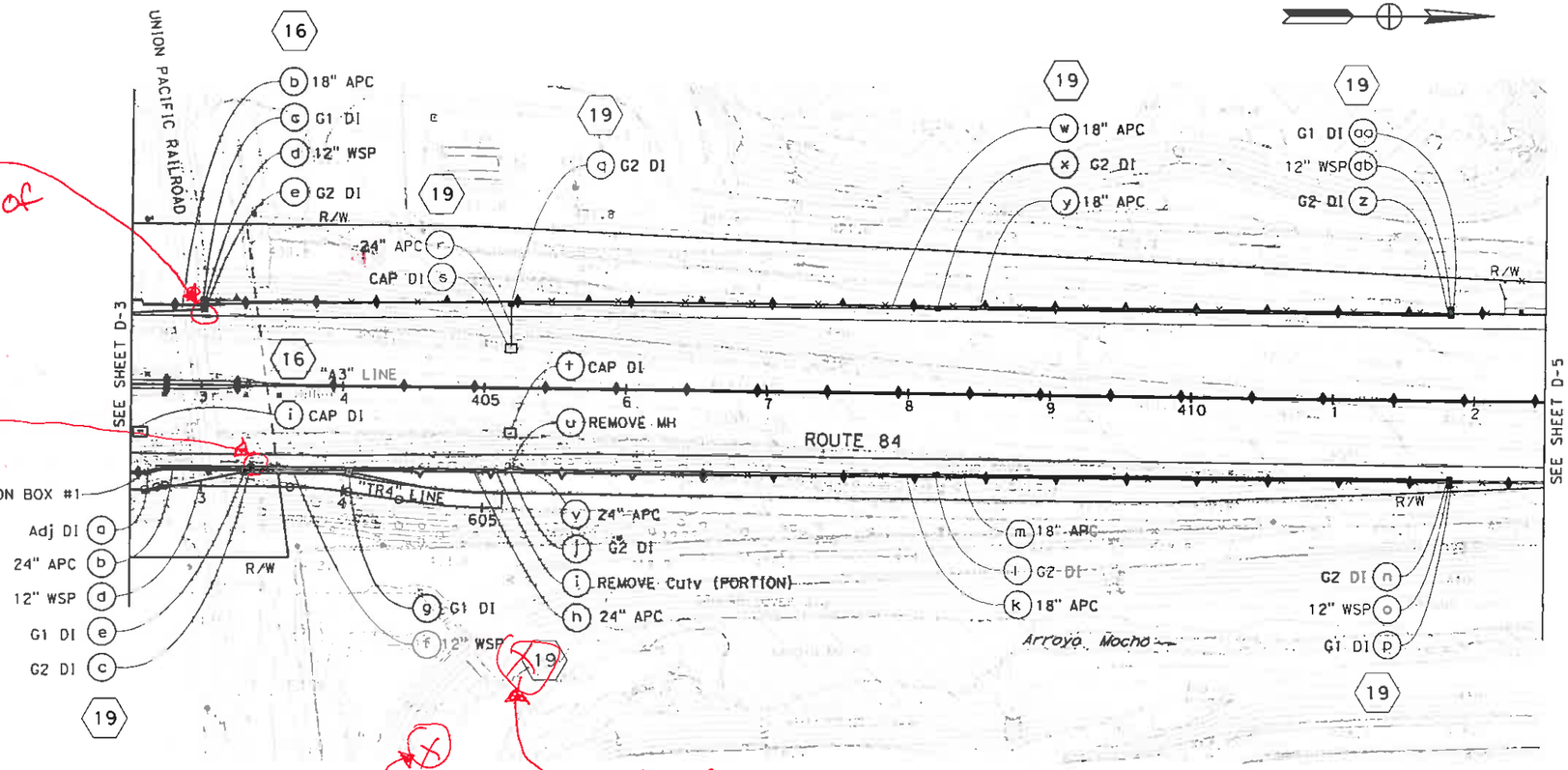
16-e
last DI U/S of pump

19-c
last DI U/S of pump



X
U/S of pump discharge

D/S of pump discharge

DRAINAGE PLAN

SCALE: 1'' = 50'

D-4

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

REVISED BY: JP
DATE REVISED: 1/11/11

LAST REVISION
DATE PLOTTED => 10-19-10
TIME PLOTTED => 5:43:58 PM

BORDER LAST REVISED 7/2/2010

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DGN FILE => ...\04000205801o004.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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"AC3" LINE
VOYAGER St
c 18" AFES
b 18" APC
a 18" AFES
28
"AC2" LINE
20-a
D/S OF (E) 24" PP discharge
Arroyo Mocho
20
a G2 DI
b REMOVE Culv (PORTION)
d 18" APC
e GDO DI
"DSW" LINE
R/W
22
a G2 DI
b 18" APC
SEE SHEET D-4
SEE SHEET D-6
ROUTE 84
"A3" LINE
G2 DI m
n REMOVE Culv (PORTION)
W/S of (E) 24" PP Discharge
g GDO DI
f 18" APC
c Adj DI
20
G2 DI a
18" APC b
GDO DI c
18" APC d
G2 DI e
18" APC f
21
f 18" ASP
k G2 DI
j REMOVE DI
i 18" ASP
h 18" APC
g G2 DI

DRAINAGE PLAN
SCALE: 1" = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-5

LAST REVISION 10-19-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 5:44:03 PM

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	JP
CHECKED BY	ANALETTE OCHOA	DATE REVISED	1/11/11
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		
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Analette Ochoa 1/17/11
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PLANS APPROVAL DATE

ANALETTE OCHOA No. C 55279 Exp. 12/31/12 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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23-d
last DI before
exiting
R/W

DISCOVERY Dr

23
GOW DI d
REMOVE Culv (PORTION) e

23
a G2 DI
b 18" APC
c Adj DI

24
a G2 DI
b 18" APC
GDO DI c

18" APC h
GDO DI g
18" APC f
G2 DI e
18" APC d

24
i G2 DI
j 18" APC
k G2 DI

l 18" APC
m G2 DI
n 18" APC
o G2 DI

27
REMOVE Culv (PORTION) a

R/W

22
"DSW" LINE
R/W
18" APC b
c G2 DI
d 18" APC
e CAP DI
22
f Adj DI
g Adj DI
R/W

SEE SHEET D-5

4 425 6 7 8 9 "O" LINE

REMOVE Culv s
REMOVE DI r
"A3" LINE
p 24" APC
q CAP DI
430
ROUTE 84
Adj DI t

1 2 3 4 435 6

a REMOVE DI
b Abn Culv
G2 DI d
c REMOVE DI

25

SEE SHEET D-7

R/W
G2W DI a
26 12" WSP b
G1 DI c
30" APC d

DRAINAGE PLAN

SCALE: 1" = 50'

D-6

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FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

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CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

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DATE REVISED: 1/11/11

LAST REVISION | DATE PLOTTED => 1/14/2011
10-19-10 | TIME PLOTTED => 5:44:09 PM

BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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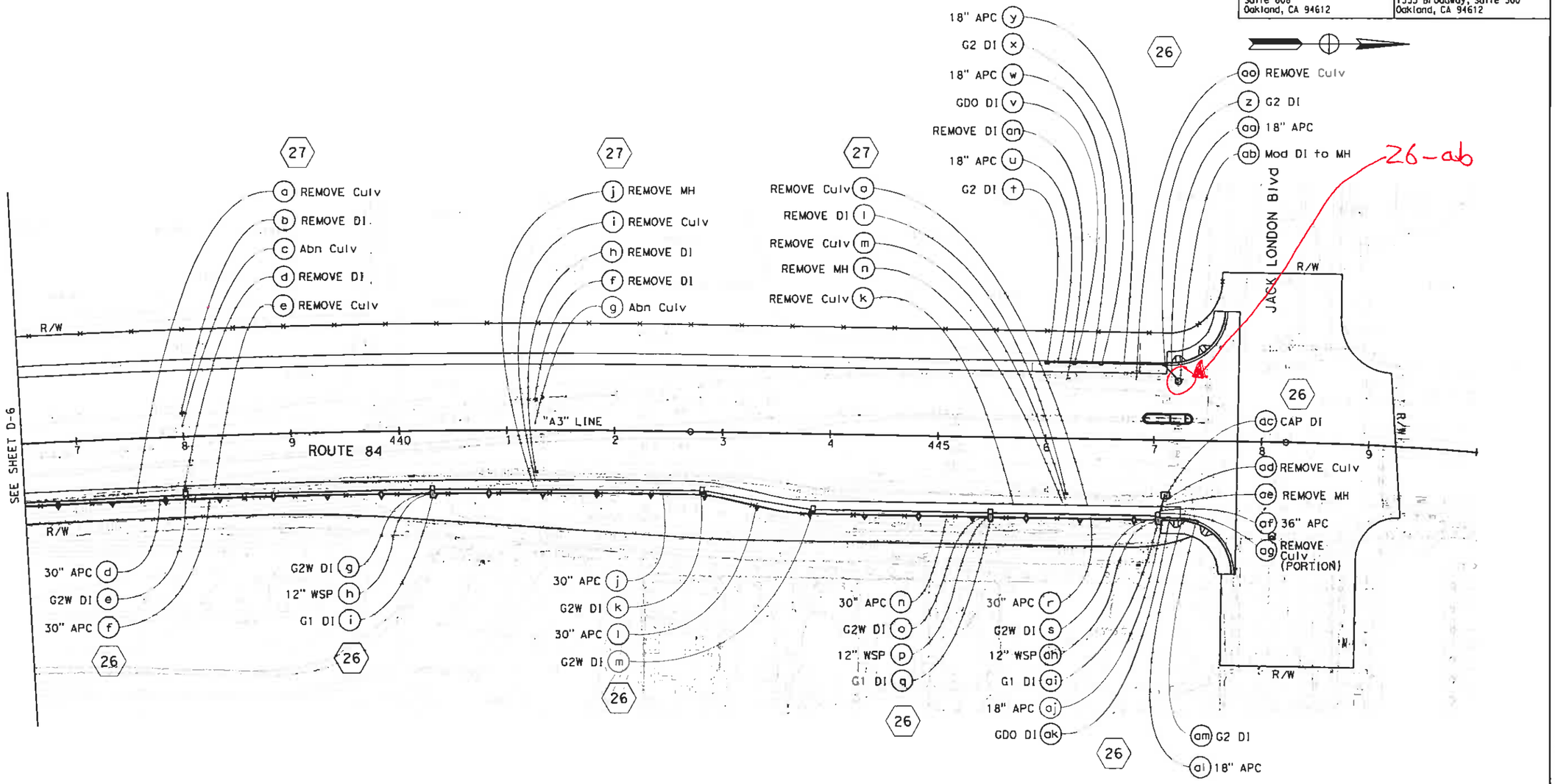

DRAINAGE PLAN

SCALE: 1'' = 50'

D-7

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FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

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REVISED BY: JP
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DATE PLOTTED => 1/14/2011
TIME PLOTTED => 5:44:14 PM
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Appendix E Off-Site Watershed Map

FOR ACCURATE RIGHT OF WAY AND DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

DRAINAGE SYSTEM UNIT
AREA (ac)

FLOW DIRECTION

PERVIOUS WATERSHED BOUNDARY

IMPERVIOUS WATERSHED BOUNDARY (TREATED)

IMPERVIOUS WATERSHED BOUNDARY (NON-TREATED)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

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ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
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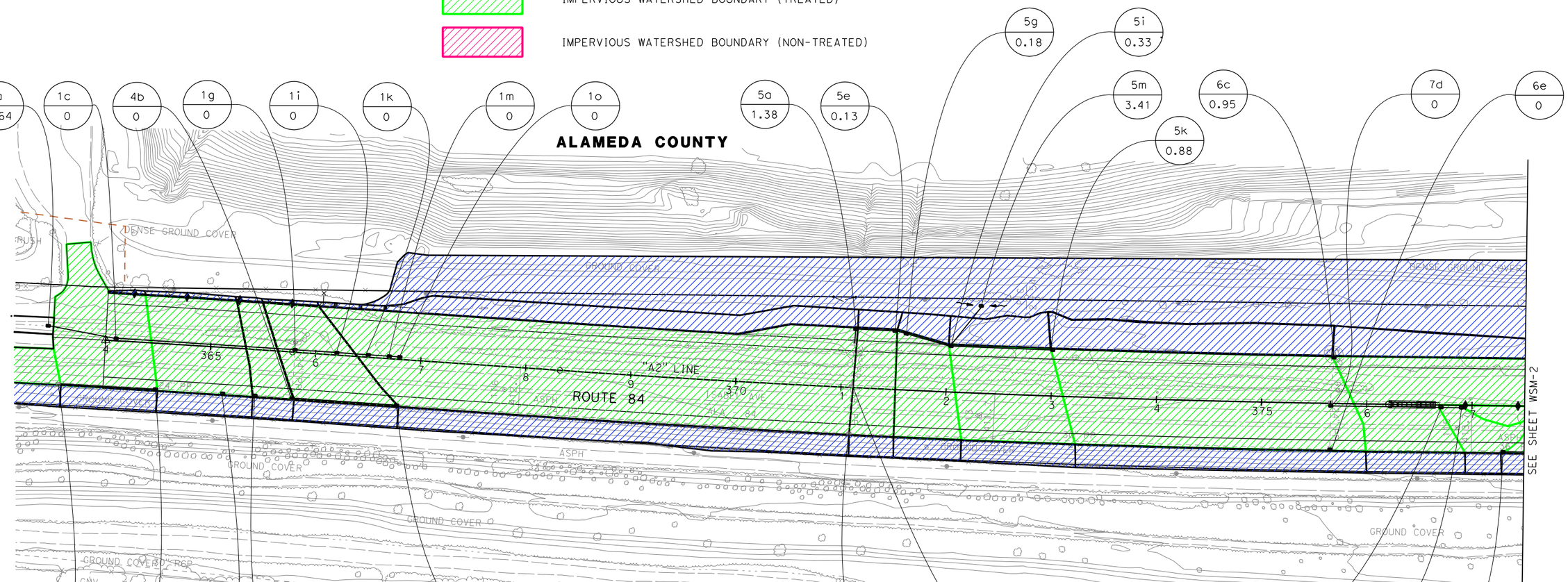

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-1

REVISED BY	DATE REVISED
IL	10/19/10

IRENE LIU — CALCULATED-DESIGNED BY
ANALETTE OCHOA — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

PLANS APPROVAL DATE

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ANALETTE OCHOA
No. C 55279
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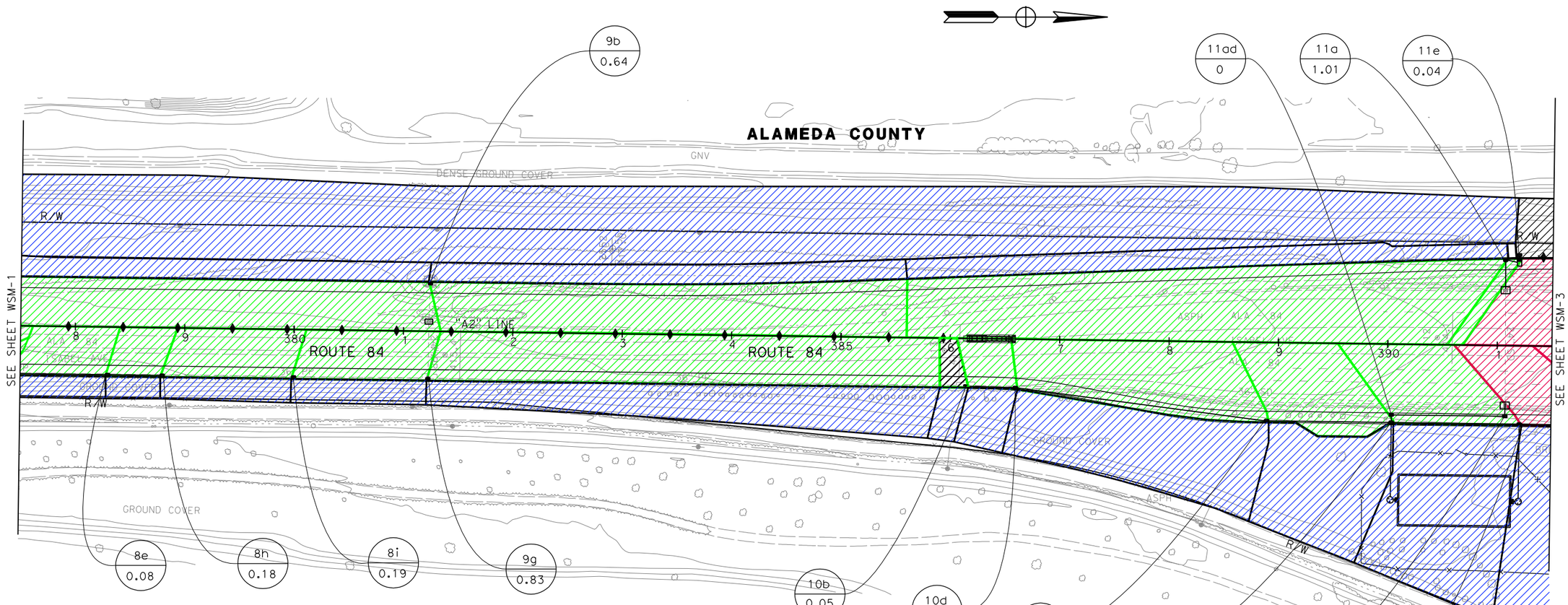

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-2

REVISED BY	DATE REVISED
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SUPERVISOR: HAN-BIN LIANG
CONSULTANT FUNCTIONAL
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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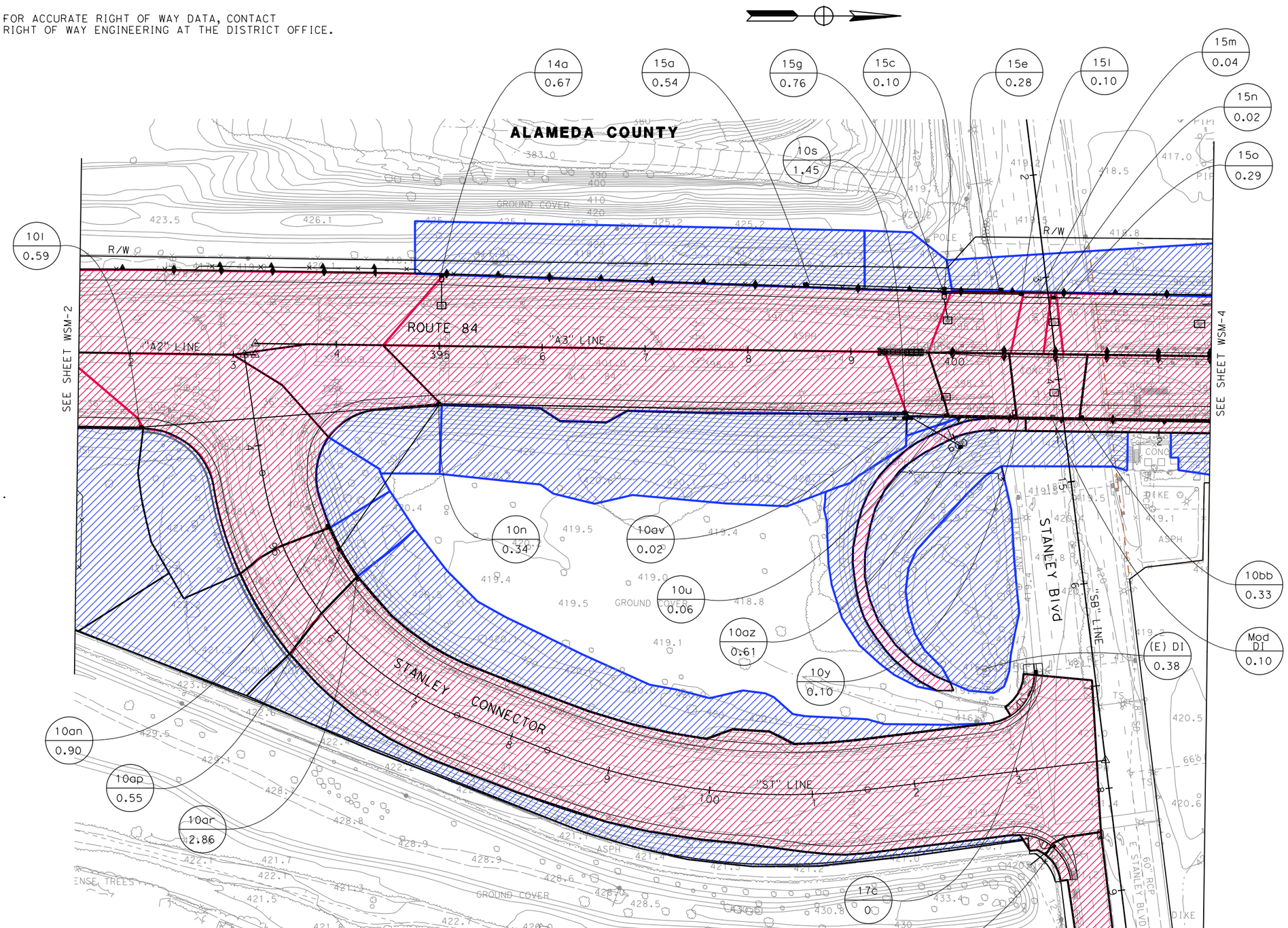
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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WATERSHED MAP

SCALE 1"=50'

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-3

REVISED BY	DATE REVISED
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RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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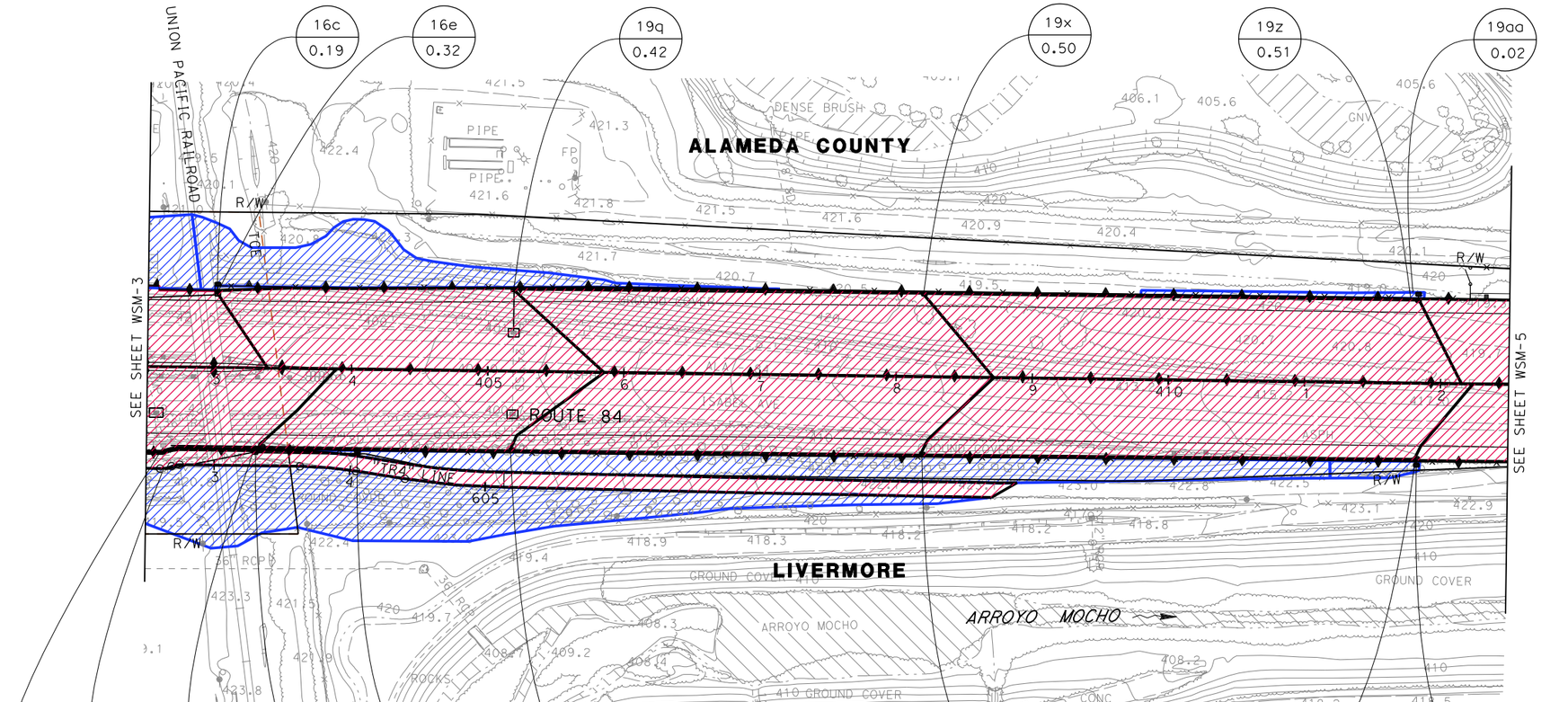

WATERSHED MAP
SCALE 1"=50'

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WSM-4

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CHECKED BY	ANALETTE OCHOA		
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG		
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LAST REVISION 10-19-10
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 7:14:43 PM

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa
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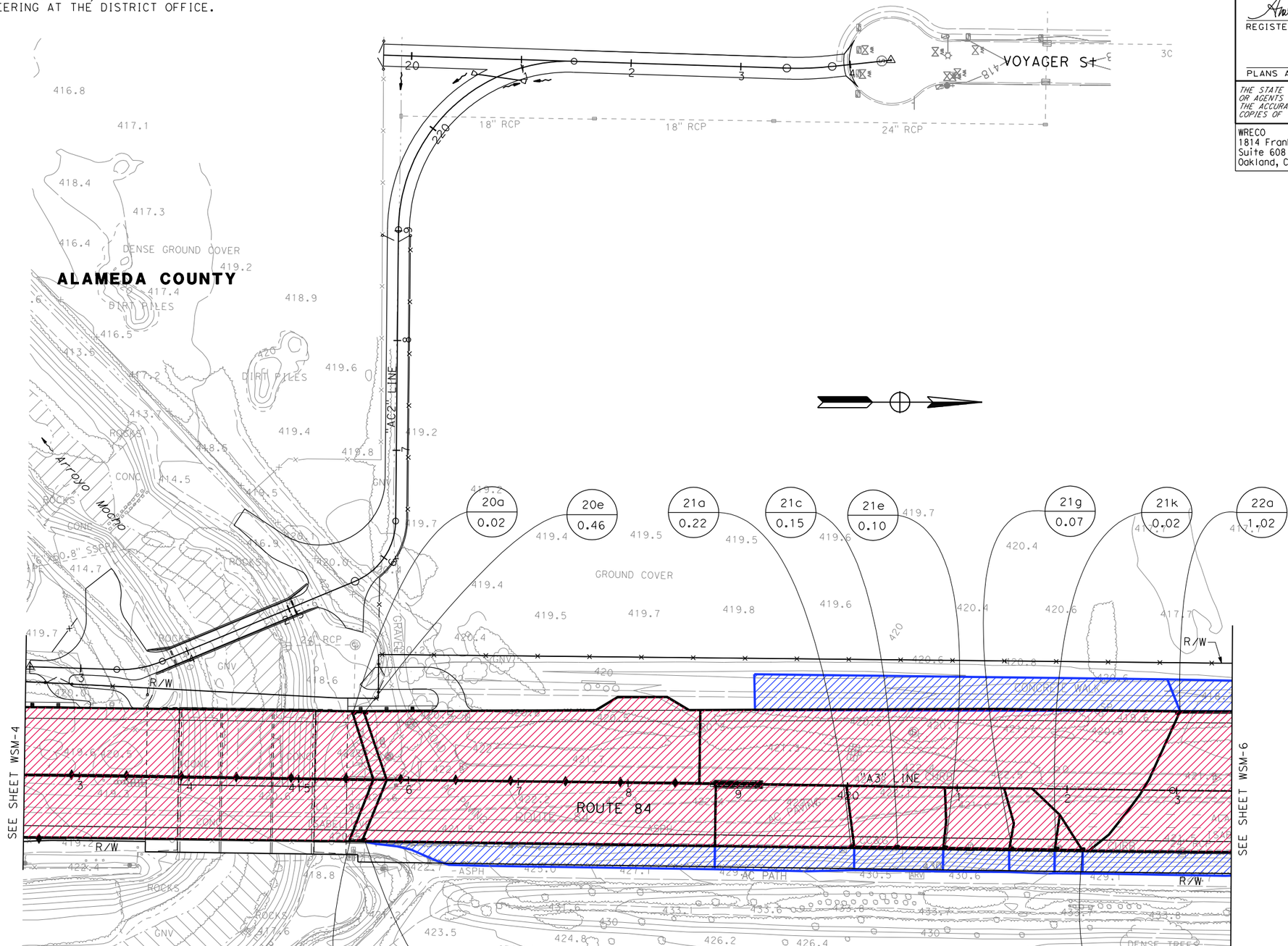

WATERSHED MAP
SCALE 1"=50'

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WSM-5

CALCULATED-DESIGNED BY	IRENE LIU	REVISED BY	IL
CHECKED BY	ANALETTE OCHOA	DATE REVISED	10/19/10

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/12
CIVIL
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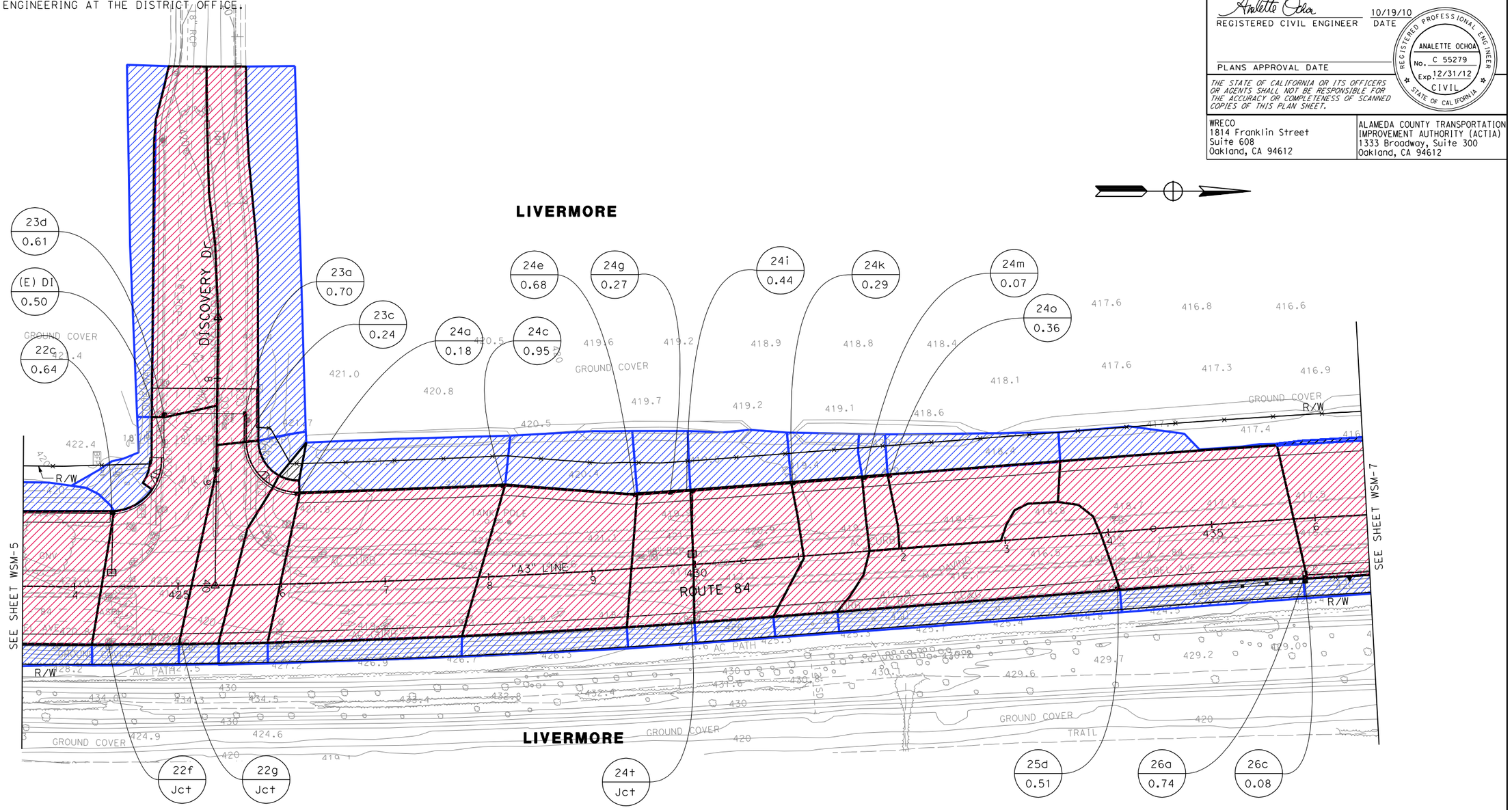

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
DATE REVISED: 10/19/10

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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Analette Ochoa
REGISTERED CIVIL ENGINEER — 10/19/10 DATE

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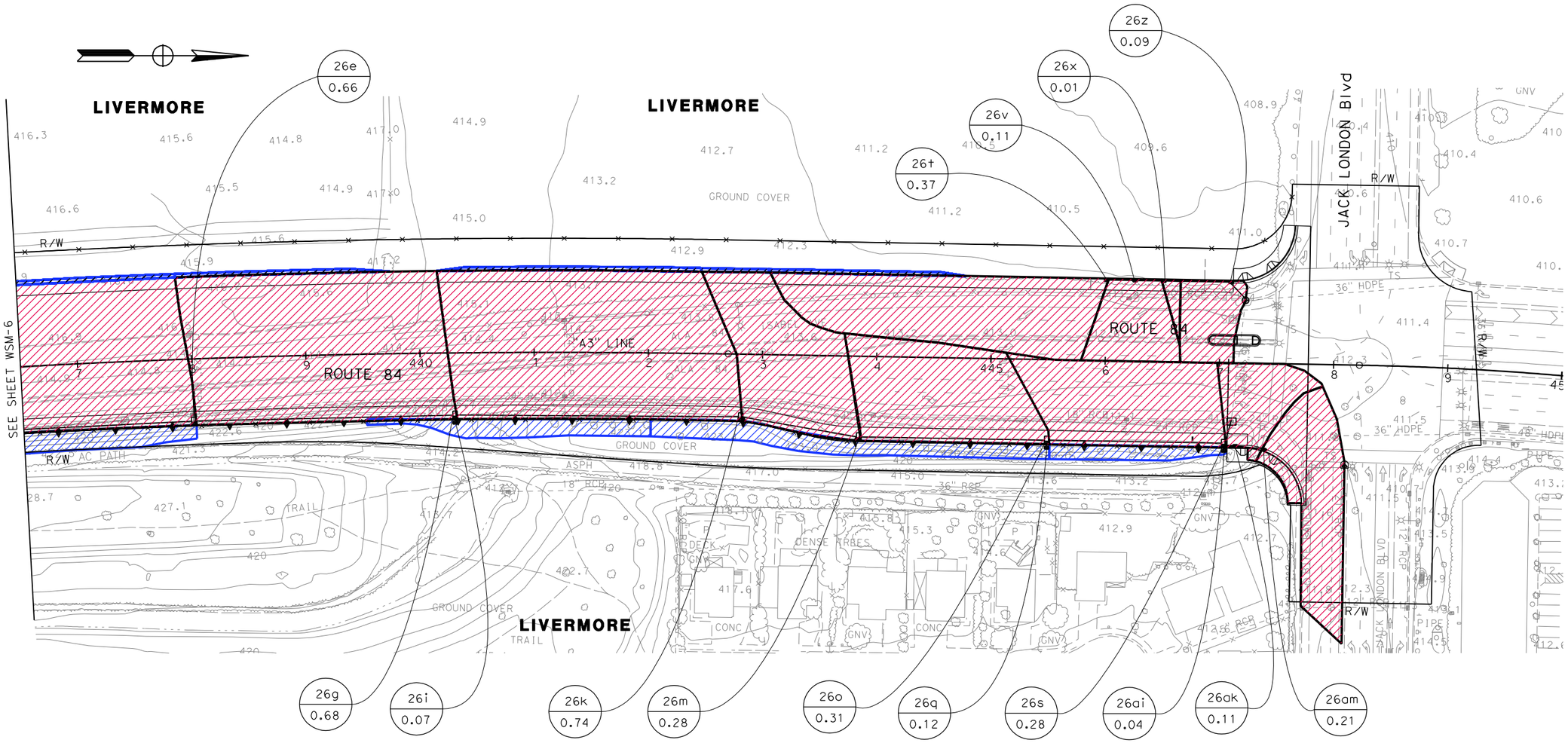

WATERSHED MAP

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-7

CALCULATED-DESIGNED BY	IRENE LIU	
CHECKED BY	ANALETTE OCHOA	
REVISED BY	IL	
DATE REVISED	10/19/10	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	

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FOR CONTRACT NO. 297614

COOPERATIVE AGREEMENTS

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND CITY OF LIVERMORE COOPERATIVE AGREEMENT

DATED 12/4/2003

015704

04-Ala-84-38.0/47.8
Route 84 Transfer & Relinquishment
04-256-233051 & 272621
District Agreement No. 4-1979-C

03-1297

COOPERATIVE AGREEMENT

THIS AGREEMENT, ENTERED INTO EFFECTIVE ON Dec. 4, 2003, is between the STATE OF CALIFORNIA, acting by and through its Department of Transportation, referred to herein as "STATE", and

CITY OF LIVERMORE, a body politic and a municipal corporation of the State of California, referred to herein as "CITY".

RECITALS

1. STATE and CITY, pursuant to Streets and Highways Code section 73, are authorized to enter into a Cooperative Agreement providing for relinquishment to CITY of a segment of State Route 84 within the City of Livermore.

2. CITY desires to sponsor the California Transportation Commission's (CTC) adoption as State Route 84, Isabel Avenue commencing at East Vallecitos Road north along Isabel Avenue to Kitty Hawk Road, then along Kitty Hawk Road to Airway Boulevard, the along Airway Boulevard connecting to Route 580 at the Airway Boulevard Interchange referred to herein as "ADOPTION". Concurrently, STATE desires to relinquish to CITY that segment of Route 84 presently located on East Vallecitos Road, Holmes Street, First Street, between Isabel Avenue and Route 580 within the City of Livermore, referred to herein as "RELINQUISHMENT," and CITY is willing to accept such RELINQUISHMENT.

3. STATE has approved a Transfer and Relinquishment of Highways Report, dated November 17, 2003, which concludes proposed ADOPTION and RELINQUISHMENT is a good business decision for STATE. STATE has determined that the ADOPTION facility has been improved by CITY to meet STATE standards for current and anticipated operating and traffic needs.

4. ADOPTION and RELINQUISHMENT are both subject to approval by the CTC and will occur only when CTC issues separate Resolutions of Adoption and Relinquishment pursuant to Streets and Highways Code Sections 81 and 73 as well as the terms of this Agreement.

5. CITY is willing to assume the responsibility of improving the RELINQUISHMENT facility utilizing funds set aside by STATE for such purposes.

6. STATE is willing to make a lump sum payment to CITY to satisfy CITY's desire to improve RELINQUISHMENT beyond the current state of good repair subject to the CTC's approval of those funds for that purpose.

7. CITY is willing to accept this lump sum payment as STATE's contribution to City's desired improvements to complete RELINQUISHMENT of this highway to CITY.

8. The adoption of the proposed new Route 84 alignment and relinquishment of the existing Route 84 facility will occur upon approval by the CTC of separate Resolutions of

ADOPTION and RELINQUISHMENT and the recording of said Resolutions in the County Recorder's Office.

9. The parties hereto desire to define herein the terms and conditions under which this ADOPTION and RELINQUISHMENT are to be accomplished.

SECTION I

CITY AGREES:

1. To prepare a traffic operations analysis satisfactory to STATE evaluating the performance of the ADOPTION facility based on directions outlined in the letter from STATE to CITY, dated March 14, 2003 and detailed in the approved Transfer and Relinquishment of Highways Report.

2. To prepare environmental investigations and documents as required for STATE and CTC to approve ADOPTION and RELINQUISHMENT pursuant to the California Environmental Quality Act (CEQA).

3. To assume stewardship and protection of historical resources, as defined in Section 15064.5 of the State CEQA Guidelines, within the limits of RELINQUISHMENT.

4. To maintain and repair the ADOPTION facility, as defined in SECTION III, Article 9 once the CTC has issued and recorded its Resolution of Adoption and until either of the following two milestones is achieved:
   a) the designation of Route 84 on the ADOPTION facility between Jack London Boulevard and the Airway Interchange to I-580 is transferred by the CTC's adoption of some other location as approved Route 84;
   b) ten years from the date of the CTC's Resolution of Relinquishment. At year five, CITY and STATE will evaluate the feasibility and timing of the milestone cited in this SECTION I, Article 4(a) above and determine, by mutual consent, whether to amend, modify or terminate CITY's maintenance responsibilities.

   When either milestone is reached and CTC has adopted that replacement Route 84, the Operation and maintenance of said ADOPTION, the new Route 84, shall become STATE's sole responsibility as specified in the Agreement for Maintenance of State Highways, the Freeway Maintenance Agreement and the agreement for Sharing Costs of State Highway Electrical Facilities, collectively hereinafter "Maintenance Agreements."

5. To accept RELINQUISHMENT, as described in Article 2 of RECITALS, upon approval by the CTC of a Resolution of Relinquishment and the recording of said separate Resolution in the County Recorder's Office.

6. To perform all project development and right of way activities as outlined in Scope of Work (Attachment 1) and Right of Way Activities (Attachment 2) attached hereto and made part of this Agreement, including preparation and submittal of an Encroachment Policy Variance Request for the ADOPTION facility, at no cost to STATE, in accordance with procedures acceptable to STATE and in compliance with all applicable State laws and regulations. Subject to State oversight, to assure that the completed work is fully acceptable for incorporation into the State Highway System when that ADOPTION is accepted by the CTC's Resolution of Adoption.

7. To utilize the services of a qualified local public agency in all right of way related matters for the ADOPTION facility in accordance with State procedures as contained in the Right of Way Procedural Handbook, Vol. 9. If outside right of way consultants are employed,

administration of the consultant contract shall be performed by qualified public agency employees.

8. To prepare all necessary Right of Way Engineering Hard Copies, Records of Survey, and Right of Way Record Map, for the ADOPTION, (excluding that portion along Kitty Hawk Road from Jack London Boulevard to Airway Boulevard and Airway Boulevard to I-580) facility in accordance with the State of California Right of Way Manual, Chapter 6 - Right of Way Engineering, the State of California Drafting and Plans Manual, the State of California Surveys Manual, Chapter 10, applicable State laws, and other pertinent reference materials and examples as provided by STATE.

9. To have all necessary Right of Way maps and documents that will be used to transfer title to the right of way for the substitute ADOPTION facility from CITY to STATE prepared by or under the direction of a person authorized to practice land surveying in the State of California. Each Right of Way map and document shall bear the appropriate professional seal, certificate number, expiration date of registration certification and signature of the licensed person in "Responsible Charge of Work."

10. To submit to STATE for review and acceptance all Right of Way Engineering Hard Copies and Maps for the ADOPTION facility, with available appurtenant back-up and reference data, prior to CITY's preparation of legal descriptions and deeds. Attachment 3, attached hereto and made a part of this Agreement, outlines items considered as necessary appurtenant back up and reference data.

11. To deliver to STATE legal title to the right of way for that segment of the ADOPTION facility along Isabel Avenue, commencing from East Vallecitos Road to the intersection of Jack London Boulevard/Kitty Hawk Road, within two years of the date of the CTC's Resolution approving that ADOPTION. Acceptance of said title by STATE for parcels acquired by CITY is subject to a review and acceptance by STATE of a Policy of Title Insurance (in an amount not less than the total of all parcel acquisition costs) in the name of the State of California to be provided and paid for by CITY.

12. To deliver said title to STATE free and clear of all liens, encumbrances, assessments, easements and leases (recorded and/or unrecorded) and taxes, except for acceptable covenants, conditions, restrictions and reservations of record, provided STATE has determined that title may safely be taken subject to said express covenants, conditions restrictions and reservations.

13. To certify that right of way parcels to be transferred to STATE were acquired in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 (as amended), Caltrans Right of Way Manual & Procedures and Titles 23 & 49 of the Code of Federal Regulations (CFR). In the event, STATE determines that its review of parcel files reveals coercion by CITY in the acquisition process, CITY agrees to remedy said deficiencies to STATE's satisfaction prior to transfer those properties to STATE.

14. To convey a highway easement to STATE for the public rights of way necessary for the segment of the ADOPTION facility along Kitty Hawk Road from Jack London Boulevard to Airway Boulevard and along Airway Boulevard from Kitty Hawk Road to the I-580/Airway Boulevard interchange. Said easement shall include a reversionary clause that reverts said easement back to CITY upon realization of the milestone outlined in SECTION I, Article 4(a) above. CITY shall indemnify STATE against any future legal actions that challenge STATE's right to operate the ADOPTION facility as a highway on said easement. Said easement shall also include a metes and bounds legal description that includes a statement setting forth the width of said easement.

15. With respect to the easement referenced in Article 14 of SECTION I above, accept any and all financial obligations related to liability, excluding claims arising from the gross negligence and willful misconduct of STATE, it's elected officials, officers, directors and employees and to represent and indemnify STATE in any legal actions and/or lawsuits involving all incidents alleged to have occurred along Airway Boulevard between Kitty Hawk Road and the I-580/Airway Boulevard Interchange and involving Kitty Hawk Road between Airway Boulevard and Jack London Boulevard until realization of either of those milestones outlined in Article 4 of SECTION I, above.

16. To assist STATE in negotiation of a satisfactory maintenance agreement with the Alameda County Flood Control District for the maintenance of the flood channel within the designated newly added ADOPTION right of way.

17. To work diligently at completing all tasks as outlined in this SECTION I in a timely manner.

18. To transfer to STATE all records and files for the ADOPTION upon the recordation of the CTC's Resolution of Adoption, including, but not limited to, maintenance logs, utility permit files, plans (including as-builts), record drawings, construction files, survey data and documents, right of way information including complete acquisition and appraisal files for each parcel acquired for the substitute facility, and contract records, and electronic files as currently available.

19. Not to compromise the integrity of the proposed ADOPTION as an expressway and to support and advocate future projects that would further improve that facility to full expressway standards. This includes, to the extent possible, eliminating all existing and avoiding the placement of new, longitudinal utility encroachments within the ADOPTION facility. Letters from CITY, the Alameda County Transportation Improvement Authority and the Alameda County Congestion Management Agency that outline local commitments to upgrade the ADOPTION to expressway standards are appended to this Agreement as Attachment 4.

20. Following adoption of a Resolution by the CTC accepting ADOPTION, any proposed improvements on the ADOPTION facility will require that an encroachment permit is issued from STATE except as outlined in SECTION III, Article 3.

21. That payment of STATE's final contribution of $5,627,544.00, to CITY fully meets STATE's agreement to fund the described improvements of RELINQUISHMENT beyond its current state of good repair and CITY shall accept RELINQUISHMENT and all rights, title and interest in said facility, without any additional cost to STATE. Said $ 5,627,544.00 is based upon the $5,000,000.00 amount cited in the Supplemental Project Scope Summary Report (SPSSR) for Route 84 approved on September 13, 2001 which represents the estimated value of improving RELINQUISHMENT facility subject to CTC's finding that this is in the best interests of the State of California as required by Section 73 of the Streets and Highways Code.

22. To accept deferred payment by STATE for the lump sum payment to CITY for satisfying STATE's RELINQUISHMENT obligation so that said payment shall occur the later of the following two milestones: upon transfer of title by CITY to STATE for the ADOPTION facility or after July 1, 2005, which date represents the first fiscal year STATE funds are currently programmed as available in the SHOPP. Payment from STATE to CITY is conditional upon CITY delivering right of way for Isabel Avenue in a form acceptable to STATE. In the event transfer of title from CITY to STATE is not accomplished within two years of the date of the CTC's Resolution approving the ADOPTION, STATE reserves the right to perform these tasks outlined in SECTION 1, Article 11 and 12 at CITY's expense.

23. If STATE opts to exercise their right described in SECTION I, Article 22, State incurred expenses may be deducted from the STATE's lump sum payment to CITY described in SECTION II, Article 3 and STATE may withhold sufficient funds from the payment referenced in SECTION I, Articles 21 and 22 to reimburse STATE for all costs of said work.

24. To prepare an ADOPTION signing plan for surface streets and I-580 for STATE's approval indicating Isabel Avenue as Route 84 and to install such signs at CITY's expense.

25. To install CITY approved traffic controllers, at CITY expense, on the RELINQUISHMENT facility. The existing Type 170 traffic controllers from the RELINQUISHMENT facility shall remain STATE property and will be returned to STATE.

SECTION II

STATE AGREES:

1. To recommend to CTC a new location for the connection of Route 84 to I-580 from its current or future location at the First Street Interchange over to the Airway Boulevard Interchange upon proper consideration of environmental studies, environmental constraints, and public sentiment for the RELINQUISHMENT and ADOPTION.

2. To transfer to CITY all available records and files for the RELINQUISHMENT, including, but not limited to, plans (including as-builts), maintenance logs, record drawings, survey data and documents, right of way information, and contract records, and electronic files as currently available.

3. Subject to CTC consent, to provide CITY a lump sum financial commitment in lieu of improving the existing Route 84 corridor between Isabel Avenue/East Vallecitos Road and I-580/First Street traversing along East Vallecitos Road, Holmes Street and First Street beyond its current state of good repair. The agreed amount is cited in the approved Supplemental Project Scope Summary Report (SPSSR) for Route 84 approved on September 13, 2001, unless said report is amended by mutual agreement. Said payment will not be payable any earlier than the 05/06 fiscal year, which is the first fiscal year the funds are programmed in the 2002 State Highway Operations and Protection Program (SHOPP).

4. Said lump sum payment, already adjusted for inflation, will be paid after the allocation of the funds and approval of the Resolution of Relinquishment by the CTC. Said lump sum payment represents STATE's final and only payment toward the cost of improving the relinquished highway beyond its current or anticipated state of good repair, as outlined in Attachment 6 appended to this Agreement, for the purpose of relinquishment, except as outlined in Article 13 of SECTION III.

5. To work diligently at completing all STATE tasks in a timely manner.

6. To maintain a good faith effort and partner with CITY to effectuate the ADOPTION and RELINQUISHMENT by December 31, 2003.

7. To provide oversight of the Adoption and Relinquishment processes and to provide prompt reviews and approvals, as appropriate, of submittals by CITY, and to cooperate in timely processing of ADOPTION and RELINQUISHMENT documents.

8. To issue, at no cost to CITY, upon proper application by CITY, an encroachment permit to CITY authorizing entry onto State highway right of way to perform survey and other investigative activities required for preparation of the Environmental Documents and the

Adoption and Relinquishment Reports. If CITY uses consultants rather than its own staff to perform required work, these consultants will also be required to obtain an encroachment permit. Said permits will be issued at no cost upon proper application by the consultants.

9. To issue, at no cost to CITY and CITY's contractor, upon proper application by CITY and by CITY's contractor, the necessary encroachment permits to modify and install directional signing within existing State highway right of way for the ADOPTION and RELINQUISHMENT.

10. To relinquish existing Route 84 to CITY following CTC's Resolution of Relinquishment, prior to STATE's assumption of title to and all rights, title and interest in the ADOPTION facility without any additional cost to STATE, except as specified in Articles 3, 4 and 15 of SECTION II, and Article 13 of SECTION III.

11. To accept and operate the ADOPTION facility once the CTC has adopted it as new Route 84, including those acceptable existing encumbrances that are not detrimental to STATE's present and future use (as determined by STATE) together with all rights, title and interest in that facility and to be responsible for the administration of the accompanying easements and/or permits.

12. To acquire title to undocumented CITY and County areas within Isabel Avenue and Kitty Hawk Road as said areas are designated on the Section 83 drawings, provided by Chaudhary & Associates titled "Original Street Area Isabel Avenue Extension", dated August 18, 2003.

13. STATE's approval of Advisory Fact Sheet, dated November 14, 2003, represents STATE's approval of the conceptual new public road connection, herein referred to as Discovery Drive, between Jack London Boulevard and the Arroyo Mocho Bridge, subject to CTC consent and CITY's satisfaction of all CEQA obligations.

14. To issue an encroachment permit to CITY, (at no cost to CITY), for a portion of State owned parcel number 43672, a non-operating right of way, subject to all applicable laws, regulations and procedures authorizing CITY to:
    a) maintain, at CITY's expense, all multi-use trails, equestrian areas, and landscaped berms required as environmental mitigation for construction of Isabel Ave (Future Route 84); and
    b) permit existing public and private utility owners access and rights to occupy Parcel 43672 for facilities that were relocated from the operating right of way for Isabel Avenue until such parcel is required for transportation purposes by STATE.

15. To install Type 170 traffic controllers, at STATE expense, on the ADOPTION facility within thirty days of the date of the California Transportation Commission's adoption for that new Route 84 and the recording of said resolution in the County Recorder's Office. Existing CITY traffic controllers from the TRANSFER facility shall remain CITY property and will be returned to CITY.

16. To furnish the signs cited in SECTION I, Article 24 (as State furnished materials), at CITY's expense.

SECTION III

IT IS MUTUALLY AGREED:

1. STATE will function as the CEQA Lead Agency for the ADOPTION and RELINQUISHMENT. As a result of CITY's fulfillment of responsibilities cited in Articles 1 and 2 of SECTION I, STATE, on November 7, 2003, approved a Categorical Exemption pursuant to CEQA and filed a Notice of Exemption with the State Clearinghouse.

2. CITY will function as the CEQA Responsible Agency for both the ADOPTION and RELINQUISHMENT.

3. Prior to realizing the milestone referenced in Article 4 of SECTION I, encroachment permits will not be required by STATE for CITY forces performing roadway and utility maintenance work along Isabel Avenue, Kitty Hawk Road or Airway Boulevard. STATE agrees to issue fee-exempt biennial encroachment permits to properly licensed contractors hired by CITY to perform roadway and utility maintenance work.

4. STATE, as authorized by the CTC, will accept the ADOPTION facility as an expressway commencing from East Vallecitos Road to the intersection of Kitty Hawk Road and Airway Boulevard, with appropriate design exceptions, provided said exceptions do not compromise the safety and proper level of traffic operations of the ADOPTION facility and its connections to other State highways.

5. STATE, as authorized by the CTC, will accept the ADOPTION as a conventional highway along Airway Boulevard, commencing from the intersection of Kitty Hawk Road to Route-580, with appropriate design exceptions, provided said exceptions do not compromise the safety and proper level of traffic operations of the ADOPTION facility and its connections to other State highways.

6. STATE encroachment permits will be required of parties requesting to perform work or make improvements on the ADOPTION, including the segment along Kitty Hawk Road and Airway Boulevard, except as outlined in Article 3 of this SECTION III.

7. CITY's construction of Discovery Drive, referred to in Article 13 of SECTION II, is contingent upon STATE's review and approval of a design acceptable to STATE and issuance of an encroachment permit by STATE for construction of Discovery Drive by CITY.

8. Maintenance Agreements will be executed between CITY and STATE following the CTC's approval of Resolutions of Adoption and Relinquishment. These Maintenance Agreements shall specify long-term maintenance responsibilities delegated to CITY for local facilities and signals.

9. Prior to the milestones referenced in Article 4 of SECTION I, maintenance of the ADOPTION facility is allocated as follows:
   a) CITY shall provide roadway maintenance, at CITY's expense, including pavement management and repair, and street sweeping.
   b) STATE shall maintain and operate the entire traffic control signal system, including safety lighting at the intersections of Vallecitos Road/Isabel Avenue, Vineyard Avenue/Isabel Avenue, Concannon Boulevard/Isabel Avenue, Isabel Avenue/Stanley-Isabel Connector, Kitty Hawk Road/Jack London Boulevard/Isabel Avenue and Kitty Hawk Road/Airway Boulevard. The cost of maintaining and operating said traffic control and safety lighting systems, including electrical costs, shall be shared between STATE and CITY on a pro rata basis in the same ratio as the number of legs in the intersection under each jurisdiction bears to the total number of legs.
   c) STATE will take lead in receiving and responding to public inquiries or complaints related to maintenance and, if appropriate, will refer such inquiries or complaints to CITY.

10. CITY shall continue to operate and maintain, at CITY's expense, the intersection of E. Stanley Boulevard/Stanley-Isabel Connector until such time said connector is reconfigured to a conventional loop on-ramp acceptable to STATE.

11. This Agreement supersedes Articles 11 and 13 of the Right of Entry dated August 7, 1998, between CITY and STATE with respect to STATE owned parcel number 43672 and is consistent with the approved Transfer and Relinquishment of Highways Report.

12. All obligations of STATE under the terms of this Agreement are subject to the appropriation of resources by the Legislature, the allocation of resources by the California Transportation Commission, and the encumbrance of funds. In the event STATE funds are not appropriated, allocated or encumbered, as agreed in SECTION II, Article 3. STATE agrees to negotiate the deferred STATE payment to the CITY, which will be resubmitted to CTC for consideration.

13. To amend the SPSSR referred to in Article 21 of SECTION I, to include the cost of signal improvements at Holmes Street and Concannon as outlined in the letter from STATE to CITY, dated April 17, 2002, and appended to this Agreement as Attachment 5. Following the amendment of the SPSSR, SECTION I, Article 21 of this Agreement will be amended to reflect the estimated cost of said signal improvements.

14. Attachment 5, attached hereto and made part of this Agreement, outlines those negotiated Improvements desired by CITY and referenced in Article 5 of RECITALS.

15. Neither STATE nor any officer or employee thereof is responsible for any damage or liability occurring by reason of anything done or omitted to be done by CITY under or in connection with any work, authority or jurisdiction delegated to CITY under this Agreement. It is understood and agreed that, pursuant to Government Code Section 895.4, CITY shall fully defend, indemnify and save harmless the State of California, all officers and employees from all claims, suits or actions of every name, kind and description brought for or on account of injury (as defined in Government Code Section 810.8) occurring by reason of anything done or omitted to be done by CITY under or in connection with any work, authority or jurisdiction delegated to CITY under this agreement.

    This indemnification by CITY shall include, but is not limited to, any claim or suit arising out of traffic and maintenance operations performed by CITY on the ADOPTION facility until the achievement of either of the two milestones referenced in Article 4 of SECTION I. Unless CITY is self-insured for all of its transportation operations, in which case it will provide STATE with a certificate of self insurance to that effect, CITY will name STATE and its officers and employees as additional insureds on CITY's liability insurance policy or policies for this ADOPTION facility and will provide an acceptable Certificate of Maintenance issued by that carrier to STATE conforming to the provisions of Section 7-1.12B (3) or (5) of State Standards Specifications July 1999.

16. Neither CITY nor any officer or employee thereof is responsible for any damage or liability occurring by reason of anything done or omitted to be done by STATE under or in connection with any work, authority or jurisdiction delegated to STATE under this Agreement. It is understood and agreed that, pursuant to Government Code Section 895.4, STATE shall fully defend, indemnify and save harmless the City of Livermore, all officers and employees from all claims, suits or actions of every name, kind and description brought for or on account of injury (as defined in Government Code Section 810.8) occurring by reason of anything done or omitted to be done by STATE under or in connection with any work, authority or jurisdiction delegated to STATE under this agreement.

17. No alteration or variation of the terms of this Agreement shall be valid unless made in writing and signed by the parties hereto and no oral understanding or agreement not incorporated herein shall be binding on any of the parties hereto.

18. The parties hereto will carry out their respective duties in accordance with the exhibits and attachments made a part of this Agreement, which outline the specific responsibilities of the parties hereto. These duties may in the future be modified in writing to reflect changes in the responsibilities of the respective parties. Such modifications shall be incorporated into this Agreement as amendments, provided that they are approved and signed by the parties hereto or their designated successors or representatives. The revised duties shall become part of this Agreement after execution by both parties.

19. This Agreement shall terminate when SECTION I, Articles 4, 6, 11, and 12 and SECTION II, Articles 3 and 4 are realized or on December 31, 2018 whichever is first in time; however, the utility relocation obligations, ownership, operation, maintenance, and indemnification clauses shall remain in effect until terminated or modified, in writing, by mutual agreement.

20. This Agreement is a formal legally binding contract. Any interpretation or matters of dispute are subject to the laws of the State of California.

STATE OF CALIFORNIA
Department of Transportation
JEFF MORALES
Director of Transportation

By: _____
Deputy District Director

CITY OF LIVERMORE

By: _____
City Manager

Attest: _____
City Clerk

Approved as to form and procedure:

_____
Attorney
Department of Transportation

Approved as to form:

_____
City Attorney

Certified as to budgeting of funds:

_____
District Budget Manager

Certified as to financial terms and conditions:

_____
Accounting Administrator

015704

SCOPE OF WORK

This Scope of Work outlines the specific areas of responsibility for various project development activities for the proposed Transfer and Relinquishment of Route 84, in Livermore.

1. STATE will be the Lead Agency and CITY will be a Responsible Agency for CEQA for the ADOPTION and RELINQUISHMENT. CITY will prepare the Environmental Document (ED) to meet the requirements of CEQA. The draft and final ED will require STATE's review and approval prior to public circulation. CITY will provide all data for and prepare drafts of the Transfer Report (TR). STATE will review those reports to determine if STATE can approve PROJECT. CITY will be responsible for the public hearing process.

2. CITY will submit drafts of environmental technical reports, and individual sections of the draft environmental documents to STATE, as they are developed, for review and comment. Traffic counts and projections to be used in the various reports shall be supplied by STATE if available, or by CITY. Existing traffic data shall be furnished by CITY.

3. All phases of PROJECT, whether done by CITY or STATE, will be developed in accordance with all policies, procedures, practices, and standards that STATE would normally follow.

4. Detailed steps in the PROJECT development process are attached to this Scope of Work. These Attachments are intended as a guide to STATE's and CITY's staff.

015704

RIGHT OF WAY ACTIVITIES

PROJECT ACTIVITY	RESPONSIBILITY STATE	CITY
1. PRELIMINARY COORDINATION		
Designate a Surveying Manager and Conduct Initial Surveys Discussion with District Staff		X
Obtain Surveys		X
Obtain Copies of Assessor Maps and Other R/W Maps		X
2. ENGINEERING STUDIES AND REPORTS		
Prepare and Submit Survey Data		X
Review and Approve Survey Data	X	
3. R/W ENGINEERING		
(Used when qualified Local Agency is performing R/W activities)		
Request Utility Verification		X
Request Preliminary Utility Relocation Plans from Utilities		X
Prepare R/W Requirements		X
Submit R/W Requirements and Utility Relocation Plans for Review		X
Review and Comment on R/W Requirements	X	
Longitudinal Encroachment Review	X	
Longitudinal Encroachment Application to District		X
Approve Longitudinal Encroachment Application	X	
Prepare Utility Agreements		X
Fence and Excess Land Review	X	
Prepare and Submit R/W Certificate of Sufficiency		X
Review and Approve R/W Certificate of Sufficiency	X	
Perform Record and Non-Record Data Search		X
Complete Property Surveys and Begin Monumentation		X
Review and Comment on Record of Survey	X	
Prepare R/W engineering Hard Copy		X
Provide STATE with R/W Engineering Back-up and Reference Data		X
Review and Accept R/W Hard Copies Maps	X	
Prepare Legal Descriptions		X
Review and Accept Legal Descriptions	X	
Complete Transfer of Real Property Title Documents		X
Review and Accept Transfer of Real Property Title Documents	X	
Transfer Title to R/W		X
Submit Monumentation Layout for Project Monuments		X
Review and Approve Agreed Layout for Project Monuments	X	
Complete new Right of Way Monumentation		X
Prepare Record of Survey (Post-construction)		X
Review and Comment on Record of Survey	X	
Transfer R/W to State		X
- Approve and Record Title Transfer Documents	X	
Prepare R/W Record Maps		X
Review and Accept R/W Record Maps	X	

ATTACHMENT 2

015704

APPURTENANT RIGHT OF WAY BACK UP AND REFERENCE DATA

STATE requires parcel files to review and accept the right of way acquired by CITY for transfer and relinquishment of Route 84.

Parcel files shall include:

- Right of Way Parcel Diary
- Copy of Notice of Decision to Appraise letter
- Appraisal Summary Statement
- Appraisal Report
- Preliminary Title Report
- Fully executed Right of Way Contract
- Executed Grant Deed or Easement Deed
- If Condemnation action was filed include Summons, Complaint, Order of Possession (if any), Stipulation of Judgement and Judgement in Condemnation and recorded Final Order of Condemnation
- Final Policy of Title

ATTACHMENT 3

015704

CITY OF LIVERMORE

"Wine Country Since 1849"

ADMINISTRATION BUILDING
1052 S. Livermore Avenue
Livermore CA 94550-4899
Ph: (925) 960-4000
Fax (925) 960-4058
TDD (925) 960-4104

MAYOR / COUNCIL
Ph: 960-4010 • Fax: 960-4035

CITY MANAGER
Ph: 960-4040 • Fax: 960-4045

CITY ATTORNEY
Ph: 960-4150 • Fax: 960-4180

RISK MANAGEMENT
Ph: 960-4170 • Fax: 960-4180

CITY CLERK
Ph: 960-4200 • Fax: 960-4205

COMMUNITY DEVELOPMENT
Ph: 960-4400 • Fax: 960-4459
Building Division
Ph: 960-4410 • Fax: 960-4419
Engineering Division
Ph: 960-4500 • Fax: 960-4505
Housing Division
Ph: 960-4580 • Fax: 960-4349
Planning Division
Ph: 960-4450 • Fax: 960-4459

ECONOMIC DEVELOPMENT
Ph: 960-4140 • Fax: 960-4149

FINANCE DEPARTMENT
Ph: 960-4300 • Fax: 960-4309

FIRE DEPARTMENT
4550 East Avenue
Ph: 454-2361 • Fax: 454-2367

LIBRARY
1000 S. Livermore Avenue
Ph: 373-5500 • Fax: 373-5503

PERSONNEL
Ph: 960-4100 • Fax: 960-4103

POLICE DEPARTMENT
1110 S. Livermore Avenue
Ph: 371-4900 • Fax: 371-4950
TDD 371-4982

PUBLIC SERVICES
3500 Robertson Park Rd
Ph: 960-8000 • Fax: 960-8005
Airport Division
636 Terminal Circle
Ph: 373-5230 • Fax: 373-5042
Golf Course Division
909 Clubhouse Drive
Ph: 373-5259 • Fax: 373-5103
Maintenance Division
3500 Robertson Park Rd
Ph: 960-8050 • Fax: 960-8025
Water Resources Division
101 W. Jack London Blvd
Ph: 960-8100 • Fax: 960-8105

November 21, 2003

Mr. Bijan Sartipi, District Division Chief
Caltrans District 04
P.O. Box 23660
Oakland, California 94623-0660

RECEIVED
NOV 26 2003

Dear Mr. Sartipi:

The Department and the City of Livermore are working in partnership to complete the relinquishment and transfer of State Route 84 to the Isabel Avenue corridor by December 2003. Our mutual efforts have produced a substitute facility that, to the extent feasible, meets State expressway standards and/or fully discloses any non-conforming areas.

Additionally the City, as the project sponsor for two significant transportation improvement projects, is fully committed to preserving the integrity of the Isabel Corridor as a future Expressway by advancing or advocating future Isabel-related projects that include improvements to Expressway standards, namely:

Isabel/I-580 Interchange: The total cost for this two-phase project is approximately $98.3 million. Approximately $6 million in local (Measure B) funding has been identified to address longitudinal utility relocations in Phase 1. This is in addition to the City's commitment of $27.8 million in traffic impact fees to fully fund the Phase 2 project (see attached funding plan - Segment D).

Isabel Avenue Improvements – 580 to 680: Per the attached outline, the Tri Valley Transportation Council (TVTC) has identified $27 million for multi-lane improvements to Isabel Avenue/Route 84. As a member of the TVTC, the City of Livermore will advocate the use of a portion of these funds to provide for longitudinal utility relocations (see attached funding plan - Segment C).

If you have any further questions regarding this matter, please contact Ken Ross, Senior Civil Engineer, at (925) 960-4512.

Sincerely,

Marc Roberts
Community Development Director

Attachment

ATTACHMENT 4

ROUTE 84 (ISABEL AVENUE) FUNDING PLAN - VALLECITOS ROAD TO AIRWAY BOULEVARD

Segments A and B - Isabel Avenue Widening Project (Vallecitos Road to Jack London Boulevard)

Project Components	STIP			SHOPP	Measure B	TVTC	Livermore Traffic Impact Fee	TEA 21 - Federal Demonstration	Others	Total Available Funding	Estimated Cost to Complete	Shortfall	Remarks
	Current	Future County Share	CMA Tier 3										
Environmental Support					$5,000,000					$5,000,000	$5,000,000	$0	
PS&E Design Support (Alternatives 3A & 3 from Route 84 PSR)					$8,340,000					$8,340,000	$8,340,000	$0	
External Design Review and Permits					$1,295,000					$1,295,000	$1,295,000	$0	
R/W Support					$800,000					$800,000	$800,000	$0	
R/W Capital					$8,000,000					$8,000,000	$8,000,000	$0	
Utilities Relocation Capital		$4,439,000			$0	$240,000			$3,350,000	$12,030,000	$12,030,000	$0	Includes Capital Outlay Support and R/W Capital Costs. Utility Owner Share Included under "Others"
R/W Capital In-Kind Contribution					$0					$0	$0	$0	
Environmental Mitigation					$2,000,000					$2,000,000	$2,000,000	$0	
Construction Support					$6,510,000					$6,510,000	$6,510,000	$0	
Construction DSDC					$835,000					$835,000	$835,000	$0	
Construction Capital					$56,500,000					$56,500,000	$56,500,000	$0	
Landscape Design Support					$200,000					$200,000	$200,000	$0	
Landscape Construction Support & DSDC					$150,000					$150,000	$150,000	$0	
Landscape Capital					$2,000,000					$2,000,000	$2,000,000	$0	
Project Closeout					$200,000					$200,000	$200,000	$0	
Project Management and Controls					$200,000					$200,000	$200,000	$0	
Miscellaneous Expenditure					$200,000					$200,000	$200,000	$0	
										$0			
TOTALS	$0	$4,439,000	$0	$0	$91,370,000	$240,000	$0	$0	$3,350,000	$103,393,000	$103,393,000	$0	

Segment C - Route 84 - 580 to 680 Improvements (Jack London Blvd to Rickenbacker Circle North)

Project Components	STIP			SHOPP	Measure B	TVTC	Livermore Traffic Impact Fee	TEA 21 - Federal Demonstration	Others	Total Available Funding	Estimated Cost to Complete	Shortfall	Remarks
	Current	Future County Share	CMA Tier 3										
													All work shown within this segment is required to relocate existing utilities outside the future State R/W limits.
PE/Env						$300,000				$300,000	$300,000	$0	
Final Design, PS&E						$1,140,000				$1,140,000	$1,140,000	$0	
R/W Support						$300,000				$300,000	$300,000	$0	
R/W Acquisition						$3,715,000				$3,715,000	$3,715,000	$0	Includes Building Demolition and Relocation Assistance
Utility Relocation						$4,430,000				$5,430,000	$5,430,000	$0	
Construction						$1,444,000				$1,444,000	$1,444,000	$0	Reflects costs to close access from Rickenbacker to Isabel Avenue
Constr Management						$1,440,000				$1,440,000	$1,440,000	$0	
TOTALS	$0	$0	$0	$0	$0	$12,800,000	$0	$0	$0	$12,800,000	$12,800,000	$0	

Segment D - Isabel Avenue / I-580 Interchange Project (Rickenbacker Circle North to Airway Blvd)

PHASE 1 - Project Components	STIP			SHOPP	Measure B	TVTC	Livermore Traffic Impact Fee	TEA 21 - Federal Demonstration	Others	Total Available Funding	Estimated Cost to Complete	Shortfall	Remarks
	Current	Future County Share	CMA Tier 3										
PE/Env	$3,600,000							$1,200,000		$4,800,000	$4,800,000	$0	
Final Design, PS&E					$100,000			$2,400,000		$2,500,000	$2,500,000	$0	
R/W Support								$1,000,000		$1,000,000	$1,000,000	$0	
R/W Acquisition					$15,000,000			$5,720,000		$20,720,000	$20,720,000	$0	
Utility Relocation					$9,500,000					$9,500,000	$9,500,000	$0	
Construction		$26,000,000			$700,000		$7,900,000			$33,600,000	$33,600,000	$0	
Constr Management		$2,000,000								$2,000,000	$2,000,000	$0	
TOTALS	$3,600,000	$28,000,000			$25,300,000		$7,900,000	$10,320,000		$74,920,000	$74,920,000	$0	
PHASE 2 - Project Components													
PE/Env							$1,300,000			$1,300,000	$1,300,000	$0	
Final Design, PS&E							$3,700,000			$3,800,000	$3,800,000	$0	
R/W Support							$100,000			$100,000	$100,000	$0	
R/W Acquisition							$1,370,000			$1,370,000	$1,370,000	$0	
Construction							$21,130,000			$21,130,000	$21,130,000	$0	
Constr Management										$700,000	$700,000	$0	
TOTALS	$0	$0	$0	$0	$0	$0	$27,600,000	$0		$27,600,000	$27,600,000	$0	

015704

015704

ALAMEDA COUNTY
CONGESTION MANAGEMENT AGENCY

1333 BROADWAY, SUITE 220 • OAKLAND, CA 94612 • PHONE: (510) 836-2560 • FAX: (510) 836-2185
E-MAIL: mail@accma.ca.gov • WEB SITE: accma.ca.gov

AC Transit
Director
Peterson Rose
Alameda County
Supervisors
Nate Miley
Scott Haggerty
City of Alameda
Mayor
Beverly Johnson
City of Albany
Mayor
Peggy Thomsen
BART
Director
Director
Tom Radulovich
City of Berkeley
Councilmember
Kriss Worthington
City of Dublin
Councilmember
Catherine A. Brown
City of Emeryville
Councilmember
Nora Davis
City of Fremont
Mayor
Gus Morrison
City of Hayward
Mayor
Roberta Cooper
City of Livermore
Councilmember
Tom Vargas
City of Newark
Vice Mayor
Luis Freitas
City of Oakland
Vice Chairperson
Chairperson
Larry Reid
City of Piedmont
Commissioner
Jeff Wieler
City of Pleasanton
Mayor
Tom Pico
City of San Leandro
Mayor
Shelia Young
City of Union City
Mayor
Mark Green
Executive Director
Dennis R. Fay

November 21, 2003

Mr. Bijan Sartipi
District Director
Caltrans District 4
P.O. Box 23660
Oakland, CA 94623-0660

Dear Bijan:

In response to your request, the following summarizes the Alameda County Congestion Management Agency's (CMA) commitment to funding improvements in the Route 84 Corridor in Livermore.

The CMA has programming responsibility for the Alameda County share of State Transportation Improvement Program (STIP) program funds that are available for projects in Alameda County. These funds are programmed every two years, consistent with state statutes.

To be eligible to receive STIP funding, statute requires that a project be consistent with the Regional Transportation Plan (RTP). Additionally, it is CMA Board policy that a project must be consistent with the CMA's 25-year Countywide Transportation Plan (CWTP) to be eligible to receive STIP funding.

The CWTP represents the CMA's adopted priorities for funding over the next 25 years. Both the current CWTP and the RTP include funding for improvement in the Route 84 Corridor consistent with the project scope identified in the attached funding plan.

If you have any questions regarding this matter, please give me a call.

Sincerely,

Dennis R. Fay

Dennis R. Fay
Executive Director

ATTACHMENT 4

015704

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY

November 20, 2003

426 17th Street
Suite 100
Oakland, CA 94612

Telephone:
510/893-3347

Facsimile:
510/893-6489

Webpage:
www.ACTA2002.com

Sheila Young, Chair
Mayor, City of San Leandro

Nate Miley, Vice-Chair
Supervisor, District 4

Keith Carson
Supervisor, District 5

Henry Chang, Jr.
Council Member, Oakland

Roberta Cooper
Mayor, City of Hayward

Mark Green
Mayor, City of Union City

Scott Haggerty
Supervisor, District 1

Beverly Johnson
Mayor, City of Alameda

Alice Lai-Bitker
Supervisor, District 3

Gus Morrison
Mayor, City of Fremont

Gail Steele
Supervisor, District 2

Christine Monsen
Executive Director

015704

Mr. Bijan Sartipi
District Director
Caltrans District 04
P.O. Box 23660
Oakland, CA 94623-0660

RE: **Relinquishment of State Route 84 – First/Holmes Streets to Isabel Avenue in conjunction with the Transfer of SR 84 to Isabel Avenue (4-Ala-Future Route 84, 4256-233051, Isabel Extension)**

Dear ~~Mr.~~ Bijan Sartipi:

The Department and the City of Livermore are working in partnership to relinquish a portion of State Route 84 and transfer it to the Isabel Avenue corridor by December 2003. Portions of the proposed substitute facility are encumbered with longitudinal utilities, both privately and publicly owned. The Department has requested that the City, as part of the approval of the proposed route transfer, develop a plan to address the relocation of these utilities with future Isabel Avenue corridor improvements.

Alameda County's 20-Year Transportation Expenditure Plan dated July 2000, administered by the Alameda County Transportation Improvement Authority, identifies $70 million for improvements on the "Route 84 Expressway" (ACTIA Project No. 24). This project provides a four-lane roadway along relocated Route 84 (the Isabel Avenue Corridor) from I-580 south to Vallecitos Road, and provides for improvements along Route 84 through Pigeon Pass to provide high speed two-lane roadway. The northerly limits of the ACTIA project are expected to conform to the southerly limits of the City of Livermore's Isabel/I-580 Interchange project, at Jack London Boulevard. The total cost to deliver the Measure B Expenditure Plan project will be developed as part of the project approval and environmental clearance process to be initiated in the summer of 2004. This project development process will be a joint effort between the appropriate jurisdictions in the Tri-Valley, as well as the Department.

The Authority is committed to the delivery of Route 84 as an expressway, consistent with the Measure B Expenditure Plan, in conformance with the

ATTACHMENT 4

015704

Department's project development procedure and project approval process, and as reflected in the attached funding plan.

If you have any questions or need additional information, please contact me or Arthur Dao, Deputy Director, at (510) 893-3347.

Sincerely,

CHRISTINE M. MONSEN
Executive Director

CC: Arthur Dao, Deputy Director
Leo Scott and Issa Bouri, Caltrans
Ken Ross and Bob Vinn, City of Livermore
Terry Bowen, Gray Bowen Company
Jim Sims, Mark Thomas & Company
Francis Lo, ACTIA Project Controls Team
ACTIA Files 23

015704

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY GRAY DAVIS, Governor

PARTMENT OF TRANSPORTATION
O. BOX 23660
KLAND, CA 94623-0660
0) 286-4444
0) 286-4454 TDD

RECEIVED

APR 1 9 2002

CITY OF LIVERMORE
ENGINEERING DIVISION

Flex your power!
Be energy efficient!

April 17, 2002

Mr. Mohammad Pournia, Transportation Manager
City of Livermore Public Works
1052 S. Livermore Avenue
Livermore, CA 94550-4899

Dear Mr. Pournia:

This is in response to the request to add left-turn signals for the Concannon Boulevard approaches to the existing traffic signal at the intersection of Holmes Street, State Route 84, and Concannon Boulevard.

The State Office of Electrical Design and Operations has analyzed the addition of left-turn phases for this intersection. During the PM peak, the 95th Queue length for the eastbound left-turns is about 298 feet and the existing storage is only 160 feet. In order to accommodate the existing left-turn volume, a 300 feet storage length is recommended. The overall Level of Service of the intersection is going to decline from C to D.

The State Office of Electrical Design has conducted an investigation of the intersection existing electrical hardware. Based on its investigation, we arrive at the following cost estimate for the modification of the traffic signals:

Traffic Signal Modifications	$	75,000
Signal Interconnection	$	10,000
Striping, Miscellaneous	$	15,000
Traffic Control	$	20,000
Subtotal:	$	120,000
Contingencies:	$	24,000
Estimated Cost of Construction:	**$**	**144,000**
Preliminary Engineering:	$	15,000
Construction Engineering:	$	21,000
Total	**$**	**180,000**

Should we decide to proceed, the State will prepare a project report and a cooperative

ATTACHMENT 5

015704

agreement with the City to initiate the design for this project. The funding for this project would be shared between the State and the City of Livermore on a fifty-fifty basis. Please advise the State if the City would want to proceed with this project. Please also advice us whether the City would be the lead agency for the project, conduct the design and oversee the construction of the project.

Should you have any questions, please call me at (510) 286-4579.

Sincerely,

New Contact

(510) 286-4569

Mahmud???

LYNN MILLER
Senior Transportation Engineer

SCOPE OF WORK ITEMS PURSUANT TO RECITALS, ARTICLE 5

Crack and slurry seal
Repair base failure
AC overlay
Cleaning drainage facilities
Raised shallow median
Replace detector loops
Replace pedestrian barricades
Remove/replace concrete divider strips
Bridge deck striping and grinding
Remove/replace traffic signal controllers
Signal improvements at intersection of Holmes and Concannon

I TTER OF TRANSMITTA

CITY OF LIVERMORE
ENGINEERING DIVISION
1052 SOUTH LIVERMORE AVENUE
LIVERMORE, CA 94550
(925) 960-4500

TO:	Department of Transportation, District 4	DATE:	December 3, 2003
	111 Grand Avenue	RE:	Isabel Avenue/State Route 84
	PO Box 23660		Transfer & Relinquishment
	Oakland, California 94623-0660		City Project No. 02-17
ATTN:	Mr. Issa Bouri, Project Manager		

WE ARE SENDING THE FOLLOWING DOCUMENTS FOR ACTION OR USE AS INDICATED:

- ☒ For approval or action
- ☐ As requested
- ☐ Sign & return one copy for our files
- ☐ For your files or information
- ☐ Approved as submitted
- ☐ Returned for corrections
- ☐ For review and comment
- ☐ Approved as noted
- ☐ See note below

COPIES	DATE	DESCRIPTION
1	11/18/03	Certified copy of City Council Resolution #2003-294
4	12/03/03	Freeway Maintenance Agreement, First Street OC in Alameda in Livermore, 04-ALA-580 KP 17.2 (PM 10.7) 03-1294
4	12/03/03	Agreement for Maintenance of State Highways in the City of Livermore 03-1292
4	12/03/03	Cost Sharing Agreement Electrical Facilities 03-1293
5	12/03/03	District Agreement No. 4-1979-C, Cooperative Agreement 03-1297

NOTES:

Issa,

Please note that once the agreements are executed by Caltrans, one copy of each should be returned to the City, directed to the City Clerk.

Thanks,

HAND DELIVERED

Signed: Mike

Original: Addressee ☒
Copies: File ☒ 02-17 w attachments (1 copy ea)
Chrono ☒

Linda Barton w/o attachments, Marc Roberts w/o attachments
Cheri Sheets w/o attachments, Mike Cavalieri w/o anachments
Ken Ross w/o attachments
Alice Calvert w attachments (1 copy ea)
Terry Bowen w attachments (1 copy ea)

Title: Mike Irby, Associate Civil Engineer

Phone No.: 925-960-4539

CITY OF LIVERMORE
INTEROFFICE MEMORANDUM

DATE: December 2, 2003

TO: Mike Irby

FROM: Alice Calvert

SUBJECT: California Department of Transportation/Hwy 84 documents

Mike: Attached are the following original documents:

- Hwy 84 Maintenance Agreement
- Hwy 84 Electrical Facilities Maintenance Agreement
- Hwy 84 First St. Interchange at 580 Maintenance Agreement

+ Conveyance dy

Per our discussion, you will be delivering these agreements to the State on Wednesday for signature. Please be sure to return one fully executed original of each document to our office.

Alice

Alice
Attached are the agreements listed above, executed by Caltrans

Mike 12-11-03

COOPERATIVE AGREEMENTS

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY
COOPERATIVE AGREEMENT

DATED 5/26/2005

04-Ala-84 KP 37.4/44.0
Widening and expressway upgrades
04241-297600
District Agreement No. 4-2041

COOPERATIVE AGREEMENT

THIS AGREEMENT, ENTERED INTO EFFECTIVE ON 5/26/05, 2005, is between the STATE OF CALIFORNIA, acting by and through its Department of Transportation, referred to herein as "STATE", and

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY, a public entity, referred to herein as "ACTIA".

RECITALS

1. STATE and ACTIA, pursuant to Streets and Highways Code section 130, are authorized to enter into a Cooperative Agreement for improvements to State highways within the City of Livermore.

2. ACTIA desires State highway improvements consisting of widening and expressway upgrades on Route 84 in the City of Livermore, referred to herein as "PROJECT", and is willing to fund one hundred percent (100%) of all capital outlay and staffing costs, except for costs of STATE's quality assurance of environmental, design and right of way activities.

3. ACTIA has secured $69.58 million funding as noted in the Alameda County's 20-Year Transportation Expenditure Plan and is willing to seek additional future funding to satisfy PROJECT costs that exceed $69.58 million.

4. STATE's funds will not be used to finance any of the capital and support costs for PROJECT.

5. This Agreement supersedes any prior Memorandum of Understanding (MOU) relating to PROJECT.

6. Construction of PROJECT will be the subject of a separate future Agreement.

7. The parties hereto intend to define herein the terms and conditions under which PROJECT is to be developed, designed, and financed.

SECTION I

ACTIA AGREES:

1. To fund one hundred percent (100%) of all preliminary and design engineering costs, including, but not limited to, costs incurred for the preparation of contract documents for PROJECT.

2. To prepare a Project Report (PR), including all necessary environmental documentation (ED), and detailed Plans, Specifications, and Estimate (PS&E), at no cost to STATE, and to submit each to STATE for STATE's review and concurrence at appropriate stages of development. A PS&E shall be prepared for the roadway work, which includes new ramps, ramp removal and ramp modifications. The PR and the final plans and specifications for the roadway portion of PROJECT shall be signed by a Civil Engineer registered in the State of California. English units shall be used for PR, ED, and PS&E documents.

3. To permit STATE to monitor and participate in the selection of personnel who will prepare the PR, conduct environmental studies and obtain approval for PROJECT, prepare the PS&E, and provide the right of way engineering services, and to permit STATE to oversee the performance of right of way activities. ACTIA agrees to consider any request by STATE to discontinue the services of any personnel considered by STATE to be unqualified on the basis of credentials, professional expertise, failure to perform in accordance with the scope of work, and/or other pertinent criteria.

4. Personnel who prepare the roadway PS&E and right of way maps shall be made available to STATE, at no cost to STATE, through completion of construction of PROJECT to discuss problems which may arise during construction and/or to make design revisions for contract change orders.

5. To not use funds from STATE for any capital and support costs for PROJECT.

6. To make written application to STATE for necessary encroachment permits authorizing entry of ACTIA onto the State highway right of way to perform surveying and other investigative activities required for preparation of the PR, ED, and/or PS&E.

7. To identify and locate all utility facilities within the area of PROJECT as part of the design responsibility for PROJECT. All utility facilities not relocated or removed in advance of construction shall be identified on the PS&E for PROJECT.

8. To identify and locate all high and low risk underground facilities within the area of PROJECT and to protect or otherwise provide for such facilities, all in accordance with STATE's "Policy on High and Low Risk Underground Facilities Within Highway Rights of Way." ACTIA hereby acknowledges receipt of STATE's "Policy on High and Low Risk Underground Facilities Within Highway Rights of Way."

9. If any existing public and/or private utility facilities conflict with the construction of PROJECT or violate STATE's encroachment policy, ACTIA shall make all necessary arrangements with the owners of such facilities for their protection, relocation, or removal in accordance with STATE's policy and procedure for those facilities located within the limits of work included in the improvement to the State highway and in accordance with ACTIA's policy for those facilities which are or will be located outside of the limits of the State highway. The total costs to PROJECT of such protection, relocation, or removal within the present or future State highway right of way shall be determined in accordance with STATE's policies and procedures.

10. To furnish evidence to STATE, in a form acceptable to STATE, that arrangements have been made for the protection, relocation, or removal of all conflicting facilities within the State highway right of way and that such work will be completed prior to the award of the contract to construct PROJECT or as covered in the PS&E for said contract. This evidence shall include a reference to all required State highway encroachment permits.

11. ACTIA shall require any utility owner and/or its contractor performing the protection or relocation work within the State highway right of way to obtain an encroachment permit from STATE prior to the performance of said work.

12. To acquire and furnish all right of way, if any, outside of the existing State highway right of way and to perform all right of way activities, including all eminent domain activities, if necessary, at no cost to STATE, and in accordance with procedures acceptable to STATE. These activities shall comply with all applicable State and Federal laws and regulations, subject to STATE's quality assurance to insure that the completed work is acceptable for incorporation into the State highway right of way.

13. To utilize the services of a qualified public agency or a qualified consultant, as determined by STATE's Deputy District Director of Right of Way, in all matters related to the acquisition of right of way in accordance with STATE's procedures as published in STATE's current Right of Way Manual. Whenever personnel other than personnel of a qualified public agency are utilized, administration of the personnel contract shall be performed by a qualified Right of Way person employed or retained by ACTIA.

14. To certify legal and physical control of right of way ready for construction and that all right of way parcels were acquired in accordance with applicable State and Federal laws and regulations, subject to review and concurrence by STATE prior to the advertisement for bids for the contract to construct PROJECT.

15. To deliver to STATE legal title to the right of way, including any access rights, free and clear of all encumbrances detrimental to STATE's present and future uses not later than the date of acceptance by STATE of maintenance and operation of the highway facility. Acceptance of said title by STATE is subject to a review of a Policy of Title Insurance in the name of the State of California to be provided and paid for by ACTIA.

16. To be responsible, at ACTIA's expense, for the investigation of potential hazardous material sites within and outside of the existing State highway right of way that would impact PROJECT as part of the responsibility for the ED for PROJECT. If ACTIA encounters hazardous material or contamination within the existing State highway right of way during said investigation, ACTIA shall immediately notify STATE and responsible control agencies of such discovery.

17. If ACTIA desires to have STATE advertise, award, and administer the construction contract for PROJECT, ACTIA shall provide all plans prepared by ACTIA or ACTIA's consultant to STATE on a CD –ROM (Microstation .dgn file, version 5.0 or later up through version 7.0 and plot files (I files using Bentley Iplot plotting software)) complying with STATE's current CADD User Manual and Plans Preparation Manual. upon completion of the final PS&E for PROJECT. STATE reserves the right to make minor modifications to the plans and STATE shall provide ACTIA advance notice of any such modifications. Reimbursement to STATE for costs incurred by STATE to advertise, award, and administer the construction contract for PROJECT will be covered in the separate Cooperative Agreement referred to in Article 12 of Section III of this Agreement.

18. To obtain, at ACTIA's expense, all necessary permits and/or agreements from appropriate regulatory agencies. All mitigation, monitoring, and/or remedial action required by said permits shall constitute parts of the cost of PROJECT.

19. All aerial photography and photogrammetric mapping shall be prepared in English units and conform to STATE's latest standards.

20. A copy of all original survey documents resulting from surveys performed for PROJECT, including original field notes, adjustment calculations, final results, and appropriate intermediate documents, shall be delivered to STATE and shall become property of STATE. For aerial mapping, survey documents to be furnished are three sets of contract prints, with one set showing control, a complete photo index - two prints and a copy of the negative, and the original aerial photography negative.

21. STATE's quality assurance activities referred to in Article 1 of Section II of this Agreement does not include performance of any engineering services required for PROJECT. These services are to be performed by ACTIA. If ACTIA requests STATE to perform any of these services, ACTIA shall reimburse STATE for such services. An Amendment to this Agreement authorizing STATE's performance of such services will be required prior to performance of any engineering work by STATE.

22. To certify that Measure Sales Tax funds are budgeted for PROJECT upon execution of this Agreement.

23. To provide, at no cost to STATE, survey and mapping services necessary to perpetuate existing land net and alignment monumentation in accordance with Sections 8771 and 8765 of the Business and Professions Code; and to permanently monument the location of all roadway alignments, realignments, and right of way acquisitions. All of the above are to be shown on a Record of Survey filed with the County Surveyor. ACTIA shall deliver one copy of any field notes, filed Corner Records, and the Record of Survey required for execution of the above obligation, to STATE's District Survey Branch.

24. To prepare Right of Way Engineering Hard Copies, Right of Way Appraisal Maps, Record of Surveys, and Right of Way Record Maps in accordance with the State of California Right of Way Manual, Chapter 6 - Right of Way Engineering, the State of California Drafting and Plans Manual, the State of California Surveys Manual Chapter 10, applicable State laws, and other pertinent reference material and examples as provided by STATE.

25. To have all necessary Right of Way Maps and Documents used to acquire right of way by ACTIA, prepared by or under the direction of a person authorized to certification and signature of the licensed person in "Responsible Charge of Work."

26. To submit to STATE for review and acceptance all Right of Way Engineering Hard Copies and Right of Way Appraisal Maps with appurtenant back-up and reference data prior to preparation of legal descriptions and acquisition documents.

27. Personnel who prepare right of way maps, documents, and related materials shall be made available to STATE, at no cost to STATE, during and after construction of PROJECT until completion and acceptance by STATE of Right of Way Record Maps and Records of Surveys.

SECTION II

STATE AGREES:

1. At no cost to ACTIA, to provide quality assurance activities of all work on PROJECT done by ACTIA, including, but not limited to, investigation of potential hazardous material sites and all right of way activities undertaken by ACTIA or its designee, to provide prompt reviews and approvals, as appropriate, of submittals by ACTIA, and to

cooperate in timely processing of PROJECT in accordance with mutually agreed upon PROJECT schedule.

2. Upon proper application by ACTIA, to issue, at no cost to ACTIA, an encroachment permit to ACTIA authorizing entry onto the State highway right of way to perform survey and other investigative activities required for preparation of the PR, ED, and/or PS&E. If ACTIA uses consultants or Alameda County staff, rather than its own staff to perform required work, the consultants and Alameda County staff will also be required to obtain a separate encroachment permit. These permits will be issued at no cost upon proper application by the Alameda County staff or by the consultants.

3. To make available to ACTIA, at no cost to STATE, STATE regulations, policies, procedures, manuals, standard plans and specifications, and other STATE standards required to define the Scope of Work for the PROJECT.

SECTION III

IT IS MUTUALLY AGREED:

1. All obligations of STATE under the terms of this Agreement are subject to the appropriation of resources by the Legislature in the annual State Budget Act and the California Transportation Commission to STATE for the purposes of fulfilling STATE's obligations herein.

2. All obligations of ACTIA under the terms of this Agreement are limited as provided in the Alameda County Transportation Improvement Authority Expenditure Plan, dated July 2000, and are subject to the availability of funds in the annual ACTIA budget pursuant to Public Utilities Code Sections 180105 and 180108. However, if ACTIA funding for PROJECT, pursuant to this Agreement, is inadequate, ACTIA may suspend or terminate PROJECT and shall notify STATE in thirty (30) days prior to the termination.

3. The parties hereto will carry out PROJECT in accordance with the Scope of Work, attached to and made a part of the Agreement, which outlines the specific responsibilities of the parties hereto. The attached Scope of Work may be modified in writing in the future to reflect changes in the responsibilities of the respective parties. Such modifications shall be concurred with by ACTIA's Executive Director or other official designated by ACTIA and STATE's District Director for District 4 and become a part of this Agreement after execution of the amending document by the respective officials of the parties.

4. The Project Study Report (PSR) for PROJECT, approved on September 15, 2003, is by this reference, made an express part of this Agreement.

5. The basic design features (as defined in Attachment 3 of the Scope of Work for PROJECT) shall comply with those addressed in the approved PSR, unless modified as required for environmental clearance and/or FHWA approval of PROJECT.

6. The design, right of way acquisition, and preparation of environmental documents for PROJECT shall be performed in accordance with STATE's standards and practices current as of the date of performance. Any exceptions to applicable design standards shall first be approved by STATE via the processes outlined in STATE's Highway Design Manual and appropriate memorandums and design bulletins published by STATE. In the event that STATE proposes and/or requires a change in design

standards, implementation of new or revised design standards shall be done as part of the work on PROJECT in accordance with STATE's current Highway Design Manual Section 82.5, "Effective Date for Implementing Revisions to Design Standards." STATE shall consult with ACTIA in a timely manner regarding effect of proposed and/or required changes on PROJECT.

7. Any hazardous material or contamination of an HM-1 category found within the existing State highway right of way during investigative studies requiring remedy or remedial action, as defined in Division 20, Chapter 6.8 et seq. of the Health and Safety Code, shall be the responsibility of STATE. Any hazardous material or contamination of an HM-1 category found within the local road right of way during investigative studies requiring the same defined remedy or remedial action shall be the responsibility of ACTIA, at PROJECT's expense. For the purpose of this Agreement, hazardous material or contamination of HM-1 category is defined as that level or type of contamination which State or Federal regulatory control agencies having jurisdiction have determined must be remediated by reason of its mere discovery, regardless of whether it is disturbed by PROJECT or not. If ACTIA decides to not proceed with PROJECT, STATE shall sign the HM-1 manifest and pay all costs for required remedy or remedial action within the existing State highway right of way and ACTIA shall sign the HM-1 manifest and pay all costs for required remedy or remedial action within the local road right of way. If ACTIA and STATE decide to proceed with PROJECT, STATE shall sign the HM-1 manifest and pay all costs for required remedy or remedial action within the existing State highway right of way, except that if STATE determines, in its sole judgment that STATE's cost for remedy or remedial action is increased as a result of ACTIA's decision to proceed with PROJECT, that additional cost identified by STATE shall be deemed a part of the costs of PROJECT. ACTIA shall sign the HM-1 manifest and pay all costs for required remedy or remedial action within the local road right of way. STATE will exert every effort to fund the remedy or remedial action for which STATE is responsible. In the event STATE is unable to provide funding, ACTIA will have the option to either delay PROJECT until STATE is able to provide funding or ACTIA may proceed with the remedy or remedial action, at ACTIA's expense, without any subsequent reimbursement by STATE.

8. The remedy or remedial action with respect to any hazardous material or contamination of an HM-2 category found within the existing State highway right of way during investigative studies shall be the responsibility of ACTIA, at PROJECT's expense, if ACTIA decides to proceed with PROJECT. For the purposes of this Agreement, hazardous material or contamination of HM-2 category is defined as that level or type of contamination which said regulatory control agencies would have allowed to remain in place if undisturbed or otherwise protected in place should PROJECT not proceed. ACTIA shall sign any HM-2 storage manifest if PROJECT proceeds and HM-2 material must be removed in lieu of being treated in place. If ACTIA decides to not proceed with PROJECT, there will be no obligation to either ACTIA or STATE other than ACTIA's duty to cover and protect HM-2 material left in place.

9. If hazardous material or contamination of either HM-1 or HM-2 category is found on new right of way to be acquired by ACTIA for PROJECT, ACTIA, as between ACTIA and STATE only, shall be responsible, at ACTIA's expense, for all required remedy or remedial action and/or protection and shall guarantee STATE that said new right of way is clean prior to transfer of title to STATE in accordance with Article 15 of Section I of this Agreement. The generator of the hazardous material or, if none can be identified or found, the present property owner, whether a private entity or a local public agency, or ACTIA, as a last resort, shall sign the manifest.

10. Locations subject to remedy or remedial action and/or protection include utility relocation work required for PROJECT. Costs for remedy and remedial action and/or protection shall include, but not be limited to, the identification, treatment, protection, removal, packaging, transportation, storage, and disposal of such material.

11. The party responsible for funding any hazardous material cleanup shall be responsible for the development of the necessary remedy and/or remedial action plans and designs. Remedial actions proposed by ACTIA on the State highway right of way shall be pre-approved by State and shall be performed in accordance with STATE's standards and practices and those standards mandated by the Federal and State regulatory agencies.

12. A separate future Cooperative Agreement will be required to cover responsibilities and funding for the construction phase of PROJECT.

13. Nothing in the provisions of this Agreement is intended to create duties or obligations to or rights in third parties not parties to this Agreement or to affect the legal liability of either party to the Agreement by imposing any standard of care with respect to the development, design, construction, operation or maintenance of State highways and public facilities different from the standard of care imposed by law.

14. Neither STATE nor any officer or employee thereof is responsible for any damage or liability occurring by reason of anything done or omitted to be done by ACTIA in connection with any work, authority or jurisdiction delegated to ACTIA under this Agreement. It is understood and agreed that, pursuant to Government Code section 895.4, ACTIA shall fully defend, indemnify and save harmless STATE and all its officers and employees from all claims, suits or actions of every name, kind and description brought for or on account of injury (as defined in Government Code section 810.8) occurring by reason of anything done or omitted to be done by ACTIA in connection with any work, authority or jurisdiction delegated to ACTIA under this Agreement.

15. Neither ACTIA nor any officer or employee thereof is responsible for any damage or liability occurring by reason of anything done or omitted to be done by STATE in connection with any work, authority or jurisdiction delegated to STATE under this Agreement. It is understood and agreed that, pursuant to Government Code section 895.4, STATE shall fully defend, indemnify and save harmless ACTIA and all its officers and employees from all claims, suits or actions of every name, kind and description brought for or on account of injury (as defined in Government Code section 810.8) occurring by reason of anything done or omitted to be done by STATE in connection with any work, authority or jurisdiction delegated to STATE under this Agreement.

16. This Agreement may be terminated or provisions contained herein may be altered, changed, or amended by mutual consent of the parties hereto.

17. Except as otherwise provided in Article 16 above, this Agreement shall terminate upon completion and acceptance of the construction contract for PROJECT, or on December 30, 2016, whichever is earlier in time.

STATE OF CALIFORNIA
Department of Transportation

WILL KEMPTON
Director

By: _____
Deputy District Director

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY

By: _____
Nate Miley, Chair

Approved as to form and procedure:

_____
Attorney
Department of Transportation

Recommended by:

_____
Christine Monsen, Executive Director

Certified as to funds:

_____
District Budget Manager

Attest: _____
Trudye A. Johnson, Clerk of Authority

Approved as to form and legality:

_____
Wendel, Rosen, Black & Dean, LLP
Legal Counsel to ACTIA

Certified as to financial terms and policies:

_____
Accounting Administrator

I hereby certify upon my own personal knowledge that budgeted funds are available for the period stated in this Agreement:

By: _____
Finance Director/Treasurer (AS TO FUNDS)

SCOPE OF WORK

This Scope of Work outlines the specific areas of responsibility for various project development activities for the proposed widening and expressway upgrades on Route 84 in Livermore.

1. STATE will be the Lead Agency and ACTIA will be a Responsible Agency for CEQA. ACTIA will assess impacts of PROJECT on the environment and, if necessary, ACTIA will prepare the Environmental Document (ED) to meet the requirements of CEQA and NEPA. The draft and final ED will require STATE's review and approval prior to public circulation. ACTIA will provide all data for and prepare drafts of the Draft Project Report (DPR) and Project Report (PR). STATE will review and process the reports and request approval of PROJECT and ED by the Federal Highway Administration (FHWA). ACTIA will be responsible for the public hearing process.

2. ACTIA and STATE concur that the proposal is a Category 3 as defined in STATE's Project Development Procedures Manual.

3. ACTIA will submit drafts of environmental technical reports and individual sections of the draft environmental documents to STATE, as they are developed, for review and comment. Traffic counts and projections to be used in the various reports shall be supplied by STATE if available, or by ACTIA. Existing traffic data shall be furnished by ACTIA.

4. STATE will review, monitor, and approve all project development reports, studies, and plans, and provide all necessary implementation activities up to but not including advertising of PROJECT.

5. STATE will prepare the revised freeway agreement and obtain approval of the new public road connection(s) from the California Transportation Commission, if necessary.

6. STATE will prepare the revised freeway maintenance agreement and ACTIA will prepare the exhibits to said agreement.

7. All phases of PROJECT, from inception through construction, whether done by ACTIA or STATE, will be developed in accordance with all policies, procedures, practices, and standards that STATE would normally follow.

8. Detailed steps in the project development process are attached to this Scope of Work. These Attachments are intended as a guide to STATE's and ACTIA's staff.

ATTACHMENT 1
PLANNING PHASE ACTIVITIES

PROJECT ACTIVITY	RESPONSIBILITY STATE	ACTIA
1. ENVIRONMENTAL ANALYSIS & DOCUMENT PREPARATION		
Establish Project Development Team (PDT)	X	X
Approve PDT	X	
Project Category Determination	X	
Prepare Preliminary Environmental Assessment		X
Identify Preliminary Alternatives and Costs		X
Prepare and Submit Environmental Studies and Reports		X
Provide Quality Assurance	X	
Provide Quality Control		X
Approve Environmental Studies and Reports	X	
Prepare and Submit Draft Environmental Document (DED)		X
2. PROJECT GEOMETRICS DEVELOPMENT		
Prepare Existing Traffic Analysis		X
Prepare Future Traffic Volumes for Alternatives		X
Prepare Project Geometrics and Profiles		X
Prepare Layouts and Estimates for Alternatives		X
Prepare Operational Analysis for Alternatives		X
Provide Quality Assurance	X	
Provide Quality Control		X
Approve Project Geometrics and Operational Analysis	X	
3. PROJECT APPROVAL		
Lead Agency for Environment Compliance Certifies ED in Accordance with its Procedures	X	
Prepare Draft Project Report (DPR)		X
Finalize and Submit Project Report with Certified ED for Approval		X
Approve Project Report	X	
Provide Quality Assurance	X	
Provide Quality Control		X

ATTACHMENT 2

DESIGN PHASE ACTIVITIES

PROJECT ACTIVITY	RESPONSIBILITY STATE	ACTIA
1. PRELIMINARY COORDINATION		
Request 1 - Phase EA	X	
Field Review of Site		X
Provide Quality Assurance	X	
Provide Quality Control		X
Provide Geometrics		X
Approve Geometrics	X	
Obtain Surveys & Aerial Mapping		X
Obtain Copies of Assessor Maps and Other R/W Maps		X
Obtain Copies of As-Builts		X
Send Approved Geometrics to Local Agencies for Review	X	
Revise Approved Geometrics if Required		X
Approve Final Geometrics	X	
Determine Need for Permits from Other Agencies		X
Request Permits		X
Initial Hydraulics Discussion with District Staff		X
Initial Electrical Design Discussion with District Staff		X
Initial Traffic & Signing Discussion with District Staff		X
Initial Landscape Design Discussion with District Staff		X
Plan Sheet Format Discussion		X
2. ENGINEERING STUDIES AND REPORTS		
Provide Quality Assurance	X	
Provide Quality Control		X
Prepare & Submit Materials Report & Typical Section		X
Approve Materials Report & Typical Section	X	
Prepare & Submit Landscaping Recommendation		X
Approve Landscaping Recommendation	X	
Prepare & Submit Hydraulic Design Studies		X
Approve Hydraulic Design Studies	X	
Prepare & Submit Bridge General Plan & Structure Type Selection		X
Approve Bridge General Plan & Structure Type Selection	X	

PROJECT ACTIVITY	RESPONSIBILITY STATE	ACTIA
3. R/W ACQUISITION & UTILITIES (Used when qualified Local Agency is performing R/W activities.)		
Provide Quality Assurance	X	
Provide Quality Control		X
Request Utility Verification		X
Request Preliminary Utility Relocation Plans from Utilities		X
Prepare R/W Requirements		X
Prepare R/W and Utility Relocation Cost Estimates		X
Submit R/W Requirements & Utility Relocation Plans for Review		X
Longitudinal Encroachment Application to District		X
Approve Longitudinal Encroachment Application	X	
Request Final Utility Relocation Plans		X
Check Utility Relocation Plans		X
Submit Utility Relocation Plans for Approval		X
Approve Utility Relocation Plans	X	
Submit Final R/W Requirements for Review & Approval		X
Approve R/W Requirements	X	
Obtain Title Reports		X
Complete Appraisals		X
Review and Approve Appraisals for Setting Just Compensation		X
Perform record and non-record data search		X
Complete property surveys and begin monumentation		X
Prepare R/W engineering hardcopy		X
Prepare R/W Appraisal Map		X
Provide STATE with R/W engineering back-up and reference data		X
Review and accept R/W hard copies and Appraisal Maps	X	
Prepare legal descriptions		X
Review and accept legal descriptions	X	
Prepare Acquisition Documents		X
Review and accept Acquisition Documents	X	
Acquire R/W		X
Open escrows and Make Payments		X
Obtain Resolution of Necessity		X
Perform Eminent Domain Proceedings		X
Provide Displacee Relocation Services		X
Prepare Relocation Payment Valuations		X
Provide Displacee Relocation Payments		X
Perform Property Management Activities		X
Perform R/W Clearance Activities		X

Prepare and Submit Certification of R/W		X
Approve Certification of R/W	X	
Transfer R/W to STATE		X
Approve & Record Title Transfer Documents	X	
Submit monumentation layout		X
Review and approve layout for project monuments	X	
Complete new R/W monumentation		X
Prepare Record of Survey		X
Review and comment on Record of Survey	X	
Prepare R/W Record Maps		X
Review and accept R/W Record Maps	X	

PROJECT ACTIVITY	RESPONSIBILITY STATE	ACTIA
4. PREPARATION OF PLANS, SPECIFICATIONS AND ESTIMATES		
Provide Quality Assurance	X	
Provide Quality Control		X
Prepare and Submit Preliminary Stage Construction Plans		X
Calculate and Plot Geometrics		X
Cross-Sections & Earthwork Quantities Calculation		X
Prepare and Submit BEES Estimate		X
Put Estimate in BEES	X	
Local Review of Preliminary Drainage Plans and Sanitary Sewer and Adjustment Details		X
Prepare & Submit Preliminary Drainage Plans		X
Prepare Traffic Striping and Roadside Delineation Plans & Submit for Review		X
Prepare & Submit Landscaping and/or Erosion Control Plans		X
Prepare & Submit Preliminary Electrical Plans		X
Prepare & Submit Preliminary Signing Plans		X
Quantity Calculations		X
Safety Review	X	X
Prepare Specifications		X
Prepare & Submit Checked Structure Plans		X
Approve Checked Structure Plans	X	
Prepare Final Contract Plans		X
Prepare Lane Closure Requirements		X
Approve Lane Closure Requirements	X	
Prepare & Submit Striping Plan		X
Approve Striping Plan	X	
Prepare Final Estimate		X
Prepare & Submit Draft PS&E		X
Finalize & Submit PS&E to District		X

ATTACHMENT 3
DEFINITIONS

Basic Design Features - A general description of the facility:

- Design speed of State highway facility and local roads and streets.
- Number of through lanes, auxiliary lanes and locations of interchanges and separations.
- Widths of through lanes, medians, and shoulders for both the State highway facility and local roads and streets.
- Need for special feature such as soundwalls, transportation system management plans, HOV lanes, bridge widening, ramp metering, etc. See Chapter 9, Article 2 of State Project Development Procedures Manual for additional discussion of items to be considered as basic design features.

Mandatory and Advisory Design Standards - See Table 82.1A and Table 82.1B of State's Highway **De**sign Manual for the definition and listing of these items.

ACTIA

RESOLUTION #A05-0021

The **FOREGOING RESOLUTION** was passed and adopted by the following vote of the Alameda County Transportation Improvement Authority, County of Alameda, State of California, on May 26, 2005 to wit:

APPROVED AS RECOMMENDED:

Consideration and Necessary action on report from the Work Program Committee

Approval of Cooperative Agreement with Caltrans for Environmental Clearance and Project Approval Activities

It was moved by Alternate-Member Worthington, seconded by Member Chang to approve the Cooperative Agreement with Caltrans for the project development activities for the Route 84 Expressway Project in Livermore (ACTIA 24).

Motion carried 10-0. Chair Miley excused himself because of a Levine Act conflict on Item CC1F.

AYES: Members Bates, Chang, Cooper, Green, Haggerty, Lai-Bitker, Lockhart, Steele, Young, Alternate-Member Worthington.

ABSTAIN: None

NOES: None

EXCUSED: Carson

AGENDA ITEM: CC1I

I CERTIFY THAT THE FOREGOING IS A COR
RECT COPY OF A RESOLUTION ADOPTE
BY THE ALAMEDA COUNTY TRANS
PORTATION IMPROVEMENT AUTHORITY
CALIFORNIA

ATTEST: Trudye A. Johnson
TRUDYE A. JOHNSON, CLERK OF THE
AUTHORITY

BY: _____

COOPERATIVE AGREEMENTS

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND
ALAMEDA COUNTY TRANSPORTATION COMISSION COOPERATIVE AGREEMENT
DATED 5/17/2011

COOPERATIVE AGREEMENT

This agreement, effective on May 17, 2011, is between the State of California, acting through its Department of Transportation, referred to as CALTRANS, and:

Alameda County Transportation Commission, a joint powers agency, referred to as Alameda CTC.

For the purpose of this agreement, the term PARTNERS collectively refers to CALTRANS and Alameda CTC (all signatory parties to this agreement). The term PARTNER refers to any one of those signatory parties individually.

RECITALS

1. California Streets and Highways Code sections 114 and 130 authorize PARTNERS to enter into a cooperative agreement for performance of work within the State Highway System (SHS) right of way.

2. This agreement outlines the terms and conditions of cooperation between PARTNERS to advertise, award and administer PROJECT for upgrading SR84 to an expressway facility with access control and improving bicycle and pedestrian access.

   For the purpose of this agreement, upgrading SR84 to an expressway facility with access control and improving bicycle and pedestrian access from north of Concannon Boulevard to Jack London Boulevard will be referred to as PROJECT. All responsibilities assigned in this agreement to advertise, award and administer PROJECT will be referred to as OBLIGATIONS.

3. This agreement is separate from and does not modify or replace any other cooperative agreement or memorandum of understanding between PARTNERS regarding PROJECT.

4. PARTNERS intend to utilize a Letter of No Prejudice (LONP) for PROJECT pursuant to Government Code 14556.33 and pending approval by the California Transportation Commission (CTC). Alameda CTC intends to provide its own funds in lieu of bond funds that would otherwise be used for CONSTRUCTION Capital expenditures. Upon sale and allocation of bond funds, CALTRANS intends to fully reimburse Alameda CTC for all qualifying CONSTRUCTION Capital expenditures.

5. Prior to this agreement, Alameda CTC developed the Project Report (Cooperative Agreement No. 4-2041); Alameda CTC developed the Plans, Specifications and Estimate (Cooperative Agreement No. 4-2041); and Alameda CTC developed the Right of Way Certification (Cooperative Agreement No. 4-2041). Alameda CTC prepared the environmental documentation for PROJECT.

6. CALTRANS approved and signed the Negative Declaration/Findings of No Significant Impact on October 9, 2007.

7. The estimated date for OBLIGATION COMPLETION is June 30, 2015.

8. In this agreement capitalized words represent defined terms and acronyms. The Definitions section contains a complete definition for each capitalized term.

9. From this point forward, PARTNERS define in this agreement the terms and conditions under which they will accomplish OBLIGATIONS.

RESPONSIBILITIES

10. Alameda CTC is SPONSOR for 100% of PROJECT.

11. CALTRANS will provide IQA for the portions of WORK within existing and proposed SHS right of way. CALTRANS retains the right to reject noncompliant WORK, protect public safety, preserve property rights, and ensure that all WORK is in the best interest of the SHS.

12. Alameda CTC may provide IQA for the portions of WORK outside existing and proposed SHS right of way.

13. CALTRANS and Alameda CTC will each be a FUNDING PARTNER for this agreement. Their funding commitments are defined in the FUNDING SUMMARY.

14. CALTRANS is the CEQA lead agency for PROJECT.

15. CALTRANS is the NEPA lead agency for PROJECT.

16. Alameda CTC is the CEQA Responsible agency for PROJECT.

17. CALTRANS is IMPLEMENTING AGENCY for CONSTRUCTION.

SCOPE

Scope: General

18. PARTNERS will perform all OBLIGATIONS in accordance with federal and California laws, regulations, and standards; FHWA STANDARDS; and CALTRANS STANDARDS.

19. IMPLEMENTING AGENCY for a PROJECT COMPONENT will provide a Quality Management Plan (QMP) for that component as part of the PROJECT MANAGEMENT PLAN.

20. Any PARTNER may, at its own expense, have representatives observe any OBLIGATIONS performed by another PARTNER. Observation does not constitute authority over those OBLIGATIONS.

21. Each PARTNER will ensure that all of its personnel participating in OBLIGATIONS are appropriately qualified, and if necessary licensed, to perform the tasks assigned to them.

22. PARTNERS will invite each other to participate in the selection and retention of any consultants who participate in OBLIGATIONS.

23. If WORK is done under contract (not completed by a PARTNER's own employees) and is governed by the California Labor Code's definition of a "public work" (section 1720(a)(a)), that PARTNER will conform to sections 1720 – 1815 of the California Labor Code and all applicable regulations and coverage determinations issued by the Director of Industrial Relations.

24. IMPLEMENTING AGENCY for each PROJECT COMPONENT included in this agreement will be available to help resolve problems generated by that component for the entire duration of PROJECT.

25. CALTRANS will issue, upon proper application, the encroachment permits required for WORK within SHS right of way.

    Contractors and/or agents, and utility owners will not perform WORK without an encroachment permit issued in their name.

26. If any PARTNER discovers unanticipated cultural, archaeological, paleontological, or other protected resources during WORK, all WORK in that area will stop and that PARTNER will notify all PARTNERS within 24 hours of discovery. WORK may only resume after a qualified professional has evaluated the nature and significance of the discovery and a plan is approved for its removal or protection.

27. PARTNERS will hold all administrative draft and administrative final reports, studies, materials, and documentation relied upon, produced, created, or utilized for PROJECT in confidence to the extent permitted by law. Where applicable, the provisions of California Government Code section 6254.5(e) will govern the disclosure of such documents in the event that PARTNERS share said documents with each other.

    PARTNERS will not distribute, release, or share said documents with anyone other than employees, agents, and consultants who require access to complete PROJECT without the written consent of the PARTNER authorized to release them, unless required or authorized to do so by law.

28. If any PARTNER receives a public records request, pertaining to OBLIGATIONS, that PARTNER will notify PARTNERS within five (5) working days of receipt and make

PARTNERS aware of any disclosed public records. PARTNERS will consult with each other prior to the release of any public documents related to the PROJECT.

29. If HM-1 or HM-2 is found during a PROJECT COMPONENT, IMPLEMENTING AGENCY for that PROJECT COMPONENT will immediately notify PARTNERS.

30. CALTRANS, independent of PROJECT, is responsible for any HM-1 found within the existing SHS right of way. CALTRANS will undertake HM MANAGEMENT ACTIVITIES related to HM-1 with minimum impact to PROJECT schedule.

31. If HM-1 is found within PROJECT limits and outside the existing SHS right of way, responsibility for such HM-1 rests with the owner(s) of the parcel(s) on which the HM-1 is found. Alameda CTC, in concert with the local agency having land use jurisdiction over the parcel(s), will ensure that HM MANAGEMENT ACTIVITIES related to HM-1 are undertaken with minimum impact to PROJECT schedule.

32. If HM-2 is found within PROJECT limits, the public agency responsible for the advertisement, award, and administration (AAA) of the PROJECT construction contract will be responsible for HM MANAGEMENT ACTIVITIES related to HM-2.

33. CALTRANS' acquisition or acceptance of title to any property on which any HM-1 or HM-2 is found will proceed in accordance with CALTRANS' policy on such acquisition.

34. PARTNERS will comply with all of the commitments and conditions set forth in the environmental documentation, environmental permits, approvals, and applicable agreements as those commitments and conditions apply to each PARTNER's responsibilities in this agreement.

35. IMPLEMENTING AGENCY for each PROJECT COMPONENT will furnish PARTNERS with written monthly progress reports during the implementation of OBLIGATIONS in that component.

36. Upon OBLIGATION COMPLETION, ownership or title to all materials and equipment constructed or installed for the operations and/or maintenance of the SHS within SHS right of way as part of WORK become the property of CALTRANS.

    CALTRANS will not accept ownership or title to any materials or equipment constructed or installed outside SHS right of way.

37. IMPLEMENTING AGENCY for a PROJECT COMPONENT will accept, reject, compromise, settle, or litigate claims of any non-agreement parties hired to do WORK in that component.

38. PARTNERS will confer on any claim that may affect OBLIGATIONS or PARTNERS' liability or responsibility under this agreement in order to retain resolution possibilities

for potential future claims. No PARTNER will prejudice the rights of another PARTNER until after PARTNERS confer on claim.

39. PARTNERS will maintain, and will ensure that any party hired by PARTNERS to participate in OBLIGATIONS will maintain, a financial management system that conforms to Generally Accepted Accounting Principles (GAAP), and that can properly accumulate and segregate incurred PROJECT costs, and provide billing and payment support.

40. PARTNERS will comply with the appropriate federal cost principles and administrative requirements outlined in the Applicable Cost Principles and Administrative Requirements table below. These principles and requirements apply to all funding types included in this agreement.

41. PARTNERS will ensure that any party hired to participate in OBLIGATIONS will comply with the appropriate federal cost principles and administrative requirements outlined in the Applicable Cost Principles and Administrative Requirements table below.

Applicable Cost Principles and Administration Requirements		
The federal cost principles and administrative requirements associated with each organization type apply to that organization.		
Organization Type	**Cost Principles**	**Administrative Requirements**
Federal Governments	2 CFR Part 225	OMB A-102
State and Local Government	2 CFR, Part 225	49 CFR, Part 18
Educational Institutions	2 CFR, Part 220	2 CFR, Part 215
Non-Profit Organizations	2 CFR, Part 230	2 CFR, Part 215
For Profit Organizations	48 CFR, Chapter 1, Part 31	49 CFR, Part 18
CFR (Code of Federal Regulations) **OMB (Office of Management and Budget)**		
Related URLs: • Various OMB Circular: http://www.whitehouse.gov/omb/grants_circulars • Code of Federal Regulations: http://www.gpoaccess.gov/CFR		

42. PARTNERS will maintain and make available to each other all OBLIGATIONS-related documents, including financial data, during the term of this agreement.

43. PARTNERS will retain all OBLIGATIONS-related records for three (3) years after the final voucher.

44. PARTNERS have the right to audit each other in accordance with generally accepted governmental audit standards.

CALTRANS, the state auditor, FHWA, and Alameda CTC will have access to all OBLIGATIONS-related records of each PARTNER, and any party hired by a PARTNER to participate in OBLIGATIONS, for audit, examination, excerpt, or transcription.

The examination of any records will take place in the offices and locations where said records are generated and/or stored and will be accomplished during reasonable hours of operation. The auditing PARTNER will be permitted to make copies of any OBLIGATIONS-related records needed for the audit.

The audited PARTNER will review the draft audit, findings, and recommendations, and provide written comments within 30 calendar days of receipt.

Upon completion of the final audit, PARTNERS have 30 days to refund or invoice as necessary in order to satisfy the obligation of the audit.

Any audit dispute not resolved by PARTNERS is subject to dispute resolution. Any costs arising out of the dispute resolution process will be paid within 30 calendar days of the final audit or dispute resolution findings.

45. Any PARTNER that hires another party to participate in OBLIGATIONS will conduct a pre-award audit of that party in accordance with the *Local Assistance Procedures Manual*.

46. PARTNERS will not incur costs beyond the funding commitments in this agreement. If IMPLEMENTING AGENCY anticipates that funding for WORK will be insufficient to complete WORK, IMPLEMENTING AGENCY will promptly notify SPONSOR.

IMPLEMENTING AGENCY has no obligation to perform WORK if funds to perform WORK are unavailable.

47. If WORK stops for any reason, IMPLEMENTING AGENCY will place all facilities impacted by WORK in a safe and operable condition acceptable to CALTRANS.

48. If WORK stops for any reason, each PARTNER will continue to implement all of its applicable commitments and conditions included in the PROJECT environmental documentation, permits, agreements, or approvals that are in effect at the time that WORK stops, as they apply to each PARTNER's responsibilities in this agreement, in order to keep PROJECT in environmental compliance until WORK resumes.

49. Each PARTNER accepts responsibility to complete the activities that it selected on the SCOPE SUMMARY. Activities marked with "N/A" on the SCOPE SUMMARY are not included in the scope of this agreement.

50. Alameda CTC will provide one or more full time qualified support staff to assist in construction support of PROJECT as a construction support cost paid by Alameda CTC from local funds. The staff person(s) shall have the expertise to review the construction

contractor's schedules, Notices of Potential Claims and act as an assistant Resident Engineer and/or construction office engineer under the specific direction of CALTRANS' Resident Engineer.

Scope: Environmental Permits, Approvals and Agreements

51. Each PARTNER identified in the Environmental Permits table below accepts the responsibility to complete the assigned activities.

Environmental Permits						
Permit	Coordinate	Prepare	Obtain	Implement	Renew	Amend
404 USACOE	Alameda CTC	Alameda CTC	Alameda CTC	CALTRANS	Alameda CTC	Alameda CTC
401 RWQCB	Alameda CTC	Alameda CTC	Alameda CTC	CALTRANS	Alameda CTC	Alameda CTC
FESA Section 7 USFWS	CALTRANS	Alameda CTC	CALTRANS	CALTRANS	CALTRANS	CALTRANS
1602 DFG	Alameda CTC	Alameda CTC	Alameda CTC	CALTRANS	Alameda CTC	Alameda CTC

Scope: CONSTRUCTION

52. CALTRANS will advertise, open bids, award, and approve the construction contract in accordance with the California Public Contract Code and the California Labor Code.

CALTRANS will not advertise the construction contract until CALTRANS completes or accepts the final plans, specifications, and estimate package; CALTRANS approves the Right of Way Certification; and SPONSOR verifies full funding of CONSTRUCTION SUPPORT and CONSTRUCTION CAPITAL.

By accepting responsibility to advertise and award the construction contract, CALTRANS also accepts responsibility to administer the construction contract.

53. CALTRANS will provide a RESIDENT ENGINEER and construction support staffs that are independent of the design engineering company and construction contractor.

54. IMPLEMENTING AGENCY will implement changes to the construction contract through contract change orders (CCOs). PARTNERS will review and concur on all CCOs over $25,000.

CALTRANS must approve all CCOs affecting public safety or the preservation of property, all design and specification changes, and all major changes as defined in the CALTRANS Construction Manual prior to implementing the CCO.

55. If the lowest responsible construction contract bid is greater than the funding commitment to CONSTRUCTION CAPITAL, all PARTNERS must be involved in determining how to proceed. If PARTNERS do not agree in writing on a course of action within 30 working days, this agreement will terminate.

    CALTRANS will require the construction contractor to furnish payment and performance bonds naming CALTRANS as obligee and to carry liability insurance in accordance with CALTRANS specifications.

56. As IMPLEMENTING AGENCY for CONSTRUCTION, CALTRANS is responsible for maintenance within PROJECT limits as part of the construction contract.

57. PARTNERS confirm that upon OBLIGATION COMPLETION, no maintenance agreement will be necessary.

COST

Cost: General

58. The cost of any awards, judgments, or settlements generated by OBLIGATIONS is an OBLIGATIONS COST.

59. CALTRANS, independent of PROJECT, will pay all costs for HM MANAGEMENT ACTIVITIES related to HM-1 found within the existing SHS right of way.

60. Independent of PROJECT, all costs for HM MANAGEMENT ACTIVITIES related to HM-1 found within PROJECT limits and outside the existing SHS right of way will be the responsibility of the owner(s) of the parcel(s) where the HM-1 is located.

61. HM MANAGEMENT ACTIVITIES costs related to HM-2 are CONSTRUCTION SUPPORT and CONSTRUCTION CAPITAL costs.(C.b.29)

62. The cost to comply with and implement the commitments set forth in the environmental documentation is an OBLIGATIONS COST.

63. The cost to ensure that PROJECT remains in environmental compliance is an OBLIGATIONS COST.

64. The cost of any legal challenges to the CEQA or NEPA environmental process or documentation is an OBLIGATIONS COST.

65. Independent of OBLIGATIONS COST, CALTRANS will fund the cost of its own IQA for WORK done within existing or proposed future SHS right of way.

66. Independent of OBLIGATIONS COST, Alameda CTC will fund the cost of its own IQA for WORK done outside existing or proposed future SHS right of way.

67. CALTRANS will provide encroachment permits to PARTNERS, their contractors, consultants and agents, at no cost.

68. Fines, interest, or penalties levied against a PARTNER will be paid, independent of OBLIGATIONS cost, by the PARTNER whose actions or lack of action caused the levy. That PARTNER will indemnify and defend each other PARTNER.

69. Travel, per diem, and third-party contract reimbursements are an OBLIGATIONS COST only after those hired by PARTNERS to participate in OBLIGATIONS incur and pay those costs.

    Payments for travel and per diem will not exceed the rates paid rank and file state employees under current California Department of Personnel Administration (DPA) rules current at the effective date of this agreement.

    If Alameda CTC invoices for rates in excess of DPA rates, Alameda CTC will fund the cost difference and reimburse CALTRANS for any overpayment. (C.b.42)

70. The cost of any engineering support performed by CALTRANS includes all direct and applicable indirect costs. CALTRANS calculates indirect costs based solely on the type of funds used to pay support costs. State and federal funds are subject the current Program Functional Rate. Local funds are subject to the current Program Functional Rate and the current Administration Rate. CALTRANS periodically adjusts the Program Functional Rate and the Administration Rate.

71. If CALTRANS reimburses Alameda CTC for any costs later determined to be unallowable, Alameda CTC will reimburse those funds.

72. The cost to place PROJECT right of way in a safe and operable condition and meet all environmental commitments is an OBLIGATIONS cost.

73. Because IMPLEMENTING AGENCY is responsible for managing the scope, cost, and schedule of a project component, if there are insufficient funds available in this agreement to place the right of way in a safe and operable condition, the appropriate IMPLEMENTING AGENCY accepts responsibility to fund these activities until such time as PARTNERS amend this agreement.

    That IMPLEMENTING AGENCY may request reimbursement for these costs during the amendment process.

74. If there are insufficient funds in this agreement to implement applicable commitments and conditions included in the PROJECT environmental documentation, permits, agreements, and/or approvals that are in effect at a time that WORK stops, each PARTNER

implementing commitments or conditions accepts responsibility to fund these activities, as they apply to each PARTNER's responsibilities, until such time are PARTNERS amend this agreement.

Each PARTNER may request reimbursement for these costs during the amendment process.

75. PARTNERS will pay invoices within 30 calendar days of receipt of a complete invoice which includes all supporting documentation for requested reimbursements.

Cost: Environmental Permits, Approvals and Agreements

76. The cost of coordinating, obtaining, complying with, implementing, and if necessary renewing and amending resource agency permits, agreements, and/or approvals is an OBLIGATIONS COST.

Cost: CONSTRUCTION Support

77. FUNDING PARTNERS will share the cost of CONSTRUCTION SUPPORT as shown on the FUNDING SUMMARY.

78. Alameda CTC will bear one hundred percent (100%) of the cost of CONSTRUCTION Support staff provided by Alameda CTC with local funds in accordance with paragraph 50 of this agreement.

79. Each PARTNER listed below may submit invoices for CONSTRUCTION Support:
    - CALTRANS may invoice Alameda CTC

80. PARTNERS will exchange funds for actual costs.

CALTRANS may submit to Alameda CTC monthly invoices for estimated monthly costs based on the prior month's actual expenditures. Detailed supporting information will be provided within seven (7) working days of invoice.

Alameda CTC will electronically transfer (wire) funds to CALTRANS within three (3) to five (5) working days of receipt of invoice. Alameda CTC's transfer of funds will not be construed as acceptance of said charges.

If Alameda CTC does not transfer the money within three (3) to five (5) working days, CALTRANS may require Alameda CTC to make all subsequent payments as deposits in advance of WORK.

Alameda CTC will notify CALTRANS of a disputed invoice in writing no later than 30 days of receipt of the detailed supporting information.

Upon receipt of a claim, CALTRANS has seven (7) working days to contest said claim. Upon resolution, CALTRANS will make the appropriate credit or debit to Alameda CTC, reflected on the next invoice.

After PARTNERS agree that all WORK is complete, CALTRANS will submit a final accounting for all OBLIGATIONS COST. Based on the final accounting, PARTNERS will refund or invoice as necessary in order to satisfy the financial commitments of this agreement.

After PARTNERS agree that all WORK is complete, Alameda CTC will submit a final accounting for all OBLIGATIONS COST. Based on the final accounting, PARTNERS will refund or invoice as necessary in order to satisfy the financial commitments of this agreement.

Cost: CONSTRUCTION Capital

81. CALTRANS will fund the cost of SFM as a CONSTRUCTION CAPITAL cost.

82. FUNDING PARTNERS will share the cost of CONSTRUCTION CAPITAL as shown on the FUNDING SUMMARY.

83. The following partners will submit invoices for CONSTRUCTION Capital:
    - CALTRANS will invoice Alameda CTC

84. FUNDING PARTNERS will exchange funds for actual costs.

85. CALTRANS will invoice Alameda CTC for a $1,000,000 initial deposit 30 working days prior to the construction contract bid advertisement date. This deposit represents one (1) months' estimated capital costs.

    Thereafter, CALTRANS will submit to Alameda CTC monthly invoices for estimated monthly costs based on the prior month's actual expenditures. Detailed supporting information will be provided within seven (7) working days of invoice.

    Alameda CTC will electronically transfer (wire) funds to CALTRANS within three (3) to five (5) working days of receipt of invoice. Alameda CTC's transfer of funds will not be construed as acceptance of said charges.

    If Alameda CTC does not transfer the money within three (3) to five (5) working days, CALTRANS may require Alameda CTC to make all subsequent payments as deposits in advance of WORK.

    Alameda CTC will notify CALTRANS of a disputed invoice in writing no later than 30 days of receipt of the detailed supporting information.

Upon receipt of a claim, CALTRANS has seven (7) working days to contest said claim. Upon resolution, CALTRANS will make the appropriate credit or debit to Alameda CTC, reflected on the next invoice.

Alameda CTC is eligible for reimbursement of actual CONSTRUCTION Capital expenses incurred in an amount not to exceed $17,050,000 from CMIA funds subject to the California Transportation Commission's (CTC) approval of the Letter of No Prejudice (LONP) in accordance with Government Code 14556.33. Alameda CTC commits a total of $17,050,000 of Construction Capital funding, in lieu of bond funds, over the course of PROJECT Construction.

After FUNDING PARTNERS agree that all WORK is complete, CALTRANS will submit a final accounting for all OBLIGATIOS COSTS. Based on the final accounting, PARTNERS will refund or invoice as necessary in order to satisfy the financial commitments of this agreement.

SCHEDULE

86. PARTNERS will manage the schedule for OBLIGATIONS through the work plan included in the PROJECT MANAGEMENT PLAN.

GENERAL CONDITIONS

87. PARTNERS understand that this agreement is in accordance with and governed by the Constitution and laws of the State of California. This agreement will be enforceable in the State of California. Any PARTNER initiating legal action arising from this agreement will file and maintain that legal action in the Superior Court of the county in which the CALTRANS district office that is signatory to this agreement resides, or in the Superior Court of the county in which PROJECT is physically located

88. All OBLIGATIONS of CALTRANS under the terms of this agreement are subject to the appropriation of resources by the Legislature, the State Budget Act authority, and the allocation of funds by the California Transportation Commission.

89. Any PARTNER performing IQA does so for its own benefit. No one can assign liability to that PARTNER due to its IQA activities.

90. PARTNERS will meet the requirements of Government Code Section 8879.20 et al. (Proposition 1 legislation), the governor's Executive Order 2007-S-02-07, and the California Transportation Commission (CTC) program guidelines for the applicable account.

91. Neither Alameda CTC nor any officer or employee thereof is responsible for any injury, damage or liability occurring by reason of anything done or omitted to be done by CALTRANS and/or its agents under or in connection with any work, authority, or jurisdiction conferred upon CALTRANS under this agreement.

It is understood and agreed that CALTRANS and/or its agents will fully defend, indemnify, and save harmless Alameda CTC and all of its officers and employees from all claims, suits, or actions of every name, kind, and description brought forth under, but not limited to, tortious, contractual, inverse condemnation, or other theories or assertions of liability occurring by reason of anything done or omitted to be done by CALTRANS and/or its agents under this agreement.

92. Neither CALTRANS nor any officer or employee thereof is responsible for any injury, damage, or liability occurring by reason of anything done or omitted to be done by Alameda CTC and/or its agents under or in connection with any work, authority, or jurisdiction conferred upon Alameda CTC under this agreement.

It is understood and agreed that Alameda CTC and/or its agents will fully defend, indemnify, and save harmless CALTRANS and all of its officers and employees from all claims, suits, or actions of every name, kind, and description brought forth under, but not limited to, tortious, contractual, inverse condemnation, or other theories or assertions of liability occurring by reason of anything done or omitted to be done by Alameda CTC and/or its agents under this agreement.

93. PARTNERS do not intend this agreement to create a third party beneficiary or define duties, obligations, or rights in parties not signatory to this agreement. PARTNERS do not intend this agreement to affect their legal liability by imposing any standard of care for fulfilling OBLIGATIONS different from the standards imposed by law.

94. PARTNERS will not assign or attempt to assign OBLIGATIONS to parties not signatory to this agreement.

95. PARTNERS will not interpret any ambiguity contained in this agreement against each other. PARTNERS waive the provisions of California Civil Code section 1654.

96. A waiver of a PARTNER's performance under this agreement will not constitute a continuous waiver of any other provision. An amendment made to any article or section of this agreement does not constitute an amendment to or negate all other articles or sections of this agreement.

97. A delay or omission to exercise a right or power due to a default does not negate the use of that right or power in the future when deemed necessary.

98. If any PARTNER defaults in its OBLIGATIONS, a non-defaulting PARTNER will request in writing that the default be remedied within 30 calendar days. If the defaulting PARTNER fails to do so, the non-defaulting PARTNER may initiate dispute resolution.

99. PARTNERS will first attempt to resolve agreement disputes at the PROJECT team level. If they cannot resolve the dispute themselves, the CALTRANS district director and the executive officer of Alameda CTC will attempt to negotiate a resolution. If PARTNERS do not reach a resolution, PARTNERS' legal counsel will initiate mediation. PARTNERS agree to participate in mediation in good faith and will share equally in its costs.

    Neither the dispute nor the mediation process relieves PARTNERS from full and timely performance of OBLIGATIONS in accordance with the terms of this agreement. However, if any PARTNER stops fulfilling OBLIGATIONS, any other PARTNER may seek equitable relief to ensure that OBLIGATIONS continue.

    Except for equitable relief, no PARTNER may file a civil complaint until after mediation, or 45 calendar days after filing the written mediation request, whichever occurs first.

    PARTNERS will file any civil complaints in the Superior Court of the county in which the CALTRANS district office signatory to this agreement resides. The prevailing PARTNER will be entitled to an award of all costs, fees, and expenses, including reasonable attorney fees as a result of litigating a dispute under this agreement or to enforce the provisions of this article including equitable relief.

100. PARTNERS maintain the ability to pursue alternative or additional dispute remedies if a previously selected remedy does not achieve resolution.

101. If any provisions in this agreement are deemed to be, or are in fact, illegal, inoperative, or unenforceable, those provisions do not render any or all other agreement provisions invalid, inoperative, or unenforceable, and PARTNERS will automatically sever those provisions from this agreement.

102. PARTNERS intend this agreement to be their final expression and supersede any oral understanding or writings pertaining to OBLIGATIONS.

103. If during performance of WORK additional activities or environmental documentation is necessary to keep PROJECT in environmental compliance, PARTNERS will amend this agreement to include completion of those additional tasks.

104. PARTNERS will execute a formal written amendment if there are any changes to OBLIGATIONS.

105. This agreement will terminate upon OBLIGATION COMPLETION or an amendment to terminate this agreement, whichever occurs first.

However, all indemnification, document retention, audit, claims, environmental commitment, legal challenge, and ownership articles will remain in effect until terminated or modified in writing by mutual agreement.

106. The following documents are attached to, and made an express part of this agreement: SCOPE SUMMARY, FUNDING SUMMARY.

DEFINITIONS

CALTRANS – The California Department of Transportation

CALTRANS STANDARDS – CALTRANS policies and procedures, including, but not limited to, the guidance provided in the *Guide to Capital Project Delivery Workplan Standards* (previously known as WBS Guide) available at http://www.dot.ca.gov/hq/projmgmt/guidance.htm.

CEQA (California Environmental Quality Act) – The act (California Public Resources Code, sections 21000 et seq.) that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those significant impacts, if feasible.

CFR (Code of Federal Regulations) – The general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government

CONSTRUCTION CAPITAL – See PROJECT COMPONENT.

CONSTRUCTION SUPPORT – See PROJECT COMPONENT.

COOPERATIVE AGREEMENT CLOSURE STATEMENT – A document signed by PARTNERS that verifies the completion of all OBLIGATIONS included in this agreement and in all amendments to this agreement.

COST – The responsibility for cost responsibilities in this agreement can take one of three assignments:

- **OBLIGATIONS COST** – A cost associated with fulfilling OBLIGATIONS that will be funded as part of this agreement. The responsibility is defined by the funding commitments in this agreement.
- **PROJECT COST** – A cost associated with PROJECT that can be funded outside of OBLIGATIONS. A PROJECT COST may not necessarily be part of this agreement. This responsibility is defined by the PARTNERS' funding commitments at the time the cost is incurred.
- **PARTNER cost** – A cost that is the responsibility of a specific PARTNER, independent of PROJECT.

FHWA – Federal Highway Administration

FHWA STANDARDS – FHWA regulations, policies and procedures, including, but not limited to, the guidance provided at www.fhwa.dot.gov/topics.htm.

FUNDING PARTNER – A PARTNER that commits a defined dollar amount to fulfill OBLIGATIONS. Each FUNDING PARTNER accepts responsibility to provide the funds identified on the FUNDING SUMMARY under its name.

FUNDING SUMMARY – The table that designates an agreement's funding sources, types of funds, and the PROJECT COMPONENT in which the funds are to be spent. Funds listed on the FUNDING SUMMARY are "not-to-exceed" amounts for each FUNDING PARTNER.

GAAP (Generally Accepted Accounting Principles) – Uniform minimum standards and guidelines for financial accounting and reporting issued by the Federal Accounting Standards Advisory Board that serve to achieve some level of standardization. See http://www.fasab.gov/accepted.html.

HM-1 – Hazardous material (including, but not limited to, hazardous waste) that may require removal and disposal pursuant to federal or state law whether it is disturbed by PROJECT or not.

HM-2 – Hazardous material (including, but not limited to, hazardous waste) that may require removal and disposal pursuant to federal or state law only if disturbed by PROJECT.

HM MANAGEMENT ACTIVITIES – Management activities related to either HM-1 or HM-2 including, without limitation, any necessary manifest requirements and disposal facility designations.

IMPLEMENTING AGENCY – The PARTNER responsible for managing the scope, cost, and schedule of a PROJECT COMPONENT to ensure the completion of that component.

IQA (Independent Quality Assurance) – Ensuring that IMPLEMENTING AGENCY's quality assurance activities result in WORK being developed in accordance with the applicable standards and within an established Quality Management Plan (QMP). IQA does not include any work necessary to actually develop or deliver WORK or any validation by verifying or rechecking work performed by another partner.

NEPA (National Environmental Policy Act of 1969) – The federal act that establishes a national policy for the environment and a process to disclose the adverse impacts of projects with a federal nexus.

OBLIGATION COMPLETION – PARTNERS have fulfilled all OBLIGATIONS included in this agreement, and all amendments to this agreement, and have signed a COOPERATIVE AGREEMENT CLOSURE STATEMENT.

OBLIGATIONS – All responsibilities included in this agreement.

OBLIGATIONS COST – See COST.

OMB (Office of Management and Budget) – The federal office that oversees preparation of the federal budget and supervises its administration in Executive Branch agencies.

PARTNER – Any individual signatory party to this agreement.

PARTNERS – The term that collectively references all of the signatory agencies to this agreement. This term only describes the relationship between these agencies to work together to achieve a mutually beneficial goal. It is not used in the traditional legal sense in which one PARTNER's individual actions legally bind the other partners.

PROJECT – The undertaking to upgrade SR84 to an expressway facility with access control and improve bicycle and pedestrian access from north of Concannon Boulevard to Jack London Boulevard.

PROJECT COMPONENT – A distinct portion of the planning and project development process of a capital project as outlined in California Government Code, section 14529(b).

- **PID (Project Initiation Document)** – The activities required to deliver the project initiation document for PROJECT.
- **PA&ED (Project Approval and Environmental Document)** – The activities required to deliver the project approval and environmental documentation for PROJECT.
- **PS&E (Plans, Specifications, and Estimate)** – The activities required to deliver the plans, specifications, and estimate for PROJECT.
- **R/W (Right of Way) SUPPORT** –The activities required to obtain all property interests for PROJECT
- **R/W (Right of Way) CAPITAL** – The funds for acquisition of property rights for PROJECT.
- **CONSTRUCTION SUPPORT** – The activities required for the administration, acceptance, and final documentation of the construction contract for PROJECT.
- **CONSTRUCTION CAPITAL** – The funds for the construction contract.

PROJECT COST – See COST.

PROJECT MANAGEMENT PLAN – A group of documents used to guide a project's execution and control throughout that project's lifecycle.

QMP (Quality Management Plan) – An integral part of the Project Management Plan that describes IMPLEMENTING AGENCY's quality policy and how it will be used.

RESIDENT ENGINEER – A civil engineer licensed in the State of California who is responsible for construction contract administration activities. Said engineer must be independent of the design engineering company and the construction contractor.

SAFETEA-LU – Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

SCOPE SUMMARY – The attachment in which each PARTNER designates its commitment to specific scope activities within each PROJECT COMPONENT as outlined by the *Guide to Capital Project Delivery Workplan Standards* (previously known as WBS Guide) available at http://www.dot.ca.gov/hq/projmgmt/guidance.htm.

SHS (State Highway System) – All highways, right of way, and related facilities acquired, laid out, constructed, improved, or maintained as a state highway pursuant to constitutional or legislative authorization.

SPONSOR – Any PARTNER that accepts the responsibility to establish scope of PROJECT and the obligation to secure financial resources to fund PROJECT. SPONSOR is responsible for adjusting the PROJECT scope to match committed funds or securing additional funds to fully fund the PROJECT scope. If a PROJECT has more than one SPONSOR, funding adjustments will be made by percentage (as outlined in Responsibilities). Scope adjustments must be developed through the project development process and must be approved by CALTRANS as the owner/operator of the SHS.

SFM (State Furnished Material) – Any materials or equipment supplied by CALTRANS.

WORK – All scope activities included in this agreement.

CONTACT INFORMATION

The information provided below indicates the primary contact data for each PARTNER to this agreement. PARTNERS will notify each other in writing of any personnel or location changes. Contact information changes do not require an amendment to this agreement.

The primary agreement contact person for CALTRANS is:
Issa Bouri, Project Manager
111 Grand Ave
Oakland, California 94612
Office Phone: (510) 286-5220
Email: issa_bouri@dot.ca.gov

The primary agreement contact person for Alameda CTC is:
Stefan Garcia, Project Manager
1333 Broadway, Suite 300
Oakland, California 94612
Office Phone: (510) 208-7474
Email: sgarcia@alamedactc.org

SIGNATURES

PARTNERS declare that:

1. Each PARTNER is an authorized legal entity under California state law.
2. Each PARTNER has the authority to enter into this agreement.
3. The people signing this agreement have the authority to do so on behalf of their public agencies.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

APPROVED

By: _____
Helena (Lenka) Culik-Caro
Deputy District Director, Design

CERTIFIED AS TO FUNDS:

By: _____
Maureen Rehs
District Budget Manager

ALAMEDA COUNTY TRANSPORTATION COMMISSION

APPROVED

By: _____
Arthur L. Dao
Executive Director

REVIEWED AS TO BUDGET/FINANCIAL CONTROLS

By: _____
Patricia Reavey
Director of Finance

APPROVED AS TO FORM AND PROCEDURE

By: _____
Wendel, Rosen, Black & Dean LLP
Legal Counsel

SCOPE SUMMARY

4	5	6	7	8	Description	CALTRANS	Alameda CTC	N/A
5	270				Construction Engineering and General Contract Administration	X	X	
		10			Construction Staking Package and Control	X	X	
		15			Construction Stakes	X	X	
		20			Construction Engineering Work	X	X	
		25			Construction Contract Administration Work	X	X	
		30			Contract Item Work Inspection	X	X	
		35			Construction Material Sampling and Testing	X	X	
		40			Safety and Maintenance Reviews	X	X	
		45			Relief From Maintenance Process	X	X	
		55			Final Inspection and Acceptance Recommendation	X	X	
		60			Plant Establishment Administration	X	X	
		65			Transportation Management Plan Implementation During Construction	X	X	
		80			Long-Term Environmental Mitigation/Mitigation Monitoring During Construction Contract	X	X	
		99			Other Construction Engineering and General Contract Administration	X	X	
5	275				Construction Engineering and General Contract Administration of Structures Work	X	X	
5	285				Contract Change Order Administration	X	X	
5	290				Resolve Contract Claims	X	X	
5	295				Accept Contract, Prepare Final Construction Estimate, and Final Report	X		
4	300				FINAL RIGHT OF WAY ENGINEERING		X	

FUNDING SUMMARY

Funding Source	Funding Partner	Fund Type		CON Capital	CON Support	Total Funds Type
STATE	CALTRANS	Local LONP (Letter Of No Prejudice)	Bond Corridor Mobility Improvement	$17,050,000	$0	$17,050,000
STATE	CALTRANS	Bond Corridor Mobility Improvement		$0	$2,950,000	$2,950,000
LOCAL	Alameda CTC	Local		$15,582,000	$830,000	$16,412,000
		Subtotals by Component		$32,632,000	$3,780,000	$36,412,000

Note: CONSTRUCTION Support staff supplied by Alameda CTC to be paid directly from local funds.

ALAMEDA County Transportation Commission

1333 Broadway, Suites 220 & 300 ▪ Oakland, CA 94612 ▪ PH: (510) 208-7400
www.AlamedaCTC.org

Commission Chair
Mark Green, Mayor – Union City

Commission Vice Chair
Scott Haggerty, Supervisor – District 1

AC Transit
Greg Harper, Director

Alameda County
Supervisors
Nadia Lockyer – District 2
Wilma Chan – District 3
Nate Miley – District 4
Keith Carson – District 5

BART
Thomas Blalock, Director

City of Alameda
Rob Bonta, Vice Mayor

City of Albany
Farid Javandel, Mayor

City of Berkeley
Laurie Capitelli, Councilmember

City of Dublin
Tim Sbranti, Mayor

City of Emeryville
Ruth Atkin, Councilmember

City of Fremont
Suzanne Chan, Vice Mayor

City of Hayward
Olden Henson, Councilmember

City of Livermore
Marshall Kamena, Mayor

City of Newark
Luis Freitas, Vice Mayor

City of Oakland
Councilmembers
Larry Reid
Rebecca Kaplan

City of Piedmont
John Chiang, Vice Mayor

City of Pleasanton
Jennifer Hosterman, Mayor

City of San Leandro
Joyce R. Starosciak, Councilmember

Executive Director
Arthur L. Dao

ALAMEDA COUNTY TRANSPORTATION COMMISSION
RESOLUTION 11-008

Administering Agency-State Agreement for State and Federal-Aid Projects

WHEREAS, the Congress of the United States has enacted Federal Legislation to fund programs which include, but are not limited to, Surface Transportation Program (STP), the Congestion Mitigation and Air Quality Improvement Program (CMAQ), the Transportation Enhancement Program (TE), Highway Safety Improvement Program (HSIP), and the Highway Bridge Program (HBP); and

WHEREAS, the Legislature of the State of California has enacted legislation by which certain State and Federal funds which include, but are not limited to, STP, CMAQ, TE, HSIP, and HBP may be made available for use on local transportation facilities of public entities qualified to act as recipients of these State and Federal funds in accordance with State and Federal law; and

WHEREAS, the Alameda County Transportation Commission (Alameda CTC) is eligible to receive Federal and/or State funding for certain Transportation Projects, through the California Department of Transportation; and

WHEREAS, Master Agreements, Program Supplemental Agreements, Cooperative Agreements, Fund Exchange Agreements and/or Fund Transfer Agreements need to be executed with the California Department of Transportation before such funds could be claimed; and

WHEREAS, the Alameda CTC wishes to delegate authorization to execute these agreements and any amendments thereto to the Executive Director.

NOW, THEREFORE, BE IT RESOLVED, that the Executive Director, or a designee of the Executive Director, be authorized to execute all Master Agreements, Program Supplemental Agreements, Cooperative Agreements, Fund Exchange Agreements, Fund Transfer Agreements, and any amendments thereto with the California Department of Transportation.

DULY PASSED AND ADOPTED by the Alameda County Transportation Commission at the regular meeting of the Board of Directors held on Thursday, April 28, 2011, in Oakland, California, by the following vote:

AYES: 24 **NOES:** ϕ **ABSTAIN:** ϕ **ABSENT:** 3

SIGNED:

Mark Green
Chair

ATTEST:

Gladys V. Parmelee
Interim Clerk of the Commission

I CERTIFY THAT THE FOREGOING IS A CORRECT COPY OF A RESOLUTION ADOPTED BY THE ALAMEDA COUNTY TRANSPORTATION COMMISSION, CALIFORNIA

ATTEST: _____
GLADYS V. PARMELEE
CLERK OF THE COMMISSION

DATE: 5/04/11

FOR CONTRACT NO. 297614

COOPERATIVE AGREEMENTS

ADDENDUM TO THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION AND CITY OF LIVERMORE COOPERATIVE AGREEMENT
DATED 3/18/2010

10-037

AMENDMENT NUMBER 1
AGREEMENT FOR MAINTENANCE OF STATE HIGHWAYS

IN THE CITY OF LIVERMORE

This Amendment No. 1 to the Agreement for Maintenance of State Highways in the City of Livermore is made and entered into by and between the State of California, acting by and through the Department of Transportation, hereinafter referred to as "STATE", and the City of Livermore, hereinafter referred to as "CITY."

WITNESSETH:

WHEREAS, an Agreement for Maintenance of State Highways in the City of Livermore, hereinafter referred to as "AGREEMENT", as provided for in Section 130 of the Streets and Highways Code, was executed by CITY on October 27, 2003, and by STATE on December 6, 2003; and

WHEREAS, AGREEMENT by its terms provides that it may be modified or amended at any time upon mutual consent of the parties; and

WHEREAS, the parties hereto now desire that AGREEMENT be amended.

NOW, THEREFORE, the parties agree to amend AGREEMENT as follows:

1. The attached Exhibit "A" and Exhibit "B" shall be substituted for like numbered page in AGREEMENT, and shall cancel and supersede such like numbered page, becoming a part of AGREEMENT for all purposes.

2. This Amendment No. 1 to AGREEMENT shall become effective on January 1, 2010 and shall remain in full force until amended or terminated as provided for in Section 13 of AGREEMENT. In all other respects, AGREEMENT shall remain in full force and effect.

CITY OF LIVERMORE

Marcia Barton
City Manager

Attest

Susan Neer
City Clerk

Approved as to form:

City Attorney Assistant

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATON

RANDELL H. IWASAKI
Director of Transportation

By

Nader Eshghipour 3/18/10
NADER ESHGHIPOUR Date
Deputy District Director
Maintenance

EXHIBIT "A"

A. DELEGATION OF MAINTENANCE

The specific maintenance function indicated below and on EXHIBIT "B" is hereby delegated to the CITY. This delegation of maintenance function set forth herein does not include the control and maintenance areas and functions which rest with the CITY under the terms of executed Freeway Agreements and/or Freeway Maintenance Agreements.

Route No.	Length Miles	Description of Routing	Program Delegated	Maximum Annual Authorized Expenditure	
84 (a)	3.7	Expressway, Isabel Avenue, from Vallecitos Road to Jack London Boulevard, a length of 3.7 miles. Footnotes 5,6	HM2C	$	0.00
84(b)	0.3	Expressway, Isabel Avenue, from Jack London Blvd to Route 580/84 separation, a length of 1.04 miles. Footnotes 1,2,3,4.	HM2C HM2E HM4K	$ $	0.00 0.00 0.00
		Total Authorized Route 84		$	0.00
580	4.7	Freeway from city limits at Greenville Road Undercrossing to city limits 1900 feet west of First Street (Jct. Rte 84), a length of 2.78 miles for this portion; also freeway from city limits at Portola Valley Overcrossing to west city limits near Doolan Road, a length of 1.93 miles for this portion; a total of 4.71 miles.	None		0.00
		TOTAL AUTHORIZATION		$	0.00

Note: A Maximum Annual Authorized Expenditure of "$0.00" for the Program Delegated indicates that CITY is to perform the work at CITY's own expense.

Footnotes:

1. CITY will require sidewalk repairs and control of trees and vegetation to be made by or at the expense of abutting owners, who are under legal obligation to perform such work.

2. Maintenance of landscaped areas or other ornamental plantings, will be performed by the CITY at no expense to STATE as provided in Cooperative Agreement and Encroachment Permits.

3. City shall maintain maintenance path adjacent to retaining wall. CITY will be responsible for debris removal, cleaning and painting to keep CITY's side of retaining wall structure free of debris, dirt and graffiti at no cost to STATE.

4. Route 84/580 Separation- CITY will maintain, at CITY expense, the lightings and electrical energy expense on the Route 84(Isabel Avenue)at Route 84/580 Separation.

5. CITY's responsibility for HM2C function is limited to maintenance of the mutli-use trail . CITY will maintain multi-use trail at CITY expense.

6. Vehicular Overcrossing (Route 84 at Stanley Boulevard):

The STATE will maintain, at STATE expense, the entire structure below the deck surface except for the grapevine staining on the columns. The CITY will maintain, at CITY expense, the deck surface, and the grapevine staining on columns together with any surface treatment thereon. The CITY will also maintain all portions of the structure above the bridge deck, as above specified, including lighting installations, as well as all traffic service facilities (signals, signs, pavement markings, rails, etc.) that may be required for the benefit or control of CITY street traffic.

At such locations, as shall be determined by the STATE, screening shall be placed on STATE freeway overpasses on which pedestrians are allowed (as directed by Sect. 92.6 of the Streets and Highways Code). All screens installed under this program will be maintained by the STATE (at STATE expense).

Exhibit "C" consists of plan drawings that delineate the pavement areas within the STATE right of way which are the responsibility of the CITY to maintain in accordance with this Agreement.

B. MAINTENANCE PROGRAM FUNCTIONS

The CITY shall perform only those maintenance functions delegated, as identified, in Section A (Delegation of Maintenance) of this Agreement.
A brief description of those maintenance functions delegated to the CITY are as follows, identified by the Caltrans HM Families (Program) codes.

HM2C SLOPES/DRAINAGE/VEGETATION

This provides for cleaning, maintaining and repairing curbs, sidewalks and other appurtenances between the roadbed and the outer highway right-of-way boundary line. It also includes weed and brush control by chemical, biological or mechanical methods, trimming and removal of trees and pest control. The following items are included:

1. Sidewalks
2. Multi-Use Trails
3. Maintenance Path

The CITY will follow the same policy and procedure generally followed by it with respect to sidewalks of the CITY in the manner of requiring repairs and control of vegetation and trees to be made by or at the expense of abutting property owners who are under legal obligation to perform such work.

HM2E LANDSCAPING

This provides for watering, fertilizing, removal and trimming of trees and shrubs and control of weeds in planted areas. Includes trimming, removal, and spraying of trees, replacement of plants, shrubs, and trees, and pest control in planted areas. The following items are included:

1. Weed control
2. Pruning/thinning/removing/replacing
3. Irrigation

HM4K ELECTRICAL

This includes maintenance work performed on highway electrical facilities including flashing beacons, traffic signals, traffic signal systems, safety lighting and sign lighting. It also includes the electrical energy for these items.

The STATE will not pay for the maintenance, installation, repair, servicing, or power for ordinary street lighting. However, lighting at intersections, which qualify as safety lighting under warrants approved/accepted by the STATE will be paid for when specifically authorized by the District Director. Where such lighting has been authorized, the maintenance and energy costs thereof shall be shared between the STATE and the CITY on a pro rata basis in the same ratio as the number of legs in the intersection under each jurisdiction bears to the total number of legs. The authorized lights are listed in Exhibit B.

C. COST SHARING OF ELECTRICAL FACILITIES

Unless a separate Electrical Facilities Cost Sharing Agreement is in force, the cost of maintaining traffic signals or other electrically operated traffic devices and safety lighting now in place or those which may hereafter be installed at the intersection of any STATE highway route and any CITY street shall be shared between the STATE and the CITY on a pro rata basis in the same ratio as the number of legs in the intersection under each jurisdiction bears to the total number of legs. The same principle of cost distribution shall apply to freeway interchanges.

Effective 12/6/2003
Revised 1/1/2010

EXHIBIT "B"

STATE and City of Livermore
In Accordance with Maintenance Agreement Effective_____

BASIS OF COST DISTRIBUTION

Maintenance and Operation of State Highway Lighting
by the City of Livermore for STATE

City to Bill State for Expenses

Route	Postmile	Intersection	Type of Facilities	Cost Distribution (%)	
				State	City
84		*Club House Drive/ Airway Blvd.	Safety Light (3)	66.67	33.33
84		*Terminal Circle	Safety Light (2)	66.67	33.33
84		Isabel Avenue ramp connector/Stanley Blvd	Signals	0	100
84		Route 84/580 Separation	Lightings	0	100

* Upon relinquishment to CITY, CITY will be responsible for 100 % of Cost Distribution, STATE share of Cost Distribution is 0 %.

FOR CONTRACT NO. 297614

CONSTRUCTION AND MAINENANCE AGREEMENT

BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
AND THE UNION PACIFIC RAILROAD COMPANY

CPUC No. 004-45.65-B
DOT No. 440-494K
DATED 3/18/2010

ROUTE: 04-Ala-84-25.5/27.1 **7/22/2011**

UPRR Folder No. 1760-77
State Agreement No. 04R371

CONSTRUCTION AND MAINTENANCE AGREEMENT

BETWEEN THE

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

AND THE

UNION PACIFIC RAILROAD COMPANY

COVERING

THE RECONSTRUCTION AND WIDENING OF THE EXISTING
SR-84 (ISABEL) UNDERPASS GRADE SEPARATION CROSSING

AT

RAILROAD MILE POST 45.73 – OAKLAND SUBDIVISION
DOT #440-494K

AT

LIVERMORE,
ALAMEDA COUNTY,
CALIFORNIA

Caltrans

State Original

State Agreement No. 04R371
CPUC No. 004-45.65-B
04- Ala-84 PM 22.9/27.1
EA 297602 (4 0000 0798 2)
DOT No. 440-494K
UPRR Folder No. 1760-77
UPRR Mile Post 45.73 - Oakland Subdivision

CONSTRUCTION AND MAINTENANCE AGREEMENT

State Route 84 Expressway Project

This Agreement ("Agreement") is entered into effective this 14 day of July, 2011 ("Effective Date"), by and between the **UNION PACIFIC RAILROAD COMPANY**, a corporation of the State of Delaware, herein called **"Railroad,"** and **STATE OF CALIFORNIA**, acting by and through its **DEPARTMENT OF TRANSPORTATION**, herein called **"State"**.

RECITALS

A. Railroad and the City of Livermore (City), a body politic and a municipal corporation of the State of California, entered into a Construction and Maintenance Agreement dated August 30, 1999 (Original Agreement), as identified in Railroad's records as its Audit No. 211570, setting forth the terms and conditions for constructing improvements on Isabel Avenue at the Railroad underpass, and for its continued associated maintenance, repair, operation, construction, and reconstruction.

B. City desired a certain portion of existing State Route 84(SR 84) in exchange for Isabel Avenue, which at that time was a local street outside the State Highway System. Through relinquishment action by State, under State and Highway Code Section 73, that certain portion of SR 84 was deeded to the City of Livermore. In exchange, the California Transportation Commission, under Streets and Highway Code Section 83, adopted Isabel Avenue into the State Highway System. City was notified of this action in a Notification Letter dated December 9, 2004, which is attached as **Exhibit B** and is made a part of this Agreement. Hereinafter, Isabel Avenue is a part of SR-84 and the State Highway System.

C. After the adoption of Isabel Avenue, State became the successor to said City's Construction and Maintenance Agreement with Railroad.

D. State and the Alameda County Transportation Commission (ACTC) now have an improvement project (Project) on the newly adopted portion SR 84, formally known as Isabel Avenue in Livermore City, Alameda County, California. A portion of Project proposes to widen SR-84 at the grade separation underpass (the **"Structure"**) near Mile Post 45.7 on Railroad's Canyon Subdivision. To support the banks in the underpass for

additional traffic lanes, new retaining walls are proposed. Proposed work is within existing easement granted by Railroad and no new easement is required.

E. The general location of the Structure is shown on the Railroad & State Location Prints collectively marked **Exhibit A**, attached hereto and hereby made part of this agreement.

F. The parties now desire to augment the Original Agreement and to set forth herein their understanding and agreement relating to the construction, reconstruction, replacement, use, maintenance and repair of the Structure.

G. The State confirms that rights granted to the State by the Railroad under the Original Agreement are sufficient to facilitate the State's improvements to SR 84 including the retaining walls.

AGREEMENT

Section 1. WORK TO BE PERFORMED BY RAILROAD

Railroad, at State's expense, shall perform: (i) design and engineering review work, and (ii) inspection. Railroad's estimated costs for performing such work are set forth in Railroad's Summary Estimate Sheet, marked **Exhibit C**, attached hereto and hereby made a part hereof (the **"Railroad Estimate"**).

Section 2. BILLING SENT BY RAILROAD TO STATE; STATE'S PAYMENT OF RAILROAD BILLS

A. Railroad shall send progressive billing to State and final billing to State within one hundred eighty (180) days after receiving written notice from State that all Project work affecting Railroad's property has been completed.

B. State agrees to pay Railroad for all actual costs and expenses incurred by Railroad in connection with the Project including, but not limited to, all actual costs of preliminary engineering review, construction, inspection, procurement of materials, equipment rental, manpower and deliveries to the job site, flagging and all direct and indirect overhead labor/construction costs. State recognizes that it can elect under 23 CFR 140.907 to reimburse Railroad for all direct and indirect overhead labor/construction costs (using Railroad's standard additive rates) and agrees to do so.

C. State agrees to pay Railroad for billings received from Railroad within forty-five (45) days of State's receipt of billing from Railroad, pursuant to the California Prompt Payment Act, Government Code Sections 927 et seq.

Section 3. RAILROAD NOT TO BEAR ANY PROJECT COSTS

The State confirms that the Railroad shall not be required to bear any Project costs nor be required to contribute any funds for the Project.

Section 4. WORK PERFORMED BY STATE

State, at its expense, shall perform all Project work including, without limitation, drainage and other applicable work, all of which shall be performed in compliance with the Plans and Minimum Requirements described and defined in Sections 6 and 11, respectively, and in a good and workmanlike manner and prosecuted diligently to conclusion.

Section 5. PLANS

A. State, at its expense, shall prepare, or cause to be prepared by others, the detailed plans and specifications for the Project and submit such plans and specifications to Railroad's Assistant Vice President Engineering - Design, or his authorized representative, for review and approval. The plans and specifications shall include all appurtenances, associated drainage, shoring, sheeting and excavations for bents and/or abutments next to or adjacent to Railroad's tracks.

B. The final project plans once they are approved in writing by the Railroad without conditions, are hereinafter referred to as the "**Plans**". The Plans are hereby made a part of this Agreement by reference.

C. No changes in the Plans shall be made unless Railroad has consented to such changes in writing.

D. Railroad's review and approval of the Plans will in no way relieve State from its responsibilities, obligations and/or liabilities under this Agreement, and will be given with the understanding that Railroad makes no representations or warranty as to the validity, accuracy, legal compliance or completeness of the Plans and that any reliance by State on the Plans is at the risk of State.

Section 6. MAINTENANCE AND REPAIR OF STRUCTURE, AND OF STREET LOCATED ON THE STRUCTURE

A. State, and/or its successors and assigns, at their expense, shall maintain, repair and renew, or cause to be maintained, repaired and renewed, the entire Structure including, the waterproofing and below, and further including, but not limited to, the superstructure, substructure, piers, abutments, walls, approaches and all backfill, retaining walls and drainage required by reason of the Structure, as well as all graffiti removal or overpainting of the Structures in a safe, clean, sturdy and sound condition.

B. The Railroad, at its expense, shall maintain and repair above the waterproofing, including, but not limited to, the rails, ties, ballast and communication and signal facilities owned by the Railroad.

C. State, and/or its successors and assigns, at their expense, shall also maintain, repair and renew SR 84 located below the Structure.

D. If any maintenance, repairs or reconstruction of the Structure require a Contractor (as defined in Section 11), to enter upon and use any portion of Railroad property, and/or if such work could jeopardize the safety of Railroad personnel and equipment beneath the Structure, such as, but not limited to, falling concrete or other debris, the State, and or its successors and assigns, shall require each Contractor to execute the Railroad's then current form of Contractor's Right of Entry Agreement and to provide to the Railroad the insurance policies, binders, certificates and endorsements that are required in the Contractor's Right of Entry Agreement prior to commencing any such work. The State, and/or its successors and assigns, shall also pay the Railroad for its use of any Railroad property for which it does not at such time already hold easement or other access rights, and for all flagging costs.

Section 7. NON-RAILROAD IMPROVEMENTS

A. Submittal of plans and specifications for protecting, encasing, reinforcing, relocating, replacing, removing, and abandoning in place all non-railroad facilities ("NR Facilities") affected by the Project including, without limitation, utilities, fiber optics, pipelines, wire lines, communication lines and fences is required under Section 5. The NR Facilities plans and specifications shall comply with Railroad's standard specifications and requirements, including, without limitation, American Railway Engineering and Maintenance-of-Way Association ("**AREMA**") standards and guidelines. Railroad has no obligation to supply additional land for NR Facilities and does not waive its right to assert preemption defenses, challenge the right-to-take, or pursue compensation in any condemnation action, regardless if the submitted NR Facilities plans and specifications comply with Railroad's standard specifications and requirements. Railroad has no obligation to permit NR Facilities to be abandoned in place or relocated on Railroad's property.

B. Upon Railroad's approval of submitted NR Facilities plans and specifications, Railroad will attempt to incorporate them into new agreements or supplements of existing agreements with NR Facilities owners or operators. Railroad may use its standard terms and conditions, including, without limitation, its standard license fee and administrative charges when requiring supplements or new agreements for NR Facilities. NR Facilities work shall not commence before a supplemental or new agreement has been fully executed by Railroad and the NR Facilities owner or operator or before Railroad and State mutually agree in writing to:

(i) deem the approved NR Facilities plans and specifications to be Plans pursuant to Section 6B,

(ii) deem the NR Facilities part of the Structure, and

(iii) supplement this Agreement with terms and conditions covering the NR Facilities.

C. In the event State requests in writing that Railroad reduce the proposed license fee or administrative charge, then Railroad agrees to execute the new agreement or amendment

for the NR Facilities containing a statement whereby Railroad acknowledges that State has paid the fee or charge for the NR Facilities owner or operator. As consideration for said acknowledgment, State and Railroad shall make a good faith effort to agree on and pay to Railroad a reasonable fair market fee or charge through either negotiation or litigation.

Section 8. NO CLAIMS BY STATE

Notwithstanding any other provisions of this Agreement, State shall not make any claim against Railroad for any damages related to any and all work delays which arise in whole or in part from accommodating or performing railroad train operations, including, without limitation, train schedule changes, and/or increased railroad train operations by Railroad.

Section 9. BOOKS AND RECORDS

The books, papers, records and accounts of Railroad, so far as they relate to the items of expense for the materials to be provided by Railroad under this Project, or are associated with the work to be performed by Railroad under this Project, shall be open to inspection and audit at Railroad's offices in Omaha, Nebraska, during normal business hours by the agents and authorized representatives of State, and the Federal Highway Administration for a period of three (3) years following the date of Railroad's last or final billing, as defined in Section 2A, sent to State.

Section 10. RAILROAD'S SPECIAL PROVISIONS AND RAILROAD'S MINIMUM REQUIREMENTS

In the event any of the work upon property of Railroad, as herein contemplated, will be advertised for bids by State, the awarded contract shall include the State's Railroad Relations and Insurance Requirements marked **Exhibit D**, attached hereto and hereby made a part hereof.

Section 11. DEFINITION OF CONTRACTOR

For purposes of this Agreement, all references in this Agreement to "Contractor" shall mean the contractor or contractors hired by State, and/or its successors and assigns, to perform any Project work on any portion of Railroad's property. The Contractor shall be responsible for the Contractor's subcontractors and the Contractor's and subcontractor's respective employees, officers and agents, and others acting under its or their authority and shall ensure their full compliance with all terms and conditions of this Agreement. Nothing in this section is intended to create rights in third parties or third party beneficiaries.

Section 12. FEDERAL AID POLICY GUIDE

The current rules, regulations and provisions of the Federal Aid Policy Guide, as contained in 23 CFR 140, subpart I and 23 CFR 646, subparts A and B are incorporated into this Agreement by reference.

Section 13. RESTRICTIONS ON COMMENCEMENT OF PROJECT WORK

A. Neither State nor any Contractor shall commence any Project work on any Railroad property until:

(i) State has obtained all necessary governmental permits, zoning clearances and approvals including, without limitation, those from the California Public Utilities Commission.

(ii) State has received approval of the Plans from the Railroad, which approval shall not be unreasonably withheld.

(iii) Railroad and State have executed the Right of Entry Agreement marked **Exhibit E**, attached hereto and the terms of which are hereby made a part hereof.

(iv) Each Contractor hired by State has executed the Contractor's Endorsement that is part of the Right of Entry Agreement.

(v) Railroad has received the insurance policies, binders, certificates and/or endorsements set forth in the Right of Entry Agreement.

B. The insurance coverage set forth in the Right of Entry Agreement shall remain in full force and effect by each Contractor during the performance of said work upon and adjacent to Railroad's property and thereafter until the Contractor removes all tools, equipment and materials from Railroad's property and cleans up the premises to a presentable condition satisfactory to Railroad.

C. State and each Contractor shall give the advance notice described in the Right of Entry Agreement to Railroad's authorized representative before commencing any Project work on Railroad's property, and shall observe Railroad's rules and regulations with respect thereto. All work on Railroad's property shall be done at such times and in such manner so as not to interfere with or endanger the operations of Railroad.

Section 14. EFFECTIVE DATE; TERM; TERMINATION

A. This Agreement is effective as of the date this Agreement is fully signed and executed by Railroad and State authorized signatories.

B. Railroad, if it so elects, may terminate this Agreement effective upon delivery of written notice to State in the event State does not commence construction on the portion of the Project located on Railroad's property within twelve (12) months from the Effective Date.

C. If the Agreement is terminated as provided above, or for any other reason, State shall pay to Railroad all actual costs and expenses incurred by Railroad in connection with the Project up to the date of termination, including, without limitation, all actual costs

incurred by Railroad in connection with reviewing any preliminary or final plans and specifications.

Section 15. FUTURE PROJECTS

In future projects, State may, at State's sole expense, alter or reconstruct the Structure if necessary or desirable ("Future Projects"), provided, however, that State shall have no right:

(i) to expand the dimensions of the Structure or

(ii) (ii) to erect false-work or other structures, temporary or permanent, or make any other use of the surface of Railroad's right-of-way other than for inspection or maintenance of the Structure as originally constructed, without obtaining Railroad's prior written consent and the execution of a supplement to this Agreement, or the completion of a separate construction and maintenance agreement, providing, without limitation, for the submission and approval of plans and specifications for such Future Project as contemplated by Section 5 of this Agreement and for a then-current standard contractor's right of entry form as contemplated by Section 6 of this Agreement. Future Projects may require additional compensation to Railroad.

Section 16. ASSIGNMENT; SUCCESSORS AND ASSIGNS

A. State shall not assign this Agreement without the prior written consent of Railroad, which consent shall not be unreasonably withheld.

B. Subject to the provisions of Section 16A, above, this Agreement shall inure to the benefit of and be binding upon the successors and assigns of Railroad and State.

Section 17. ORIGINAL AGREEMENT

This Agreement terminates and supersedes the Original Agreement and the use, maintenance and repair of the Structure shall be governed by the terms and conditions of this Agreement.

IN WITNESS WHEREOF, the parties have caused these presents to be executed in duplicate as of the Effective Date, by their officers thereunto duly authorized.

STATE OF CALIFORNIA
by and through its
DEPARTMENT OF TRANSPORTATION

By _____
DONALD E. GREBE, Chief
Office of Project Delivery
Division of Right of Way and Land Surveys

UNION PACIFIC RAILROAD COMPANY

By _____
PAUL G. FARRELL
Senior Manager Contracts

APPROVED AS TO FORM AND PROCEDURES:

By _____
ROGER FORMANEK, Attorney
Department of Transportation

APPROVAL RECOMMENDED

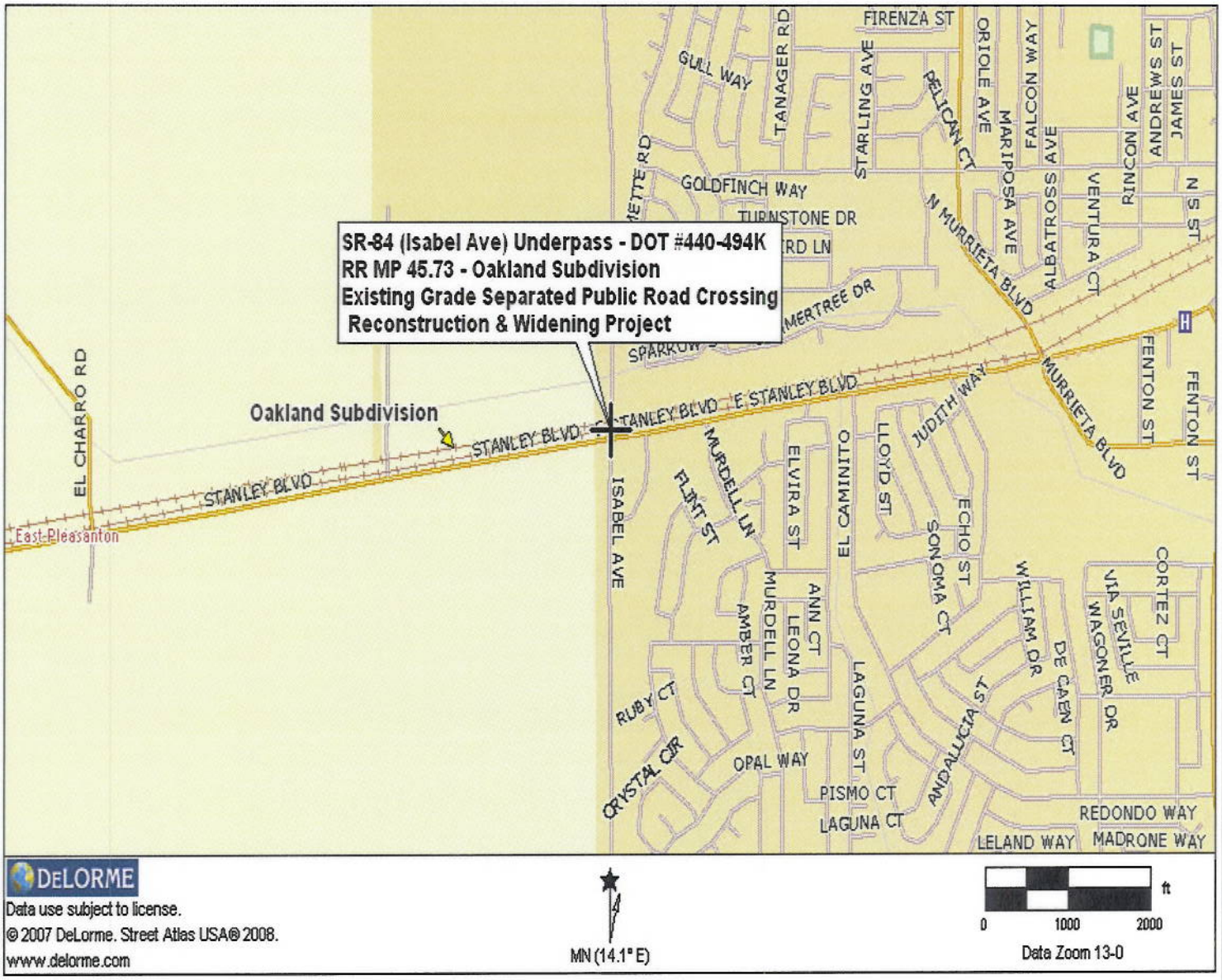
By _____
DENNY FONG, P.E.
Railroad Agreements Engineer

EXHIBIT A

To Construction and Maintenance Agreement

Cover Sheet for the
Railroad & State Location Prints

RAILROAD LOCATION PRINT
OF AN EXISTING GRADE SEPARATED PUBLIC ROAD CROSSING RECONSTRUCTION & WIDENING PROJECT



RAILROAD WORK TO BE PERFORMED:

1. Engineering Design Review.

EXHIBIT "A"

UNION PACIFIC RAILROAD COMPANY

OAKLAND SUBDIVISION
MILE POST 45.73
GPS: N 37° 40.5888', W 121° 48.3191'
LIVERMORE, ALAMEDA CO., CA.

Railroad Location Print of an existing grade separated public road crossing reconstruction & widening project with the

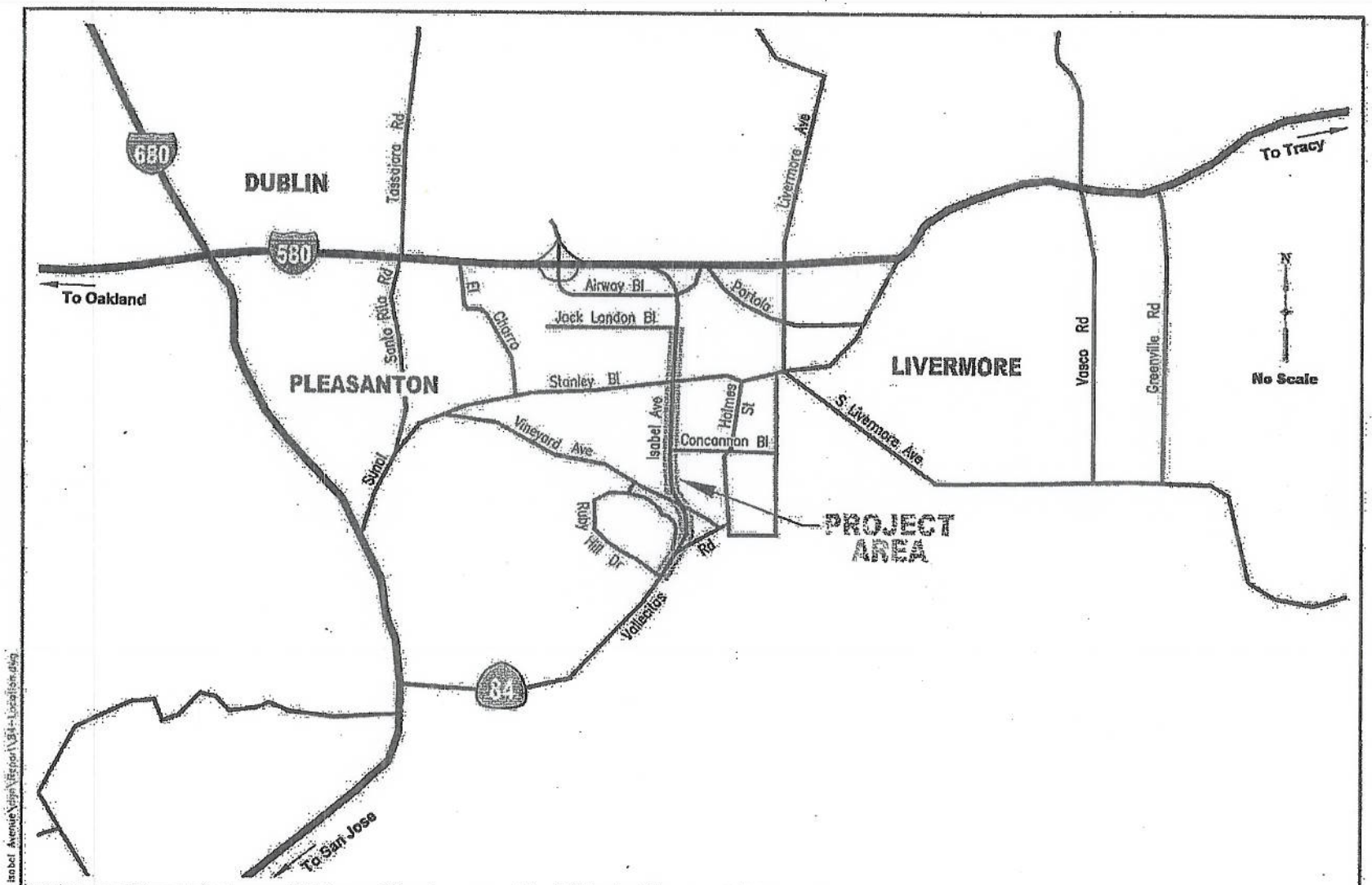
CALIFORNIA DEPARTMENT OF TRANSPORTATION.

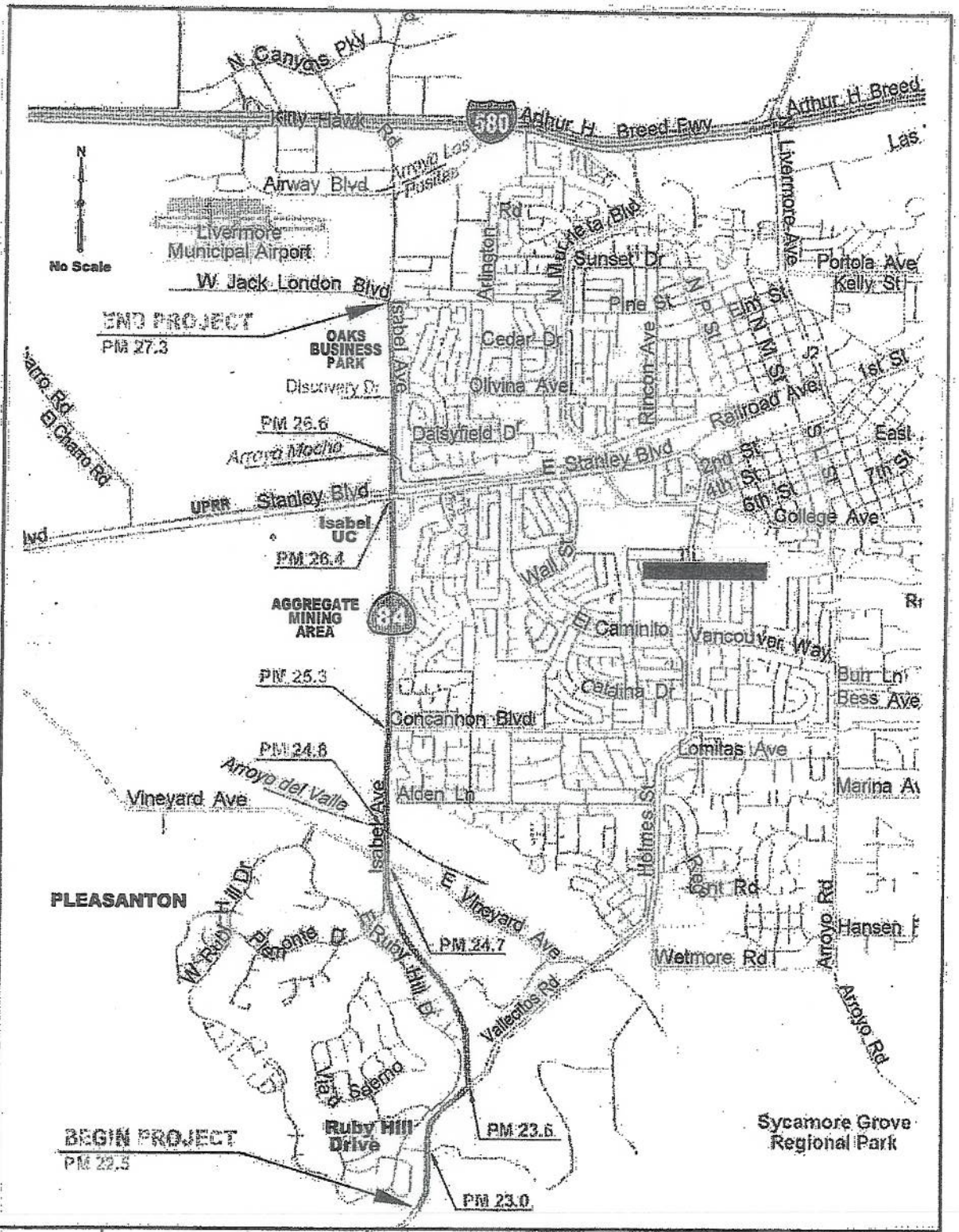
Folder No. 1760-77 Date: March 28, 2011

WARNING

IN ALL OCCASIONS, U.P. COMMUNICATIONS DEPARTMENT MUST BE CONTACTED IN ADVANCE OF ANY WORK TO DETERMINE EXISTENCE AND LOCATION OF FIBER OPTIC CABLE.
PHONE: 1-(800) 336-9193

EXHIBIT A


680
DUBLIN
Tassajara Rd
580
To Oakland
Santa Rita Rd
El Charro
Airway Bl
Jack London Bl
Portola
Livermore Ave
To Tracy
LIVERMORE
Vasco Rd
Greenville Rd
N
No Scale
PLEASANTON
Stanley Bl
Vineyard Ave
Isabel Ave
Holmes St
Concannon Bl
S. Livermore Ave
Sunol
Ruby Hill Dr
PROJECT AREA
Vallecitos Rd
84
To San Jose
X:\Route 84 - Isabel Avenue\Align\Report\84-Location.dwg
URS
ROUTE 84
EXPRESSWAY WIDENING
ALA 84 - PM 22.5 / 27.3
04 - 297600
SITE LOCATION MAP
September 2005
Figure
1



X:\Route 84 - Isabel Avenue\Work\Report\84-Vicinity.dwg

URS	ROUTE 84 EXPRESSWAY WIDENING ALA 84 - PM 22.5 / 27.3 04 - 297600	VICINITY MAP	September 2005 Figure 2

EXHIBIT B

To Construction and Maintenance Agreement

Cover Sheet for the
Notification Letter

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY 58290 ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF TRANSPORTATION
111 GRAND AVENUE
P. O. BOX 23360
OAKLAND, CA 94612
IONE (510) 286-5295
AX (510) 622-5466
TTY (800) 735-2929

ENTERED ON R/W MAP
BY DZC 11-30-05
DATE

Flex your power!
Be energy efficient!

December 9, 2004

SEE MAP NO. R-60
SHEET R-10315.1A

Ms. Cheri Sheets
City Engineer
City of Livermore
1052 South Livermore Ave.
Livermore, CA 94550

ADOPTION OF ISABEL AVENUE IN THE CITY OF LIVERMORE AS SEGMENT OF STATE ROUTE 84 - SECTION 83 RIGHT OF WAY ACQUISITION

Dear Ms. Sheets:

Isabel Avenue in the City of Livermore was improved by the City of Livermore and adopted as a segment of Route 84 by the State Department of Transportation.

The Department has reviewed the project's right of way needs and has identified a portion of the right of way along the project that requires transfer to the State by application of Section 83.

Please be advised that under the authority of Section 83 of California Streets and Highway Code, the identified portion of the project on the attached Section 83 Plat is hereby included in the State operating right of way for State Rout 84.

If you have any questions or need further information, please call me at (510) 286-5295 or Nestor Perez, District Branch Chief, at (510) 286-5633.

Sincerely,

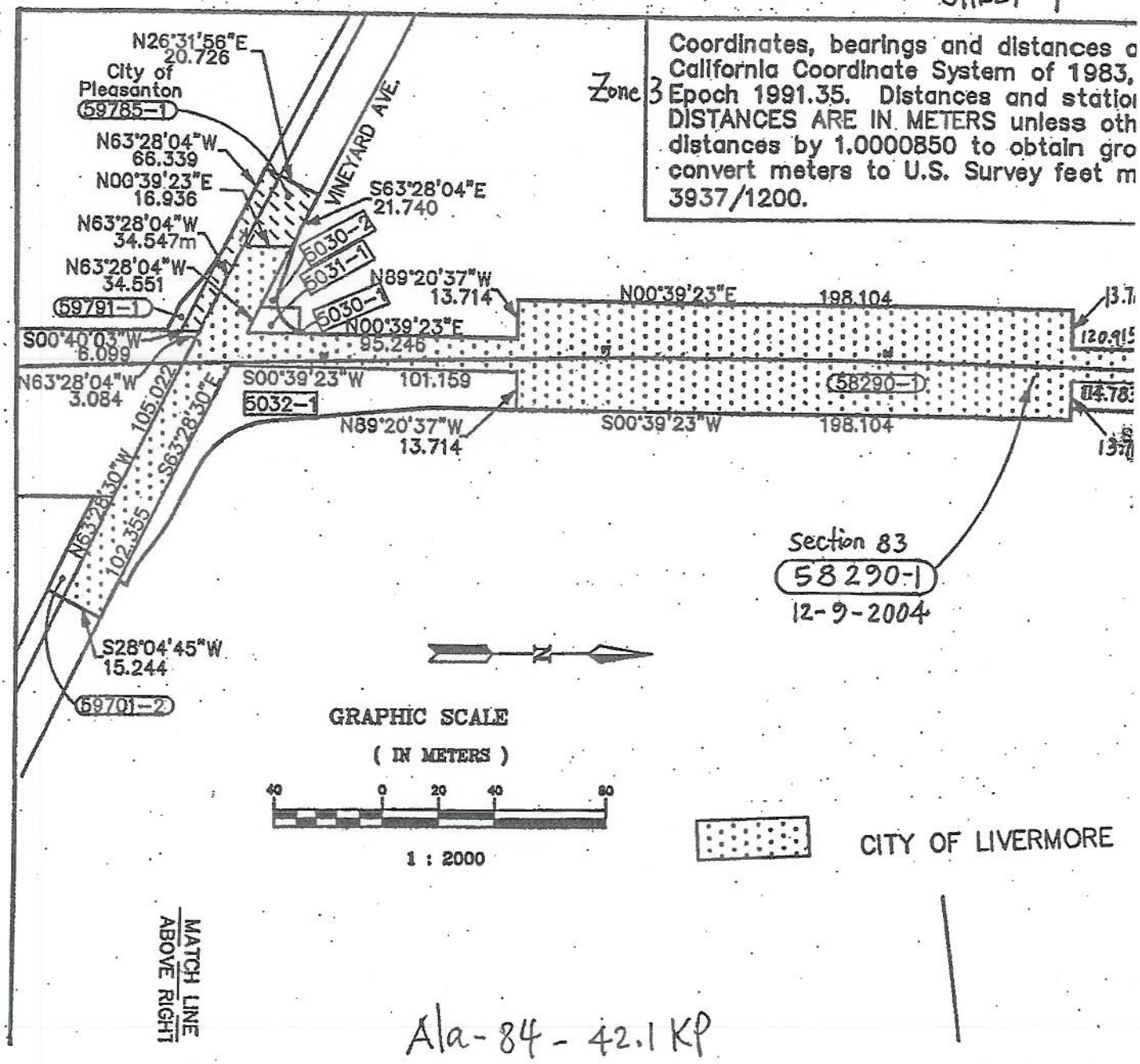
RONALD TSUNG
District Office Chief
Office of Design Alameda II

Attachments

c: Ken Ross - Engineering Division, City of Livermore, w/o attachments

EXHIBIT B

SHEET 1



Ala-84-42.1 KP

EXHIBIT B

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level distances. To
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SHEET 2

CITY

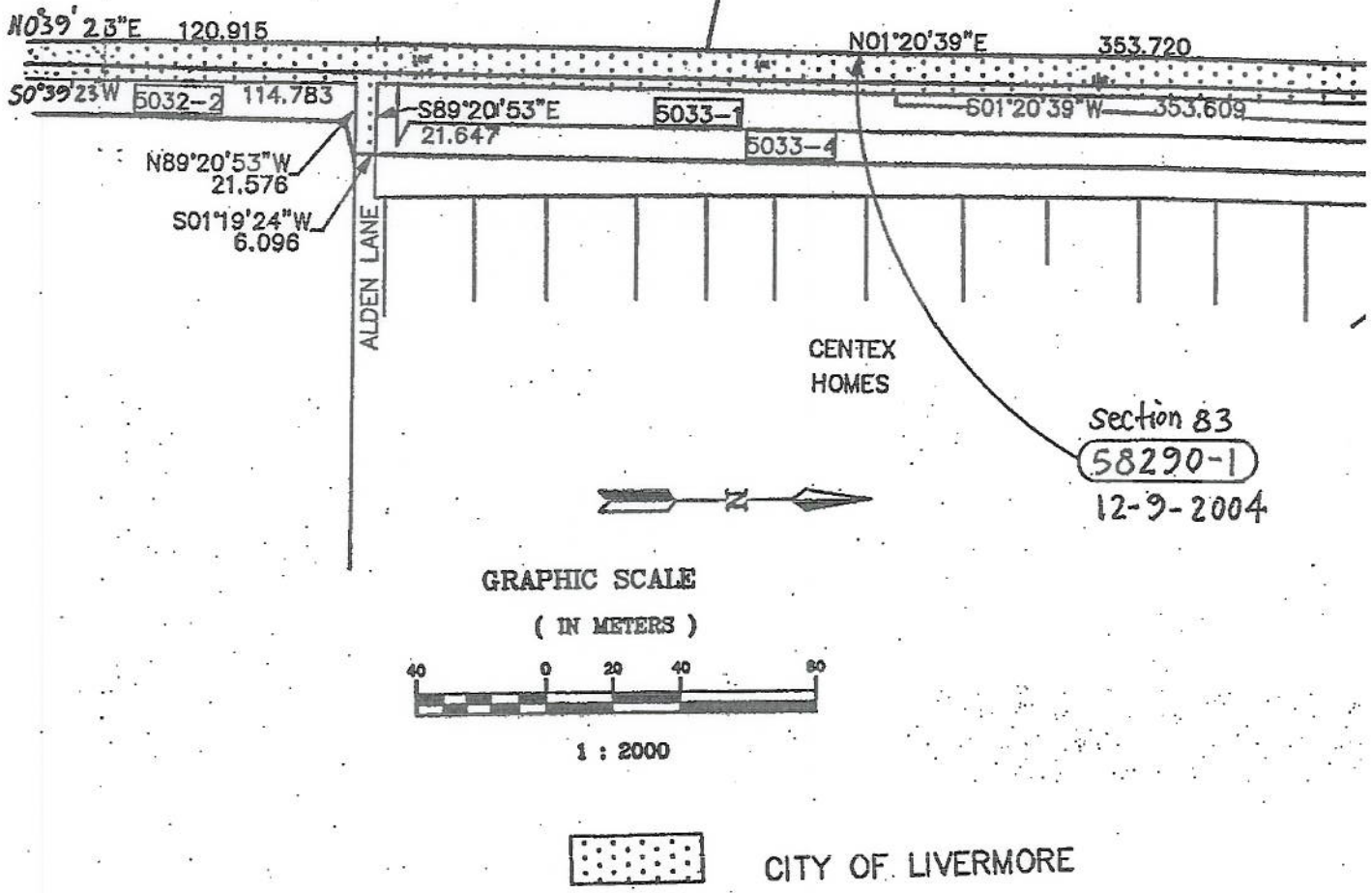


EXHIBIT B

SHEET 3

LIVERMORE

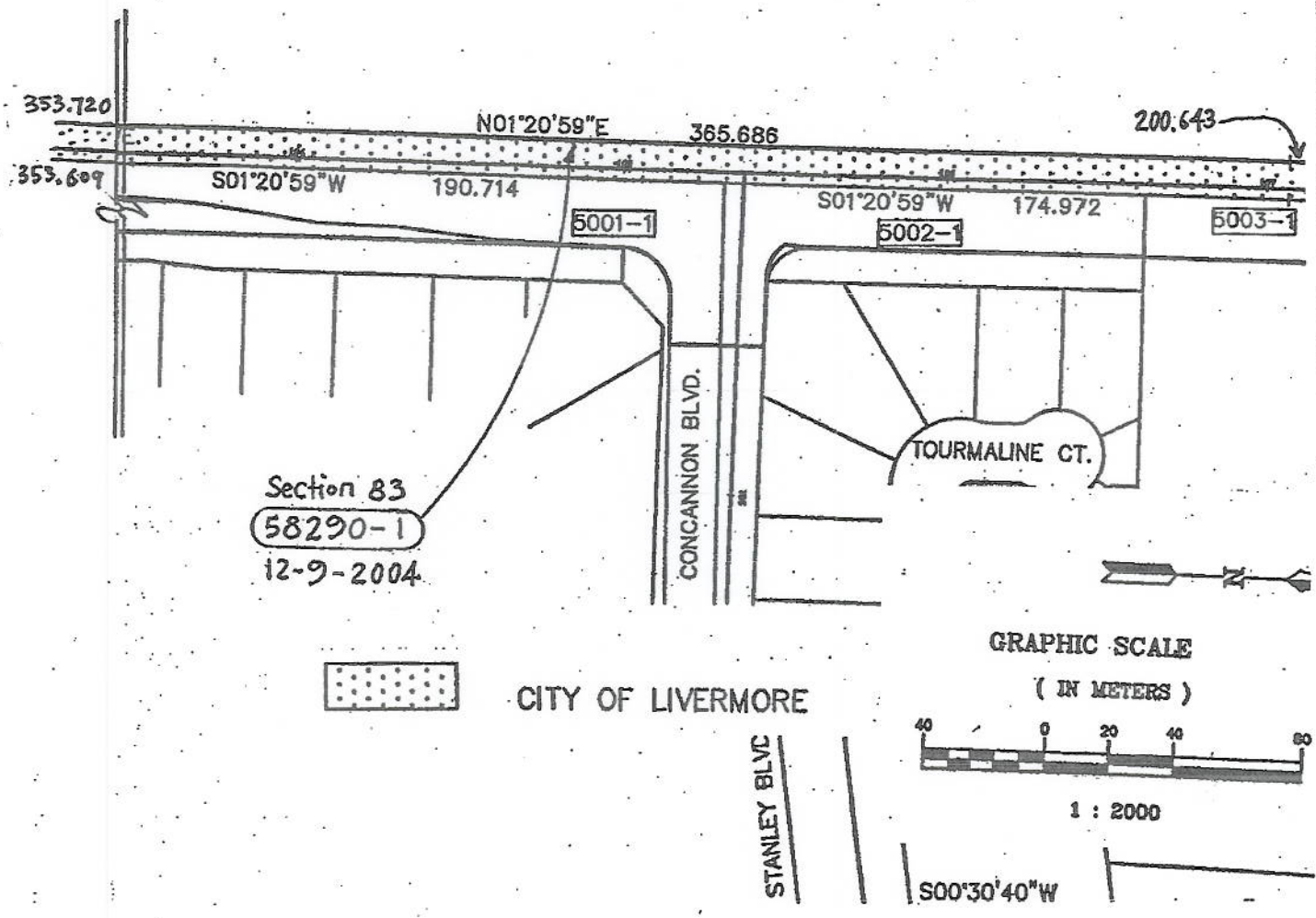
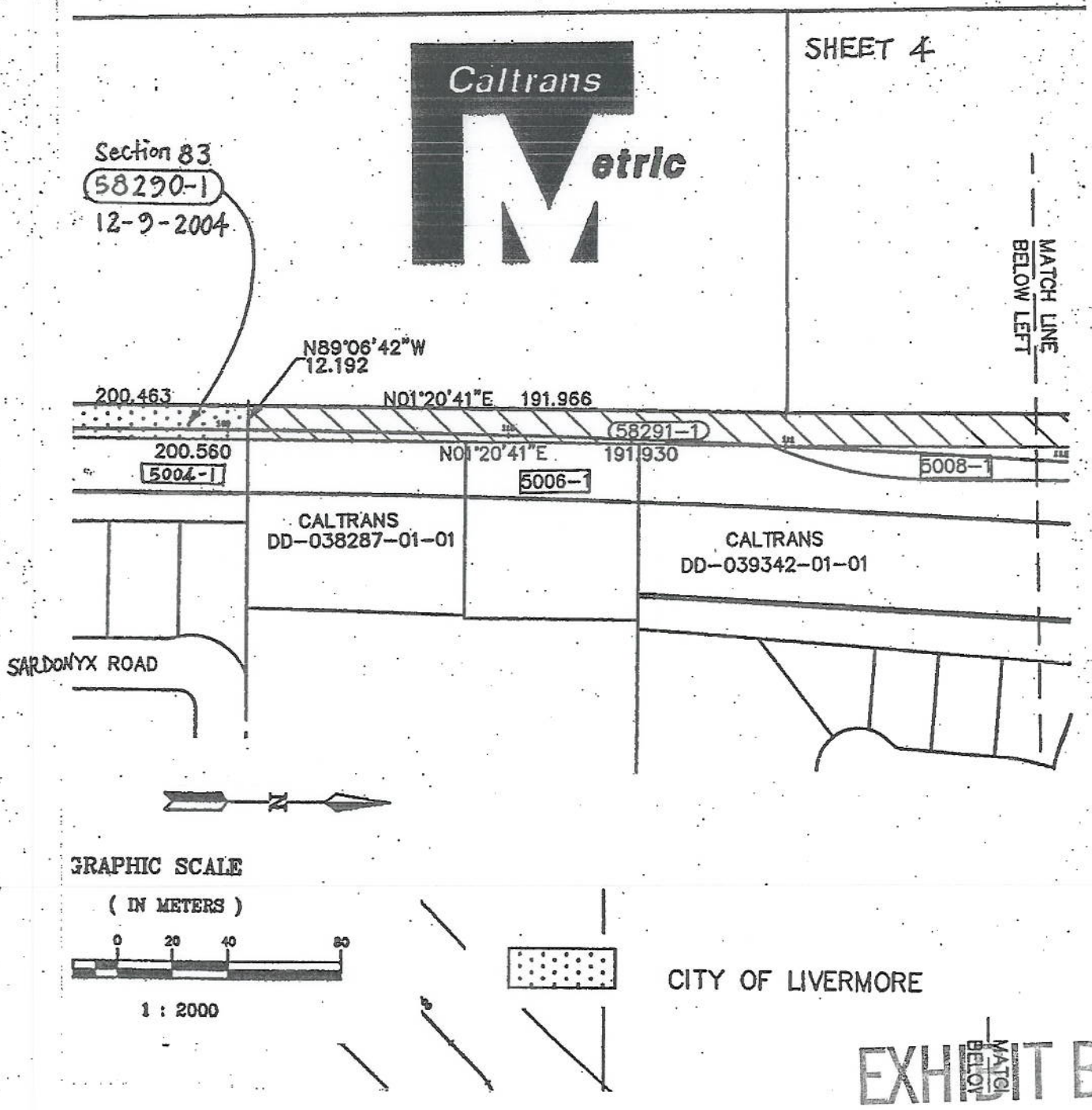


EXHIBIT B


SHEET 4
Caltrans
Metric
Section 83
58290-1
12-9-2004
MATCH LINE BELOW LEFT
N89°06'42"W
12.192
200.463
N01°20'41"E 191.966
58291-1
200.560
5004-1
N01°20'41"E 191.930
5006-1
5008-1
CALTRANS
DD-038287-01-01
CALTRANS
DD-039342-01-01
SARDONYX ROAD
N
GRAPHIC SCALE
(IN METERS)
0 20 40 80
1 : 2000
CITY OF LIVERMORE
MATCH BELOW
EXHIBIT B

SHEET 5

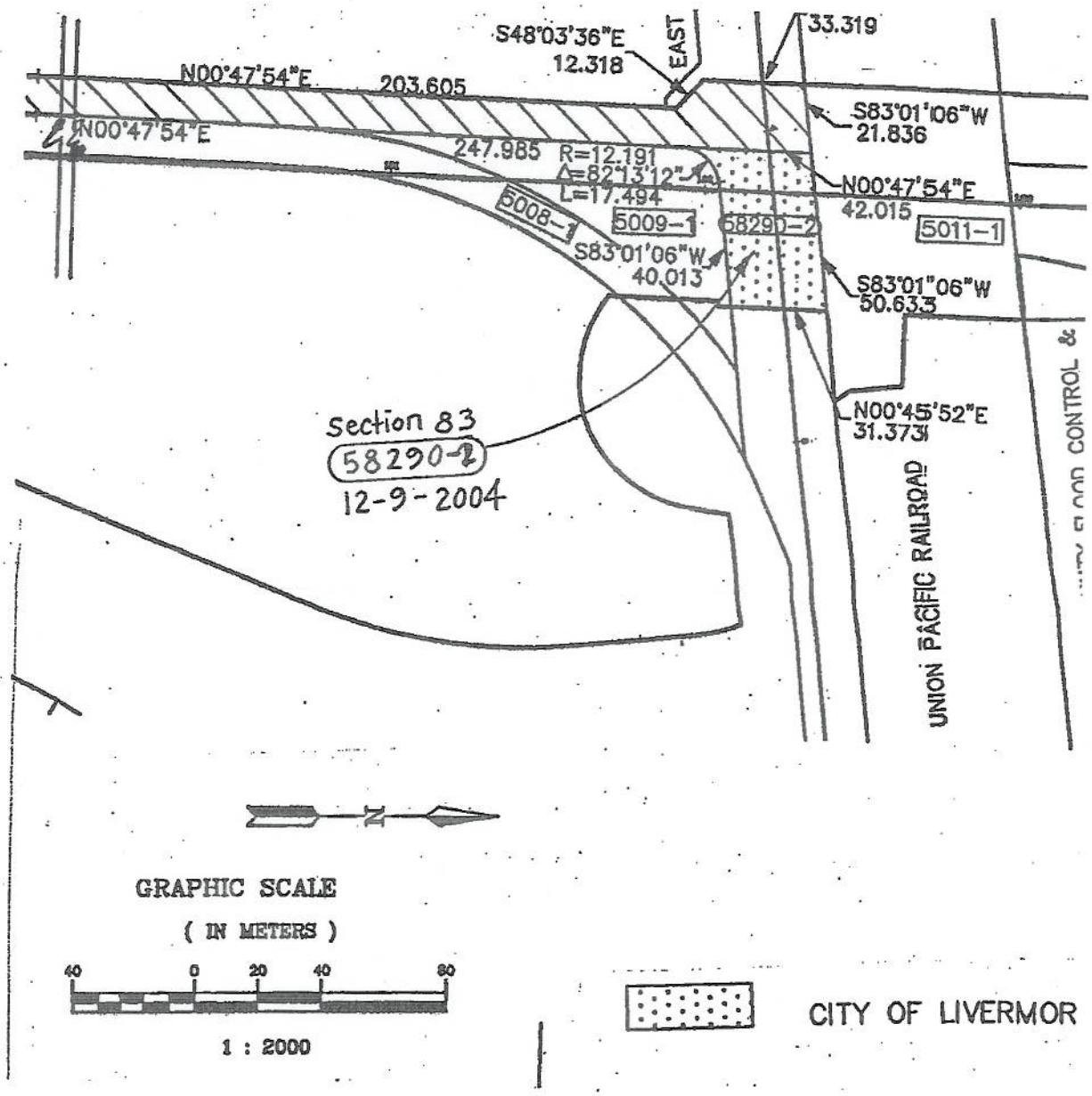


EXHIBIT B

EXHIBIT C

To Construction and Maintenance Agreement

Cover Sheet for the Railroad's Summary Estimate

EXHIBIT C

RAILROAD'S SUMMARY ESTIMATE

TO CONSTRUCTION & MAINTENANCE AGREEMENT

DESCRIPTION OF WORK:

Perform engineering review for the California Department of Transportation for the reconstruction and widening of the existing SR-84 (Isabel Avenue) Underpass grade separated public road crossing, (USDOT #440-494K), at Railroad Mile Post 45.73 on the Oakland Subdivision in Livermore, Alameda County, California.

LOCATION: Livermore, Alameda County, California DATE: January 14, 2011

DESCRIPTION	LABOR	MATERIAL	AUTHORITY TOTAL
ENGINEERING WORK	$5,000.00		$5,000.00
Contingency (10%)	$500.00		$500.00
TOTAL PROJECT	$5,500.00		$5,500.00
TOTAL ESTIMATED COST OF PROJECT LESS CREDITS			**$5,500.00**

THE ABOVE FIGURES ARE ESTIMATES ONLY AND SUBJECT TO FLUCTUATION. IN THE EVENT OF AN INCREASE OR DECREASE IN THE COST OF AMOUNT OF MATERIAL OR LABOR REQUIRED, THE AUTHORITY WILL BE BILLED FOR ACTUAL COST AT THE CURRENT RATES EFFECTIVE THEREOF.

EXHIBIT D

To Construction and Maintenance Agreement

Cover Sheet for the
State's Railroad Relations & Insurance
Requirements

EXHIBIT D

TO CONSTRUCTION & MAINTENANCE AGREEMENT

SECTION 13: RAILROAD RELATIONS AND INSURANCE REQUIREMENTS

13-1.01 GENERAL

The term "Railroad" shall mean the Union Pacific Railroad Company.

It is expected that the Railroad will cooperate with the Contractor to the end that the work may be handled in an efficient manner. However, except for the additional compensation provided for hereinafter for delays in completion of specific unit of work to be performed by the Railroad, and except as provided in Public Contracts Code Section 7102, the Contractor shall have no claim for damages, extension of time, or extra compensation in the event his work is held up by railroad train operations or other work performed by the Railroad.

The Contractor must understand the Contractor's right to enter the Railroad's property is subject to the absolute right of the Railroad to cause the Contractor's work on the Railroad's property to cease if, in the opinion of the Railroad, the Contractor's activities create a hazard to the Railroad's property, employees, and operations.

The Contractor acknowledges its receipt from the State of a copy of the Contractor's Right of Entry Agreement that has been executed by the Railroad and the State. The Contractor agrees to execute and deliver to the Railroad the Contractor's Endorsement that is attached hereto as Appendix 1 and to provide to the State and/or the Railroad all insurance policies, binders, certificates or endorsements that are set forth in Exhibit B of the Contractor's Right of Entry Agreement.

13-1.02 RAILROAD REQUIREMENTS

The Contractor shall provide to Railroad's Senior Manager, Industry and Public Projects, 9451 Atkinson Street, Roseville, California 95747, and the Engineer, in writing, the advance notice requirements set forth in Section 1 of **Exhibit A** of the Right of Entry Agreement before performing any work on, or adjacent to the property or tracks of the Railroad.

The Contractor shall cooperate with the Railroad where work is over or under the tracks, or within the limits of the Railroad property to expedite the work and avoid interference with the operation of railroad equipment.

The Contractor shall comply with the rules and regulations of the Railroad or the instructions of its representatives in relation to protecting the tracks and property of the Railroad and the traffic moving on such tracks, as well as the wires, signals and other property of the Railroad, its tenants or licensees, at and in the vicinity of the work during the period of construction. The responsibility of the Contractor for safe conduct and adequate policing and supervision of its work at the job site shall not be lessened or otherwise affected by the presence at the work site of the Railroad representatives, or by the Contractor's compliance with any requests or recommendations made by the Railroad representatives.

The Contractor shall perform work so as not to endanger or interfere with the safe operation of the tracks and property of the Railroad and traffic moving on such tracks, as well as wires, signals and other property of the Railroad, its tenants or licensees, at or in the vicinity of the work.

The Contractor shall take protective measures to keep the Railroad facilities, including track ballast, free of sand or debris resulting from his operations. Damage to the Railroad facilities resulting from the Contractor's operations will be repaired or replaced by the Railroad and the cost of such repairs or replacement shall be deducted from the Contractor's progress and final pay estimates.

The Contractor shall contact the Railroad's "Call Before You Dig" at least forty-eight (48) hours prior to commencing work, at 1-800-336-9193 during normal business hours (7:00 a.m. to 9:00 p.m. Central Time, Monday through Friday, except holidays – also a 24-hour, 7-day number for emergency calls) to determine location of fiber optics. If a telecommunications system is buried anywhere on or near the Railroad property, the Contractor will coordinate with the Railroad and the Telecommunication Company(ies) to arrange for relocation or other protection of the system prior to beginning any work on or near Railroad property.

The Contractor shall not pile or store any materials nor park any equipment closer than 25'-0" to the centerline of the nearest track, unless directed by the Railroad's representative.

The Contractor shall also abide by the following temporary clearances during the course of construction:

- 3.66 meter (12'-0") horizontally from centerline of track
- 6.40 meter (21'-0") vertically above top of rail

The temporary vertical construction clearance above provided will not be permitted until authorized by the Public Utilities Commission. It is anticipated that authorization will be received not later than fifteen (15) days after the approval of the contract. In the event authorization is not received by the time specified, and, if in the opinion of the Engineer, the Contractor's operations are delayed or interfered with by reason of authorization not being received by the said time, the Licensee will compensate the Contractor for such delay to the extent provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications and not otherwise.

Walkways with railing shall be constructed by the Contractor over open excavation areas when in close proximity of tracks, and railings shall not be closer than 2.60-meter (8'-6") horizontally from centerline of the nearest track, if tangent, or 2.90-meter (9'-6") if curved.

Infringement on the above temporary construction clearances by the Contractor's operations shall be submitted to the Railroad by the Engineer, and shall not be undertaken until approved by the Railroad, and until the Engineer has obtained any necessary authorization from any governmental body or bodies having jurisdiction thereover. No extension of time or extra compensation will be allowed in the event the Contractor's work is delayed pending Railroad approval and governmental authorization.

When the temporary vertical clearance is less than 6.86-meter (22'-6") above top of rail, the Railroad shall have the option of installing tell-tales or other protective devices the Railroad deems necessary for protection of the Railroad trainmen or rail traffic.

Four (4) sets of plans, in 279mm x 432mm (11" x 17") format, and two (2) sets of calculations showing details of construction affecting the Railroad's tracks and property not included in the contract plans, including but not limited to shoring and falsework, shall be submitted to the Engineer for review prior to submittal to the Railroad for final approval. Falsework shall comply with the Railroad guidelines. Demolition of existing structures shall comply with the Railroad guidelines. Shoring shall be designed in accordance with the Railroad's shoring requirement of Drawing No. 106613 and guidelines for shoring and falsework, latest edition, issued by the Railroad's Office of Chief Engineer. Shoring and falsework plans and calculations shall be prepared and signed by a professional engineer registered in California. This work shall not be undertaken until such time as the Railroad has given such approval, review by the Railroad may take up to six (6) weeks after receipt of necessary information.

The Contractor shall notify the Engineer in writing, at least twenty-five (25) calendar days but not more than forty (40) days in advance of the starting date of installing temporary work with less than permanent clearance at each structure site. The Contractor shall not be permitted to proceed with work across railroad tracks until this requirement has been met. No extension of time or extra compensation will be allowed if the Contractor's work is delayed due to failure to comply with the requirements in this paragraph.

Blasting will be permitted only when approved by the Railroad.

The Contractor shall, upon completion of the work covered by this Contract to be performed by the Contractor upon the premises or over or beneath the tracks of the Railroad, promptly remove from the premises of the Railroad, the Contractor's tools, implements and other materials, whether brought upon said premises and cause said premises to be left in a clean and presentable condition.

Under track pipeline installations shall be constructed in accordance with the Railroad's current standards which may be obtained from the Railroad. The general guidelines are as follows:

Edges of jacking or boring pit excavations shall be a minimum of 6.10-meter (20 feet) from the centerline of the nearest track.

If the pipe to be installed under the track is 100mm (4 inches) in diameter or less, the top of the pipe shall be at least 42 inches below base of rail.

If the pipe diameter is greater than 100-meter (4 inches) in diameter, it shall be encased and the top of the steel pipe casing shall be at least1.60-meter (66 inches) below base of rail.

Installation of pipe or conduit under the Railroad's tracks shall be done by dry bore and jack method.

Hydraulic jacking or boring will not be permitted.

Safety of personnel, property, rail operations and the public is of paramount importance. As reinforcement and in furtherance of overall safety measures to be observed by the Contractor (and not by way of limitation), the following special safety rules shall be followed:

(a) The Contractor shall keep the job site free from safety and health hazards and ensure that its employees are competent and adequately trained in all safety and health aspects of the job. The Contractor shall have proper first aid supplies available on the job site so that prompt first aid services can be provided to any person that may be injured on the job site. The Contractor shall promptly notify the Railroad of any U.S. Occupational Safety and Health Administration reportable injuries occurring to any person that may arise during the work performed on the job site. The Contractor shall have a non-delegable duty to control its employees while they are on the job site or any other property of the Railroad to be certain they do not use, be under the influence of, or have in their possession any alcoholic beverage, drug, narcotic or other substance that may inhibit the safe performance of work by the employee.

(b) The employees of the Contractor shall be suitably dressed to perform their duties safely and in a manner that will not interfere with their vision, hearing or free use of their hands or feet. Only waist length shirts with sleeves and trousers that cover the entire leg are to be worn. If flare-legged trousers are worn, the trouser bottoms must be tied to prevent catching. The employees should wear sturdy and protective work boots and at least the following protective equipment:

(1) Protective head gear that meets American National Standard-Z89.l-latest revision. It is suggested that all hardhats be affixed with the Contractor's or the subcontractor's company logo or name.

(2) Eye protection that meets American National Standard for occupational and educational eye and face protection, Z87.1-latest revision. Additional eye protection must be provided to meet specific job situations such as welding, grinding, burning, etc.; and

(3) Hearing protection which affords enough attenuation to give protection from noise levels that will be occurring on the job site.

(c) All heavy equipment provided or leased by the Contractor shall be equipped with audible back-up warning devices. If in the opinion of the Railroad Representative any of the Contractor's or the subcontractor's equipment is unsafe for use on the Railroad's right-of-way, the Contractor, at the request of the Railroad representative, shall remove such equipment from the Railroad's right-of-way.

13-1.03 PROTECTION OF RAILROAD FACILITIES

Upon the advance notification provided to the Railroad as set forth in Section 1 of Exhibit A of the Contractor's Right of Entry Agreement, the Railroad representatives, conductors, flagmen or watchmen will be provided by the Railroad to protect its facilities, property and movements of its trains or engines. Notice shall be made to the Railroad's Manager of Track Maintenance at (402) 501-3774. At the time of notification, the Contractor shall provide the Railroad with a schedule of dates that flagging services will be needed, as well as times, if outside normal working hours. Subsequent deviation from the schedule shall require ten (10) working days' advance notice from the first affected date. The Railroad will furnish such personnel or other protective devices:

(a) When equipment is standing or being operated within 25 feet, measured horizontally, from centerline of any track on which trains may operate, or when any erection or construction activities are in progress within such limits, regardless of elevation above or below track.

(b) For any excavation below elevation of track subgrade if, in the opinion of the Railroad's representative, track or other Railroad facilities may be subject to settlement or movement.

(c) During any clearing, grubbing, grading or blasting in proximity to the Railroad which, in the opinion of the Railroad's representative, may endanger the Railroad facilities or operations.

(d) During any of the Contractor's operations when, in the opinion of the Railroad's representatives, the Railroad facilities, including, but not limited to, tracks, buildings, signals, wire lines or pipe lines, may be endangered.

The cost of flagging and inspection provided by the Railroad during the period of constructing that portion of the project located on or near the Railroad property, as deemed necessary for the protection of the Railroad's facilities and trains, will be borne by the State. The Railroad has indicated that its estimated flagging rate will be around One Thousand Dollars ($1,000.00) per day and that the State has estimated a total of two hundred (200) days of flagging. The State shall pay the Railroad for all actual flagging costs incurred by the Railroad under this Project.

13-1.04 WORK BY RAILROAD

The following work by the Railroad will be performed by Railroad forces and is not a part of the work under this Contract.

(a) The Railroad will perform preliminary engineering and inspection (if any) and flagging as specified in Section 13-1.03 "Protection of Railroad Facilities," of these special provisions.

(b) Temporary crossings at grade over tracks of Railroad for the purpose of hauling earth, rock, paving or other materials will not be permitted. If the Contractor, for the purpose of constructing highway-railway grade separation structures, including construction ramps thereto, desires to move equipment or materials across Railroad's tracks, the Contractor shall first obtain permission from Railroad via the State Engineer. Should Railroad approve the temporary crossing, State shall execute a Service Contract with Railroad for Railroad to construct the temporary crossing. Under the Service Contract, State shall bear the cost of the crossing surface, warning devices and other components that might be required. Notwithstanding State's Service Contract with Railroad, the Contractor is required to execute Railroad's form of Contractor's Haul Road Crossing Agreement. Railroad, at State's expense, shall provide flagmen to control movements of vehicles across the temporary crossing. State and its Contractor shall prevent the use of such temporary crossing by unauthorized persons and vehicles.

13-1.05 DELAYS DUE TO WORK BY RAILROAD.

If delays due to work by the Railroad occur, and the Contractor sustains loss which, in the opinion of the Engineer, could not have been avoided by the judicious handling of forces, equipment and plant, the amount of said loss shall be determined as provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

If a delay due to work by the Railroad occurs, an extension of time determined pursuant to the provisions in Section 8-1.07, "Liquidated Damages," of the Standard Specifications will be granted.

13-1.06 LEGAL RELATIONS

The provisions of Section 13-1, "Relations with Railroad Company," and the provisions of Section 13-2, "Railroad Protective Insurance," of these special provisions shall inure directly to the benefit of the Railroad.

13-2 RAILROAD PROTECTIVE INSURANCE

In addition to any other form of insurance or bonds required under the terms of the contract and specifications, the Contractor will be required to carry insurance of the kinds and in the amounts hereinafter specified.

Such insurance shall be approved by the Railroad before any work is performed on the Railroad's property and shall be carried until all work required to be performed on or adjacent to the Railroad's property under the terms of the contract is satisfactorily completed as determined by the Engineer, and thereafter until all tools, equipment and materials have been removed from the Railroad's property and such property is left in a clean and presentable condition.

Full compensation for all premiums which the Contractor is required to pay on all the insurance described hereinafter shall be considered as included in the prices paid for the various items of work to be performed under the contract, and no additional allowance will be made thereof or for additional premiums which may be required by extensions of the policies of insurance.

The following insurance coverage will be required:

A. **Commercial General Liability** insurance. Commercial general liability (CGL) with a limit of not less than $5,000,000 each occurrence and an aggregate limit of not less than $10,000,000. CGL insurance must be written on ISO occurrence form CG 00 01 12 04 (or a substitute form providing equivalent coverage).

The policy must also contain the following endorsement, which must be stated on the certificate of insurance:

- Contractual Liability Railroads ISO form CG 24 17 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Railroad Company Property" as the Designated Job Site.

B. **Business Automobile Coverage** insurance. Business auto coverage written on ISO form CA 00 01 (or a substitute form providing equivalent liability coverage) with a combined single limit of not less $5,000,000 for each accident.

The policy must contain the following endorsements, which must be stated on the certificate of insurance:

- Coverage For Certain Operations In Connection With Railroads ISO form CA 20 70 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Property" as the Designated Job Site.
- Motor Carrier Act Endorsement - Hazardous materials clean up (MCS-90) if required by law.

C. **Workers' Compensation and Employers' Liability** insurance. Coverage must include but not be limited to:

- Contractor's statutory liability under the workers' compensation laws of the State of California.
- Employers' Liability (Part B) with limits of at least $500,000 each accident, $500,000 disease policy limit $500,000 each employee.

If Contractor is self-insured, evidence of state approval and excess workers compensation coverage must be provided. Coverage must include liability arising out of the U. S. Longshoremen's and Harbor Workers' Act, the Jones Act, and the Outer Continental Shelf Land Act, if applicable.

The policy must contain the following endorsement, which must be stated on the certificate of insurance:

- Alternate Employer endorsement ISO form WC 00 03 01 A (or a substitute form providing equivalent coverage) showing Railroad in the schedule as the alternate employer (or a substitute form providing equivalent coverage).

D. **Railroad Protective Liability** insurance. Contractor must maintain Railroad Protective Liability insurance written on ISO occurrence form CG 00 35 12 04 (or a substitute form providing equivalent coverage) on behalf of Railroad as named insured, with a limit of not less than $2,000,000 per occurrence and an aggregate of $6,000,000. A binder stating the policy is in place must be submitted to Railroad before the work may be commenced and until the original policy is forwarded to Railroad.

E. **Umbrella or Excess** insurance. If Contractor utilizes umbrella or excess policies, these policies must "follow form" and afford no less coverage than the primary policy.

F. **Pollution Liability** insurance. Pollution liability coverage must be written on ISO form Pollution Liability Coverage Form Designated Sites CG 00 39 12 04 (or a substitute form providing equivalent liability coverage), with limits of at least $5,000,000 per occurrence and an aggregate limit of $10,000,000.

If the scope of work as defined in this Agreement includes the disposal of any hazardous or non-hazardous materials from the job site, Contractor must furnish to Railroad evidence of pollution legal liability insurance maintained by the disposal site operator for losses arising from the insured facility accepting the materials, with coverage in minimum amounts of $1,000,000 per loss, and an annual aggregate of $2,000,000.

Other Requirements

G. All policy(ies) required above (except worker's compensation and employers liability) must include Railroad as "Additional Insured" using ISO Additional Insured Endorsements CG 20 26, and CA 20 48 (or substitute forms providing equivalent coverage). The coverage provided to Railroad as additional insured shall, to the extent provided under ISO Additional Insured Endorsement CG 20 26, and CA 20 48 provide coverage for Railroad's negligence whether sole or partial, active or passive, and shall not be limited by Contractor's liability under the indemnity provisions of this Agreement.

H. Punitive damages exclusion, if any, must be deleted (and the deletion indicated on the certificate of insurance), unless the law governing this Agreement prohibits all punitive damages that might arise under this Agreement.

I. Contractor waives all rights of recovery, and its insurers also waive all rights of subrogation of damages against Railroad and its agents, officers, directors and employees. This waiver must be stated on the certificate of insurance.

J. Prior to commencing the work, Contractor shall furnish Railroad with a certificate(s) of insurance, executed by a duly authorized representative of each insurer, showing compliance with the insurance requirements in this Agreement.

K. All insurance policies must be written by a reputable insurance company acceptable to Railroad or with a current Best's Insurance Guide Rating of A- and Class VII or better, and authorized to do business in the State of California.

L. The fact that insurance is obtained by Contractor or by Railroad on behalf of Contractor will not be deemed to release or diminish the liability of Contractor, including, without limitation, liability under the indemnity provisions of this Agreement. Damages recoverable by Railroad from Contractor or any third party will not be limited by the amount of the required insurance coverage.

APPENDIX 1

TO SECTION 13: RAILROAD RELATIONS AND INSURANCE REQUIREMENTS

CONTRACTOR'S ENDORSEMENT

A. As a condition to entering upon the Railroad's right-of-way to perform Work pursuant to this agreement, State's contractor, _____
(Name of Contractor)
whose address is _____,
(Contractor's Mailing Address)
(hereinafter "Contractor"), agrees to comply with and be bound by all the terms and provisions of the attached Caltrans Right of Entry Agreement that was signed by Union Pacific Railroad Company ("Railroad") and the State of California, Department of Transportation ("State") relating to the Work to be performed and the insurance requirements set forth in Exhibit B of the Right of Entry Agreement. The Contractor further acknowledges and agrees that the reference to Cal. Gov. Code §14662.5 in Sections 5.b) and 8.b) of Exhibit A to the Right of Entry Agreement does not apply to the Contractor and in no way limits the indemnities set forth in those provisions, to which the Contractor agrees to be bound.

B. Before the Contractor commences any Work, the Contractor will provide the Railroad with (i) a binder of insurance for the Railroad Protective Liability Insurance described in Section 13-2 of the Contract Special Provisions, hereto attached, and the original policy, or a certified duplicate original policy when available, and (ii) a certificate issued by its insurance carrier providing the other insurance coverage and endorsements required pursuant to Section 13-2 of the Contract Special Provisions.

C. All insurance correspondence, binders or originals shall be directed to:

Union Pacific Railroad Company
Attn: Real Estate Department
1400 Douglas Street, MS 1690
Omaha, Nebraska 68179-1690
Attn.: Senior Manager - Contracts
Folder No. 1760-77

D. Please note that fiber optic cable may be buried on the Railroad's property. **Prior to commencing any work, the Contractor agrees to contact the Railroad's Telecommunications Operation Center as provided in Section 5 of Exhibit A of the Right of Entry Agreement to determine if any fiber optic cable is located on the Railroad's property on or near the location where the work is to be performed.** If there is, the Contractor must comply with the terms and conditions of Section 5 of Exhibit A before commencing any work on the Railroad's property.

E. **The Contractor agrees to also provide to the Railroad's Manager-Track Maintenance at 200 South Adams Street, Anaheim CA 92802, (909) 685-2469,** the advance

notice required in Section 1 of Exhibit A of the Right of Entry Agreement prior to working on the Railroad's property in order for the Railroad to coordinate the Contractor's work with the Railroad's operations and to make arrangements for flagging protection (if applicable).

This endorsement shall be completed and sent to the person named in Paragraph C above.

_____
(Name of Contractor)

By_____

Title:_____

EXHIBIT E

To Construction and Maintenance Agreement

Cover Sheet for the
Caltrans Right of Entry Agreement

UPRR Folder No. _____

UPRR Audit No.: _____

RIGHT OF ENTRY AGREEMENT

THIS AGREEMENT is made and entered into as of the ___ day of _____, 200__, by and between **UNION PACIFIC RAILROAD COMPANY**, a Delaware corporation (hereinafter "Railroad) and **STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION** (hereinafter "Licensee").

IT IS MUTUALLY AGREED BY AND BETWEEN THE PARTIES HERETO AS FOLLOWS:

ARTICLE 1 - DEFINITION OF LICENSEE

For purposes of this Agreement, all references in this Agreement to Licensee shall include Licensee's contractors, subcontractors, officers, agents and employees, and others acting under its or their authority.

ARTICLE 2 - RIGHT GRANTED; PURPOSE

Railroad hereby grants to Licensee the right, during the term hereinafter stated and upon and subject to each and all of the terms, provisions and conditions herein contained, to enter upon and have ingress to and egress from the portion of Railroad's property located at or near Mile Post _____, on Railroad's _____ located at or near _____, California, for the purpose of performing work relating to _____ (the "Work"), is in the general location shown on the Railroad Location Print marked **Exhibit A**, attached hereto and hereby made a part hereof. The right herein granted to Licensee is limited to those portions of Railroad's property specifically described herein, or designated by the Railroad representative named in Article 4.

ARTICLE 3 - TERMS AND CONDITIONS CONTAINED IN EXHIBITS B, C, D AND E

The Terms and Conditions contained in **Exhibit B**, the Insurance Provisions contained in **Exhibit C**, the Minimum Safety Requirements contained in **Exhibit D** and the Contractor's Endorsement marked **Exhibit E**, each attached hereto, are hereby made a part of this Agreement.

ARTICLE 4 - ALL EXPENSES TO BE BORNE BY LICENSEE; RAILROAD REPRESENTATIVE

A. Licensee shall bear any and all costs and expenses associated with any work performed by Licensee, or any costs or expenses incurred by Railroad relating to this Agreement.

SAMPLE

B. Licensee shall coordinate all of its work with the following Railroad representatives or his or her duly authorized representatives (the "Railroad Representative"):

_____ _____
Name & Address of MTM *Name & Address of MSM*

C. Licensee, at its own expense, shall adequately police and supervise all Work to be performed by Licensee and shall ensure that such Work is performed in a safe manner as set forth in Section 7 of **Exhibit B**. The responsibility of Licensee for safe conduct and adequate policing and supervision of Licensee's work shall not be lessened or otherwise affected by Railroad's approval of the plans and specifications involving the Work, or by Railroad's collaboration in performance of any of the Work, or by the presence at the work site of a Railroad Representative, or by compliance by Licensee with any requests or recommendations made by the Railroad Representative.

ARTICLE 5 - TERM; TERMINATION

A. The grant of right herein made to Licensee shall commence on the date of this Agreement, and continue until _____, unless sooner
(Expiration Date)
terminated as herein provided, or at such time as Licensee has completed its Work on Railroad's property, whichever is earlier. Licensee agrees to notify the Railroad Representative in writing when it has completed its Work on Railroad's property.

B. Railroad may terminate this Agreement if it reasonably determines in good faith that Licensee has failed to comply with any of the material terms and conditions of this Agreement and has not cured such failure within ten (10) days after receiving notice (oral or written) from Railroad describing such failure in reasonable detail.

ARTICLE 6 - INSURANCE - CONTRACTOR ENDORSEMENT

A. Licensee is self-insured. Licensee shall provide Railroad defense and indemnification at least equal to the defense, indemnification and insurance provisions (including the endorsements) contained in **Exhibit C**. Nothing herein shall be deemed to insure Railroad against its sole negligence or willful misconduct.

B. In the event any of the Work to be done upon the property of Railroad is to be done by a contractor or subcontractor of Licensee, said contractor or subcontractor may have the benefit of the license herein granted, while performing work for Licensee, provided such contractor or subcontractor agrees to be subject to and bound by the terms and conditions of this Agreement by: (1) executing an endorsement to this Agreement in the form set forth in Contractor's Endorsement marked **Exhibit E**, attached hereto, (2) providing to Railroad the insurance policies, certificates, binders, and/or endorsements described in

SAMPLE

Exhibit C, and (3) providing to Railroad the insurance endorsements required under Section 12 of **Exhibit B** of this Agreement.

C. All insurance correspondence, certificates, endorsements, binders or originals shall be sent to:

Union Pacific Railroad Company
Real Estate Department
1400 Douglas Street, Mail Stop 1690
Omaha, Nebraska 68179-1690
Attn: Senior Manager Contracts
Folder No.: _____

ARTICLE 7 - CHOICE OF FORUM

Unless otherwise preempted by applicable federal laws, rules or regulations, this Agreement shall be governed, construed and enforced in accordance with the laws of the State of California. Litigation arising out of or connected with this Agreement may be instituted and maintained in the courts of the State of California only, and the parties consent to jurisdiction over their person and over the subject matter of any such litigation, in those courts, and consent to service of process issued by such courts.

ARTICLE 8 - REMOVAL OF CONTRACTOR/SUBCONTRACTOR EMPLOYEE

At the request of Railroad, Licensee shall remove from Railroad property any contractor, subcontractor, officer, agent and/or employee of Licensee who fails to conform to the instructions of the Railroad Representative in connection with the Work on Railroad's property, and any right of Licensee shall be suspended until such removal has occurred. Licensee shall indemnify Railroad against any claims arising from the removal of any such contractor, subcontractor, officer, agent and/or employee from Railroad property.

ARTICLE 9 - ADMINISTRATIVE FEE

Upon the execution and delivery of this Agreement, Licensee shall pay to Railroad **Five Hundred Dollars ($500.00)** as reimbursement for clerical, administrative and handling expenses in connection with the processing of this Agreement.

ARTICLE 10 - SPECIAL PROVISIONS

A. No additional vehicular crossings (including temporary haul roads) or pedestrian crossings over Railroad's trackage shall be installed or used by Licensee without the prior written permission of Railroad.

B. Explosives or other highly flammable substances shall not be stored on Railroad property without the prior written approval of the Railroad Representative.

C. The parties agree that this agreement is not, and is not intended to be, a construction contract for purposes of Cal. Civ. Code § 2782(a). Accordingly, to the maximum extent permitted by law, the provisions of Cal. Civ. Code § 2782(a), as interpreted by the California courts in Southern Pacific Transportation Co. v.

SAMPLE

Sandyland Protective Association, 224 Cal.App.3d 1494, 274 Cal.Rptr. 626 (1990), and in other past and future cases, shall not apply to this Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement in duplicate as of the date first herein written.

UNION PACIFIC RAILROAD COMPANY
(Federal Tax ID #94-6001323)

By: _____
PAUL G. FARRELL
Senior Manager Contracts

STATE OF CALIFORNIA,
DEPARTMENT OF TRANSPORTATION

By: _____

Title: _____

SAMPLE

EXHIBIT A

TO CONTRACTOR'S RIGHT OF ENTRY AGREEMENT

Railroad Location Print.

EXHIBIT B

TERMS & CONDITIONS

TO CALTRANS RIGHT OF ENTRY AGREEMENT

Section 1. NOTICE OF COMMENCEMENT OF WORK - FLAGGING.

a. Licensee agrees to notify the Railroad Representative at least ten (10) working days in advance of Licensee commencing its Work and at least ten (10) working days in advance of proposed performance of any Work by Licensee in which any person or equipment will be within twenty-five (25) feet of any track, or will be near enough to any track that any equipment extension (such as, but not limited to, a crane boom) will reach to within twenty-five (25) feet of any track. No Work of any kind shall be performed, and no person, equipment, machinery, tool(s), material(s), vehicle(s), or thing(s) shall be located, operated, placed, or stored within twenty-five (25) feet of any of Railroad's track(s) at any time, for any reason, unless and until a Railroad flagman is provided to watch for trains. Upon receipt of such 10-day notice, the Railroad Representative will determine and inform Licensee whether a flagman need be present and whether Licensee need implement any special protective or safety measures. If flagging or other special protective or safety measures are performed by Railroad, such services will be provided at Licensee's expense with the understanding that if Railroad provides any flagging or other services, Licensee shall not be relieved of any of its responsibilities or liabilities set forth herein. Licensee shall promptly pay to Railroad all charges connected with such services within 30 days after presentation of a bill therefore.

b. The rate of pay per hour for each flagman will be the prevailing hourly rate in effect for an eight hour day for the class of persons used during regularly assigned hours and overtime in accordance with Labor Agreements and Schedules in effect at the time the Work is performed. In addition to the cost of such labor, a composite charge for vacation, holiday, health & welfare, supplemental sickness, Railroad Retirement & UC, supplemental pension, Employee's Liability & Property Damage and Administration will be included, computed on actual payroll. The composite charge will be the prevailing composite charge in effect at the time the work is performed. One and one-half times the current hourly rate is paid for overtime, Saturdays and Sundays and two and one-half times current hourly rate for holidays. Wage rates are subject to change, at any time, by law or by agreement between Railroad and its employees, and may be retroactive as a result of negotiations or a ruling of an authorized governmental agency. Additional charges on labor are also subject to change. If the wage rate or additional charges are changed, Licensee shall pay on the basis of the new rates and charges.

c. Reimbursement to Railroad will be required covering the full eight hour day during which any flagman is furnished, unless the flagman can be assigned to other Railroad work during a portion of such day, in which event reimbursement will not be required for the portion of the day during which the flagman is engaged in other Railroad work. Reimbursement will also be required for any day not actually worked by the flagman following the flagman's assignment to work on the project for which Railroad is required to pay the flagman and which could not reasonably be avoided by Railroad by assignment of such flagman to other work, even though the Licensee may not be working during such time. When it becomes necessary for Railroad to bulletin and assign an employee to a flagging position in compliance with union collective bargaining agreements, Licensee must provide Railroad a minimum of five (5) days notice prior to the cessation of the need for a flagman. If five (5) days notice of cessation is not given, Licensee will still be required to pay flagging charges for the five (5) day notice period required by union agreement to be given to the employee, even though flagging is not required for that period. An additional ten (10) days-notice must then be given to Railroad if flagging services are needed again after such five (5) day cessation notice has been given to Railroad.

Section 2. LIMITATION AND SUBORDINATION OF RIGHTS GRANTED

a. The foregoing grant of right is subject and subordinate to the prior and continuing right and obligation of Railroad to use and maintain its entire property including the right and power of Railroad to construct, maintain, repair, renew, use, operate, change, modify or relocate railroad tracks, roadways, signal, communication, fiber optics, or other wirelines, pipelines and other facilities upon, along or across any or all parts of its property, all or any of which may be reasonably done at any time or times by Railroad without liability to Licensee or to any other party for compensation or damages.

b. The foregoing grant is also subject to all outstanding superior rights (including those in favor of licensees and lessees of Railroad's property, and others) and the right of Railroad to renew and extend the same, and is made without covenant of title or for quiet enjoyment.

Section 3. NO INTERFERENCE WITH OPERATION OF RAILROAD AND ITS TENANTS.

a. Licensee shall conduct its operations so as not to interfere with the continuous and uninterrupted use and operation of the railroad tracks and property of Railroad, including, without limitation, the operations of Railroad's lessees, licensees or others, unless specifically authorized in advance by the Railroad Representative. Nothing shall be done or permitted to be

done by Licensee at any time that would in any manner impair the safety of such operations. When not in use, Licensee's machinery and materials shall be kept at least fifty (50) feet from the centerline of Railroad's nearest track, and there shall be no vehicular crossings of Railroad's tracks except at existing open public crossings.

b. Operations of Railroad and work performed by Railroad personnel and delays in the work to be performed by Licensee caused by such railroad operations and work are expected by Licensee, and Licensee agrees that Railroad shall have no liability to Licensee, or any other person or entity for any such delays. Licensee shall coordinate its activities with those of Railroad and third parties so as to avoid interference with railroad operations. The safe operation of Railroad train movements and other activities by Railroad takes precedence over any work to be performed by Licensee.

Section 4. LIENS.

Licensee shall pay in full all persons who perform labor or provide materials for the work to be performed by Licensee. Licensee shall not create, permit or suffer any mechanic's or materialmen's liens of any kind or nature to be created or enforced against any property of Railroad for any such work performed. Licensee shall indemnify and hold harmless Railroad from and against any and all liens, claims, demands, costs or expenses of whatsoever nature in any way connected with or growing out of such work done, labor performed, or materials furnished.

Section 5. PROTECTION OF FIBER OPTIC CABLE SYSTEMS.

a. Fiber optic cable systems may be buried on Railroad's property. Protection of the fiber optic cable systems is of extreme importance since any break could disrupt service to users resulting in business interruption and loss of revenue and profits. Licensee shall telephone Railroad during normal business hours (7:00 a.m. to 9:00 p.m. Central Time, Monday through Friday, except holidays) at 1-800-336-9193 (also a 24-hour, 7-day number for emergency calls) to determine if fiber optic cable is buried anywhere on Railroad's property to be used by Licensee. If it is, Licensee shall telephone the telecommunications company(ies) involved, arrange for a cable locator, make arrangements for relocation or other protection of the fiber optic cable, and shall commence no work on the right of way until all such protection or relocation has been accomplished.

b. In addition to other indemnity provisions in this Agreement, Licensee shall, pursuant to Cal. Gov. Code §14662.5, indemnify and hold Railroad harmless from and against all costs, liability and expense whatsoever (including, without limitation, attorneys' fees, court costs and expenses) arising out of any act or omission of Licensee, its contractor, agents and/or employees, that proximately causes or contributes to (1) any damage to or destruction of any telecommunications system on Railroad's property, and/or (2) any injury to or death of any person employed by or on behalf of any telecommunications company, and/or its contractors, agents and/or employees, on Railroad's property. Licensee shall not have or seek recourse against Railroad for any claim or cause of action for alleged loss of profits or revenue or loss of service or other consequential damage to a telecommunication company using Railroad's property or a customer or user of services of the fiber optic cable on Railroad's property.

Section 6. PERMITS - COMPLIANCE WITH LAWS.

In the prosecution of the work covered by this Agreement, Licensee shall secure any and all necessary permits and shall comply with all applicable federal, state and local laws, regulations and enactments affecting the work, including, without limitation, all applicable Federal Railroad Administration regulations.

Section 7. SAFETY.

a. Safety of personnel, property, rail operations and the public is of paramount importance in the prosecution of the work performed by Licensee. Licensee shall be responsible for initiating, maintaining and supervising all safety, operations and programs in connection with the work. Licensee shall at a minimum comply with Railroad's safety standards listed in **Exhibit D**, hereto attached, to ensure uniformity with the safety standards followed by Railroad's own forces. As a part of Licensee's safety responsibilities, Licensee shall notify Railroad if Licensee determines that any of Railroad's safety standards are contrary to good safety practices. Licensee shall furnish copies of **Exhibit D** to each of its employees before they enter the job site.

b. Without limitation of the provisions of paragraph A above, Licensee shall keep the job site free from safety and health hazards and ensure that its employees are competent and adequately trained in all safety and health aspects of the job.

c. Licensee shall have proper first aid supplies available on the job site so that prompt first aid services may be provided to any person injured on the job site. Licensee shall promptly notify Railroad of any U.S. Occupational Safety and Health Administration reportable injuries. Licensee shall have a nondelegable duty to control its employees while they are on the

job site or any other property of Railroad, and to be certain they do not use, be under the influence of, or have in their possession any alcoholic beverage, drug or other substance that may inhibit the safe performance of any work.

d. If and when requested by Railroad, Licensee shall deliver to Railroad a copy of Railroad's safety plan for conducting the work (the "Safety Plan"). Railroad shall have the right, but not the obligation, to require Licensee to correct any deficiencies in the Safety Plan. The terms of this Agreement shall control if there are any inconsistencies between this Agreement and the Safety Plan.

Section 8. INDEMNITY.

a. To the extent not prohibited by Cal. Gov. Code §14662.5, Licensee shall indemnify, defend and hold harmless Railroad, its affiliates, and its and their officers, agents and employees ("Indemnified Parties") from and against any and all loss, damage, injury, liability, claim, demand, cost or expense (including, without limitation, attorney's, consultant's and expert's fees, and court costs), fine or penalty (collectively, "Loss") incurred by any person (including, without limitation, any Indemnified Party, Licensee, or any employee of Licensee or of any Indemnified Party) arising out of or in any manner connected with (i) any Work performed by Licensee, or (ii) any act or omission of Licensee, its officers, agents or employees, or (iii) any breach of this agreement by Licensee.

b. To the extent not prohibited by Cal. Gov. Code §14662.5, the right to indemnity under this Section 8 shall accrue upon occurrence of the event giving rise to the Loss, and shall apply regardless of any negligence or strict liability of any Indemnified Party, except where the Loss is caused by the sole active negligence or willful misconduct of an Indemnified Party as established by the final judgment of a court of competent jurisdiction. The sole active negligence or willful misconduct of any Indemnified Party shall not bar the recovery of any other Indemnified Party.

c. To the extent not prohibited by Cal. Gov. Code §14662.5, Licensee expressly and specifically assumes potential liability under this Section 8 for claims or actions brought by Licensee's own employees. Licensee waives any immunity it may have under worker's compensation or industrial insurance acts to indemnify Railroad under this Section 8. Licensee acknowledges that this waiver was mutually negotiated by the parties hereto.

d. To the extent not prohibited by Cal. Gov. Code §14662.5, no court or jury findings in any employee's suit pursuant to any worker's compensation act or the Federal Employer's Liability Act against a party to this Agreement may be relied upon or used by Licensee in any attempt to assert liability against Railroad.

e. The provisions of this Section 8 shall survive the completion of any Work performed by Licensee or the termination or expiration of this Agreement. To the extent not prohibited by Cal. Gov. Code §14662.5, in no event shall this Section 8 or any other provision of this Agreement be deemed to limit any liability Licensee may have to any Indemnified Party by statute or under common law.

Section 9. RESTORATION OF PROPERTY.

In the event Railroad authorizes Licensee to take down any fence of Railroad or in any manner move or disturb any of the other property of Railroad in connection with the Work to be performed by Licensee, then in that event Licensee shall, as soon as possible and at Licensee's sole expense, restore such fence and other property to the same condition as the same were in before such fence was taken down or such other property was moved or disturbed. Licensee shall remove all of Licensee's tools, equipment and materials from Railroad's property promptly upon completion of the Work, restoring Railroad's property to the same state and condition as when Licensee entered thereon.

Section 10. WAIVER OF DEFAULT.

Waiver by Railroad of any breach or default of any condition, covenant or agreement herein contained to be kept, observed and performed by Licensee shall in no way impair the right of Railroad to avail itself of any remedy for any subsequent breach or default.

Section 11. MODIFICATION - ENTIRE AGREEMENT.

No modification of this Agreement shall be effective unless made in writing and signed by Licensee and Railroad. This Agreement and the exhibits attached hereto and made a part hereof constitute the entire understanding between Licensee and Railroad and cancel and supersede any prior negotiations, understandings or agreements, whether written or oral, with respect to the work to be performed by Licensee.

Section 12. ASSIGNMENT - SUBCONTRACTING.

Contractor shall not assign or subcontract this Agreement, or any interest therein, without the written consent of the Railroad. Contractor shall be responsible for the acts and omissions of all subcontractors. Before Contractor commences any work, the Contractor shall, except to the extent prohibited by law; (1) require each of its subcontractors to include the Contractor as "Additional Insured" in the subcontractor's Commercial General Liability policy and Business Automobile policies with respect to all liabilities arising out of the subcontractor's performance of work on behalf of the Contractor by endorsing these policies with ISO Additional Insured Endorsements CG 20 26, and CA 20 48 (or substitute forms providing equivalent coverage; (2) require each of its subcontractors to endorse their Commercial General Liability Policy with "Contractual Liability Railroads" ISO Form CG 24 17 10 01 (or a substitute form providing equivalent coverage) for the job site; and (3) require each of its subcontractors to endorse their Business Automobile Policy with "Coverage For Certain Operations In Connection With Railroads" ISO Form CA 20 70 10 01 (or a substitute form providing equivalent coverage) for the job site.

EXHIBIT C

INSURANCE PROVISIONS

TO CALTRANS RIGHT OF ENTRY AGREEMENT

Contractor shall, at its sole cost and expense, procure and maintain during the course of the Project and until all Project work on Railroad's property has been completed and Contractor has removed all equipment and materials from Railroad's property and has cleaned and restored Railroad's property to Railroad's satisfaction, the following insurance coverage:

A. **Commercial General Liability Insurance**. Commercial general liability (CGL) with a limit of not less than $5,000,000 each occurrence and an aggregate limit of not less than $10,000,000. CGL insurance must be written on ISO occurrence form CG 00 01 12 04 (or a substitute form providing equivalent coverage).

The policy must also contain the following endorsement, which must be stated on the certificate of insurance:

- Contractual Liability Railroads ISO form CG 24 17 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Railroad Company Property" as the Designated Job Site.
- Designated Construction Project(s) General Aggregate Limit ISO Form CG 25 03 03 97 (or a substitute form providing equivalent coverage) showing the project on the form schedule.

B. **Business Automobile Coverage Insurance**. Business auto coverage written on ISO form CA 00 01 (or a substitute form providing equivalent liability coverage) with a combined single limit of not less $5,000,000 for each accident.

The policy must contain the following endorsements, which must be stated on the certificate of insurance:

- Coverage For Certain Operations In Connection With Railroads ISO form CA 20 70 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Property" as the Designated Job Site.
- Motor Carrier Act Endorsement - Hazardous materials clean up (MCS-90) if required by law.

C. **Workers' Compensation And Employers' Liability Insurance**. Coverage must include but not be limited to:

- Contractor's statutory liability under the workers' compensation laws of the State of California.
- Employers' Liability (Part B) with limits of at least $500,000 each accident, $500,000 disease policy limit $500,000 each employee.

If Contractor is self-insured, evidence of state approval and excess workers compensation coverage must be provided. Coverage must include liability arising out of the U. S. Longshoremen's and Harbor Workers' Act, the Jones Act, and the Outer Continental Shelf Land Act, if applicable.

The policy must contain the following endorsement, which must be stated on the certificate of insurance:

- Alternate Employer endorsement ISO form WC 00 03 01 A (or a substitute form providing equivalent coverage) showing Railroad in the schedule as the alternate employer (or a substitute form providing equivalent coverage).

D. **Railroad Protective Liability Insurance**. Contractor must maintain Railroad Protective Liability insurance written on ISO occurrence form CG 00 35 12 04 (or a substitute form providing equivalent coverage) on behalf of Railroad as named insured, with a limit of not less than $2,000,000 per occurrence and an aggregate of $6,000,000. A binder stating the policy is in place must be submitted to Railroad before the work may be commenced and until the original policy is forwarded to Railroad.

E. **Umbrella Or Excess Insurance**. If Contractor utilizes umbrella or excess policies, these policies must "follow form" and afford no less coverage than the primary policy.

F. **Pollution Liability Insurance**. Pollution liability coverage must be written on ISO form Pollution Liability Coverage Form Designated Sites CG 00 39 12 04 (or a substitute form providing equivalent liability coverage), with limits of at least $5,000,000 per occurrence and an aggregate limit of $10,000,000.

If the scope of work as defined in this Agreement includes the disposal of any hazardous or non-hazardous materials from the job site, Contractor must furnish to Railroad evidence of pollution legal liability insurance maintained by the

disposal site operator for losses arising from the insured facility accepting the materials, with coverage in minimum amounts of $1,000,000 per loss, and an annual aggregate of $2,000,000.

Other Requirements

G. All policy(ies) required above (except worker's compensation and employers liability) must include Railroad as "Additional Insured" using ISO Additional Insured Endorsements CG 20 26, and CA 20 48 (or substitute forms providing equivalent coverage). The coverage provided to Railroad as additional insured shall, to the extent provided under ISO Additional Insured Endorsement CG 20 26, and CA 20 48 provide coverage for Railroad's negligence whether sole or partial, active or passive, and shall not be limited by Contractor's liability under the indemnity provisions of this Agreement.

H. Punitive damages exclusion, if any, must be deleted (and the deletion indicated on the certificate of insurance), unless the law governing this Agreement prohibits all punitive damages that might arise under this Agreement.

I. Contractor waives all rights of recovery, and its insurers also waive all rights of subrogation of damages against Railroad and its agents, officers, directors and employees. This waiver must be stated on the certificate of insurance.

J. Prior to commencing the work, Contractor shall furnish Railroad with a certificate(s) of insurance, executed by a duly authorized representative of each insurer, showing compliance with the insurance requirements in this Agreement.

K. All insurance policies must be written by a reputable insurance company acceptable to Railroad or with a current Best's Insurance Guide Rating of A- and Class VII or better, and authorized to do business in the State of California.

L. The fact that insurance is obtained by Contractor or by Railroad on behalf of Contractor will not be deemed to release or diminish the liability of Contractor, including, without limitation, liability under the indemnity provisions of this Agreement. Damages recoverable by Railroad from Contractor or any third party will not be limited by the amount of the required insurance coverage.

EXHIBIT D

MINIMUM SAFETY REQUIREMENTS

TO CALTRAN'S RIGHT OF ENTRY AGREEMENT

The term "employees" as used herein refer to all employees of Licensee as well as all employees of any subcontractor or agent of Licensee.

I. Clothing

A. All employees of Licensee will be suitably dressed to perform their duties safely and in a manner that will not interfere with their vision, hearing, or free use of their hands or feet.

Specifically, Licensee's employees must wear:

(i) Waist-length shirts with sleeves.
(ii) Trousers that cover the entire leg. If flare-legged trousers are worn, the trouser bottoms must be tied to prevent catching.
(iii) Footwear that covers their ankles and has a defined heel. Employees working on bridges are required to wear safety-toed footwear that conforms to the American National Standards Institute (ANSI) and FRA footwear requirements.

B. Employees shall not wear boots (other than work boots), sandals, canvas-type shoes, or other shoes that have thin soles or heels that are higher than normal.

C. Employees must not wear loose or ragged clothing, neckties, finger rings, or other loose jewelry while operating or working on machinery.

II. Personal Protective Equipment

Licensee shall require its employees to wear personal protective equipment as specified by Railroad rules, regulations, or recommended or requested by the Railroad Representative.

(i) Hard hat that meets the American National Standard (ANSI) Z89.1 – latest revision. Hard hats should be affixed with Licensee's company logo or name.
(ii) Eye protection that meets American National Standard (ANSI) for occupational and educational eye and face protection, Z87.1 – latest revision. Additional eye protection must be provided to meet specific job situations such as welding, grinding, etc.
(iii) Hearing protection, which affords enough attenuation to give protection from noise levels that will be occurring on the job site. Hearing protection, in the form of plugs or muffs, must be worn when employees are within:

- 100 feet of a locomotive or roadway/work equipment
- 15 feet of power operated tools
- 150 feet of jet blowers or pile drivers
- 150 feet of retarders in use (when within 10 feet, employees must wear dual ear protection – plugs and muffs)

(iv) Other types of personal protective equipment, such as respirators, fall protection equipment, and face shields, must be worn as recommended or requested by the Railroad Representative.

III. On Track Safety

Licensee is responsible for compliance with the Federal Railroad Administration's Roadway Worker Protection regulations – 49 CFR 214, Subpart C and Railroad's On-Track Safety Rules. Under 49 CFR 214, Subpart C, railroad contractors are responsible for the training of their employees on such regulations. In addition to the instructions contained in Roadway Worker Protection regulations, all employees must:

(i) Maintain a distance of twenty-five (25) feet to any track unless the Railroad Representative is present to authorize movements.
(ii) Wear an orange, reflectorized workwear approved by the Railroad Representative.
(iii) Participate in a job briefing that will specify the type of On-Track Safety for the type of work being performed. Licensee must take special note of limits of track authority, which tracks may or may not be fouled, and clearing the track. Licensee will also receive special instructions relating to the work zone around machines and minimum distances between machines while working or traveling.

IV. Equipment

A. It is the responsibility of Licensee to ensure that all equipment is in a safe condition to operate. If, in the opinion of the Railroad Representative, any of Licensee's equipment is unsafe for use, Licensee shall remove such equipment from the

Railroad's property. In addition, Licensee must ensure that the operators of all equipment are properly trained and competent in the safe operation of the equipment. In addition, operators must be:

- Familiar and comply with Railroad's rules on lockout/tagout of equipment.
- Trained in and comply with the applicable operating rules if operating any hy-rail equipment on-track.
- Trained in and comply with the applicable air brake rules if operating any equipment that moves rail cars or any other railbound equipment.

B. All self-propelled equipment must be equipped with a first-aid kit, fire extinguisher, and audible back-up warning device.

C. Unless otherwise authorized by the Railroad Representative, all equipment must be parked a minimum of twenty-five (25) feet from any track. Before leaving any equipment unattended, the operator must stop the engine and properly secure the equipment against movement.

D.7 Cranes must be equipped with three orange cones that will be used to mark the working area of the crane and the minimum clearances to overhead powerlines.

V. General Safety Requirements

A. Licensee shall ensure that all waste is properly disposed of in accordance with applicable federal and state regulations.

B. Licensee shall ensure that all employees participate in and comply with a job briefing conducted by the Railroad Representative, if applicable. During this briefing, the Railroad Representative will specify safe work procedures, (including On-Track Safety) and the potential hazards of the job. If any employee has any questions or concerns about the work, the employee must voice them during the job briefing. Additional job briefings will be conducted during the work as conditions, work procedures, or personnel change.

C. All track work performed by Licensee meets the minimum safety requirements established by the Federal Railroad Administration's Track Safety Standards 49 CFR 213.

D. All employees comply with the following safety procedures when working around any railroad track:

(i) Always be on the alert for moving equipment. Employees must always expect movement on any track, at any time, in either direction.
(ii) Do not step or walk on the top of the rail, frog, switches, guard rails, or other track components.
(iii) In passing around the ends of standing cars, engines, roadway machines or work equipment, leave at least 20 feet between yourself and the end of the equipment. Do not go between pieces of equipment of the opening is less than one car length (50 feet).
(iv) Avoid walking or standing on a track unless so authorized by the employee in charge.
(v) Before stepping over or crossing tracks, look in both directions first.
(vi) Do not sit on, lie under, or cross between cars except as required in the performance of your duties and only when track and equipment have been protected against movement.

E. All employees must comply with all federal and state regulations concerning workplace safety.

EXHIBIT E

CONTRACTOR'S ENDORSEMENT

TO CALTRANS RIGHT OF ENTRY AGREEMENT

A. As a condition to entering upon the Railroad's right-of-way to perform Work pursuant to this agreement, State's contractor, _____
(Name of Contractor)
whose address is _____
(Contractor's Mailing Address)
(hereinafter "Contractor"), agrees to comply with and be bound by all the terms and provisions of the attached Caltrans Right of Entry Agreement that was signed by Union Pacific Railroad Company ("Railroad") and the State of California, Department of Transportation ("State") relating to the Work to be performed in connection with State's Project No. _____ covering work in _____ County, California, and the insurance requirements set forth in **Exhibit C** of the Right of Entry Agreement. The Contractor further acknowledges and agrees that the reference to Cal. Gov. Code §14662.5 in Sections 5.b) and 8.b) of **Exhibit B** to the Right of Entry Agreement does not apply to the Contractor and in no way limits the indemnities set forth in those provisions, to which the Contractor agrees to be bound.

B. Before the Contractor commences any Work, the Contractor will provide the Railroad with (i) a binder of insurance for the Railroad Protective Liability Insurance described in Section 13-2 of the Contract Special Provisions, hereto attached, and the original policy, or a certified duplicate original policy when available, and (ii) a certificate issued by its insurance carrier providing the other insurance coverage and endorsements required pursuant to Section 13-2 of the Contract Special Provisions.

C. All insurance correspondence, binders or originals shall be directed to:

Union Pacific Railroad Company
Real Estate Department
1400 Douglas Street, Mail Stop 1690
Omaha, Nebraska 68179-1690
Folder No. _____

D. **Please note that fiber optic cable may be buried on the Railroad's property. Prior to commencing any work, the Contractor agrees to contact the Railroad's Telecommunications Operation Center as provided in Section 5 of Exhibit B of the Right of Entry Agreement to determine if any fiber optic cable is located on the Railroad's property on or near the location where the work is to be performed. If there is, the Contractor must comply with the terms and conditions of Section 5 of Exhibit B before commencing any work on the Railroad's property.**

E. **The Contractor agrees to also provide to:**

_____
Name & Address of MTM

the advance notice required in Section 1 of **Exhibit B** of the Right of Entry Agreement prior to working on the Railroad's property in order for the Railroad to coordinate the Contractor's work with the Railroad's operations and to make arrangements for flagging protection (if applicable).

This endorsement shall be completed and sent to the person named in Paragraph C above.

_____
(Name of Contractor)

By_____

Title:_____

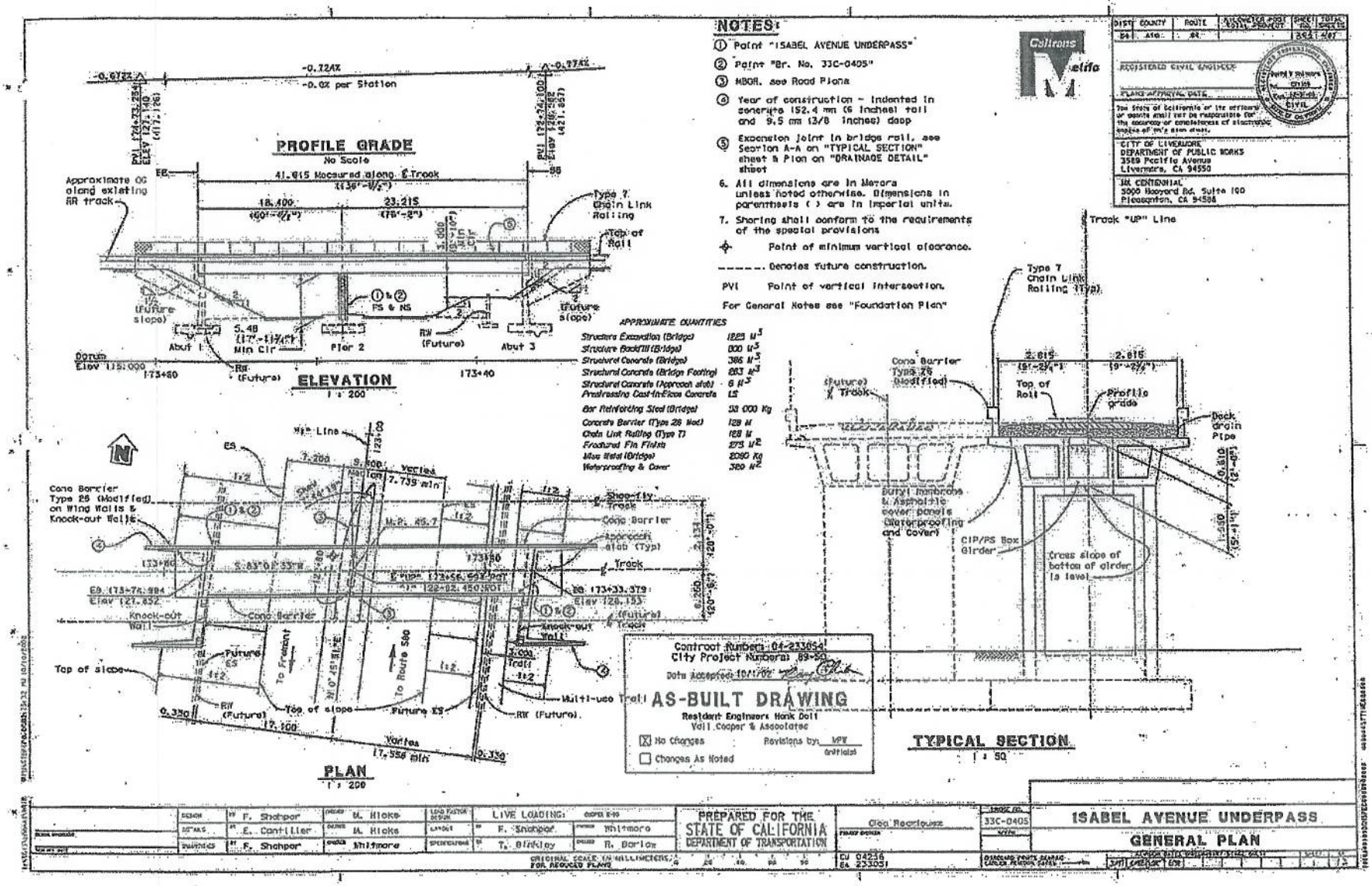
Date:_____

PLANS

To Construction and Maintenance Agreement

Cover Sheet for the State's Detailed Plans

EXHIBIT B


NOTES:
1. Paint "ISABEL AVENUE UNDERPASS"
2. Paint "Br. No. 33C-0405"
3. MBGR. See Road Plans
4. Year of construction - indented in concrete 152.4 mm (6 inches) tall and 9.5 mm (3/8 inches) deep
5. Expansion joint in bridge rail, see Section A-A on "TYPICAL SECTION" sheet & Plan on "DRAINAGE DETAIL" sheet
6. All dimensions are in Metric unless noted otherwise. Dimensions in parenthesis ( ) are in Imperial units.
7. Shoring shall conform to the requirements of the special provisions
Point of minimum vertical clearance.
Denotes future construction.
PVI Point of vertical intersection.
For General Notes see "Foundation Plan"
PROFILE GRADE
No Scale
ELEVATION
PLAN
TYPICAL SECTION
Abut 1
Pier 2
Abut 3
Type 7 Chain Link Railing
Top of Rail
Cone Barrier Type 26 (Modified)
Track "UP" Line
Deck drain Pipe
CIP/PS Box Girder
Cross slope of bottom of girder is level
Multi-use Trail
Knock-out Wall
Top of slope
To Fremont
To Route 580
APPROXIMATE QUANTITIES
Structure Excavation (Bridge) 1225 M3
Structure Backfill (Bridge) 800 M3
Structural Concrete (Bridge) 386 M3
Structural Concrete (Bridge Footing) 283 M3
Structural Concrete (Approach slab) 6 M3
Prestressing Cast-in-Place Concrete LS
Bar Reinforcing Steel (Bridge) 53 000 Kg
Concrete Barrier (Type 26 Mod) 128 M
Chain Link Railing (Type 7) 128 M
Fractured Fin Finish 275 M2
Misc Metal (Bridge) 2090 Kg
Waterproofing & Cover 580 M2
Contract Number 04-233054
City Project Number 89-50
Date Accepted 10/1/02
AS-BUILT DRAWING
Resident Engineers Hank Doll
Vail Cooper & Associates
No Changes
Changes As Noted
Revisions by: MPW drafting
CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3569 Pacific Avenue
Livermore, CA 94550
JR CENTENNIAL
3000 Hacienda Rd. Suite 100
Pleasanton, CA 94588
PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
ISABEL AVENUE UNDERPASS
GENERAL PLAN
33C-0405
LIVE LOADING: